Title[1,2]

The Convenience Yield Implied in the European Natural Gas Markets - The Impact of Storage and Weather

Keywords

Natural Gas, Futures, Convenience Yield, Options, GARCH.

JEL classification

G13, G14, O13

Overview

In this article we determine the convenience yield implied in the European natural gas markets and investigate driving factors and the according dynamics. In a first step, we derive the appropriate model for the convenience yield approximation as given by the option-based approach, in which the convenience yield is determined as the difference between two average floating strike Asian options, one on the spot, and the other on futures contracts. In a second step, we fit an ARMA-GARCH model to explain the convenience yield via key driving factors, storage and weather. We find that seasonalities and weather are the main drivers for the volatility of the convenience yield implied in Europe. Moreover, we find distinct results for the different hubs that are sometimes in line with existing literature while sometimes they are opposed which can be explained by the different levels of efficiency implied in European natural gas hubs.

Methods

The convenience yield determination is a rather old concept and traces back to Working (1949). In its basic form, it deals with the benefits from owning a commodity in inventory instead of purchasing it, every time it is needed. In general, these benefits are not directly observable and often hard to determine as storage cost data is not available. Hence, in addition to the "theory of storage" several different concepts that deal with the convenience yield approximation came up that control for certain problems in the markets and shortcomings of certain other approaches.

The oldest, and thus in the article called, traditional approach to approximate the convenience yield is based on the "theory of storage" which links spot and futures prices as follows: Investors will be indifferent between (1) buying the commodity at the spot price and holding it, by paying the storage costs and receiving the convenience yield, or (2) entering a long position in a futures contract and investing in a risk-free bond. This no-arbitrage situation is in line with the cost-of-carry approach and can be used to calculate an implied convenience yield. In this context, Pindyck (1993) or Pindyck (2001) give a detailed review of this approach. As mentioned in Hochradl and Rammerstorfer (2012), the disadvantage of this approach becomes apparent as soon as for example constraints, as short-sale restrictions or restricted storage access, hinder the implementation of arbitrage-exploiting trading strategies in the considered market. In these cases, a more direct way to estimate the convenience yield would be preferable. Here, techniques that apply option-pricing techniques give the market agents the possibility to determine the convenience yield in a more direct way as for example mentioned in Heinkel et al. (1990), Milonas and Thomadakis (1997), and Heaney (2002) and more recently Hochradl and Rammerstorfer (2012).

Hence, in the following article we compare the different concepts to determine the convenience yield:

1. The first way to determine the convenience yield is given by the traditional approach (Cost-of-Carry).
2. The second approach is based on the well known approximation provided in Heaney (2002) in which under the assumption of perfect foresight, the investor is able to determine the convenience yield as the

[1] Thomas Kremser; Vienna University of Economics and Business; Institute for Banking, Finance and Insurance; Postal address: Heilligenstaedter Strasse 46-48, A-1190 Vienna, Austria; Email: thomas.kremser@wu.ac.at; Phone: +43-1-31336-6342.

[2] Margarethe Rammerstorfer; Modul University Vienna; Department for International Management; Postal address: Am Kahlenberg 1, A-1190 Vienna, Austria; Email: margarethe.rammerstorfer@modul.ac.at.

difference between two floating strike look-back put options, written on the underlying commodity spot, or futures contract, respectively.

3. As third approximation, we refer to the convenience yield approximation given in Hochradl and Rammerstorfer (2012) in which the idea of Heaney (2002) is extended by relaxing the assumption of the investors' perfect foresight. In this case, the convenience yield can be derived as the difference between two average strike Asian put options.

As mentioned in Hochradl and Rammerstorfer (2012), each of the three approaches to approximate the convenience yield has several shortcomings such that no overall sufficient conclusion on the convenience yield implied in a certain market can be drawn (with respect to all approaches in the same manner).
As soon as the optimum model for the European market is found, we shed light on the factors impacting the yield. For this, we refer to an ARMA-GARCH model that gives insights into the driving factors of the mean and the variance of the convenience yield, implied in the European natural gas markets

Results and Implications

We find that the temperature variable has a statistically significant and economically significant effect on the conditional mean and conditional volatility of the convenience yield. Moreover, we find a significant negative effect of the storage announcement dummy, which indicates that the release of natural gas storage information reduces volatility considerably, while the storage level does not affect the convenience yield for maturities greater than one month. In opposite to several articles, we do not find a significant impact of the oil volatility, which indicates that there is no significant spillover effect between oil return (volatility) and convenience yield. Finally, our results also indicate the existence of strong seasonalities of the variance of the convenience yield during autumn and winter months. This is not astonishing, as one would expect the convenience yield to be rather high in autumn and winter and this at a rather persistent level, so that the fluctuation during these seasons may be reduced. Overall, our findings contribute to the question what drives the volatility of the convenience yield implied in certain commodity markets. This is of major importance as not only the volatility of the prices but also the volatility of the related facilities may play a key role for financial decisions. For example, the valuation of commodity-based options and risk hedging decisions rely on the assumptions about volatilities and their evolution over time. Moreover, it is of extraordinary importance for traders in inefficient markets to determine the best information set available, even when storage facilities cannot be exhausted by every single trader. Our findings also undermine the ongoing debate on the lack of efficiency in the European gas markets which still hinders the implementation of efficient and profitable (clear) trading strategies. However, the results also reveal that the European markets are on the best way to improve.

References (Selection)

Heaney, R., 2002. Approximation for convenience yield in commodity futures pricing. The Journal of Futures Markets 22, 1005–1017.

Heinkel, R., Howe, M. E., Hughes, J. S., 1990. Commodity convenience yields as an option profit. Journal of Futures Markets 10, 519–533.

Hochradl, M., Rammerstorfer, M., 2012. The convenience yield implied in European natural gas trading. Journal of Futures Markets.

Milonas, N. T., Thomadakis, S. B., 1997. Convenience yield and the option to liquidate for commodities with a crop cycle. European Review of Agricultural Economics 24, 267–283.

Pindyck, R. S., 1993. The present value model of rational commodity pricing. Economic Journal 103, 511-530.

Pindyck, R. S., 2001. The dynamics of commodity spot and futures markets: A primer. Energy Journal 22, 1–30.

Mu, X., 2007. Weather, storage, and natural gas price dynamics: Fundamentals and volatility. Energy Economics 29, 46–63.

Working, H., 1949. The theory of price of storage. American Economic Review 6, 1254–1262.