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The symmetrical and positive relationship between crude oil and nominal exchange rate returns

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ABSTRACT

This paper investigates both the static and dynamic relationships between daily crude oil returns and US dollar exchange rate returns using a test for symmetrical exceedance correlations and two mixture copulas. Empirical results demonstrate that the exceedance correlations between oil and exchange rate returns are both positive and symmetrical, indicating that the two return rates move in the same direction and that the relationship between them is symmetrical for the upper and lower quantiles. The crude oil-exchange rate relationship is sensitive to the sample period investigated. Before the 1998 financial crisis, exceedance correlations are close to zero, showing almost no correlation between the oil and exchange rate markets. However, the positive co-movement has significantly increased since the 2008 financial crisis. Furthermore, Kendall's tau coefficients of two symmetrized copulas greatly increase after the 2008 financial crisis, revealing that the probability of both returns moving in the same direction is higher than it is in the opposite direction.

1. Introduction

Because crude oil prices and exchange rates have been recognized as two of the critical factors of economic activity, the relationship between them has been investigated by both theoretical and

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empirical researchers. Although identifying and evaluating the relationship between the crude oil and exchange rate returns has received considerable attention, there is still no consensus on the relationship between the two. This paper aims to empirically investigate the crude oil-exchange rate relationship using the symmetric exceedance correlation test of Hong, Tu, and Zhou (2007) and Kendall's tau measures of mixture copulas. The symmetric test is used in order to investigate whether the right-tail exceedance correlations are equal to the left-tail exceedance correlations for all given thresholds. The dynamic Kendall's tau explores the direction of dependence and examines whether the dependence measure changes over time.

A number of theoretical models have discussed the oil price-exchange rate relationship.[1] For example, a simple theoretical specification of Chen and Chen (2007) expounds the relationship between the exchange rate and the oil price, showing that this relationship may be either positive or negative depending on the relative intensity of the tradable and non-tradable sectors in terms of the demand for crude oil. Similarly, Reboredo and Rivera-Castro (2013) derive the potentially positive or negative relationship between the oil price and the exchange rate according to the law of one price.

However, the empirical studies available in the literature observe different results.[2] For example, Narayan, Narayan, and Prasad (2008), Ding and Vo (2012), Reboredo and Rivera-Castro (2013) and Wu, Chung, and Chang (2012) demonstrate a positive relationship; Chen and Chen (2007) and Ghosh (2011) find a negative relationship; and Amano and Norden (1998), Zhang, Fan, Tsai, and Ta Wei (2008), Lizardo and Mollick (2010), Reboredo (2012), Aloui, Ben Aissa, and Nguyen (2013) and Salisu and Mobolaji (2013) observe an unclear relationship. Thus, further investigation on the direction of the co-movement is needed.

Traditional time-series models, such as the linear autoregressive regression model, cointegration specification, impulse response function, the generalized method of moment and the volatility clustering model have been used to examine the oil price-exchange rate relationship in existing empirical studies.[3] Recently, nonlinear specifications have been found to provide more information about the relationship between the exchange rate and the oil price. For example, Akram (2004) investigates the nonlinear effect of the oil price on the Norwegian exchange rate and finds that when there is a substantial change to the oil price, regardless of whether this change is positive or negative, the exchange rate increases sharply, and that this positive effect is weakened when the movement of the oil price is restricted within a normal range. From the point of view of nonlinear Granger causality, Wang and Wu (2012) demonstrate that the causal relationship between the US exchange rate and energy prices takes a nonlinear form. Benhmad (2012) adopts the wavelet approach in order to analyze the relationship between the US exchange rate and the oil price and finds that they are able to affect each other over a long period of time. However, there is only one-way Granger causality from the oil price to the US exchange rate over a shorter period of time.

Compared with the previous nonlinear specification, a strand of the literature pays attention to the relationship between the crude oil and exchange rate returns in terms of both extreme positive and negative tails. For example, Reboredo (2012), Wu et al. (2012) and Aloui et al. (2013) employ the copula specification in order to measure the magnitude of co-movement between the oil price and the exchange rate. Wu et al. (2012) study the relationship between WTI crude oil and US dollar index futures returns. Aloui et al. (2013) analyze the crude oil-exchange rate relationship for five currencies (the Euro, Canadian dollar, British Pound sterling, Swiss franc and Japanese yen). Wu et al. (2012) and Aloui et al. (2013) contend that the Student's-*t* copula is the most suitable specification for describing the positive relationship between the oil price and the exchange rate, indicating that the

[1] See Beckmann and Czudaj (2013) and references herein for further details.

[2] In the empirical literature, two different ways are used to express the definition of the exchange rate. The first uses a direct quotation and the second uses an indirect quotation. For ease of comparison, the exchange rate is defined here as the quantity of US dollars per local currency of the investigated country. The US dollar depreciates relative to the currency of the interested country if the value of the exchange rate increases.

[3] For example, Amano and Norden (1998), Yousefi and Wirjanto (2004), Chen and Chen (2007), Narayan et al. (2008), Zhang et al. (2008), Chen, Rogoff, and Rossi (2010), Lizardo and Mollick (2010), Ghosh (2011), Nazlioglu and Soytas (2011) and Basher, Haug, and Sadorsky (2012).