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Forecasting commodity price indexes using macroeconomic and financial predictors



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ABSTRACT

Using a long sample of commodity spot price indexes over the period 1947–2010, we examine the out-of-sample predictability of commodity prices by means of macroeconomic and financial variables. Commodity currencies are found to have some predictive power at short (monthly and quarterly) forecast horizons, while growth in industrial production and the investment–capital ratio have some predictive power at longer (yearly) horizons. Commodity price predictability is strongest when based on multivariate approaches that account for parameter estimation error. Commodity price predictability varies substantially across economic states, being strongest during economic recessions.

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1. Introduction

Commodity prices are widely believed to influence price levels more broadly, and thus are of interest to central banks, policy makers, firms and consumers whose decisions depend on their expectations of future inflation.¹ It is therefore of interest to explore whether commodity prices can be predicted, and, if so, by which variables. This paper considers the question of whether macroeconomic and financial variables are useful in this regard. We study both in-sample and out-of-sample forecasts, and consider evidence across monthly, quarterly, and annual horizons, as well as across recession and expansion states.

Why might macroeconomic and financial variables help to forecast movements in commodity prices? The predictability of commodity spot prices can be expected to be driven by time-varying storage costs and convenience yields. Both of these can be influenced by the state of

the economy through short-term mismatches between demand and supply for commodities, and through financing costs. Time varying risk-premia form another possible source of predictability for commodity prices.²

With few exceptions, relatively little empirical work has been undertaken on the predictability of commodity spot prices by means of macroeconomic and financial variables. *Chen, Rogoff, and Rossi (2010)* study predictability in an aggregate commodity price index which comprises more than forty traded products. Using five commodity currencies, they find evidence that exchange rates predict commodity prices both in-sample (after accounting for parameter instability) and out-of-sample.

Groen and Pesenti (2011) study the predictability of ten spot price indexes in an out-of-sample experiment.

² *Acharya, Lochstoer, and Ramadorai (2011)* propose a model in which producers' hedging demand induces a common component in spot and futures prices. Speculators are assumed to be liquidity constrained, and so producers' hedging demand affects optimal inventory holdings and equilibrium spot prices. In their model, expected spot prices reflect a common risk term, as well as inventory stock-out and supply effects. Empirically, *Acharya et al. (2011)* find mild evidence of predictability of petroleum spot returns from fundamental hedging demand variables, as well as from the term spread.

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¹ *Groen and Pesenti (2011)* quote Federal Reserve Chairman Bernanke as “underscoring the importance for policy of both forecasting commodity price changes and understanding the factors that drive those changes.”

They conclude that neither commodity exchange rates (as per [Chen et al., 2010](#)) nor a broad cross-section of macroeconomic variables produce overwhelmingly strong evidence of spot price predictability when compared with random walk or autoregressive benchmarks.

The predictability of commodity futures prices has attracted more interest. [Bessembinder and Chan \(1992\)](#) find that the T-bill yield, dividend yield and junk bond premium have limited predictive power over movements in agricultural, metal, and currency futures prices. [Hong and Yogo \(2012\)](#) find evidence of limited in-sample predictability of returns on commodity futures. Predictable changes in commodity futures prices are driven mostly by time-varying risk premia. However, given the weak evidence of predictability of commodity futures prices, predictable variations in risk premia are likely to be only a small component of any predictable dynamics in commodity spot prices.

Our study focuses on four questions. First, do macroeconomic and financial variables possess predictive power over commodity prices? To address this issue, we explore out-of-sample predictability for a range of commodity spot price indexes over the 40-year period 1971–2010. Our analysis considers financial variables from the literature on stock return predictability, in addition to macroeconomic predictors such as inflation, money supply growth, growth in industrial production, and the unemployment rate, along with exchange rates for commodity currencies, and indicators of global economic activity.

Second, how does commodity price predictability vary with the forecast horizon? To address this question, we consider the monthly, quarterly, and annual horizons separately. Bottlenecks between the demand and supply of different types of commodities can be important in the short run, but we would expect them to be resolved in the longer run, and so the evidence of predictability may well depend on the forecast horizon.

Third, does commodity price predictability depend on the underlying economic state? The evidence from stock markets presented by [Henkel, Martin, and Nardari \(2011\)](#) and [Rapach, Strauss, and Zhou \(2010\)](#) suggests that the predictability of stock returns is largely confined to economic recessions. Clearly, it is of interest to see whether a similar finding carries over to commodity markets, in which the state of the economy would be expected to play an important role. We address this question by considering the strength of the predictive evidence during recessions and expansions separately.

Fourth, does the predictability of commodity prices vary across different types of commodities, such as agricultural versus raw industrial commodities? Findings of such differences are of interest, since they could be indicative of the types of storage costs and convenience yields that are affected by macroeconomic conditions.

Empirically, we find that the strength of the evidence on commodity price predictability is linked to the length of the forecast horizon. For example, the two commodity currencies possess strong predictive power at the monthly and quarterly horizons, but not at the annual horizon. In contrast, growth in industrial production has some predictive power in annual forecasts. One other variable,

the investment–capital ratio, also comes out as having predictive power in the quarterly and annual regressions. Overall, the out-of-sample evidence on the predictability of commodity prices is strongest at the quarterly horizon.

We also find evidence that the predictability of commodity prices is strongest in recessions and largely absent in expansions. Specifically, the unemployment rate, changes in the two commodity currencies, the term spread, and the investment–capital ratio are capable of predicting commodity price movements with higher levels of accuracy in recessions than in expansions, in a way that is statistically significant.

A decomposition of this result suggests that many predictor variables become more volatile during recessions, but also that their slope coefficients in predictive regressions increase in recessions. This dominates the concomitant increase in the volatility of the residuals of the predictive regressions during recessions.

Return predictability appears to vary considerably across different types of commodities. There is some evidence of out-of-sample predictability of movements in metals and raw industrial commodity spot price indexes, as well as for the aggregate commodity spot price index. In contrast, there is very little evidence suggesting that movements in the prices of fats and oils, foods, or livestock are predictable.

Finally, we find that multivariate regressions that adjust for the effects of estimation error on the forecasts through either shrinkage (ridge regression) or model combination (complete subset regressions) produce reasonably good out-of-sample forecasts, particularly for the metals, industrials, and aggregate commodity price indexes.

The outline of the paper is as follows. Section 2 introduces the data. Section 3 presents empirical results for the univariate models which are used to capture the predictability of movements in commodity spot prices associated with individual predictor variables. Section 4 explores predictability using multivariate predictability models, Section 5 considers variations in commodity price predictability across recessions and expansions, and Section 6 concludes.

2. Data

This section describes the data sources for the commodity prices and predictor variables, and provides a brief characterization of the data.

2.1. Commodity prices

Commodity spot prices are measured by the Reuters/Jeffries–CRB indexes compiled by the Commodity Research Bureau. These are computed as an unweighted geometric mean of the individual commodity prices relative to their base periods, which reduces the impact of extreme movements in individual commodity prices in the index. We use end-of-month prices measured at close, denominated in US dollars. When available, the spot price is based on the listed exchange price for a commodity of standard quality,

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