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The predictive performance of commodity futures risk factors

Shamim Ahmed [a,*], Daniel Tsvetanov [b]

[a] Nottingham University Business School, University of Nottingham, Nottingham NG8 1BB, United Kingdom
[b] Essex Business School, University of Essex, Colchester CO4 3SQ, United Kingdom

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ABSTRACT

This paper investigates the time-series predictability of commodity futures excess returns from factor models that exploit two risk factors – the equally weighted average excess return on long positions in a universe of futures contracts and the return difference between the high- and low-basis portfolios. Adopting a standard set of statistical evaluation metrics, we find weak evidence that the factor models provide out-of-sample forecasts of monthly excess returns significantly better than the benchmark of random walk with drift model. We also show, in a dynamic asset allocation environment, that the information contained in the commodity-based risk factors does not generate systematic economic value to risk-averse investors pursuing a commodity stand-alone strategy or a diversification strategy.

1. Introduction

Systematic risk factors, motivated by conventional asset pricing models, are insignificantly correlated with commodity futures excess returns (see, among others, Bessembinder, 1992; Daskalaki et al., 2014; Dusak, 1973; Erb and Harvey, 2006; Jagannathan, 1985).[1] On the other hand, several studies show that the difference between the current spot price and the contemporaneous futures price, which is commonly known as the basis, contains information about expected futures excess returns (see Fama and French, 1987; Gorton and Rouwenhorst, 2006; de Roon et al., 1998, Gorton et al., 2013). Assuming that the spot price is well approximated by a martingale, a contract whose price is lower (higher) than the current spot price is then expected to yield a positive (negative) excess return over the term to maturity. Such an intuition has led researchers like Yang (2013) and Szymanowska et al. (2014) to identify commodity-based risk factors by analyzing the excess returns on a trading strategy that speculates on the slope of the term structure of futures contracts. In particular, Yang (2013) sorts a universe of commodity futures contracts into portfolios by basis and shows that two factors account for most of the in-sample time-series and cross-sectional variation in excess returns on these portfolios. The first factor is a commodity market factor, which corresponds to the equally weighted average excess return on a long position in all futures contracts (henceforth EWA). The second factor is the return difference between the high- and low-basis portfolios (henceforth HML).

The EWA and HML factors are far from being perfectly correlated and therefore capture the different aspects of systematic variation in commodity futures excess returns. Consistent with this risk-based interpretation, Bakshi et al. (2014) also show empirically that these commodity-based risk factors forecast changes in the investment opportunity set. Intuitively, when the EWA and HML factors are indeed proxies for systematic risk that are priced in the cross-section of commodity futures excess returns, combining expectations of these factors and knowledge of their betas should translate into expectations of future excess returns. There is extensive evidence, both empirical and anecdotal, that similar asset pricing intuition is often exploited in practice. More precisely, financial managers almost always use the traditional capital asset

* Corresponding author. Tel.: +44 (0) 115 823 2359; fax: +44 (0) 115 846 6667.
E-mail addresses: shamim.ahmed@nottingham.ac.uk (S. Ahmed), dtsvet@essex.ac.uk (D. Tsvetanov).

[1] Carter et al. (1983) provide evidence in support of systematic risk for commodity futures when the market portfolio includes both stock and commodity futures indexes. However, Marcus (1984) argues that the amended market portfolio constructed by Carter et al. (1983) is inappropriate and therefore questions the validity of the corresponding empirical results.

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pricing model (CAPM) and the multifactor models motivated by the arbitrage pricing theory (APT) as a primary tool to compute expectations of returns, especially in the context of equity markets (see, for example, Fama and French, 1997; Gitman and Mercurio, 1982; Graham and Harvey, 2001; Jagannathan and Meier, 2002; Simin, 2008, Ferson et al., 2013). It is, therefore, appealing for practitioners, especially active portfolio managers who trade commodity futures as part of their broader diversification strategy, to know whether the EWA and HML factors contain information that adds to the out-of-sample predictability of futures excess returns. Said differently, whether these commodity-based risk factors, utilized in a contemporaneous regression model setup based on asset pricing theory, can ultimately help minimize real time uncertainty faced by market participants when forecasting future excess returns, making investment decisions, and/or modeling future risk exposure.[2] Knowing this is timely and important considering the fact that the use of commodity futures contracts as an alternative asset class has grown rapidly in recent years.[3]

The goal of our paper is thus threefold. First, we examine the ability of EWA and HML factors, identified by Yang (2013) and Szymanowska et al. (2014), to generate accurate expectations of monthly commodity futures excess returns in an out-of-sample setting. In other words, we investigate whether the asset pricing models that utilize these risk factors including their unconditional and conditional expectations provide accurate one-step ahead forecasts of excess returns in the time-series domain. Our test assets include individual commodity futures as well as basis-sorted portfolios. Furthermore, in the case of individual commodity futures, we also exploit the information content embedded in commodity-specific characteristics, such as the hedging pressure and the open interest, and perform the out-of-sample forecasting exercises using the Fama and MacBeth (1973) cross-sectional procedure.

Second, we examine whether the factor model forecasts translate into systematic economic value to risk-averse investors. In particular, we quantify the economic value due to a dynamic mean-variance efficient asset allocation strategy that exploits predictability in commodity futures excess returns. This empirical exercise is motivated by the evidence from a growing body of literature that statistical significance does not necessarily guarantee economic significance (see, among others, Della Corte et al., 2009; Leitch and Tanner, 1991; McCracken and Valente, 2014; Thornton and Valente, 2012, and references therein).

Finally, we aim to investigate the economic gains accruing to an investor who diversifies her exposure to conventional assets, such as stocks and bonds, by dynamically allocating commodity futures contracts in her portfolio conditioning on the predictive ability of the risk factors out of sample. The potential benefits of allocating commodity futures to conventional portfolios have long been a subject of academic research. In fact, several empirical studies show that investors can improve the risk-return profile of their portfolios by also investing in commodities (see, among others, Bodie and Rosansky, 1980; Erb and Harvey, 2006; Fortenbery and Hauser, 1990; Jensen et al., 2000). For ease of exposition throughout this paper, we refer to the optimal asset allocation strategies in our latter two objectives as the commodity stand-alone strategy and the diversification strategy, respectively.

Our paper makes several contributions to the extant literature on commodity futures. First, we evaluate the performance of a set of commodity-based risk factors in an out-of-sample setting, whereas the existing evidence is based solely on in-sample data fitting framework.[4] Our analysis therefore shows the extent to which asset pricing models with commodity-based risk factors can be useful for practical applications including modeling future risk exposure. Second, an out-of-sample analysis enables us to assess the performance of the asset pricing models in terms of forecast errors and circumvents well-known issues, such as useless factor biases, errors-in-variables problem, the use of weak instruments, and data snooping biases.[5] Third, an assessment of economic significance due to out-of-sample predictability allows us to investigate whether investors who trade commodity futures contracts as part of their commodity stand-alone strategy or diversification strategy can gain value by conditioning on expectations of returns provided by the factor models. To the best of our knowledge, this is the first study that examines the diversification benefits of commodity futures in the context of return predictability, more so using forecasts from asset pricing models with commodity-based risk factors.

We find a host of interesting results based on a cross-section of 15 commodity futures. First, the factor models hardly outperform a random walk with drift benchmark in the out-of-sample forecasting horse races. The poor statistical performance of the models remain invariant regardless of the way we form factor expectations, including forecasting methods, and whether we focus on predicting individual commodity futures excess returns or the excess returns on basis-sorted portfolios. We also find that the use of commodity-specific characteristics does not improve the ability of factor models to produce more accurate forecasts of excess returns.

Second, factor models using unconditional factor expectations generally produce step ahead forecasts more accurate than models using conditional expectations of risk factors. The implications of these findings, mentioned above, are largely consistent with those of Simin (2008), who also finds that neither the CAPM of Sharpe (1964) and Lintner (1965) nor the three-factor model of Fama and French (1993) is capable of producing more accurate expectations of future equity returns relative to the historical average of the market return.

Third, the out-of-sample economic value results for a commodity stand-alone investment strategy lead to a similar conclusion obtained for the statistical evaluation of the models. Put differently, the factor models with commodity-based risk factors fail to outperform the random walk with drift benchmark in economic terms. Expectations of commodity futures excess returns generated by asset pricing models do not offer systematic diversification benefits either. A risk-averse investor who is already exposed to conventional assets gains no tangible economic value from dynamically allocating commodity futures contracts to her portfolio by exploiting the next period return forecasts offered by the factor models. These results are fairly robust to the use of different performance evaluation metrics and echo those of Daskalaki and Skiadopoulos (2011). The authors show that a utility maximizing investor is better off with a portfolio of stocks and bonds only and there are no tangible economic gains from investing in a commodity index or in individual commodity futures contracts.

[2] Fama and MacBeth (1973, p. 618) also stress that "As a normative theory the model only has content if there is some relationship between future returns and estimates of risk that can be made on the basis of current information."

[3] According to a Staff Report prepared by the Commodity Futures Trading Commission (CFTC), the total value of commodity index-related instruments purchased by institutional investors increased markedly to US dollar (USD) 200 billion in 2008 from a modest figure of USD 15 billion in 2003. Recently, Barclayhedge reports that the commodity assets under management reached at about USD 320 billion in the last quarter of 2014.

[4] Recently, Simin (2008) adopts a similar empirical approach but focusing only on conventional risk factors (i.e., Fama and French, 1993 factors) in the context of equity market alone. More importantly, we investigate not only the statistical significance but also the economic significance of the forecasting power of the factor models with commodity-based risk factors. Clearly, these dimensions of predictability assessment differentiates our paper from that investigated in Simin (2008).

[5] Asset pricing models can also be evaluated based on out-of-sample pricing errors (see, for example, Ferson et al., 2013).