Determination of European Biofuel Prices and their Impact on Agricultural Commodity Prices

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***Abstract* - World annual biofuel production has exceeded 100 billion litres in 2009. Development of biofuel production is partly influenced by the development of oil prices. The main purpose of this paper is to analyze the price relationship between fossil fuels, biofuels and agricultural commodities. We are interested in analyzing how each variable is related to another, so we evaluate the inter-relationship among the variables in a Vector Autoregression (VAR) and Impulse Response Function (IRF). In order to achieve our goal, we first collected weekly data for each variable from April, 2005 to October, 2009. The results provide evidence of cointegration relationship between oil and gasoline prices, but no cointegration between other price series. As a result, we used a VAR model on first differences. After running an Impulse Response Function, we found out that the impact of the oil price shock on the other variables is considerable larger than vice versa.**

INTRODUCTION

There has been a tremendous increase in production of biofuels in recent years. Global production of biofuels reached 62 billion litres in 2007. Of this amount around 85 percent of liquid biofuels is ethanol, while remaining 15 percent is biodiesel. In 2009 the annual production of biofuels has already exceeded 100 billion litres. Incentives motivating the rise of biofuel production come mainly from government support programs.

Governments in the USA, EU, Brazil as well as in other developed but also developing countries use a plethora of instruments to support the production of biofuels. Among the most important instruments belong consumer excise-tax exemptions, mandatory blending of biofuels and fossil fuels, import tariffs on biofuels, production subsidies for biofuel feedstock (e.g., energy crops) and biofuels themselves (grants, loan guarantees, tax incentives, etc.), subsidies for R&D of new technologies.

In the EU, the biofuel directive (The Directive 2003/30/EC) sets that by 2010 the European Union should reach the reference target of 5.75 percent share of biofuels in total transport fuel use. By year 2020 the European Union has a mandatory plan to achieve 10 percent share of biofuels in transport fuels. Member states in order to achieve the reference target can provide tax concession to support biofuel industry. EU also uses import tariff on denaturated and undenaturated ethanol imports of 10.20 EUR per hl and 19.20 EUR per hl respectively which is an equivalent of 33.2 and 62.4 percent respectively in ad valorem terms. The import tariff on biodiesel is 6.5 percent. EU also provides 45 € per hectare to farmers that produce feedstock that are used for production of biofuels (energy crops) or to generate heat or power. Set aside land can be used for production of feedstock used for biofuels or for generation of heat of power. Member states of the EU provide tax concessions. On average tax on biofuels is 50 percent lower than the tax on fossil fuels.

Biofuels involve the trade-off between using scarce resources to produce fuel and to produce food (Runge 2007). Along with emerging government policies, a major uncertainty in the future growth and profitability of the corn-starch ethanol industry is the stability and strength of the corn-ethanol-crude oil price relationship. Ethanol production converts corn to a more valuable product, a motor fuel whose price is closely related to the major alternative, namely gasoline (Wisner, 2009).

O'Brien and Woolverton (2009) quantify the relationships between ethanol, motor fuel prices and corn prices in U.S. They confirm that the corn market is closely related to the energy sector. A sizeable increase in corn processing for ethanol now tends to strengthen corn prices much more significantly than in the past. The relationship of commodity prices to various fuel prices has major implications for crop and livestock farmers.

Tokgoz and Elobeid found out, that ethanol and sugar prices tend to move together in Brazil. This study illustrates that the discussions about the role of ethanol as a fuel source need to take into consideration the response of world agricultural markets (Tokgoz, Elobeid, 2006).

However the report of Renewable Fuels Association shows that the role of corn prices and ethanol production in rising food prices is minimal. Only 4 percent of the change in the food CPI (Consumer Price Index) is explained by fluctuations in corn futures prices, even when the corn price is lagged (RFA, 2008).

Ethanol is still a very minor outlet for EU cereals since it represents less than 1% of end use of the latter. The world has consumed more wheat than has been produced in six of the last seven years.

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Rice consumption has been higher than rice production in five of the last seven years. The resulting drawdown in wheat and rice stocks is largely responsible for the large increase in rice and wheat prices because neither rice nor wheat is used in biofuels. It is difficult to find a link between the prices for these staple food crops and expanded biofuel production (Babcock, 2008).

An analysis made by the Energy Information Administration suggested that up to 16 billion gallons of corn-ethanol could still be produced in 2015 without affecting the corn price (EIA, 2007).

METHODS AND DATA

In spite of the review mentioned above, most of the literature suggests the current increase in ethanol production was an important factor that led to the rise in food prices. The main goal of our study is to check whether the relationship between fuel and food prices is statistically significant. We expect to find a positive relationship between ethanol prices and the prices of corn, wheat and sugar; in other words, we expect an increase in ethanol price to lead to an increase in the demand for corn, wheat and sugar beet and therefore, an increase in corn, wheat and sugar prices.

We aim to evaluate the relationship among the following variables: fuel prices (oil, ethanol and gasoline) and selected food prices (corn, wheat and sugar). We conduct a series of statistical tests, starting with tests for unit roots and stationarity, estimation of cointegrating relationships between price pairs, estimation of linear cointegration and evaluating the inter-relationship among the variables in a Vector Autoregression (VAR) and Impulse Response Function (IRF). The direction of causation in the variables is tested by means of Granger causality tests.

We use weekly data (April, 2005 to October, 2009) for gasoline, oil, ethanol, corn, wheat and sugar prices. The total number of data points is 221×6 weekly observations. Prices are expressed in USD per gallon of fuel and USD per ton of food. German ethanol prices come from Bloomberg database (2005-2009). German gasoline prices and Europe Brent oil prices are from Energy Information Administration (2005-2009) and German corn, wheat and sugar prices come from Deutsche Boerse database (2005-2009). German prices are used, because Germany has been one of the most important ethanol producers in Europe during the observed period. Logarithmic transformation of the prices is used due to the assumed multiplicative effect.

RESULTS

All the original time series are non-stationary and can be used for cointegration test. In Johansen cointegration test we used the 1% level of significance because the power of this test is low. As a result we found out that, gasoline and crude oil time series are cointegrated as expected, while other time series are not cointegrated.

To estimate parameters of the relationship between oil, gasoline and ethanol price time series we used Vector Autoregression (VAR) model because not all of the variables were cointegrated. Based on the AIC criterion, we estimated VAR(1) model on the first differences of the logarithms of each variable. We found a relationship between the prices of ethanol and crude oil. If the price of ethanol in period t-1 increases by one unit, the coefficient shows that oil price in period t increases by 0.1581. Similar, but much stronger is the relationship between the gasoline and oil prices. If the price of gasoline in period t-1 increases by one unit, the oil price in period t increases by 0.2248.

The strongest is the relationship observed between the oil prices and gasoline prices. The model suggests that the increase in oil price by one unit in period t-1 will lead to an increase in gasoline price by 0.3923. Finally, we found that each variable in this period is affected by its own values from the previous periods.

According to our results, there is not a significant relationship between biofuel prices and agricultural commodity prices. The one statistically significant relationship was observed between crude oil and corn prices, when an increase in oil price by one unit will lead to a decrease in corn price by 0.1641.

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