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.

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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. 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
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 Abhy-
ankar (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 substi-
tuated.3 Recent work has revealed the existence of nonlinear structure in the process
generating returns in financial and commodity markets. These nonlinearities are nor-
manly 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 fluctua-
tions 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 pro-
duce 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 evi-
dence. 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
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