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Relative value arbitrage in European commodity markets

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ABSTRACT

This study offers insights into the profitability of convergence trading in European commodity markets, thereby shedding light on the compensation for enforcing the Law of One Price. We analyze profits of a cointegration-based statistical arbitrage strategy on a wide range of European energy sectors and indeed find economically and statistically significant risk-adjusted excess returns which are also different from simple contrarian and momentum-based strategies. More importantly, the magnitude of this intermediation fee seems to be linked to commodity specific frictions limiting arbitrage possibilities. Consistent to the limits to arbitrage literature (e.g. Shleifer and Vishny, 1997 or Xiong, 2001), we find that convergence traders in Europe's commodity markets tend to be non-diversified investors focusing on specific market niches.

1. Introduction

Rising energy demand, price fluctuations, supply disruptions, and the urgent priority to reduce the environmental impact of the energy sector are key challenges of a European energy policy. Whatever solutions emerge from these problems, effective policy implementation will not be possible without reliable energy commodity price signals. By their very nature, energy commodity markets are highly complex. Prices possess relationships across time, location, and state due to physical restrictions which can vary significantly from market to market. We analyze whether and to what extent investors can exploit economic relationships among different energy commodity prices in a trading strategy. The strategies' returns can be interpreted as compensation for enforcing the Law of One Price (LoP) and therefore provide insights into the significance of market frictions, physical restrictions, and institutional rigidities within the European commodity market.

We investigate profits from relative value arbitrage strategies on the most important energy commodities in Europe. Based on daily data of 85 futures contracts on coal, natural gas, crude oil, gasoil, emission allowances, and electricity over the period from 2006 to 2013 we find that trading suitably chosen pairs or trios of commodity futures is indeed highly profitable and robust to a conservative setting of transaction costs, yielding excess returns of about 6–8% annually. We can readily reject that our strategies' returns are just a compensation for systematic risk factors such as equity- and commodity-market returns or exchange-rate risk. The returns are also different from those of a simple reversal or momentum strategy. We therefore attribute the strategies' excess returns to an intermediation fee for keeping energy commodity prices in equilibrium. The strategies, while identified on a purely statistical notion of co-integrated prices, reflect economically meaningful price relationships such as the difference between market prices for refined petroleum products and crude oil (crack spread), inter-market spreads between UK and Dutch natural gas, inter-market spreads between French and German electricity, or French base-peak spreads. Indeed, commodity-trading houses have been trading such kinds of inter-commodity, location, or calendar spreads based on these linkages for decades. We find that a significant fraction of our trades are carried out in the oil- and electricity-sector with coal and emission allowances playing a less important role.

We further show that our portfolio composition changes significantly over time. While before the recent financial crisis virtually all our trades arise from playing the crack spread, the methodology largely chooses positions in the electricity and gas sector later on.

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This shift goes hand-in-hand with a major market coupling event between the German and French electricity markets in 2010 which not only increased the dependence between markets but apparently also the trading opportunities.

Focusing on sector specific strategies we provide evidence of significant differences in profitability highlighting the heterogeneity among the considered energy commodities. Consistent with the notion that arbitrage can be costly and enforcing it is potentially more difficult in certain sub-sectors, profits are highest for the case of electricity and lowest for the coal sector.

The paper is related to several strands of the literature. Motivated by the success of relative value arbitrage strategies on equity markets, Gatev et al. (2006) were one of the first to thoroughly examine pairs trading, a very popular strategy among hedge-funds, which builds on the idea to identify stocks that have moved together historically and then trades winning and loosing stocks by betting on their consecutive convergence. The authors find significant positive abnormal returns for their pairs trading strategies in the U.S equity market and interpret them as compensation for enforcing the LoP, i.e. for ensuring market efficiency. In the following years many researchers were concerned with this promising investment strategy in national and international stock markets (Andrade et al., 2005; Papadakis and Wysocki, 2008; Engelberg et al., 2009; Do and Faff, 2010, 2012; Jacobs and Weber, 2015). The literature confirms significant risk-adjusted excess returns, generally agrees on the view that the observed profits do not arise from an information advantage, and more recently elaborates on the drivers of profitability. We extend this literature to the European energy commodity sector and provide evidence that physical restrictions and the heterogeneity among the energy commodities are clearly linked with compensatory returns.

Second, we contribute to the empirical literature on the relation between energy commodity prices. There is overwhelming evidence of long-run relationships between energy commodity prices for both the U.S. (Selertis and Herbert, 1999; Villar and Joutz, 2006; Mohammadi, 2008) and the European energy commodity market (Bencivenga et al., 2010; Joets and Mignon, 2011). In contrast, studies concerned with exploiting those relationships in a relative value arbitrage-trading framework are almost nonexistent. Exceptions are Emery and Liu (2002), Bianchi et al. (2009) and Cummins and Bucca (2012). The first study considers only a few energy-related futures contracts and does not include any calendar- or location spreads. The latter two focus on specific sub-sectors only and are not concerned with the portfolio's sensitivity to priced risk factors. We build on the long-run relationships between energy commodity prices, which we identify using Johansen's cointegration procedure (Johansen, 1988), undertake a comprehensive analysis of the resulting strategies' performance, and contribute to the understanding of the profitability and risks of following such strategies on the most important energy commodities in Europe. To grasp the order of magnitude for the compensatory returns within the European energy market we take into account that long-run relationships regularly comprise more than two securities such as e.g. emission-allowances, gas, and electricity. This is why our analysis also includes trios.

Finally, our study also contributes to research concerned with limits to arbitrage, that is how pricing anomalies (like the significant excess returns we obtain) can be explained by other means than systematic risk factors. Given the presence of a significant intermediation fee for maintaining market efficiency in the European energy commodity sector, it seems natural to analyze how this fee could be affected by costs and frictions present in the various energy commodity sub-sectors we consider. Consistent with the notion of costly arbitrage (e.g. Shleifer and Vishny, 1997; Xiong, 2001; or Acharya et al., 2013) we find that sector specific physical peculiarities in terms of storage costs seem to have a considerable impact on the profitability of following relative value arbitrage strategies within different sub-sectors. Additionally, we provide evidence that arbitrageurs indeed are rather specialized types of investors, that tend to focus on a specific market niche, contrasting the often assumed notion of a group of highly diversified traders. This evidence is fully consistent to arguments brought forward by Shleifer and Vishny (1997) or Xiong (2001).

The remainder of the paper is structured as follows. Section 2 introduces the economic intuition behind pairs-trading in energy commodity markets. Section 3 introduces our framework for identifying relationships among different commodity prices, building trading strategies, and calculating returns. Section 4 provides the empirical results while Section 5 concludes.

2. Energy commodity markets and relative value arbitrage

Conceptually, the idea behind pairs trading is a very simple one and builds on the principle of the LoP. Close economic substitutes, or in other words securities which have very similar payoffs, should also be priced similarly.

We follow the reasoning of Gatev et al. (2006) which builds on the idea that there can exist temporary deviations from this price. Profits obtained from trading those deviations are basically a compensation for enforcing the LoP on the long-run. Market participants undertaking those trades thus fulfill a vital role for achieving market efficiency. The question arises how large these compensatory returns are for energy commodities.

Examples for "economic substitutes" within the energy commodity sector are easy to find. Thus, it is not surprising that there is an overwhelming evidence for comovement among various energy prices. Virtually all energy commodities must undergo some kind of transformation in order to be consumed by the end-user (Pirrong, 2014). Some commodities must be moved from areas with excess supply to areas with high demand and low stock, thus be spatially transformed. Others need to be stored in order to make them available in periods of higher demand, thereby in a sense undergoing a temporal transformation. The costs and associated restrictions with which these transformations can be undertaken usually determine the linkages between different commodity prices associated in such a process. The European energy sector contains several interconnected market areas in which we observe vivid export- and import-trading activities. Moreover, Europe uses a large mix of different generation technologies to generate electricity and even launched an emission trading scheme that also interacts with the former markets. Thus, the European energy commodity market is a highly interesting sector to examine returns from convergence trades, the more so because evidence on pursuing relative value arbitrage strategies on it is virtually non-existent.

Fig. 1 depicts exemplary combinations of energy commodity prices that show comovement among each other. The top two graphs show how fuel or electricity prices in interconnected markets tend to move together in the long-run simply due to the fact that market participants can take advantage of price discrepancies by export- and import-activities. Prices for peakload hours of electricity in Germany and France usually closely follow each other since there are various transportation linkages between both markets. In a similar fashion, prices for gas at the TTF- and NBP-hubs never deviate too far from each other due to the Balgzand Bacton Line (BBL), a large transportation pipeline that connects the UK with the European mainland being used to balance excess supply and demand. Besides spatial linkages, commodities can also exhibit relationships across time or physical states. For instance, the crack-spread, the difference between the price of a refined product such as gasoil and crude oil itself is usually determined by the costs of the refining process. Therefore, movements in crude oil are ultimately also reflected in refined products (bottom left graph). With similar reasoning, the price of electricity and fuel prices possess relationships as well,