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An analysis of commodity markets: What gain for investors?

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ABSTRACT

In this paper we study whether the commodity futures market predicts the commodity spot market. Using historical daily data on four commodities—oil, gold, platinum, and silver—we find that they do. We then show how investors can use this information on the futures market to devise trading strategies and make profits. In particular, dynamic trading strategies based on a mean–variance investor framework produce somewhat different results compared with those based on technical trading rules. Dynamic trading strategies suggest that all commodities are profitable and profits are dependent on structural breaks. The most recent global financial crisis marked a period in which commodity profits were the weakest.

1. Introduction

Our focus on commodity futures and spot markets is motivated by the fact that commodity markets—gold and oil in particular—have been at the forefront of financial and economic news over the last half-decade. Oil and gold prices have risen persistently over the last five years. Oil prices, for instance, peaked at over US$140 per barrel, after reaching the US$100 per barrel mark for the first time in 2008. So great was the influence of the oil price rise that when it reached the US$100 per barrel mark, it created a psychological barrier for investors in the US market (Narayan and Narayan, 2013). Gold prices have also risen sharply over the last decade, having quadrupled over the 2001–2010 period; a detailed analysis can be found in Baur and McDermott (2010). As noted in Baur and McDermott (2010), gold prices tend to react positively to negative market shocks, which is a behavior inconsistent with other asset classes. With respect to oil prices, Narayan and Sharma (2011) show that all sectors on the New York Stock Exchange respond significantly to oil price shocks. It follows that the relevance of oil and gold prices to the functioning of financial markets has been well-documented by the literature.

The commodity futures market is even more relevant because, as explained by French (1986), it serves two social functions. The first function is that the futures market facilitates the transfer of commodity price risk. Risk transfer refers to hedgers using futures contracts to shift price risk to others (Garbade and Silber, 1983). The second function is that futures prices forecast spot prices. In other words, investors can use futures prices for pricing cash market transactions (Working, 1953). The subject of the current paper is based on the second function of the futures market with respect to four commodities, namely, crude oil, gold, silver, and platinum. We test whether the commodity futures market predicts the commodity spot market. This line of research is nothing new, however. Several studies (see, *inter alia*, Coppola, 2008) examine evidence of commodity spot price predictability using the commodity futures price. That there is a motivating theory behind this predictability relationship has provoked significant interest in this topic. The key limitations of this literature, however, are the economic implications and the significance of the role of the commodity futures market. In this regard, two questions remain unanswered. The first question is: if the commodity futures market predicts the commodity spot market, as shown by Coppola (2008) for instance, can investors devise profitable trading strategies? The second question is: can different trading rules, such as the simple moving average technical trading rules, break trading rules, and the dynamic trading strategies based on a mean–variance investor framework, produce statistically significant profits across all four commodities? In other words, are profits, if they exist, in these four commodity markets robust? These questions are relevant for investors. Deciding whether or not the futures market predicts

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the spot market is only the first step in informing investors. How such knowledge from the futures market can be used to devise profitable trading strategies is equally, if not significantly more, interesting. Subsequently, this is our contribution to this literature.

Our results provide three main messages. First, we find that commodity futures returns do predict commodity spot returns. We observe that these results hold in both linear and non-linear models and in models that account for structural breaks. Thus, we find robust evidence that the commodity futures market predicts the commodity spot market. Second, we observe that the simple moving average technical trading rule and trading range break rule-based strategies consistently produce statistically significant profits in three of the four markets—with the exception of the platinum market. We also note that profits, like predictability, are influenced by structural breaks in the data. Finally, we devise dynamic trading strategies based on a mean–variance investor framework. We find that regardless of whether or not we allow for short-sales, profits from the oil, gold, and silver markets are statistically significant. Platinum remains the only market where investors do not make statistically significant profits.

The rest of the paper is organized as follows. In Section 2, we discuss the theory that motivates our research question and explain the estimation approach. In Section 3, we discuss the results, and in the final section we provide the concluding remarks.

2. Motivating theory and estimation approach

2.1. Motivating theory

As explained in substantial detail by Kaldor (1939), the relationship between spot and futures prices is driven by three things: interest rates, convenience yields, and warehousing costs. There are at least two reasons why one can expect the commodity futures market to alter the information reflected in spot prices. First, as argued by Cox (1976), organized futures trading attracts an additional set of traders to a commodity's market. Speculators are key market players. Cox (1976: 1217) notes the role of speculators eloquently: "When these speculators have either a net long or short position in the futures market, hedgers (firms that deal in physical commodity) have a corresponding net short or long position which causes the amount of stock held for later consumption to be different than it would have been in the absence of futures trading". Second, because transaction costs in the futures market are relatively low, it provides an incentive for speculators to close out their positions with an off-setting sale or purchase of futures contracts at the expense of accepting delivery of and selling the physical commodity (Cox, 1976). Trading in the futures market is completely centralized. Compared to dispersed trading and private negotiations, investors are able to trade and communicate their information—such as identifying potential traders, searching for best bid or offer, and negotiating a contract—in the futures market relatively cheaply (see Hayek, 1945).

The empirical framework that binds the relationship between the price of an index futures contract and the price level of the underlying spot index is motivated by the work of Stoll and Whaley (1990), and has the following mathematical form:

$$F_t = S_t e^{(r-d)(T-t)}, \tag{1}$$

where F_t is the index futures price at time t, S_t is the index spot price at time t, $r - d$ is the net cost of carrying the underlying stocks in the index—that is, the rate of interest cost r less the rate at which dividend yield accrues to the stock index portfolio holder d, and T is the expiration date of the futures contract, so $T - t$ is the time remaining in the futures contract life. Stoll and Whaley (1990) show that the instantaneous rate of price appreciation in the stock index equals the net cost of carrying the stock portfolio plus the instantaneous relative price change of the futures contract. This relationship is depicted as follows:

$$R_t^S = (r-d) + R_t^F, \tag{2}$$

where R_t^S is the spot price index return computed as $R_t^S = \ln(S_t/S_{t-1}) * 100$, and R_t^F is the futures price index return computed as $R_t^F = \ln(F_t/F_{t-1}) * 100$.

2.2. Estimation approach

Based on Eq. (2), our predictive regression model is of the following form:

$$R_t^S = \beta_0 + \beta_1 R_{t-1}^F + \varepsilon_t, \tag{3}$$

The variables are as previously defined; the error term is characterized by a zero mean and variance σ^2. Eq. (3), assuming that $y_{t-1} = \left(1, R_{t-1}^F\right)'$ and $\beta = (\beta_0, \beta_1)'$, can be expressed as follows:

$$R_t^S = y_{t-1}'\beta + \varepsilon_t, \tag{4}$$

Following Rapach and Wohar (2006), we allow for a structural break in both the intercept and slope coefficients of the predictive regression model. This dual structural break treatment is relevant as both the predictive slope and the intercept affect the conditional expected return. Rapach and Wohar (2006: 4–5)[1] show that the predictive regression model with a structural break has the following form:

$$R_t^S = y_{t-1}'\beta^0 + \varepsilon_t, \quad t = 1, \ldots, k, \tag{5}$$

$$R_t^S = y_{t-1}'(\beta^0 + \varphi) + \varepsilon_t, \quad t = k+1, \ldots, T, \tag{6}$$

where $\beta^0 = (\beta_0^0, \beta_1^0)$ and $\varphi = (\varphi_0, \varphi_1)$. The structural break model in matrix notation takes the following form:

$$R_t^S = Y\beta^0 + Y_{0k}\varphi + \varepsilon, \tag{7}$$

Here $R^S = \left(R_1^S, \ldots, R_T^S\right)'$, $Y = (y_0, \ldots, y_{T-1})'$ and $\varepsilon = (\varepsilon_1, \ldots, \varepsilon_T)$. Rapach and Wohar (2006) show that when the structural break date, k, is known, one can simply apply the familiar Chow (1960) structural break test. The Chow test amounts to testing the null hypothesis that $\varphi = 0$ against the alternative hypothesis that there is a structural break ($\varphi \neq 0$). The Chow test has been extended by Andrews (1993) in the case of an unknown structural break date. Specifically, Andrews (1993) considers *SupF* test statistic. This requires a sample trimming factor (say τ), which we set to 15%. The *SupF* statistic is nonstandard and trimming factor dependent. We examine the null hypothesis of no structural break by comparing this test statistic with the asymptotic critical values reported in Andrews (1993). When the null hypothesis is rejected, Andrews recommends estimating the break data as:

$$\hat{k} = \text{argmin}_{k \in [\tau T, (1-\tau)T]} \left(\hat{\varepsilon}_k' \hat{\varepsilon}_k\right). \tag{8}$$

So far we have just focused on the possibility of a single structural break. There is no reason to believe that the regression model does not contain multiple structural breaks. Bai and Perron (1998) propose a test that allows us to extract multiple (as much as five) structural breaks. Bai and Perron (1998) propose a multiple linear regression model with m breaks and ($m + 1$ *regimes*), which takes the following form:

$$R_t^S = y_{t-1}'\beta^l + \varepsilon_t, \quad t = T_{l-1} + 1, \ldots, T_l. \tag{9}$$

[1] The model was estimated using the GAUSS codes available from David Rapach's website.