Energy Economics 51 (2015) 510–520

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneco

Dynamic steam coal market integration: Evidence from rolling cointegration analysis

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ARTICLE INFO

Article history:
Received 12 November 2014
Received in revised form 14 July 2015
Accepted 9 August 2015
Available online 16 August 2015

JEL classification:
C32
F18
F49
Q37

Keywords:
Integration
Steam coal market
Rolling cointegration
Weak exogeneity

ABSTRACT

The aim of the paper is twofold: first, to assess the dynamics of the integration process of the international steam coal prices and, second, to investigate the changes in the roles of particular coal prices in this market in the light of changes in the structure of supply and demand. The analysis is based on steam coal prices set by the largest world exporters and importers on both the Atlantic and the Pacific markets. We use weekly data spanning from October 5, 2001 to March 28, 2014. The aim is achieved in two stages. During the first one, we use the rolling trace test to identify the integration of the steam coal market, and during the second one, we apply the rolling weak exogeneity test to determine the roles of the participants of the international steam coal market, namely price setters and price takers. Our main findings can be summarized in two observations. Firstly, the main world steam coal prices are integrated and during the period when freight costs are higher, the coal market integration is weaker, and when the costs are lower, the integration is stronger. Secondly, the role of particular coal prices is not stable in time. Generally, price setters appear in the market which covers greater shares in the physical coal trade. Although Indonesia and Russia have a great share in the global export, their prices remain price takers during the whole period. As a consequence, although Russia remains the largest coal exporter of the steam coal to the European market, it cannot dictate its prices in this market.

1. Introduction

For the last several decades international trade in coal has been growing systematically. In 2002 the trading volume of the world steam coal amounted to 480.1 Mt, and in 2013 it increased to 1027.8 Mt. It was caused by a number of factors including the following ones: the standardization of energy coal supply contracts, increased liquidity in coal forward contracts (especially in Europe), consolidated freight routes, and the constant growth in energy demand. However, due to physical properties of coal (which is bulky and heavy), freight costs still constitute a large proportion of the final price set for importers. Consequently, international coal trade takes place mostly between buyers and sellers who are not separated by long distances. There are two main geographical areas of this trade: the Pacific market and the Atlantic market. The development of trade in these two areas is twofold. The first aspect is connected with the physical exchange of this commodity, while the second is of a financial nature, in which coal is treated as a financial instrument. Europe remains the domain of the latter one: the total volume of financial transactions of coal instruments here increased in the last decade from 190 Mt (in 2002) to 3029 Mt (in 2013) and now exceeds the global physical turnover of coal almost three times.

The change of the coal trade structure entails decisions taken on the level of international politics; the consequences of these decisions are felt especially in the European Union, as its aim is to become energy self-sufficient. It is to be guaranteed by a greater percentage of renewable energy sources and limiting the use of non-renewable energy sources (a low-carbon economy in Europe, which is in line with energy security, environmental and economic goals of the European Union as stated in Roadmap 2050). It covers restrictions imposed on energy obtained from steam coal. (On 13 October 2003 the European Parliament and the Council of Europe introduced the directive 2003/87/EC establishing Emission Trading Scheme (ETS) for greenhouse gas emission allowance trading and CO_2 emission allowance trading in the European Union, which was meant to result in increasing the costs of using coal). During the last decade Europe has become a leader in promoting and introducing renewable energy sources, which is, however, not the case in developing countries (BRIC). Most of them, in spite of ratifying the Kyoto Protocol, are not obliged to observe it (China, Brazil), and they do not do it. The countries with the greatest amount of greenhouse gas emissions are located outside Europe and include China, the USA, and India. Since in developing countries energy production grows, the percentage of coal in energy production there also increases.

That is why the Pacific market experiences an increase in coal demand, as the physical trade in this commodity outweighs the one in the Atlantic market. In 2002 about 33% of the total export was directed at the Asian market, while about 24.3% — at the European market.

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http://dx.doi.org/10.1016/j.eneco.2015.08.006
0140-9883/

However, in 2013 about 67.3% (that is 692.7 Mt) of the coal export was directed at the Asian market, and only 14.4% (148.2 Mt) — at the European market.

The purpose of this paper is to assess the dynamics of the integration process of the international steam coal market and to assess changes in the role of coal prices in this market in the light of changes in the structure of supply and demand.

The study is divided into two main stages.

The objective of the first one is to identify the integration of the market, which should guarantee the same coal price (accurate within freight prices) and the price adjustment mechanisms. The issue of international coal market integration has a long history, as it is initiated in the seminal work of Ellerman (1995) and continues in studies by Ekawan and Duchêne (2006), Ekawan et al. (2006), Warell (2006), Li et al. (2010) and Zaklan et al. (2012). Additionally, in the paper we focus not only on the integration itself but also investigate how the integration level of the international steam coal market evolves over time.[1]

During the second stage we analyze the changing roles of the participants of the international steam coal market. The aim of this part is to indicate which prices in particular periods should be treated as price setters and which are price takers. Earlier attempts to identify the decisive part in the coal market can be found in Warell (2006), Zaklan et al. (2012) and Papież and Śmiech (2013).

In order to establish the coal market integration and the role of prices in particular periods, we use the standard methodology of cointegration analysis developed by Johansen (1988) and Johansen and Juselius (1990) and the test of weak exogeneity (Johansen, 1991, 1992). In order to analyze dynamic interrelations in the system, we apply the recursive cointegration approach proposed by Hansen and Johansen (1992, 1999) and Rangvid and Sørensen (2002).

Cointegration of coal prices indicates that they do not drift apart in an unbounded fashion. Thus, the system defined by this variable is integrated (Zaklan et al., 2012). However, to assess the level of integration of the international coal market, a number of common stochastic trends are investigated. The lower the number of common stochastic trends, the more integrated the market is (Corhay et al., 1993; Engsted and Lund, 1997; Yang et al., 2003). The weak exogenous variable for the long-run (cointegration) relationship defines a common driving trend as the cumulated sum of the empirical shocks (Juselius, 2006, p. 193). In the analysis of coal prices, weak exogeneity of a given price will mean that it is a price setter. Applying a test of weak exogeneity allows us to indicate price leaders and price takers, that is prices which adjust to long-term relations.

In order to analyze the evolution of the integration process over time and the changes in the roles of particular prices, we apply the rolling window approach (Gilmore et al., 2008; Mylonidis and Kollias, 2010; Pascual, 2003; Rangvid, 2001; Rangvid and Sorensen, 2002). In this approach the sample size remains unchanged but the sample period moves ahead by one observation at a time, which allows us to observe the changes in relations between prices triggered by new information. The rolling window analysis seems to be correct as long as the international coal market evolves gradually and smoothly.[2] In addition, this approach is very useful in accounting for multiple structural changes in the underlying interrelations among coal prices.

The analysis of the international steam coal market conducted in this paper is based on steam coal prices set by the largest world exporters and importers on both the Atlantic and the Pacific markets. The Pacific market includes Indonesia and Australia, while the Atlantic market includes Northwest Europe, South Africa, Colombia, and Russia. The analysis is conducted using weekly data from the period between October 5, 2001 and March 28, 2014, which yields 652 observations. The size of the rolling windows is set at 208 weeks, that is about four calendar years. Consequently, tests results are obtained for 443 overlapping windows, which makes it possible to follow the evolution of the international coal market.

This article contributes to the literature in three main aspects.

Firstly, the analysis of the integration of the international steam coal market is conducted in a novel way in two dimensions: by taking into consideration a definition which links the market integration level with common stochastic trends and by taking into consideration the dynamic approach. That is why the results obtained in our study can be interpreted with reference to changes in the structure of the market, changing costs of sea transport (which are crucial for integration), and some additional factors.

Secondly, the analysis offers a broader picture of the coal market and identifies leading prices and following prices. The analysis of the changes in the roles of particular prices allows for additional economic interpretations.

Finally, our study takes into account the steam coal prices in the Baltic ports (Russia has been the largest exporter in the Atlantic market for the last few years). It is significant due to two reasons. First, the prices in the Baltic ports have been ignored in previous studies. Second, our study offers an interpretation of the role of the Baltic prices as well. As Russia is the main coal supplier in Europe, it is crucial for the UE policy makers to know whether the Baltic coal prices lead or follow other coal prices. The answer to this question facilitates the process of developing a sensible energy security policy.

The paper consists of the following sections. Section 2 reviews the existing literature, Section 3 describes the international steam coal market, and Section 4 presents empirical methodology that allows for the rolling cointegration procedure. Section 5 presents and discusses the data, and Section 6 reports and comments on the empirical results. The paper ends with the conclusions and discussion.

2. Review of literature

Existing studies devoted to the integration of the international coal market are not conclusive. Analyzing the data from the period 1970 to 1990, Ellerman (1995) argues that there is a unified global coal market with a dominating role of the USA as the price setter. The regional aspects of this market are described by Warell (2005). In his later work, Warell (2006) tests the hypothesis of the existence of a single market for the global coal industry (divided into coking coal and steam coal). She applies cointegration analysis for the European and Japanese prices for different periods in 1980s and 1990s, and she shows that there is no long-term cointegration relationship between the respective price series in different world regions in the 1990s for steam coal. However, the links between the regions can be found in Australia. Ekawan and Duchêne (2006) and Ekawan et al. (2006) point at the integration of the international coal trade at the beginning of the 21st century. Similarly, Balat (2010) describes the contribution of coal to the global energy demand and enumerates coal perspectives for several countries. However, the analyses mentioned above have not been conducted with the use of econometric tools. Zaklan et al. (2012) conduct a detailed analysis taking into account the links between importers and exporters. Using weekly data (December 2001–August 2009), they prove the integration of coal prices for exporters and, separately, for importers. They check the following hypotheses: the prices of export, transport and import of steam coal are integrated to a significant degree, the global steam coal market is not yet integrated, and the steam coal prices and freight rates are not directly related to oil prices. They also show that price adjustment varies on different

[1] The analysis might be extended to the problem of contemporaneous relationships (see Swanson and Granger (1997), Sims (1980) or Mjelde and Bessler (2009)). However, taking into account the main objective of the paper (the evolution of market interrelations), we have decided to not to include this issue in the paper.

[2] For this reason (Rangvid and Sørensen, 2002) "econometric techniques that test for structural breaks in the data-generating process at well-defined points in time (such as, for instance, the Perron, 1989) are ill-suited for analyzing the kind of questions raised in this paper. In order to analyze how the process evolves over time, one needs techniques that allows for an investigation of the gradual change in the data-generating process, such as rolling and recursive techniques."