The Determinants of Convenience Yields

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In this study, we investigate the determinants of convenience yields across a broad range of commodities. We find that the convenience yields of commodities are exposed to both commodity-specific and systematic factors, but to a different extent. The difference in explanatory power of these factors for each commodity sheds light on the heterogeneity of commodity markets. One main difference between commodity sectors lies in their different sensitivities towards the state of the economy.

Introduction

Quite simply, the price level of a futures contract is equal to the value of the underlying asset, plus the cost of the asset, minus the benefit of the asset. For example, a futures contract on a basket of equities will have a price that is equal to the value of the equities, plus the cost of financing the purchase of the basket, minus the benefit of all the equity holdings' dividends. If the price of the futures contract diverges from this formula then there would be a riskless arbitrage. Therefore, under "no arbitrage" conditions, we would say that this relationship holds.

Interestingly, with commodity futures contracts, there is a complication with this "no arbitrage" condition. At times for some commodity futures contracts, the futures contract's price level will be below what it would cost to finance, store, and insure the spot commodity. This is because there can be an industrial benefit to holding commodities so that a commercial entity can avoid the disruption to its business operations from a potential stock-out. We call this benefit the "convenience yield," and this is a concept that was formalized in Kaldor (1939).

For commodity futures contracts, then, the futures price level is equal to the value of the spot commodity, plus the cost of holding the commodity, minus its convenience yield. The convenience yield is unobservable and we infer it from the futures contract price. In effect, it is a "plug factor" in the typical cost-of-carry formula, but it is also a logical, economically sound factor, nonetheless.

The research paper at hand uses a number of sophisticated mathematical techniques to examine to what extent convenience yields across commodities are driven by (a) commodity-specific factors such as inventories and hedging pressure, and to what extent convenience yields are driven by (b) macroeconomic factors such as inflation and industrial production.

Why the Paper's Research Question is Important

The authors explain that "convenience yield dynamics … play a crucial role in commodity derivatives pricing." In addition, as noted in Till (2016), commodity traders regard convenience yields as quite important in both short-horizon trading strategies and in long-horizon investment strategies. Understanding what may drive convenience yields across commodities would be helpful in both enterprises.

Data Description

The study includes "18 commodities … which can be categorized into 5 subgroups, namely grains, softs, animals and woods, precious metals and energy. … The sample period dates back to April 1990 and ends in December 2011," write the researchers. Table 1 on the next page summarizes the paper's data sources.

Description of Investigation

The authors use Schwartz (1997)'s three-factor model to represent all futures curve shapes, across time and across commodities, from which they extract a representation of each commodity futures contract's convenience yield through time. The researchers note that Schwartz's model has "been studied in detail and has been found to do a good job in pricing [commodity] futures contracts." The authors then use a set of sophisticated mathematical techniques to solve for their representation of convenience yields for each commodity through time.

Once the researchers have created time series for each commodity's convenience yields, they then proceed to examining how much of the variability of each commodity's convenience yields can be explained (a) by commodity-specific fundamental variables and (b) by broad macroeconomic variables. They do so via regressions.

Table 1
Research Paper's Data Sources

Data	Source
Commodity Futures Prices	Commodity Research Bureau
Interest Rates	Thomson Reuters Datastream's *US Treasury Constant Maturity Yield*
Agricultural Inventories	United States Department of Agriculture
Energy Inventories	U.S. Energy Information Administration
Cotton, Cocoa, and Cocoa Inventories	Intercontinental Exchange (ICE) warehouse data on The Bloomberg
Gold and Silver Inventories	COMEX warehouse data on The Bloomberg
Platinum Inventories	NYMEX warehouse data on The Bloomberg
Hedging Pressure ("[R]elevant net positions taken by commercial traders")	U.S. Commodity Futures Trading Commission's Commitments of Traders Report
Expected U.S. Industrial Production	*Blue Chip Economic Indicators*
Expected Consumer Price Index	*Blue Chip Economic Indicators*
10-Year / 2-Year Term Spread, "a measure of future economic activity."	Thomson Reuters Datastream

Results

The paper's noteworthy empirical results are as follows, quoting the authors:

- "Significant positive correlations between the convenience yields and the spot prices are observed across all commodities."

- "[For] 13 out of 18 commodities[,] ... the convenience yield is [more often] … below the level of storage costs [which shows] … that markets have sufficient supply most of the time, and inventory holders benefit little from owning the underlying good."

- "On the other end, … soybean meal, feeder cattle, … platinum and crude oil often exhibit … convenience yields" greater than storage costs.

- "[T]he convenience yields of most commodities show only relatively low correlations with each other."

- "Considering inventory …, we … observe that 15 out of 18 commodities exhibit a negative relationship [with convenience yields], with 10 of them being [statistically] significant ..." This is as generally as expected, given the theory covering convenience yields.

- "The explanatory power of inventory levels varies substantially across commodities. It is highest for silver [at] 27% …"

- Regarding hedging pressure, the authors "observe negative coefficients of the *net* long positions of commercial traders for 15 commodities … [with] 12 of them [statistically] significant. This result shows that a higher number of long commercial traders' positions (typically consumers) implies lower convenience yields." [Italics added.]

- Except for one commodity, the expected Consumer Price Index (CPI) and expected industrial production factors "exhibit significantly positive relationships with the convenience yields."

- "The term spread … is only significant for precious metals."

- "[T]he convenience yields of grains are less exposed to economic expectations than other sectors."

- Whereas the results above used only one explanatory variable at a time, the researchers also examined "all explanatory variables at once by conducting multiple regressions." The results "generally match those from simple regressions."

- "[T]he overall explanatory ability of the [authors'] variables … [is] strongest for metals and energy commodities."

Conclusion

The authors emphasize the usefulness of modeling convenience yields for derivatives pricing applications. But their paper is also useful for holders of long-term positions in commodity futures contracts.

Till (2016) discusses how the realized convenience yield for a commodity can be quite significant for the long-run returns of a commodity futures contract. Therefore, an understanding of what drives convenience yields is potentially useful to long-term holders of commodity futures contracts so that these investors can wisely choose which commodities to include (and which commodities to exclude) in their futures basket.

Erb and Harvey (2006, p. 83) find that "the efficacy of an individual commodity futures contract in hedging unexpected inflation has historically been correlated with its roll return," (which, in turn, is linearly related to the commodity's convenience yield, according to Lewis (2005).) This digest article's research paper provides additional evidence that convenience yields have statistically significant

relationships with key macroeconomic variables. If an investor is choosing a strategy based on its potential exposure to key macroeconomic variables, then this paper's results will be useful to this class of investors as well.

References

Erb and Harvey, 2006, "The Strategic and Tactical Value of Commodity Futures," *Financial Analysts Journal*, Vol. 62, No. 2, March/April, pp. 69-97.

Kaldor, N., 1939, "Speculation and Economic Stability," *Review of Economic Studies*, Vol. 7, No. 1, October, pp. 1-27.

Lewis, M., 2005, **"**Convenience Yields, Term Structures & Volatility Across Commodity Markets," *An Investor Guide to Commodities*, Deutsche Bank, April, pp. 18-23.

Schwarz, E., 1997, "The Stochastic Behavior of Commodity Prices: Implications for Valuation and Hedging," *Journal of Finance*, Vol. 52, No. 3, July, pp. 923–973.

Till, H., 2016, "Contributing Editor's Collection of Digest Articles," *Global Commodities Applied Research Digest*, Vol. 1, No. 1, Spring.

Keywords

Commodity futures, convenience yield