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Crude oil shocks and stock markets: A panel threshold cointegration approach

Hui-Ming Zhu [a,*], Su-Fang Li [a], Keming Yu [b,c]

[a] College of Business Administration, Hunan University, Changsha 410082, PR China
[b] School of Business, Shihezi University of Xinjiang, Wujiaqu 831300, PR China
[c] School of Information Systems, Computing and Mathematics, Brunel University, London UB8 3PH, UK

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ABSTRACT

This paper proposes a panel threshold cointegration approach to investigate the relationship between crude oil shocks and stock markets for the OECD and non-OECD panel from January 1995 to December 2009. Nonlinear cointegration is confirmed for the oil–stock nexus in the panel. Because threshold cointegration is found, the threshold vector error correction models can be run to investigate the presence of asymmetric dynamic adjustment. The Granger causality tests demonstrate the existence of bidirectional long-run Granger causality between crude oil shocks and stock markets for these OECD and non-OECD countries. However, the short-run Granger causality between them is bidirectional under positive changes in the deviation and unidirectional under negative ones. Moreover, the speed of adjustment toward equilibrium is faster under negative changes in the deviation than that under positive ones in these OECD and non-OECD countries.

1. Introduction

Hamilton (1983) indicates that crude oil price shocks were a factor in the US recession after World War II. Since then, the identification of connections between crude oil prices and the macroeconomy has been a major concern in theory and practice. A large amount of literature tries to shed light on the effects of crude oil price shocks on economic activities, such as aggregate demand, inflation, employment and real economic growth (Bachmeier, 2008; Cunado and Perez de Garcia, 2005; Hamilton, 2003). The aforementioned studies have yielded mixed results. However, in the empirical literature, only a relatively small number of works have looked into the effects of crude oil prices on the stock markets. Studies by Jones and Kaul (1996) and Sadorsky (1999) report a significant negative impact of crude oil shocks on stock returns, a result that is further supported by Papapetrou (2001). According to the latter paper, an oil price shock has a negative effect on stock returns for the first 4 months. In this line of research, however, Chen et al. (1986) and Huang et al. (1996) do not reach the same conclusions. All of these results show that there is no consensus on the relationship between crude oil shocks and stock markets; therefore, more research may be necessary on this subject.

Much of the literature thus far has focused on the connection between crude oil price changes and stock prices. Specifically, almost all publications stress the influence of crude oil shocks on stock markets combined with other economic determinants. The new literature can be categorized into four types: first, the relationship between crude oil shocks and stock markets seems to be significantly evident and negative. This observation tends to be in line with Jones and Kaul (1996) and Sadorsky (1999) (Ciner, 2001; Kilian and Park, 2007, among others). In particular, Hammoudeh and Li (2005) suggest that on a daily basis, there is a negative bidirectional dynamic relationship between crude oil price growth and the world capital market. Ghouri (2006) also reveals that there is a very strong negative relation between West Texas Intermediate Cushing (WTI) and US monthly stock positions. Miller and Ratti (2009) analyze the long-run relationship between the world price of crude oil and international stock markets, utilizing a cointegration vector error correction model (VECM) with additional regressors. Aloui and Jammazi (2009) and Chen (2010), who use Markov-switching models, obtain similar results. Moreover, Basher and Sadorsky (2006) provide strong evidence of the impact of oil price risk on emerging stock market returns. Hammoudeh and Choi (2007) and Nandha and Hammoudeh (2007) further document that oil plays an important role in emerging stock markets. They find that stock prices increase as the crude oil price decreases and decrease as the crude oil price increases. Second, the relationship between crude oil shocks and stock markets seems to be significantly evident and positive (Arouri and Rault, 2011; Chen et

* Corresponding author. Tel./fax: +86 731 88823670.
E-mail address: zhuhuiming1999@yahoo.com.cn (H.-M. Zhu).

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al., 1986; El-Sharif et al., 2005; Narayan and Narayan, 2010). El-Sharif et al. (2005) find that a rise in oil prices results in an increase in the returns of oil and gas markets. Narayan and Narayan (2010) provide evidence in favor of cointegration of stock prices, oil prices and nominal exchange rates, and have also found that oil prices have positive and statistically significant impact on Vietnam's stock prices. Arouri and Rault (2011) also indicate that oil price increases influence stock prices in Gulf Cooperation Council (GCC) countries positively except in Saudi Arabia. Third, some studies show that oil price shocks have a statistically significant impact on stock markets, but whether the impact is positive or negative depends on the various conditions (Cong et al., 2008; Park and Ratti, 2008). Park and Ratti (2008) demonstrate that the stock market's response to crude oil shocks partly depends on whether the country is an oil importer or oil exporter. Cong et al. (2008) investigate the interactions between oil price shocks and the Chinese stock market, finding that the relative importance of oil price shocks and interest rates is different in various conditions of the Chinese market. Finally, the fourth category of research concludes that there is no significant relationship between oil shocks and stock markets (Al Janabi et al., 2010; Apergis and Miller, 2009; Henriques and Sadorsky, 2008). Using a four-variable vector autoregression model, Henriques and Sadorsky (2008) show that shocks to oil prices do not have a significant impact on the stock prices of alternative energy companies. Apergis and Miller (2009) investigate the effects of oil market shocks on stock markets in a multi-country context. The results also indicate that international stock market returns only respond to oil market shocks in a minor way. Al Janabi et al. (2010) conduct an empirical study of the impact of oil and gold prices on the GCC stock markets. The empirical findings reveal that neither gold nor oil prices Granger-cause the stock price index in each market.

Within the debate on the role of crude oil prices in stock markets, the previous analysis is conducted mainly with the assumption that the underlying variables exhibit a linear and symmetrical adjustment process. In reality, however, asymmetry is manifested in most macro variables. In finance variables, for example, asymmetry may be caused by the fact that bullish and bearish markets behave differently; stock markets may respond in various ways to increases and decreases in the price of crude oil. Likewise, financial market frictions and the availability of future contracts, as well as institutional and regulatory constraints in financial markets, are also major factors in stock and oil prices, and may influence the movement toward long-run equilibrium. For example, the existence of adjustment costs may prevent economic agents from adjusting continuously. It is useful for investors and managers to explore the asymmetric behaviors of these economic and finance variables. Ignoring the asymmetric adjustment among variables may lead to biased inference and misleading conclusions. Asymmetric adjustment assumes that the adjustment toward equilibrium varies with internal or external characteristics of the system. Specifically, the convergence toward long-run equilibrium may be faster under positive deviations than under negative ones, or vice versa. Therefore, conventional Granger causality and cointegration approaches have been criticized on the ground that they neglect the potential asymmetric adjustment. Some research has considered the asymmetry in the oil price-macroeconomy relationship (Hamilton, 1996, 2003; Lee et al., 1995; Mork, 1989). However, except for Chiou and Lee (2009), the existing analysis does not recognize the asymmetric adjustment involving threshold cointegration tests.[1] Therefore, this study combines traditional cointegrating and threshold cointegrating analysis to examine the links between crude oil shocks and stock markets.

In the majority of the prior empirical works, the linkage exploration between crude oil and stock markets generally uses time series for single countries. More recently, there have been some studies that deal with the interactions between energy and economic activities based on panel data. To the best of our knowledge, no work has analyzed the oil–stock nexus by applying a panel approach at the international level. This paper aims to provide the first empirical study that tests a panel of 14 OECD and non-OECD countries in terms of long-run equilibrium and the Granger-causal relationship between crude oil shocks and stock markets. Furthermore, using threshold cointegration in panel framework, we are able to better estimate the asymmetric adjustment.

This study makes several unique contributions. First, the estimates adopting a large group of panel data are more robust than those based on time series models because the former account for the long run relationship and Granger-causal relationship between crude oil shocks and stock markets with more reliable identification. Second, we consider a multivariate framework with additional regressors. Except for crude oil prices and stock market prices, we also incorporate interest rates and industrial production. Following Fama's (1981) hypothesis, measures of economic activity and inflation have played a role in the analysis of stock market activity. It is thus important to consider interest rates and industrial production in the context of international economies. The effect of crude oil prices on stock markets is better captured by considering these necessary variables.[2] Thirdly, we take into account the possibility that the long-run relationship between crude oil shocks and stock markets may involve threshold effects. Thus, the panel threshold cointegration tests are conducted to examine the possible asymmetric effects on the oil–stock nexus, which accommodate asymmetric adjustment in the long run.[3]

The rest of this paper proceeds as follows. Section 2 introduces the econometric methodology employed in this study. Section 3 presents the data and preliminary investigation. Section 4 reports the empirical results, and the final section presents our conclusions.

2. Econometric methodology

To evaluate the potential linkages between crude oil prices and stock market prices, we employ panel cointegration techniques. Unlike the existing studies in the single nonstationary time-series literature, recently developed panel methods have produced new strands of panel cointegrating regression analysis. In a panel context, the number of observations available is greatly increased when testing the long-run relationship, and as a result, more informative data can be obtained. Thus, the panel-based tests can gain statistical power substantially and overcome the low power problem of asymmetric adjustment in the tests' univariate counterparts.

In this paper, the test for long-run equilibrium between crude oil prices and stock markets in a panel framework is conducted based on panel cointegration tests. Before proceeding to the panel-based cointegration tests, the panel-based unit root tests are performed. Panel-based cointegration tests are then conducted to examine the long-run relationship between the variables in question. In addition, it is possible that there are threshold effects in a potential cointegrating relationship between crude oil prices and stock markets, which indicates asymmetric adjustment in the oil–stock nexus. Thus, panel threshold cointegration tests are used to detect the asymmetry. Given that the variables are cointegrated, a panel VECM can be adopted to check whether a linear combination of nonstationary variables exists, which then suggests that a long-run equilibrium relation holds between the variables. However, if the variables are threshold

[1] See Balke and Fomby (1997), Enders and Granger (1998), Enders and Siklos (2001), and Pippenger and Goering (1993).

[2] These particular covariates should be included in levels, and we choose the real economic variables but not the nominal ones.

[3] Since our interest in this study is merely discovering whether there exists asymmetric cointegration relationship, the identification of the number of cointegration relationships is beyond the scope of this study.