DOI: 10.2478/vjbsd-2019-0014

EVALUATION OF ECONOMIC IMPACTS OF BIODIESEL PRODUCTION IN SLOVAKIA

Zuzana Bajusová*, Jana Ladvenicová, Tatiana Bullová, Ľubomír Gurčík

Slovak University of Agriculture in Nitra, Slovak Republic

The increasing consumption of energy, as well as exhaustibility of fossil resources, initiate the necessity of finding renewable resources. Especially biofuels represent the important role in terms of renewable resources, development of which is often question under debate in many countries. By increasing of blending mandate in the European Union (EU), the SR after joining the EU forced to implement the changes in its action plan for renewable energy in transport and set benchmarks share of methyl ester of rapeseed oil in diesel fuel. The aim of the paper is to evaluate the economic impact of biodiesel production in the Slovak republic. At the same time, biofuel production has an impact on the price of conventional fuels. The relationship between biofuel production and prices of agricultural crops as well as conventional fuels we examined through regression and correlation analysis, which showed that between production of biodiesel and the prices indicated exists certain dependency.

Keywords: biofuels; policy of the EU; blending mandate; biodiesel

Introduction

Biofuels represent fuels which are produced from biomass resulting from agriculture, forestry, fisheries as well as waste products of the food and other industries (FAO, 2008). The most suitable agricultural commodities used in the production of biofuels are currently considered to be rapeseed oil, sugar cane, maize and cereals. In general, commodities that grow rapidly, or contain oil or have a high sugar content are considered to be a suitable source for biofuel production (Pokrivčák et al., 2011). Unlike solid biofuels, liquid biofuels are mainly used to power motor vehicles. Currently, the most important biomass liquid fuels are bioethanol, biomethanol and biodiesel (Palkova and Dymacz, 2015).

Biodiesel represents a fuel that has many of the same properties as fossil diesel, but is not a product of oil, but of vegetable oil. Vegetable oil can be obtained from more than 300 kinds of oil crops, mainly rape, sunflower, soya and coconut. Although there are significant differences in viscosity between oils, they can all be used as a diesel substitute. In Central Europe, oilseed rape is preferred for biodiesel production. Within biodiesel production it is produced vegetable oil methyl ester, known as FAME, and a by-product glycerol. FAME is an environmentally clean propellant that has reduced smoke compared to conventional diesel, and the exhaust gases contain less solids containing hazardous substances (Šooš et al., 2012). Based on harmonized European fuel standards, they can only be sold on the market if they meet the quality requirements of Directive 98/70/EC. The standards for the quality of biofuels contain emission as well as technical parameters that are in accordance with the requirements of motor vehicle manufacturers. Standards are more detailed than individual directives and all participating countries are obliged to adopt them in their legislation (Jablonický et al., 2012).

Material and methods

In recent years, when the reserves of fossil fuels, especially oil, as the primary raw material of conventional fuels, declined considerably, the theme of biofuels became an important part of alternative energy sources.

The main goal of the paper is to evaluate the economic impacts of biodiesel production on the price of oilseed rape and of the share of biodiesel in total diesel consumption on food prices in Slovakia, which are expressed in the Harmonized Index of Consumer Prices (HCPI).

The period under analysis is 2004–20017, when the Slovak republic (SR) entered the EU. Accurate assessment of developments requires accurate data. The data we analyzed in the work were obtained from the databases of Statistical Office of the SR, EU*ROS*TAT, and Research Institute for Agricultural and Food Economics. We analyze the economic impacts of liquid biofuel production through regression analysis

The regression equation was used to determine the dependence:

$$y = b_0 + b_1 x + \varepsilon_i$$

where:

- y – dependent variable
- b_0 – locating constant
- b_1 – regression coefficient
- x – independent variable
- ε_i – random deviation

Results and discussion

Oilseed rape is the main agricultural crop entering the biodiesel production process in the Slovak Republic. Total consumption of oilseed rape decreased by 15% in 2005 compared to the previous year, reaching 151.3 thousand tonnes, while 74.4 thousand tonnes of rape was used for food and for the production of FAME it was 77 thousand tonnes. Between 2007 and 2009, the total consumption of oilseed rape had an upward trend, reaching its highest value of 260 thousand tonnes in 2009. In 2011, food consumption decreased by 40 thousand tonnes and consumption for FAME increased by 39.4 thousand tonnes. Of the total oilseed rape consumption in 2012, 67.4% of rape was used to produce biodiesel and food consumption remained at the same level as in the previous year. Due to the lack of processing capacity of oilseeds, the consumption of rapeseed for food purposes decreased to 5 000 tonnes in 2013. Of the total consumption in 2013, almost 95.6% was used for FAME production. Total consumption in the period 2014 to 2016 had again growing character and reached the amount of 243.2 thousand tonnes in 2016. In 2016, FAME consumption reached the highest value of 220 thousand tonnes. In

Table 1 Consumption of oilseed rape (in thousand tonnes)

Year	Consumption total	Consumption food	Consumption FAME
2004	178	101	77
2005	151.3	74.4	77
2006	142.1	46.4	95.7
2007	186.9	53	133.9
2008	248.4	95.1	153.3
2009	260	80	180
2010	240.6	70	170.6
2011	240	30	210
2012	207.8	30	177.8
2013	205.3	5	200.3
2014	213	5	208
2015	236.1	26.5	209.6
2016	243.2	23.2	220
2017	234.9	15	219.9

Source: Authors own processing based on data from Research Institute for Agricultural and Food Economics

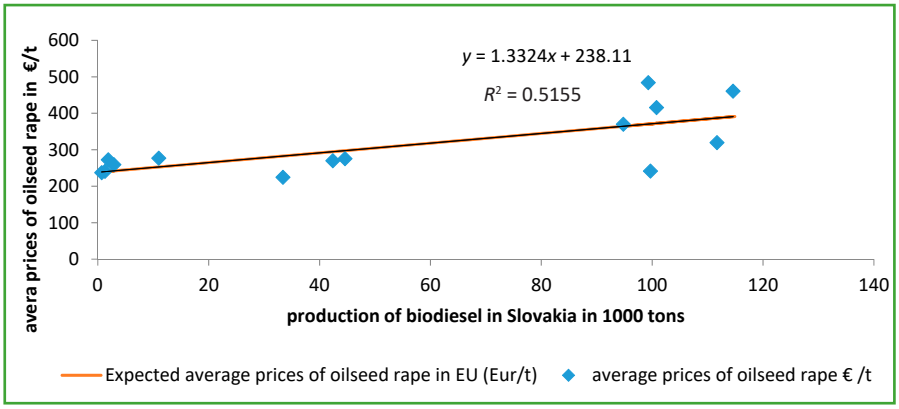

Figure 1 Impact of biodiesel production on the price of oilseed rape in Slovakia
Source: Authors own processing

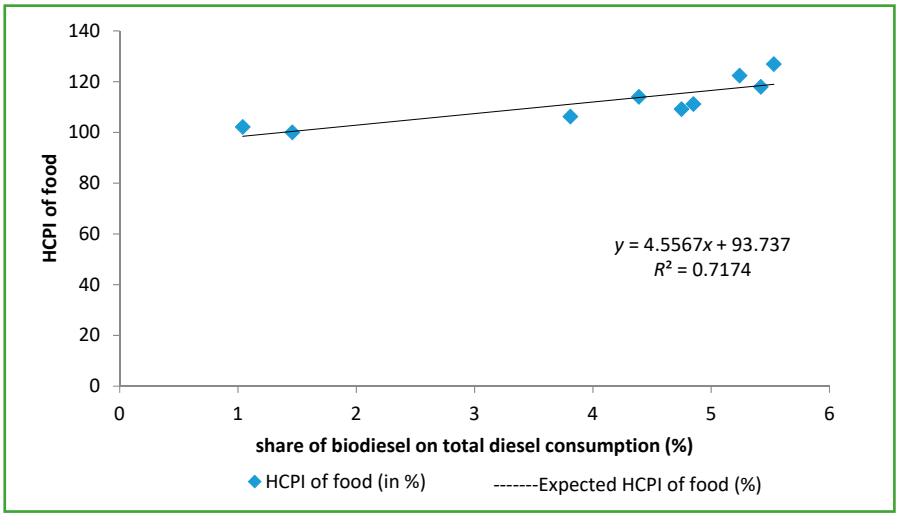

Figure 2 Impact of biodiesel share on total diesel consumption on food price in Slovak republic
Source: Authors own processing

2017 total consumption reached 234.9 thousand tonnes, with 93.6% used for the production of FAME and the rest for food purposes.

There are many questions related to the issue of biofuel production about their impact on agricultural crop prices or motor fuel prices. It is known, that there exist some economic impacts associated with the production of biofuels, as their production also affects the prices of agricultural crops that are used in the biofuel production process. At the same time, biofuel production has a significant impact on the price of conventional fuels.

To determine the impact of increasing biodiesel production on rapeseed prices we used regression analysis. Based on the correlation coefficient we explain the moderate dependence of rapeseed price on biodiesel production and on the basis of the determination coefficient we determine that the price of oilseed rape is 51.5% dependent on biodiesel production in Slovakia.

Regression line equation:

$$P_{OR} = 238.11 + 1.3324Q_B + \varepsilon_i$$

From the calculated parameter tests, it is clear that *b*0 and *b*1 are statistically highly significant because their *p*-values are less than 0.01. The model as a whole is also statistically significant because the *F*-test result is less than 0.05.

The equation shows that biodiesel production affects the average prices of oilseed rape in the SR so when biodiesel production increases by 1 unit (by 1000 tons), the average price of oilseed rape will increase by an average of 1.3324 €/t. If biodiesel production were zero, the average price of oilseed rape would be 238.11 €/t. The above equation implies that biodiesel production has an impact on the price of oilseed rape in Slovakia, but it is not a decisive factor, as the change in oilseed price is relatively small with a relatively high increase in biodiesel production.

There is consensus that the current EU policy which focuses on support of the expansion of biofuel production is one of the main reasons for rising food prices. The promotion of biofuels in 2007/2008 caused a demand shock that triggered the world food crisis, largely due to a massive increase in world food prices. Of course, other factors have also contributed to food prices.

Using a regression and correlation analysis, we find a correlation between the increasing share of biodiesel in total diesel fuel consumption and rising food prices, expressed by HCPI.

Based on the correlation coefficient, we explain the moderate dependence of food prices

on the share of biodiesel in total diesel fuel consumption in Slovakia and on the basis of the determination coefficient we determine that food prices depend on biodiesel's share in total diesel fuel consumption in Slovakia at 71.7%.

Regression line equation:

$$P_F = 93.74 + 4.5567Q_{SB} + \varepsilon_i$$

The equation implies that the share of biodiesel in total diesel fuel consumption affects food prices in the SR so that when the share of biodiesel in diesel fuel increases by 1 unit (by 1%), the average food price expressed by HCPI will increase by 4.56% per year. If the share of biodiesel in diesel was zero, the HCPI index in Slovakia would be expressed as 93.74%. The above equation implies that the share of biodiesel in total diesel consumption in Slovakia has an impact on food prices in Slovakia, but it is not a decisive factor, as food prices are not created in Slovakia and Slovakia is only a fraction of EU countries where production and consumption of biofuels is much higher, and at EU level, we can talk about the effects of increased biodiesel consumption on food prices.

Conclusion

In biodiesel production, the main agricultural crop used for its production in the territory of the Slovak Republic is oilseed rape. The production of oilseed rape, as well as maize, was the highest in 2014, when it reached 448.8 thousand tonnes. The consumption of oilseed rape is broken down into consumption for food and biodiesel production. Oilseed rape consumption for biodiesel production has a growing character, reaching the level of 219.9 thousand tonnes in 2017. The fulfillment of the biofuel use program, which determines the percentage of biofuels blended into fuels, has a significant impact on the biofuel market.

From the analysis where we evaluated the impact of biodiesel production on the price of oilseed rape in the SR, it follows that on the basis of the correlation coefficient we explain the moderate dependence of rapeseed price on biodiesel production and on the basis of the determination coefficient we determine that the price of oilseed rape is on 51.5% dependent on biodiesel production in Slovakia. Given this fact, we conclude that the price of oilseed rape depends mainly on factors other than the production of biodiesel from oilseed rape in Slovakia. Since the price of oilseed rape is not created in Slovakia, it is created mainly in Germany and France, which are leaders in both oilseed rape and biodiesel production. Subsequent analysis of the dependence of the share of biodiesel on total diesel consumption in the Slovak Republic on food prices showed that the variability of these variables was explained by the regression model to 71.4%. However, in this case too, the Slovak Republic is too small for the increasing share of biodiesel in diesel fuel to have an impact on food prices in the Slovak Republic. However, the correlation coefficient reflects that there is a dependency in the relationship that is due to EU policy.

References

EUROPEAN STATISTICS, Complete energy balances. [online] [cit. 2019-03-13] Available online: https://ec.europa.eu/eurostat/web/products-datasets/-/nrg_bal_c

FOOD AND AGRICULTURAL ORGANIZATION. Bioenergy terminology. [online] 2008. [cit. 2019-01-24] Available online: http://www.fao.org/docrep/007//j4504e07.htm/P628_38818

JABLONICKÝ, J. – TKÁČ, Z. – MAJDAN, R. – UHRINOVÁ, D. – HUJO, Ľ. – VOZÁROVÁ, V. 2012. Hodnotenie vlastností biopalív a biomazív: vedecká monografia. Nitra : SPU, 2012, 143 s. ISBN 978-80-552-0766-7.

PALKOVÁ, Z. – DYMACZ, M. 2015. Alternatívne energetické zdroje vo vidieckej krajine. Nitra : SPU, 2015, 200 s. ISBN 978-80-552-1422-1.

POKRIVČÁK, J. – RAJČÁNIOVÁ, M. – QINETI, A. 2011. The economic impacts of increasing biofuel production. Nitra : SUA, 2011, 84 p. ISBN 978-80-552-0609-7.

RESEARCH INSTITUTE FOR AGRICULTURAL AND FOOD ECONOMICS (Situačné a výhľadové správy olejniny). [online] [cit. 2019-03-17] Available online: http://www.vuepp.sk/dokumenty/komodity/2017/Olejniny17.pdf

STATISTICAL OFFICE of SR (Priemerné ceny pohonných látok v SR). [online] [cit. 2019-03-25] Available online: http://datacube.statistics.sk/#!/view/sk/VBD_SLOVSTAT/sp2039rs/Priemern%C3%A9%20ceny%20pohonn%C3%BDch%20l%C3%A1tok%20v%20SR%20-%20ro%C4%8Dn%C3%A9%20%C3%BAdaje%20%5Bsp2039rs%5D

ŠOOŠ, Ľ. – KOLEJÁK, M. – URBAN, F. 2012. Biomasa – obnoviteľný zdroj energie. Bratislava : Vert, 2012, 398 s. ISBN 978-80-970957-3-4.

Contact address

Ing. Zuzana Bajusová, PhD., Slovak University of Agriculture in Nitra, Faculty of Economics and Management, Department of Economics, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia, tel. +421 37 641 45 27; e-mail: zuzana.bajusova@uniag.sk