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A MODEL-BASED ANALYSIS OF THE STEAM COAL WORLD MARKET – PRICE PEAKS VS. COST ESCALATION

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OVERVIEW

Coal is after oil and before natural gas the second most important primary energy source. It is mainly used for electricity and heat generation. About 36% of the global electricity generation is based on hard coal (see [1]). Prices on the market for internationally traded coal used to be relatively low and not very volatile for many years. However, during the years 2007 and 2008 prices suddenly soared and reached an unprecedented peak of 210 [USD/tARA] in mid-2008. Finally, prices collapsed in the second half of 2008 dwindling down to 61 [USD/tARA] in spring 2009 (for price data see [2]).

However, to what extend were these price peaks cost-driven? A computer-based optimisation model focussing on the supply chain of the seaborne steam coal market is developed to answer this question. Model outputs are traded quantities and marginal costs for the period 2005-2009. The goal of the analysis is to compare these model outputs, particularly marginal costs, with real-market data.

METHODS

Compared to the markets for oil and natural gas, we consider the seaborne steam coal market competitively organised and well integrated. Theoretically, the spatial price equilibrium in this market is fundamentally marginal cost based (see e. g. [3]). Therefore, to analyse if the recent price peaks were due to cost increases, detailed supply cost curves for all major exporting countries are an essential model input. The cash cost curves we derive are based on the assumption that all existing mines produce coal with a linear homogenous production function. Hence, the supply curve of an exporting country is a step function of different (constant) marginal cost levels. Firstly, we evaluate publicly available sources to approximate the supply curves for 14 major coal mining regions in 9 exporting countries for the year 2005. Secondly, the cash-cost curves are enhanced with country and technology specific mining cost structures. The cost structures indicate how much diesel, steel, explosives, tyres, chemicals, electricity and labour is used per technology. The proportions of these commodities differ significantly between the four predominant extraction technologies dragline, truck/shovel, longwalling and bord/pillar. Furthermore, productivity figures and country specific exposures to FX-changes are included. Thirdly, the mining cost curves are escalated according to the cost structures using price index data for the above mentioned commodities from various statistical offices. This method yields the shifts in supply curves for the period 2006-2009. Moreover, average inland transport costs are added to the mining costs in order to obtain f.o.b. cash-cost curves. Seaborne freight rates are often a major cost component. Freight rates are calculated for all routes and also escalated with an index.

Finally, the supply curves and the freight rates are implemented into a network optimisation model consisting of exporting and importing nodes. The model is designed as a non-linear cost minimisation problem in a spatial market, assuming exogenous (inelastic) demand.

RESULTS

Optimal trade flows and volumes show a good fit with actually traded quantities during all periods. Prices in the ARA (Amsterdam/Rotterdam/Antwerp) port region are slightly higher than endogenously determined marginal costs in the years 2005-2007 and 2009 (see Figure 1). Hence, the results indicate that the model is able to simulate the real market mechanism well in "normal" times. Marginal costs in the ARA port region clearly peak in 2008, however, they stay well below prices. Similar results are obtained for the Japanese reference price.

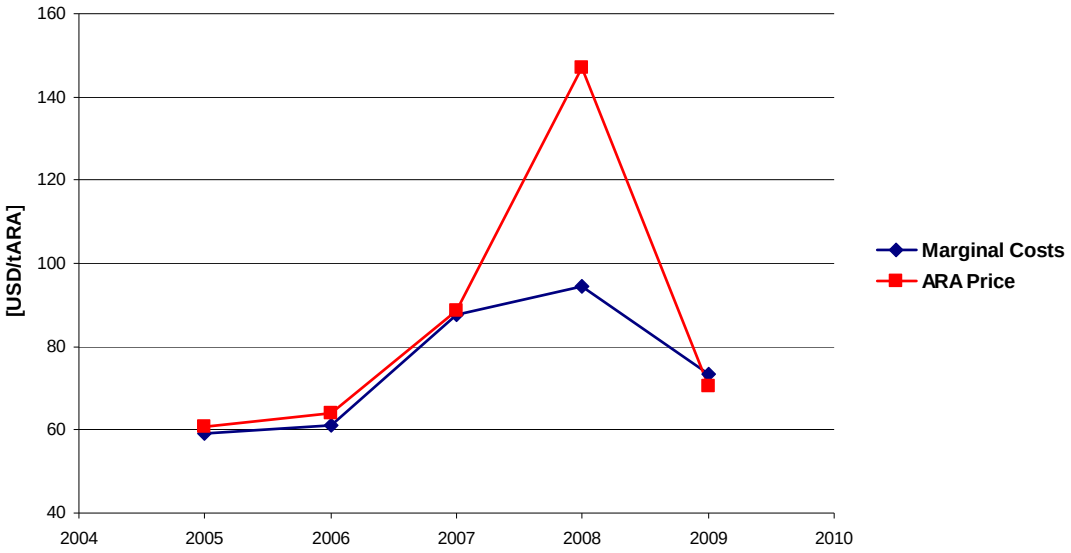

Fig. 1. Comparison of marginal costs with real ARA prices

CONCLUSIONS

The findings suggest that marginal costs are a major determinant of prices in the seaborne steam coal market. However, the price peaks in 2008 can only partially be explained by cost increases. Consequently, further research on other fundamental aspects is needed to fully understand the price equilibrium in this market. Issues that we consider important are the interaction between the seaborne market and the national coal markets, but also between the coking coal market, as high quality steam coal can also be used for metallurgical purposes. Moreover, a higher granularity of the model would allow analysing the role of short term infrastructure bottlenecks.

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