The price–volume relationship in the crude oil futures market
Some results based on linear and nonlinear causality testing

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Abstract

This article presents some evidence for the presence of a causal relationship between price and volume in the crude oil futures market. The results of linear causality testing reveal the presence of causality running from volume to price but not vice versa. While the results of testing for nonlinear causality are inconsistent, most of the evidence shows that causality runs in both directions. In general, there is evidence for the sequential information arrival hypothesis and the noise trading model, but not for market efficiency. There is also some evidence for the presence of a maturity or a liquidity effect. Finally, there is some variation in the results, depending on the sample period.   © 2000 Elsevier Science Inc. All rights reserved.

1. Introduction

This article examines the price–volume relationship in the crude oil futures market using linear and nonlinear causality testing. This relationship is important for a number of reasons.[1] For example, Gallant et al. (1992) assert that more can be learned about the market by studying the joint dynamics of prices and trading volume than by focusing on the univariate dynamics of prices. Moreover, the trading volume is thought

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to reflect information about changes in investors' expectations. Another reason for the interest in the presence or otherwise of a strong price–volume relationship is that it provides support for using technical analysis as opposed (or in addition) to fundamental analysis.[2]

Apart from Hiemstra and Jones (1994), Fujihara and Mougoue (1997), and Abhyankar (1998), the available empirical evidence on the price–volume relationship is based on conventional (linear) Granger causality testing. Baek and Brock (1992) have shown that these tests have low power against the nonlinear alternatives. Hence, any test based on the assumption of linearity will fail to detect nonlinear dependence. Nonlinear dependence may be present if the price and volume are generated by nonlinear processes: this hypothesis is theoretically plausible and empirically substantiated.[3] Recent work has revealed the existence of nonlinear structure in the process generating returns in financial and commodity markets. These nonlinearities are normally attributed to nonlinear transaction cost functions, the role of noise traders, and market microstructure effects (Abhyankar, 1998). It is now widely accepted that the relationship between economic and financial time series are mainly nonlinear. As a result, testing for nonlinear causal relationships between two time series has received considerable attention in the recent literature. In this article, the nonlinear causality test proposed by Baek and Brock (1992) is used to study the price–volume relationship in the crude oil futures market.

Further motivation for using nonlinear models is provided by Savit (1988, pp. 271–272), who argued that financial and commodity markets are likely to be examples of dynamic systems manifesting nonlinearities. He disputes the argument that fluctuations in time series are random and argues instead that the fluctuations are generated by inherent nonlinearities. The distinction between linear and nonlinear adjustment to any deviation from the equilibrium price lies in whether or not the magnitude of adjustment is proportional to the deviation. A proportional adjustment implies a linear relationship, but this kind of adjustment cannot generate the randomness observed in financial and commodity markets. Savit argues that nonlinear adjustment can produce this kind of behavior. Hsieh (1991) put forward a similar point by arguing that large moves in prices, which are greater than what is expected under a normal distribution, may be attributed to nonlinearities.

This article is organized as follows: We first present a discussion of the theory of the price–volume relationship, followed by a brief outline of the recent empirical evidence. We then present the data and examine the time series properties of the underlying variables. This is followed by an outline of the methodology used to test for linear causality and the results of the tests. The same follows for nonlinear causality testing.

2. The price–volume relationship: theory and empirical evidence

2.1. The theory

The rationale for postulating a positive relationship between volume and absolute price changes can be found in the basic supply and demand model. Starting from an