CLEAN FUELS FOR THE WORLD REFINING INDUSTRY: IMPACTS ON THE MARKET PRICE BEHAVIOUR

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Overview

The World oil refining industry faces to several challenges such as the increasing oil derivatives demand in the transport sector, the improvement of the specifications of these products, the crude oil availability and the limitation of carbon emissions. An aggregated refining model linked to the POLES energy model has been developped to study these questions. According to oil products demand forecasts and crude oil supply and prices scenarios, the model provides marginal costs of oil products. Because the equilibrium between the oil product prices and the crude oil price correspond to the equilibrium between the marginal cost of the oil products and the crude oil price, we study the market price behaviour through the analysis of the marginal costs.

The paper is organised as follows: After the introduction, the second section gives a brief overview the world-wide refining model. In the third section, we compare the marginal costs over the recent years to the econometric estimation of the market price behaviour. Then, the fourth section is dedicated to the analysis of several scenarios (according to different hypotheses on crude oil prices and oil product demand) up to 2030. The main issues are summarized in the conclusion.

Methods

An aggregated refining model has been developped to study these questions. The OURSE (Oil is Used in Refineries to Supply Energy) model is a worldwide aggregated refining model which is designed to simulate the world oil product supply for the POLES (Prospective Outlook for the Long-term Energy System) model. OURSE is able to simulate the impact on the world refining industry of changes in the crude oil supply (in costs and qualities) as in the oil product demand (in terms of level, structure and specifications). OURSE also enables to assess the consequences of a carbon emission regulation (bounds and taxes) as the adoption of various kinds of alternative fuel policies.
The OURSE model is based on a linear programming (LP) model, that is frequently used in the refining industry, both for refinery management and investment analysis, since a marginal cost pricing is relevant for the oil products. Designed to represent the world-wide refining industry into the POLES model, the OURSE model has to contain a restricted number of equations. This justifies that OURSE includes a representative upgrading refinery defined for nine aggregated refining regions in the world that are North and central America, Latin America, North and South Europe, CIS, Africa, Middle Esat, China, Other Asia and Oceania. Similarly, since directly linked to the number of crude oils considered, the model size is also reduced by considering, for each world refining area, an aggregated crude oil supply based on five representative crude oil qualities in the model. Moreover, the non-conventional supply (extra-heavy oil, tar sands, gas to liquid, coal to liquid, biomass to liquid) has been introduced in the model.
Based on scenarii about the world oil product demand, the crude oil slate and prices and different environmental policies, some long-term simulations are performed to assess the world oil product prices through the calculation of the marginal costs of oil products.
For a joint products industry such as the refining industry, there is no single key to the breakdown of the total processing cost by products. In the cost minimization model, at the equilibrium indeed, the sum of the products of the marginal costs by the associated right-hand-side coefficients of primal constraints is equal under some assumptions to the global processing cost (objective function of the primal problem). Consequently, the equilibrium between the oil product prices and the crude oil price correspond to the equilibrium between the marginal cost of the oil products and the crude oil price. Thus, an analysis of the oil product market behaviour could be done from through the study of the marginal costs.

Results

We have carried out a study over the period 2005 to 2030.
First, on the period 2005-2007, we have compared the marginal costs from the LP refining model with the econometric estimation of the relationship between crude oil price (Brent price) and the oil products prices

(premium, gas oil , heavy fuel oil) on the European market (cointegration analysis). The econometric equilibrium between the oil products prices and the crude oil price are around 1.3 for premium (eurosuper 95) and gas oil. It stands at 0.6 for heavy fuel oil (1% sulphur). The equilibrium between the oil product prices and the crude oil price corresponds to the equilibrium between the marginal cost of the oil products and the crude oil price.
Second, on the future period up to 2030, we analyze the marginal costs behaviour of gasoline, gas oil and heavy fuel oil on the three main places North America, Asia and Europe.

Conclusions

Three main conclusions raise from this study :

- the oil product price behaviour exhibit the same evolution than the marginal cost.
- the improvement of the specification of oil products (such as the decrease of the sulphur content) has a significant impact of the oil product prices.
- the actual and future choice of automotive fuel (between gasoline and diesel oil) should have a strong influence of marginal costs of these products (due to their relative share in the total demand of oil products). Consequently, the relative prices of these two fuels could be strongly modified.

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