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Commodity convenience yield and risk premium determination: The case of the U.S. natural gas market

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Abstract

This paper contributes to the understanding of commodity pricing issues by measuring and modeling two of the most important concepts in the storable commodity markets: the convenience yield and risk premium. An emphasis is placed on the empirical determination of these factors in the U.S. natural gas market. We find that the convenience yield and risk premium are measurable and economically significant. While we find that the determination of the convenience yield is largely consistent with economic theories, the evidence regarding the determination of the risk premium is mixed.

JEL classification: G13; Q40

Keywords: Convenience yield; Risk premium; Energy commodity; Efficient market

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1. Introduction

Commodity price determination has long been an important aspect of investigation by academic researchers as well as industry practitioners. At the center of the rationality of commodity pricing lays the concept of convenience yield, which was initially put forth by Kaldor (1939). Working (1949) provided some first evidence of the existence of convenience yield from the U.S. wheat market – stocks were held even when the inter-temporal spread within Chicago prices was "inverted." It is now conventional wisdom that the convenience yield drives a wedge between commodity futures and spot prices (Gibson and Schwartz, 1990; Schwartz, 1997; Chambers and Bailey, 1996, to mention a few). Even though some theories of storage do not rely on convenience yield (Khoury and Martel, 1989; Brennan et al., 1997), the convenience yield is found to be economically significant and it explains the futures and spot price relationships, especially when commodity prices are in backwardation (e.g., Considine and Larson, 2001a,b; Milonas and Henker, 2001).

We contribute to the understanding of the commodity markets, in particular, the U.S. natural gas market, by focusing on two related issues in this study. The first issue is the empirical definition, measurement, and determination of the convenience yield. The second is the definition, measurement, and determination of the risk premium. Despite various theoretical discussions of convenience yield and risk premium, the empirical evidence regarding the theories is scant. A study of these topics provides further and direct empirical evidence regarding the theory of commodity price determination (for example, Pindyck (2001), Considine and Larson (2001b), Schwartz (1997), and Pilipovic (1998)). In addition, in this research we choose to use forward prices instead of futures prices since in addition to a very active natural gas futures market, there is a very active forward market for natural gas. To our knowledge, there is no study of the U.S. natural gas forward market.

The paper is organized as follows. The next section briefly introduces the U.S. natural gas forward market and explains various theoretical relationships among the forward price, spot price, and the marginal convenience yields. We review the relationship between the spot price, forward price, and risk premium as suggested by various recent theories. We also explain the theoretical determination of the convenience yield and risk premium. The Third section explains data and empirical methods that are used to estimate the convenience yield and risk premium and the determination of the variables. The Fourth section provides empirical evidence regarding the theories. The Final section concludes.

2. Forward price, spot price, and convenience yield

2.1. The natural gas forward market

There is a very active forward market for natural gas in the U.S. The forward market we investigate is the so-called First-Of-Month (FOM) market. The FOM contract specifies the price and quantity of natural gas for delivery throughout the next whole month at different delivery points (hubs). Since there are many gas hubs in the U.S., the FOM prices are different depending on the locations. We choose the most liquid hub, Henry Hub (HH) in Louisiana, for our study. HH is the hub on which the New York Mercantile Exchange (NYMEX) natural gas futures contracts are based.

The FOM prices are determined during the bid week – the last five working days of a month – during which the FOM contracts are actively negotiated. The FOM index prices remain fixed