The Impact of Energy Markets on the EU Agricultural Sector

Simla Tokgoz [1]

[1] Center for Agricultural and Rural Development, Iowa State University, Ames, Iowa, USA

Abstract— **The objective of this study is to analyze the impact of crude oil prices on the EU-27 agricultural sector in an era when the biofuels sector is expanding because of the policy initiatives taken by the EU Commission and member states. To this end, first a baseline is set up for the EU-27 ethanol, grain, and dried distillers grains markets. In the next step, two different scenarios are run. The first scenario incorporates a $10-per-barrel increase in the EU-27 crude oil price with the ethanol import tariffs in place. The second scenario incorporates the same shock with the ethanol import tariffs removed. In the first scenario, higher crude oil prices increase ethanol consumption, production, and therefore grain prices. In the second scenario, the impact of trade liberalisation is larger than the impact of the higher crude oil price. So, grain prices decline in this scenario despite an expansion in ethanol consumption. If there were a high enough crude oil price shock, which would affect the EU-27 ethanol market more than trade liberalisation, the net impact on grain, feed, and food prices from the crude oil price shock would be mitigated by the increased trade from trade liberalisation. The study shows that the impact of energy prices on the EU-27 agricultural sector is increasing with the emergence of the biofuels sector. It also illustrates the importance of trade policy in responding to higher crude oil and grain prices.**

Keywords— **Ethanol, energy prices, trade liberalisation**

I. Introduction

The objective of this study is to analyze the impact of crude oil prices on the EU-27 agricultural sector in an era when biofuels' share in energy consumption is increasing rapidly because of the policy initiatives taken by the EU Commission and the member states. To this end, first a baseline is set up for the EU-27 ethanol, grain, and dried distillers grains (DDG) markets. In the next step, two different scenarios are run. The first scenario incorporates a $10-per-barrel increase in the EU-27 crude oil price with the ethanol import tariffs in place. The second scenario incorporates the same crude oil price shock with the ethanol import tariffs removed. In the first scenario, higher crude oil prices increase ethanol consumption, production, and therefore grain prices. In the second scenario, the impact of trade liberalisation is larger than the impact of the higher crude oil price. So, the grain prices decline in the second scenario despite an expansion in ethanol consumption. If there were a high enough crude oil price shock, which would affect the EU-27 ethanol market more than trade liberalisation, the net impact on grain, feed, and food prices from the crude oil price shock would be mitigated by the increased trade from trade liberalisation.

This study analyzes the "new" link between the energy and the agricultural sectors of the EU-27 using an ethanol model. The EU-27 ethanol model contains an energy sector component and is tied to a full-fledged EU-27 grain model that includes wheat, corn, barley, rye, and DDG models. The results show that the energy sector affects the EU-27 agricultural sector, particularly the grain prices, through the ethanol sector. It also shows the importance of trade policy in responding to higher crude oil and grain prices. This analysis also contributes to the food-versus-fuel debate generated by the recent increases in world and EU-27 grain prices, which are partially brought about by the emerging biofuels sector.

II. EU Biofuel Policies

Europe has a growing market for ethanol because of the European Commission's targets for including renewable fuels in the transportation sector's fuel consumption. The EU renewable fuels directive of 2003 promoted the use of biofuels and other renewable fuels for transportation by setting a goal for member states to achieve a 2% share of renewables by the end of 2005 and a 5.75% share by the end of 2010, though these shares are non-binding. In January 2007, the European Commission proposed a binding 10% target for biofuels in transport fuel by 2020 for all

member states. In December 2007, the Commission had another proposal that suggested that all member states should ensure that 6.5% of their transport fuel consumption comes from biofuels by 2012, in order to be able to reach the legally binding target for 2020 [1].

These policies have been effective in increasing biofuel production and consumption in the EU-27. Biofuel consumption in the EU-27 reached a 1.8% share of the total consumption of fuels for transport in 2006 compared to 1% in 2005 [2]. In 2006, biodiesel represented 71.6% of the energy content of biofuels dedicated to transport, whereas ethanol had 16.3%, and other biofuels had 12.1% [2]. The increase in biofuel consumption has increased the demand for feedstocks used in ethanol production and vegetable oil used in biodiesel production. This demand increase combined with supply shortages has caused a dramatic increase in grain and oilseed prices in the EU-27 in the 2007/08 marketing year.

Another source of supply of ethanol in the EU-27 is imports, mainly from Pakistan, Brazil, Egypt, Guatemala, Ukraine, and the U.S. In the EU-27, ethanol is subject to an import duty of 10.2 euros per hectoliter (0.386 euros per gallon) for denatured alcohol, and 19.2 euros per hectoliter (0.727 euros per gallon) for undenatured alcohol. The import duties do not apply to countries that are part of the Generalized System of Preferences (GSP) and Everything But Arms (EBA), and Cotonou agreements [3].

III. Development of EU Ethanol Markets

In the EU, the main biofuel is biodiesel, followed by ethanol and ETBE. Biodiesel constitutes approximately 80% of biofuels used for transportation [4]. Ethanol is made from wheat, sugar beet, barley, rye, corn, and wine alcohol. Ethanol is usually blended with conventional gasoline in any proportion up to 5%. ETBE, produced from ethanol, is blended up to 15%. In producing ethanol from cereals, a by-product is DDG, which can be fed to animals as a replacement for feed grains. The EU-27 imports DDG as well as producing it domestically.

The ethanol sectors in many EU member states have responded to policy initiatives and have started growing rapidly. EU-27 ethanol production increased by 71% in 2007, reaching 773 million gallons. Ethanol consumption reached 653 million gallons in 2007, an increase of 58%. Net imports of ethanol increased to 158 million gallons in 2007.

IV. International Ethanol and Grain Models

The international ethanol model is a non-spatial, multi-market world model consisting of a number of countries, including a Rest-of-World aggregate (ROW) to close the model. The general structure of the country model is made up of behavioural equations for production, consumption, stocks, and net trade. Complete country models are established for the U.S., Brazil, EU-27, Canada, China, and India, while only net trade equations are set up for Japan, South Korea, and ROW. The model solves for a representative world ethanol price (Brazilian anhydrous ethanol price) by equating excess supply and excess demand across countries. Using price transmission equations, the domestic price of ethanol for each country is linked to the representative world price through exchange rates and other price policy wedges. For the U.S. and the EU-27 ethanol models, a domestic ethanol price is solved by equating excess supply with excess demand in these countries separately.

The international grain model is a non-spatial, multi-market model that is composed of 36 countries/regions that includes a ROW. The commodities included are barley, corn, DDG, rye, sorghum, and wheat. Each country model consists of behavioural equations for crop acreage, yields, feed demand, non-feed demand, stocks, and net trade. The international grain model is linked to the international ethanol model through the prices of the feedstocks that are used for ethanol production and the demand for feedstocks used by the ethanol sector.

V. EU-27 Ethanol and Grain Models

The EU-27 ethanol model, which is embedded within the international ethanol model, endogenously solves for a domestic ethanol price for the EU-27 market. The demand for ethanol is composed of two behavioural equations; one for final energy consumption by the transportation sector and one for the share of ethanol in final energy consumption. Since ethanol and gasoline are modelled as close

substitutes, both ethanol and gasoline prices are included in the equation for share of ethanol. Ethanol production depends on the net profit margins for ethanol producers, which are computed using ethanol, by-product, and feedstocks prices, and fixed and operating costs for ethanol plants. The net import equation depends on the ratio between the domestic and the world ethanol price with the necessary policy wedges. The import duty for both denatured and undenatured ethanol is included, weighted by their relative shares in ethanol imports. Ethanol production from the ethanol model is utilized to derive the production of DDG and the grain use of ethanol in the EU-27. The grain used for ethanol is divided into wheat, corn, barley, and rye demand and then linked to the EU-27 grain model by adding their demand to total grain demand in the EU-27.

The grain prices in the EU-27 are solved endogenously by equating excess supply to excess demand in each grain market. There are behavioural equations for crop acreage, yields, feed demand, non-feed demand, stocks, and net trade. The EU-27 DDG model consists of production as a by-product of ethanol production, and behavioural equations for DDG consumption and net trade. A DDG price for the EU-27 is solved by equating excess supply with excess demand in the EU-27.

VI. Data Sources and Methodology

Both the international ethanol and the grain models are calibrated on the most recently available data (2007) and used to generate a 10-year baseline through 2017. In general, data for ethanol supply and utilization were obtained from the U.S. Department of Agriculture's Foreign Agricultural Service reports, the Food and Agricultural Organization (FAO) of the United Nations (FAOSTAT Online), the F.O. Lichts Online Database, and the European Commission's Directorate General for Energy and Transport. Macroeconomic data were gathered from various sources, including the International Monetary Fund and Global Insight. The world crude oil price projections are from NYMEX futures prices gathered on January 31, 2008. The EU-27 crude oil price is the Brent Blend (38) for the UK. The gasoline price for the EU-27 is the member states' average of unleaded gasoline prices including taxes. The grain prices for the EU-27 are from Eurostat.

VII. Scenarios and Results

Two scenarios are considered as deviations from the baseline. The first scenario is a $10-per-barrel increase in the EU-27 crude oil price throughout the projection period. The second scenario incorporates a $10-per-barrel increase in the EU-27 crude oil price and removes the trade barriers in the EU-27 ethanol market. In each scenario, the price shock and the policy reform are fully implemented in 2008 and their impact is measured in deviations for the years 2008 to 2017. The averages of these annual changes are reported as a summary indicator of the impacts.

A. Scenario 1: Impact of Crude Oil Price Shock

With the increase in the crude oil price, the gasoline price increases by 14.26%, which results in a decline of 1.31% in the final energy consumption by the transportation sector, as seen in table 1. Since ethanol and gasoline are modelled as close substitutes, the share of ethanol in final energy consumption increases by 2.58% because refiners switch to blending ethanol with gasoline. This results in a net increase of 1.24% in ethanol consumption in the EU-27. The domestic ethanol price increases by 2.25%, leading to an increase of 1.06% in both ethanol and DDG production.

The effect of the crude oil price increase extends beyond the ethanol market, affecting grain and ethanol by-product markets. Higher ethanol production increases grain use in ethanol plants, causing grain prices to increase. For example, the wheat price increases by 0.058% and the barley price increases by 0.055%. Higher DDG production decreases the DDG price by 2.99%, which in turn causes an increase in DDG consumption and a decrease in DDG net imports.

A higher domestic ethanol price in the EU-27 also leads to an increase of 0.70% in net imports of ethanol. This is translated into a higher world ethanol price and higher world ethanol net trade. The impacts on the world ethanol market are relatively small since the EU-27 is a small net importer of ethanol.

Table 1 Impact of a $10-per-barrel crude oil price shock

Average (2008-2017)	Percentage Change from Baseline
World Ethanol Price	0.08%
World Ethanol Net Exports	0.09%
EU-27 Crude Oil Price	13.82%
EU-27 Gasoline Price	14.26%
EU-27 Domestic Ethanol Price	2.25%
EU-27 Imported Ethanol Price	0.04%
EU-27 Ethanol Production	1.06%
EU-27 Ethanol Consumption	1.24%
EU-27 Ethanol Net Imports	0.70%
EU-27 Energy Consumption	-1.31%
EU-27 Share of Ethanol in Energy Consumption	2.58%
EU-27 Grain Use in Ethanol	1.06%
EU-27 DDG production	1.06%
EU-27 DDG Consumption	0.85%
EU-27 DDG Net Imports	-1.77%
EU-27 DDG Price	-2.99%
EU-27 Wheat Price	0.058%
EU-27 Barley Price	0.055%

B. Scenario 2: Impact of a Crude Oil Price Shock with Trade Liberalisation

In this scenario, the crude oil price shock is implemented with the removal of trade distortions in the ethanol market to analyze how the increased ethanol demand would be met in an open trade regime. In this case, the increase in ethanol consumption coming from higher crude oil prices and gasoline prices is met through higher imports since the removal of trade distortions greatly reduces the imported ethanol price in the EU-27; a decline of 41.25%, as seen in table 2. Ethanol net imports increase by 20.31% and consumption increases by 2.58%. Higher ethanol imports by the EU-27 increase the world ethanol price by 2.16% and world net trade by 2.73%. Since the imports and therefore supply in the EU-27 increase, the domestic ethanol price in the EU-27 falls, causing a 1.88% decline in ethanol and DDG production. Grain use in ethanol facilities declines, which in turn leads to lower grain prices. For example, the wheat price decreases by 0.104% and the barley price decreases by 0.098%.

Table 2 Impact of a $10-per-barrel crude oil price shock with trade liberalisation

Average (2008-2017)	Percentage Change from Baseline
World Ethanol Price	2.16%
World Ethanol Net Exports	2.73%
EU-27 Crude Oil Price	13.82%
EU-27 Gasoline Price	14.26%
EU-27 Domestic Ethanol Price	-4.01%
EU-27 Imported Ethanol Price	-41.25%
EU-27 Ethanol Production	-1.88%
EU-27 Ethanol Consumption	2.58%
EU-27 Ethanol Net Imports	20.31%
EU-27 Energy Consumption	-1.31%
EU-27 Share of Ethanol in Energy Consumption	3.95%
EU-27 Grain Use in Ethanol	-1.88%
EU-27 DDG production	-1.88%
EU-27 DDG Consumption	-1.48%
EU-27 DDG Net Imports	3.14%
EU-27 DDG Price	5.31%
EU-27 Wheat Price	-0.104%
EU-27 Barley Price	-0.098%

VIII. Conclusions

The biofuels sector in the EU-27 is expanding rapidly because of policy initiatives taken by the EU Commission and the member states. This links the energy and agricultural sectors of the EU-27 much more strongly than before. In an environment of increasing crude oil prices and an expanding biofuels sector, it is crucial to understand this "new" link between the energy and agricultural sectors.

This study attempts to analyze the impact of crude oil prices on the EU-27 agricultural sector. First, a baseline is set up for the EU-27 ethanol, grain, and DDG markets. Next, two different scenarios are run and compared to the baseline. The first scenario introduces a $10-per-barrel increase in the EU-27 crude oil price with the ethanol import tariffs in place. The second scenario incorporates the same crude oil price shock with the ethanol import tariffs removed.

In the first scenario, higher crude oil prices lead to an increase in ethanol demand and a higher ethanol price. In response, ethanol production rises, increasing demand for the feedstocks used for ethanol production. This leads to higher grain, feed, and food

prices in the EU-27. In the second scenario, the impact of trade liberalisation for the ethanol sector is larger than the crude oil price shock introduced into the model. Thus, the domestic ethanol price decreases with cheaper imports coming into the market. This leads to lower ethanol production, lower demand for feedstocks, and therefore lower grain, feed, and food prices.

Results for the two scenarios show that with open borders, the impact of higher crude oil prices and ethanol sector expansion on grain, feed, and food prices would be changed by the increased trade. In the second scenario, the impact of trade liberalisation is larger than the impact of the higher crude oil price. So, grain prices decline in this scenario despite an expansion in ethanol consumption. If there were a high enough crude oil price shock, which would affect the EU-27 ethanol market more than would trade liberalisation, the net impact on grain, feed, and food prices from the crude oil price shock would be mitigated by the increased trade from trade liberalisation.

This study shows that the impact of energy prices on the EU-27 agricultural sector is increasing with the emergence of the biofuels sector, and this link needs to be analyzed thoroughly. It also illustrates the importance of trade policy in responding to higher crude oil and grain prices.

REFERENCES

1. F.O. Lichts (2007) World Ethanol and Biofuels Report. December 12, 2007 at http://www.agra-net.com/portal/
2. Biofuels Barometer (2007) European Commission Directorate-General for Energy and Transport publications, May 2007 at http://www.energies-renouvelables.org/observer/stat_baro/observ/baro179_b.pdf
3. U.S. Department of Agriculture Foreign Agricultural Service GAIN Reports (2006) “EU-25 Biofuels Annual 2006”, GAIN Report Number E36122, July 11, 2006 at http://www.fas.usda.gov/gainfiles/200609/146249020.pdf
4. U.S. Department of Agriculture Foreign Agricultural Service GAIN Reports (2007) “EU-27 Biofuels Annual 2007”, GAIN Report Number E47051, June 4, 2007 at http://www.fas.usda.gov/gainfiles/200707/146291616.pdf

Corresponding author:

- Author: Simla Tokgoz
- Institute: Center for Agricultural and Rural Development, Iowa State University
- Street:560B Heady Hall
- City: Ames, Iowa 50011
- Country: USA
- Email: stokgoz@iastate.edu