EUROPEAN RAPESEED AND FOSSIL DIESEL: THRESHOLD COINTEGRATION ANALYSIS AND POSSIBLE IMPLICATIONS

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Abstract

For European operators of biofuels plants there are not many hedge vehicles available to hedge operational margins. Cross hedges for rapeoil (with the rapeseed futures contract) and RME (with the NYMEX diesel futures contract) could be useful instruments. We use recent developments on threshold cointegration approaches to investigate if asymmetric dynamic adjusting processes exist among rapeseed and diesel prices. The results suggest that a three-regime threshold cointegration model suitably explains the dynamics of the data.

Keywords

Hedging, Rapeseed, Heating Oil, Threshold cointegration analysis.

1 Introduction

Several studies in the past have analyzed vegetable oil price relationships, among others IN & INDER (1997) and OWEN, CHOWDHURY & GARRIDO (1997). In addition to the recent YU, BESSLER & FULLER (2006), CAMPICHE, BRYANT, RICHARDSON & OUTLAW (2007) and PERI & BALDI (2008), studies have considered the potential link between vegetable and mineral oil. Furthermore it is evident, that European biofuels producers suffer from a lack of tradable hedging vehicles, to manage their price risks. In consequence we examine the ability of comparable futures contracts, to serve as an efficient price and risk management tool for European plant operators. In other words: Can biodiesel producers lock in future operational margins, because of the indication of a long-run relationship between the markets? Hence, it is beneficial to investigate possible interactions. With the aim to gain better insight into price behaviors, we applied a threshold vector error correction model (TVECM) to investigate if asymmetric dynamic adjusting processes exist between EU Rapeseed futures prices and fossil fuel prices.

2 Theoretical issues

BALKE and FOMBY (1997) introduced the concept of threshold cointegration, which allows taking into consideration this main criticism raised against linear cointegration. In their framework, the adjustment need not to occur instantaneously but only once the deviations exceed some critical threshold, allowing thus the presence of an inaction, or no-arbitrage band (STIGLER, 2010:5). Hence, for further analysis a threshold vector error correction (TVECM) model with three states is employed, accounting for the “no-arbitrage” state of the world as well as one exceptional state in each direction. A priori it is not clear (to us) how wide such a band might be, thus we employ a grid search for optimum threshold parameters minimizing RSS.

3 Empirical analysis

For the analysis, we use daily data for Heating Oil futures contracts[1] and Rapeseed futures contracts[2] ranging from January 3, 2005 until December 30, 2010. Prices for Heating Oil are given in US dollars per 100 gallons and are transformed to Euros per 100 gallons via daily exchange rates; prices for Rapeseed are given in Euros per ton.

[1] NYMEX HO futures contract, settlement prices, nearest delivery month, downloaded from www.nymex.com

[2] Euronext Paris ECO futures contract, settlement prices, nearest delivery month, downloaded from www.hgca.com

The estimated TVECMs are presented below with corresponding p-values in parentheses:

Regime 1 (Low, $ECT_t \le -0.2953$; 4.7% of all cases)

$$\Delta Oil_t = -0.1243_{(3.8e\text{-}05)} - 0.3606_{(2.5e\text{-}05)} \mathrm{ECT}_{t\text{-}1} - 0.2425_{(0.0035)} \Delta Oil_{t-1} + 0.3781_{(0.0720)} \Delta Rape_{t-1} + \varepsilon_t$$

$$\Delta Rape_t = -0.0076_{(0.6509)} - 0.0213_{(0.6542)} \mathrm{ECT}_{t\text{-}1} - 0.0374_{(0.4187)} \Delta Oil_{t-1} + 0.0258_{(0.8254)} \Delta Rape_{t-1} + \varepsilon_t$$

Regime 2 (Middle, $-0.2953 < ECT_t < 0.1653$; 73.5% of all cases)

$$\Delta Oil_t = 0.0003_{(0.6631)} - 0.0093_{(0.1528)} \mathrm{ECT}_{t\text{-}1} - 0.0612_{(0.0615)} \Delta Oil_{t-1} + 0.0393_{(0.4983)} \Delta Rape_{t-1} + \varepsilon_t$$

$$\Delta Rape_t = 0.0005_{(0.2183)} - 0.0032_{(0.3828)} \mathrm{ECT}_{t\text{-}1} + 0.0309_{(0.0905)} \Delta Oil_{t-1} + 0.0526_{(0.1038)} \Delta Rape_{t-1} + \varepsilon_t$$

Regime 3 (High, $ECT_t \ge 0.1653$, 21.8% of all cases)

$$\Delta Oil_t = 0.0082_{(0.1426)} - 0.0370_{(0.1000)} \mathrm{ECT}_{t\text{-}1} - 0.0578_{(0.2832)} \Delta Oil_{t-1} + 0.0332_{(0.6771)} \Delta Rape_{t-1} + \varepsilon_t$$

$$\Delta Rape_t = -0.0055_{(0.0784)} + 0.0249_{(0.0466)} \mathrm{ECT}_{t\text{-}1} + 0.0444_{(0.1386)} \Delta Oil_{t-1} - 0.4301_{(1.5e\text{-}21)} \Delta Rape_{t-1} + \varepsilon_t$$

Looking at the ECT-coefficient, we can see no statistically significant terms in either second regime. This is also true for the VAR-terms, showing that it is not possible to (linearly) predict future returns – a feature frequently observed for returns in general. Observing the first regime, we notice significant negative dependence of ΔOil_t on ECT_{t-1} (which is negative itself in this regime) and ΔOil_{t-1} as well as a negative constant. We see a tendency towards negative Oil returns in general, a strong mean reversion effect and a great deal of error correction, accompanied by high volatility. In the third regime, where Rapeseed price is low compared to Heating Oil, thus ECT strongly positive, we can observe that both Heating Oil and Rapeseed prices are slightly pushed towards the long run equilibrium.

4 Conclusions

We have demonstrated that there is evidence of asymmetric movements and the presence of a threshold defining three different regimes. 73.5% of all states can be understood as a "normal state of the world". In the two other regimes, (possibly non-causal) dependences can be shown. Where Rapeseed price is extremely low compared to Heating Oil, we can demonstrate that Rapeseed adjusts to its long run equilibrium more strongly and faster than in the remaining periods. This is in line with Peri & Baldi (2008), who pointed out similar coherences between Rape oil and Gasoil. Based on these results, we recognize Euronext Rapeseed futures contracts as reliable risk management tools for biodiesel operators.

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