Simulation of Agricultural Policy Scenarios Using the AGMEMOD Model

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Abstract. The article considers and generalizes using evolutionary models of economics on the AGMEMOD model example - a partial equilibrium, dynamic, multi-country, and multi-market model that is used for analyzing the effects of agricultural policies on the respective sectors of each EU Member State and the EU as a whole. The use of the AGMEMOD model was illustrated in the example of designed specific scenarios of the development of the biofuel market in Ukraine until 2030. The practical application of the development is the possibility of using the research results by the relevant state institutions to stimulate the development of the biofuel market in Ukraine. The simulation example described in this paper can also be used by scientists from other countries to predict the impact of agricultural policy on the economy.

Keywords: AGMEMOD model, Simulation analysis, Mathematical programming, Biofuel market.

1 Introduction

The simulation economic systems are very important for understanding future trends of the contributions of such systems to the national economy. In this case, computer modeling becomes an essential tool for the national planning of economic processes.

The Member States in the EU can adopt different positions in respect of policy proposals, based on their assessment of the merits of the policy for their agriculture sector and the whole economy. Who charged with developing policy proposals at the EU level, should have an appreciation for the likely impact of a particular policy in order to identify, at an early stage, any problem that would prevent a policy proposal's acceptance by the Member States. For this purpose, a model such as the AGMEMOD model will be highly useful for EU and Member State based policymakers.

The main aim of the article is to substantiate the scenarios of biofuel market development in Ukraine till 2030.

This paper has been divided into several parts. The second part deals with a brief presentation of previous studies in this field, the nowadays trends, and the research methodology, to be able to theoretically substantiate using the econometric AGMEMOD model for making policy decisions in economics.

The third section highlighted is a description of the model's practical use of the model for making policy decisions in economics on the example biofuel sector that was realized and was implemented in the model AGMEMOD for the first time.

Finally, the conclusion gives a summary and critique of the findings, the model’s limits, and the importance of using the model as IT instruments for making policy decisions in economics.

2 Theoretical and Methodological Background

2.1 The AGMEMOD Model and Other Simulation Models

Computer simulations are a powerful and useful research tool available to scientists to study the behavior of systems in different areas especially in the economy, among others whose performance depends on multiple dynamic variables acting simultaneously.

Research is based on the intersection of computer science and economics has been widely used in recent years and is a source of great interest and excitement for both disciplines. One of the advantages of a simulation system is that it can be used to study the dynamic behavior of systems in situations, where real systems cannot be easily or safely used and can also be applied to understand and evaluate “what-if” case scenarios [1-8].

Hayenga, M. et al. [9] determines the computer simulation as a systems analysis tool that utilizes subject matter theory, certain mathematical structures, programming logic and empirical analyses to condense a complex system into a mathematical formulation duplicating to the essence of the real system. On top of that, they believe that computer simulation is the best planning tool in developing economies.

Economic models are a simplified representation of economic reality, showing the interrelationships between selected economic variables. They are used to analyze the impacts of policy and market changes. The most common approaches for quantitative assessments of policy reforms and market changes are based on partial equilibrium (PE) and general equilibrium (GE) programming models [10].

Models for simulation agrarian policy are potentially relevant tools for policy impact assessment [11]. The methodology of analyzing the agriculture sector involves the use of a system of models and their program implementation, which provide multivariate analytical and predictive calculations. There are two types of models for agro-economic system: partial equilibrium and computable general equilibrium models.

Van Tongeren et al. [12] have given an overview of the most significant models used for agricultural economic analysis and classify them following specific criteria: a regional unit of analysis, treatment of quantitative policies, the scope of representation, dynamics, trade representation, regional scope, availability of data and parameter estimation. Taking into account this methodological classification, a sub-sample of well-established models was selected in order to shape the construction of an Integrated Modeling Platform for Agro-economic Policy Analysis (iMAP) in the premises of the Joint Research Centre in Seville (JRC -IPTS) in close collaboration with DG AGRI [13].

The AGLINK model is a partial equilibrium, a recursive-dynamic, supply-demand model of world agriculture, developed by the Organization for Economic Cooperation and Development Secretariat, in close co-operation with member countries and certain Non-Member Economies as well as with the Food and Agricultural Organization of the United Nations. The model covers annual supply, demand, and prices for the principal agricultural commodities produced, consumed, and traded in each of the countries represented in the model. The model focuses, in particular, on the potential influence of agricultural and trade policies on agricultural markets in the medium term.

The examples of partial equilibrium models are ESIM and WATSIM. These models simulate the future effects of the policy reforms on trade, production, consumption, and domestic prices of a wide range of EU countries from a static perspective. Changes of these models in the rest of the sectors of the economy are considered only exogenously and parameters of the functions are calibrated to the values of the models' reference year.

An example of the computable general equilibrium is the GTAP model. The model is characterized by global coverage and simulates the development of all the sectors of economies of the countries considered. Moreover, the model also includes linkages and feedbacks between the sectors and can simulate bilateral trade flows between the countries [14]

AGMEMOD is a partial equilibrium model [15] that estimates future effects of the policy reforms on the agricultural sector of the EU and few non-EU countries on a year-to-year basis (i.e., dynamic perspective). Unlike AGMEMOD, CAPRI [16] is a static model and includes only EU countries. The main difference between the two modeling systems used in these models is that in AGMEMOD, parameters of the core functions (e.g., consumption, yields, animal stocks) are estimated econometrically, and in CAPRI, mathematical programming technique is used for estimation of the land-use change.

AGMEMOD is a modeling tool designed to analyze European agriculture and the Common Agricultural Policy (hereinafter - CAP) and this model is very popular in the EU and there is a lot of researches related to applying it for simulation of changes in agricultural policy and its assessment [17].

For example, the Finnish AGMEMOD model includes the building blocks of the national policy models. The specific goal of the Finnish modeling project was to build a country model on a common format so that it would link-up to provide an integrated model for the whole EU. The policy changes in the model is demonstrated by comparing the results of different policy scenarios with that of the baseline scenario [18].

Mariusz Hamulczuk & Katarzyna Hertel [19] presented the using of partial equilibrium models in the the agri-food sector. One of the most important reforms carried on currently by the European Commission in this sector is the dairy market reform. Therefore, a modeling of milk quota abolition for the Polish dairy sector was performed and displayed as an example of the model application.

The AGMEMOD model stands for Agricultural Member State Modelling and was established in 2001. The AGMEMOD Partnership has developed the model, which currently contains the EU27 member states, as well as the countries Macedonia, Croatia, Russia, Ukraine, and Turkey.

The AGMEMOD Partnership develops and maintains the model and is a consortium of numerous universities and research institutes across Europe and beyond. The core group of the AGMEMOD Partnership is located in the Netherlands (Wageningen Economic Research) and Germany (Thünen Institute of Market Analysis) and combines, coordinates the work done with the model.

The model includes about 50 agricultural products (including product groups) in about 35 countries (including country groups), which allows assessing the impact of policy decisions on the agrarian sector and modeling the future development of relevant indicators. Most of the equations in the model have been estimated using annual data over the period 1973-2017, or over shorter periods in case of data were not available (such as for the new member states). The variables entering in each sub-model represent consecutive positions in the balance sheet of each market. By the supply side are represented the beginning stocks, production, and imports and on the demand side the domestic use, exports, and ending stock are modeled. In each country for each product, also the respective domestic prices (market-clearing prices) are modeled. In each market, the equilibrium is reached in the model also on the level of the whole EU.

The model uses a combination of exogenous and endogenous data to create projections of agricultural market development. The AGMEMOD relies on some exogenous variables, values of which are not estimated by the model, but by other organizations. They include projections of the world market prices of major agricultural commodities such as corn, barley, wheat, oilseeds, beef, pork, poultry, and other types of meat, milk, and dairy products. Furthermore, the model includes the following macroeconomic exogenous parameters which currently include population number, national currency exchange rates, Gross domestic product (GDP), and GDP deflator. The inclusion of exogenous variables allows a better representation of the processes and linkages in the agricultural sector and each of the exogenous variables affects variables estimated by the model.

2.2 The Authors' Contribution to the Development of the AGMEMOD Model

In the framework of Deep and comprehensive free trade area agreement between Ukraine and the EU (hereinafter – DCFTA) from 2014 Ukraine set a course on reformation of its agricultural policy to less regulated and more market oriented. To help Ukraine in dealing with this task, the German-Ukrainian Agricultural Policy Dialogue took initiative to develop an advanced up-to-date tool for quantitative assessment of the effects of policy measures on the agricultural sector of Ukraine. For this purpose and following the best practices of the EU and Germany, the AGMEMOD model, the economic policy simulation model of the agricultural sector, was chosen. Since 2018 Faculty of Economic Sciences of The National University of Life and Environmental Sciences of Ukraine (Kyiv) has launched a new analytical laboratory AGMEMOD.

AGMEMOD-Ukraine has three main modelling blocks: database (CC-Datagmemod_Base.xlsx), model specification (CountryTimeSet_Baseline.xlsm, PolicyHarmon_Baseline.xlsm) and modeling assumptions (AssumptionsInput_Baseline.xlsm) (Fig. 1).

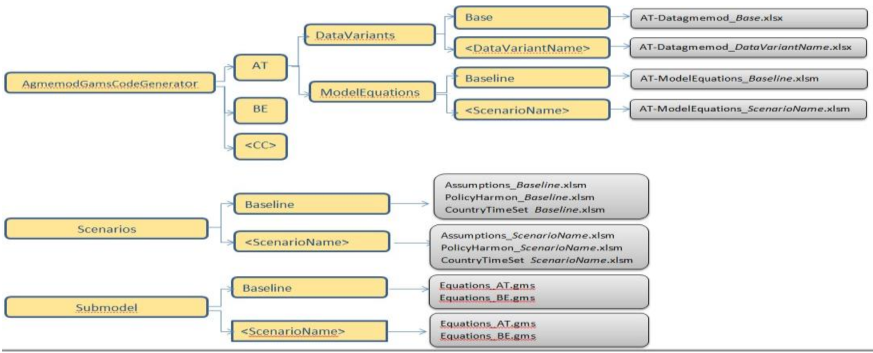


Fig. 1. The model's internal structure on data and scenario variants

From this perspective, Figure 1 shows how model's internal structure has been organized regarding: the country commodity databases (Data variant dependent); the econometrically estimated country model equations (Scenario dependent); the macro, policy and other assumptions (Scenario dependent). At the same time, Figure 1 shows the rationale behind the naming conventions connected to the data variant name use and the scenario name used.

The Database of the model includes historical data on prices, quantities produced, used, imported, and exported of the commodities included in the model. Currently, AGMEMOD-Ukraine holds the following commodities: wheat, corn, oats, rye, barley, rape-seed seeds, oil and meal, sunflower seeds, oil and meal, soya beans, oil and meal, beef, pork, poultry, lamb, milk and milk products, eggs.

With each creation of a new data variant and/or scenario, its associated subfolder and file naming structures are automatically generated by the program according to the structure shown in the figure.

Model runs under a researcher friendly framework (GsePro.exe program), which will be indicated in this paper as the AGMEMOD tool. In particular, the Agmemod2Gams tool plays the main role as an intermediary between the development of the conceptual model and the development of the computer model [20].

Taking into account the commitments undertaken by Ukraine with the accession to the Energy Community, the Resolution of the Cabinet of Ministers of Ukraine dated October 01, 2014 No. 902 approved the "National Renewable Energy Action Plan for the period up to 2020" (hereinafter – NREAP), which established mandatory national indicative targets for the use of renewable energy sources with final energy consumption in the transport sector in 2020 – 10% [21]. According to the Energy Strategy of Ukraine until 2035, the share of green energy in the overall consumption will be 25% in 2035 [22]. However, the actual results of renewable energy sources (RES) development threaten to fail to meet the planned targets: in 2018, the share of RES in the energy balance was only 2%, which is almost 5 times less than the 2020 target [21]. According to many experts, the slow pace of growth of "green" energy in the country is conditioned by the imperfection of existing economic mechanisms managing and supporting the development of this sector.

Provided the appropriate framework conditions it is worth to consider Ukraine's ability to achieve the above objectives for the consumption of liquid biofuels by the transport sector, analyze the state of the biofuel production in Ukraine, identify the obstacles that exist in achieving the mandatory national indicative targets, assess the feasibility of implementation taken on Ukraine's international obligations regarding motor biofuels, and propose measures to enable the obligations. Growing demand for biofuels in the world poses a question on Ukraine's potential of its production, as the country is large grain and oilseed producer.

For the first time in Ukraine in 2019, we realized the abovementioned goals and was designed a new sector in the AGMEMOD model – biofuel sector (Fig. 2).

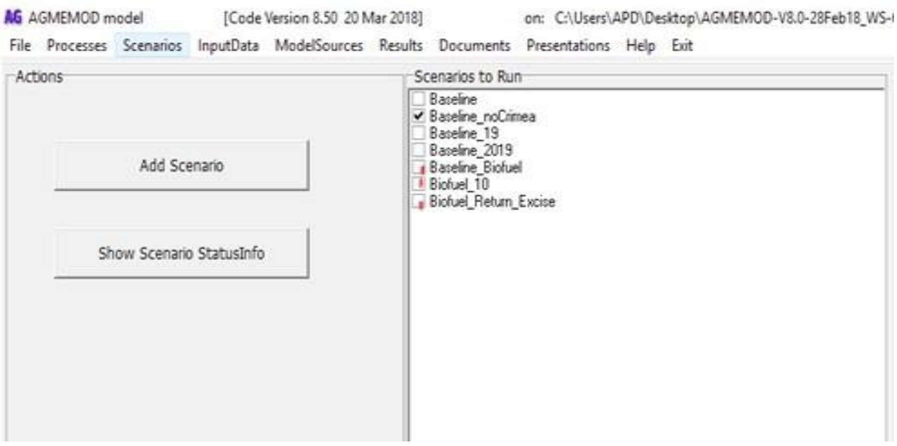


Fig. 2. Created Biofuels Scenarios in the model

In particular, the Ukraine country model was enlarged to include the use of crops for bioethanol and biodiesel production and the respective domestic market indicators (i.e., prices, export and import volumes, stocks, etc.). Wheat, corn, rye, sugar beet, rapeseed, sunflower seeds, and soya beans are currently and potentially the main sources for bioethanol and biodiesel production in Ukraine. Although markets of these crops are already presented in the AGMEMOD Ukraine country model, the use of these crops for biofuel production and the respective market indicators we have introduced as well. In particular, domestic market prices, production, import, export, final stocks and domestic use quantities of biofuels produced from each of the above- mentioned crops were incorporated.

The main data for our research was collected from publications of State Statistics Service of Ukraine (SSSU), personal communication with the largest biofuel producer in Ukraine "Ukrspyrt" and with the Ukrainian association of alternative fuels producers "Ukrbiopalivo". The exogenous future values of variables (by 2030) of the model (that is not estimated by the model), such as GDP, GDP deflator, the exchange rate of the national currency, and world diesel, gasoline prices, gasoline and diesel consumption in Ukraine, excise duty on alternative motor fuel, on gasoline and biodiesel, are forecast estimates of various institutions. The world market prices are FAO, OECD, projections, and macroeconomic parameters – USDA (United States Department of Agriculture) projections.

To create a comprehensive GAMS dataset that was used to solve the combined model all common exogenous data (stored in AssumptionsInput.xls and PolicyHarmon.xls) and specific Ukraine country data (stored in CC-Datagmemod.xls) were read.

The model is specified by econometrically estimated functions of key model parameters and algebraic identities. If data for function estimation is not available, the functions are calibrated. The calibration of specific model parameters is most often necessary where short and incomplete data series prevent the use of regular estimation procedures. In such cases, some parameters are chosen on the basis of estimates available from the literature, expert knowledge, or results obtained from similar equations in other country models. The remaining parameters, such as possibly time trend parameters and the constant term are estimated to fit the equation as much as possible to the available statistical data.

The collected data allowed solving the model for market equilibrium and were estimated in R version 3.4.4 software as time-series regressions. For data processing (regularization, decomposition, and analysis of space-time series), we used the R package "pastecs", for estimation linear regression models for our research was used "dyn" and "plm" packages. Their R code fragment is shown in Fig. 3 and Fig. 4.

```
# package required for descriptive statistics (stat.desc comm
# install.packages("pastecs")
library(pastecs)
# export regression results
# install.packages("stargazer")
library(stargazer)
# to use lagged operator
# install.packages("dyn")
library(dyn)
# numbers are printed in a fixed notation, unless they are mo
options(scipen=50)
# set the number of digits to print when printing numeric val
options(digits=2)
```

Fig. 3. The R code fragment for uploading R packages for processing datasets

```
############ biofuel use in cereal sector (bioethanol)  from

wheat_ethanol <- subset(biofuel, select=c("Year", "WSUFBUA",
                                          "WSPFNUA", "dummy",
                                          "ETWMPRICE_EXRDUA",

wheat1 <- dyn$lm(WSUFBUA ~ ETPFNUA_R + dummy, data=biofuel)
summary(wheat1)
stargazer(wheat1,
          type="text",
```

Fig. 4. The R code fragment of using R package "dyn" for estimation linear regression of the bioethanol from wheat

For making visualization researching variables during estimation of our models we used the function "plot", the histogram, and normal probability plot to indicate that the normal distribution provides an adequate fit for these models. In Fig.5 are shown the R function "plot" for making visualization of model variables.

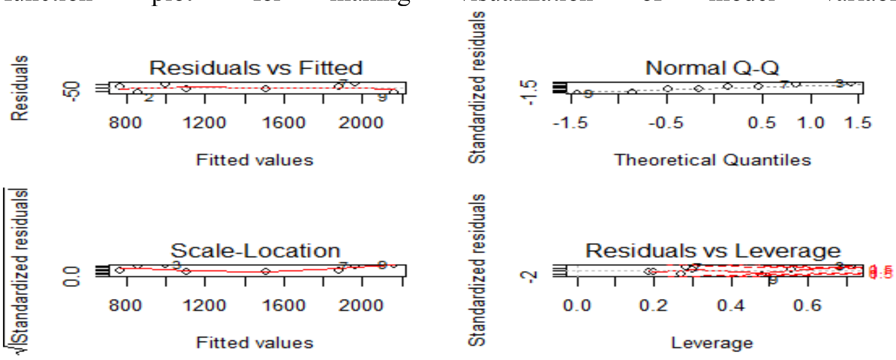


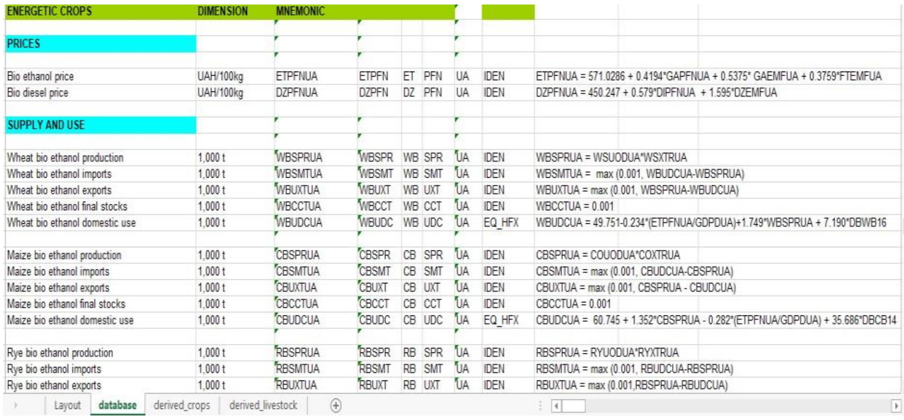
Fig. 5. R function "plot" for making visualization of model variables

To provide a regression diagnostic, particularly graphical diagnostic methods we used R packages "car", for cleaning and working with data was made use of "tidyver-sel" packages. To test the hypothesis of modeling was made by the estimation for the original dataset with using "IMTest" package (Fig.6).

```
install.packages("tidyversel")
library(tidyverse)
install.packages("readxl")
library(readxl)
install.packages("car")
library(car)
# install.packages("plm")
library(plm)
# install.packages("IMTest")
library(IMTest)
```

Fig. 6. The R code fragment of using R packages for regression diagnostic and estimation of the original dataset

The dataset was integrated with the estimated country-level equations and stored in CC-Model Equations.xls (Fig. 7). The model was solved every year until 2030.



ENERGETIC CROPS	DIMENSION	MNEMONIC						
PRICES								
Bio ethanol price	UAH/100kg	ETPFNUA	ETPFN	ET	PFN	UA	IDEN	ETPFNUA = 571.0286 + 0.4194*GAPFNUA + 0.5375* GAEMFUA + 0.3759*FTEMFUA
Bio diesel price	UAH/100kg	DZPFNUA	DZPFN	DZ	PFN	UA	IDEN	DZPFNUA = 450.247 + 0.579*DIPFNUA + 1.595*DZEMFUA
SUPPLY AND USE								
Wheat bio ethanol production	1,000 t	WBSPRUA	WBSPR	WB	SPR	UA	IDEN	WBSPRUA = WSUODUA*WSXTRUA
Wheat bio ethanol imports	1,000 t	WBSMTUA	WBSMT	WB	SMT	UA	IDEN	WBSMTUA = max (0.001, WBUDCUA-WBSPRUA)
Wheat bio ethanol exports	1,000 t	WBUXTUA	WBUXT	WB	UXT	UA	IDEN	WBUXTUA = max (0.001, WBSPRUA-WBUDCUA)
Wheat bio ethanol final stocks	1,000 t	WBCCTUA	WBCCT	WB	CCT	UA	IDEN	WBCCTUA = 0.001
Wheat bio ethanol domestic use	1,000 t	WBUDCUA	WBUDC	WB	UDC	UA	EQ_HFX	WBUDCUA = 49.751-0.234*(ETPFNUA/GDPDUA)+1.749*WBSPRUA + 7.190*DBWB16
Maize bio ethanol production	1,000 t	CBSPRUA	CBSPR	CB	SPR	UA	IDEN	CBSPRUA = COUODUA*COXTRUA
Maize bio ethanol imports	1,000 t	CBSMTUA	CBSMT	CB	SMT	UA	IDEN	CBSMTUA = max (0.001, CBUDCUA-CBSPRUA)
Maize bio ethanol exports	1,000 t	CBUXTUA	CBUXT	CB	UXT	UA	IDEN	CBUXTUA = max (0.001, CBSPRUA - CBUDCUA)
Maize bio ethanol final stocks	1,000 t	CBCCTUA	CBCCT	CB	CCT	UA	IDEN	CBCCTUA = 0.001
Maize bio ethanol domestic use	1,000 t	CBUDCUA	CBUDC	CB	UDC	UA	EQ_HFX	CBUDCUA = 60.745 + 1.352*CBSPRUA - 0.282*(ETPFNUA/GDPDUA) + 35.686*DBCB14
Rye bio ethanol production	1,000 t	RBSPRUA	RBSPR	RB	SPR	UA	IDEN	RBSPRUA = RYUODUA*RYXTRUA
Rye bio ethanol imports	1,000 t	RBSMTUA	RBSMT	RB	SMT	UA	IDEN	RBSMTUA = max (0.001, RBUDCUA-RBSPRUA)
Rye bio ethanol exports	1,000 t	RBUXTUA	RBUXT	RB	UXT	UA	IDEN	RBUXTUA = max (0.001,RBSPRUA-RBUDCUA)

Layout | database | derived_crops | derived_livestock

Fig. 7. AGMEMOD ModelEquations.xls for estimating model

In Fig. 7 the equations of the Baseline scenario are shown. The connections between variables we will show, on the example, equation of the alternative motor fuel price of under constant conditions, that consists of:

$$ETPFNUA = 571.0286 + 0.4194 * GAPFNUA + 0.5375 * GAEMFUA + 0.3759 * FTEMFUA,$$

where ETPFNUA **-** alternative motor fuel price, UAH/100 kg;
GAEMFUA - gasoline excise duty, UAH/100 kg;
GAPFNUA - gasoline price, UAH/100 kg;
FTEMFUA **-** alternative motor fuel excise duty, UAH/100 kg.

To assess the adequacy of the econometric model, the following coefficients were calculated using the above packages R:

1. F-test (Fisher's F-test).
2. Using Student's t-distribution to assess the reliability of the correlation coefficient.
3. Testing the model for homo/heteroskedasticity.
4. Checking the factors of the econometric model for multicollinearity.

The model quality test results for some of the equations are shown in Table 1.

The further steps in analyzing the agricultural sector of European countries include modeling of the so-called "what if" scenarios. These scenarios show the impact of various policy measures on policy and the economy as a whole. The practical use of the model and the creation of such scenarios will be described in the next chapter.

Table 1. The model quality test results for some equations of the Baseline scenario

Type of test	p-value				
	ETPFNUA	**DZPFNUA**	**STUODUA**	**WSUODUA**	**COUODUA**
Shapiro. test of normality	0.83	0.6	0.47	0.36	0.82

Breusch-Pagan test for heteroskedasticity	0.11	0.10	0.11	0.39	0.18
Non-constant Variance Score Test	0.13	0.5	0.37	0.49	0.07
Durbin-Watson Test for Autocorrelated Errors (library (car)	0.72	0.7	0.82	0.12	0.73
Breusch-Godfrey test for serial correlation	0.11	0.10	0.12	0.25	0.55
Nonlinearity	NO	NO	NO	NO	NO
Residuals vs Leverage - describes the Cook's distance	Normal	Normal	Normal	Normal	Normal
Multicollinearity	FALSE	FALSE	FALSE	FALSE	FALSE

3 The Modelling Results of the Biofuel Market in Ukraine

Proposals and solutions for the Ukrainian biofuel market were generated using GAMS and the endogenous model results were exported to output files. These model output files capture the endogenous projections of development of the biofuel market till 2030 supply and use balances (biofuel production, consumption, imports, exports, and ending stocks) and prices at the country and EU levels. Some of the results are highlighted in Fig. 8.

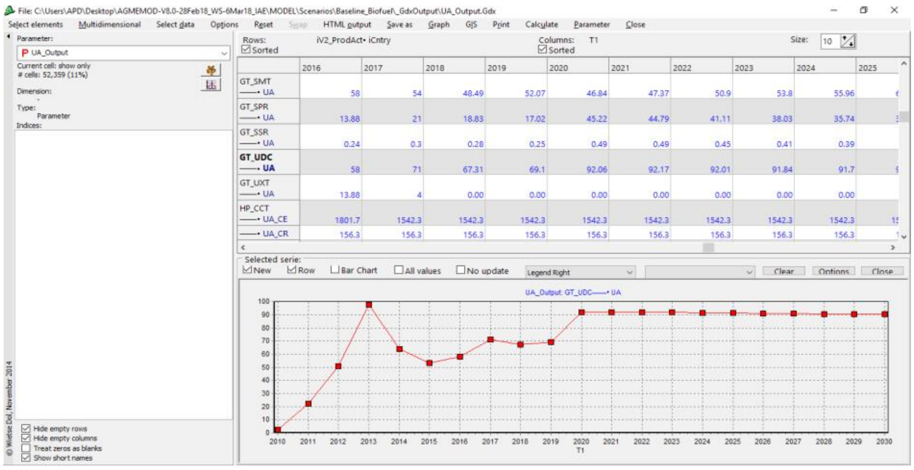


Fig. 8. AGMEMOD results file

It is worth noting that on the graph we can see the slow change in biofuel consumption on the constant condition of the Baseline scenario without any state support which would more sharply influence bioethanol development in Ukraine.

To assess the development of the motor biofuel market (bioethanol, alternative motor fuel, biodiesel), the following scenarios were developed for the achievement of the above-mentioned goals: “Baseline Scenario”, “Policy_10%”, “Direct support_10%”, “Direct support”, “The Returning excise duty” and “The Cancelling excise duty” that was realized for help creating the following scenarios: “Baseline_Biofuel”, “Biofuel_10”, “Biofuel _Return_Excise” (see above, Fig. 2).

The “Baseline scenario” is based on the assumption that during the projected period 2018-2030, the policy framework conditions in general in Ukraine remain at the 2017 level and the biofuel sector does not receive any state support from 2018 on. It also means that the model considers such factors as conditions of DCFTA as well as other trade regulations, military conflicts in the Donbas region and annexed Crimea, which is excluded from modeling as they were in 2017.

The “Policy_10%” scenario is designed to assess the required level of bioethanol consumption from different crops (wheat, corn, rye, sugar beet) and biodiesel (rapeseed and sunflower oil) based on the performance of the NREAP to determine the amount of bioethanol, alternative motor fuel (hereinafter – AMF) and biodiesel consumption to achieve 10% of biofuels in the total consumption of motor fuels by 2030. According to NREAP, bioethanol (AMF) consumption of 320 ktoe, biodiesel consumption of 70 ktoe should be achieved by the end of 2020.

Taking into account the low level of liquid biofuels production in Ukraine in 2018, achieving these indicative targets is impossible until 2021 without state support. Today in Ukraine there is no direct support and incentives for the production of liquid biofuels and development of the appropriate market. That why we assessed the effect, implementing direct support and tax preferences for bioethanol and biodiesel producers on further biofuel development.

For the analysis of the results of simulation of support scenarios and tax preferences, consideration first was given to changing the price of bioethanol, alternative motor fuel, and biodiesel when introducing each type of support and tax preferences to the biofuels producers concerned. The size of support in the model implemented in the form of price additions in the calculation of UAH per 100 kg of preferential products. Pricing additions are included in the scenario equations, which results in calculating the impact on biofuel production.

The “Direct Support_10%” scenario was designed to assess the implications of introducing a new producer support system in the form of direct subsidies to stimulate and expand biofuel production and achieve 10% biofuel consumption (bioethanol, alternative motor fuel, biodiesel) in total consumption of motor fuels.

To achieve 10% biofuel consumption by the transport sector in the total consumption of motor fuel, the support for bioethanol producers, alternative motor fuel, biodiesel and mixtures based on it was 5500 UAH/100 kg of the finished product. To simulate the state support scenario, this amount of subsidies was calculated as per UAH/100 kg, which is then added to the producer price of the product that is being subsidized and is applied in the equations of the processing model and affects the production and consumption of the product concerned.

By analyzing the modeling results of biofuel domestic use in the “Direct support_10%” scenario, bioethanol domestic use by 2030 will increase from 95 thousand tons to 545 thousand tons (by 5.74 times), for alternative motor fuel - from

90.59 to 538.71 thousand tons (by 5.95 times). It is the best indicator for this scenario. But it can be achieved only with the introduction of direct support to biofuel's producers (Fig. 9).

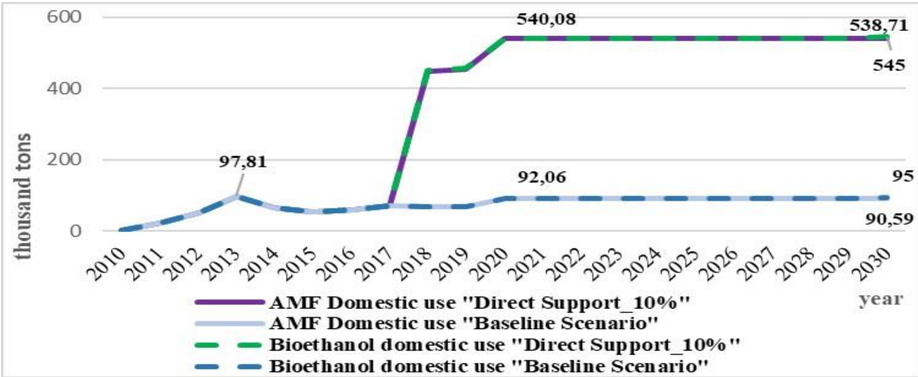


Fig. 9. Bioethanol and AMF domestic use in the "Direct Support_10%" scenario

The "Direct Support" scenario is designed to assess the implications of introducing a new system of direct support for producers, calculated and estimated depending on the expected level of gasoline and diesel consumption by 2030 to meet the needs of consumers in bioethanol, alternative motor fuel and biodiesel in the domestic motor fuel market.

The results of the "Direct Support" scenario indicate that direct support will positively influence the rapid development of the bioethanol sector to meet the needs of the domestic market. As regard bioethanol domestic use will increase from 95 to 180 thousand tons (by 1.89 times), alternative motor fuel - from 90.59 to 170.4 (by 1,88 times) (Fig. 10).

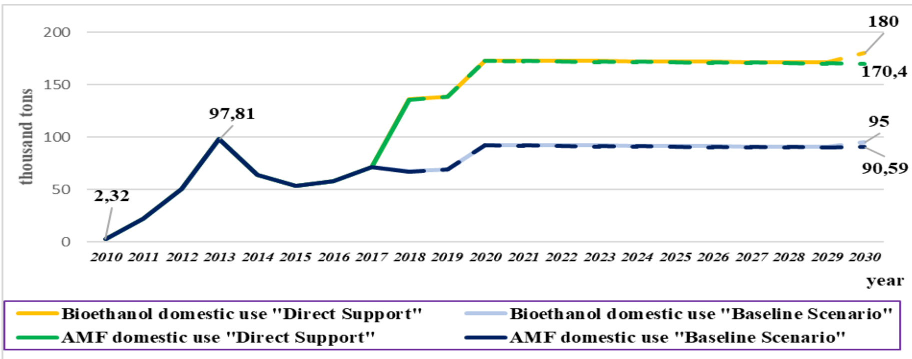


Fig. 10. Bioethanol and AMF domestic use in the "Direct Support" scenario compared to the Baseline scenario

The “Returning excise duty” scenario is designed to assess the implications of introducing a new support system for alternative motor fuels producers and biodiesel producers in the form of returning excise duty to producers from the sales of alternative motor fuels and biodiesel for a year.

The introduction of returning excise duty system for alternative motor fuel producers for sold AMF will stimulate an increase in AMF production, compared to the Baseline Scenario by 3.87 times (from 6.61 to 25.62) and its domestic use in 2030, respectively, will increase by 1.2 times (from 90.59 to 109.72) (Fig. 11). The returning excise duty to producer's AMF for the sector will yield the desired effect and will stimulate expanding production alternative motor fuels.

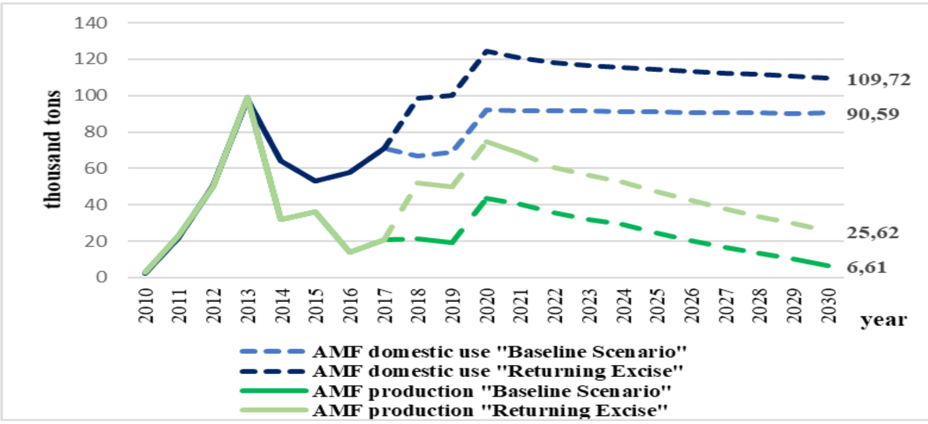


Fig. 11. AMF domestic use and production in the “Returning excise duty” Scenario compared to the Baseline scenario

The “Cancelling excise duty” scenario is designed to assess the consequences of the abolition of the excise duty on the sale of alternative motor fuels and biodiesel produced by these biofuels’ producers. The tool for supporting the development of this sector is the tax exemption for bioethanol and biodiesel as an excisable product. According to the Tax Code of Ukraine, as of 01.11.2018, excise duty on the alternative motor fuel was 130 EUR/1000 kg, biodiesel - 91.2 EUR/1000 kg [23]. If we cancel the above types of excise, the price for producers will have the potential to grow, given the stable demand for these products. For example, the producer's price of alternative fuel motor will increase by 5% in 2030, the producer's price of biodiesel and products based on it will increase by 13.27%.

Besides, the introduction of direct support for producers of liquid biofuels, tax preferences will help producers to increase the production of biofuels, and therefore to achieve the indicative goal of using 10% of liquid biofuels in transport. As follows, for prospering biofuel production in Ukraine has to apply strict well-designed laws, regulations and efficient administrative procedures are necessary that will promote widely development of biofuel production and consumption. Reducing excessive regulations of biofuel activities will improve the business environment that contributes to increasing the competitiveness and growth of this sector.

4 Conclusions

The paper has highlighted the results of the modelling of the biofuel market in Ukraine until 2030. To achieve the above goals and to quantify the amount of support, an econometric partial equilibrium model was used – AGMEMOD – dynamic model that models the effects of changes in biofuel policy on production biofuels, consumption, imports, exports and biodiesel, and bioethanol prices. For this purpose, was created scenarios of the development of the biofuel market in Ukraine with introduction state support for biofuel producers.

The simulation results of the liquid biofuel market in Ukraine showed that the introduction of state support in the form of direct subsidies to producers of biofuels (scenarios "Direct support_10%", "Direct support") and tax preference of state support in the form of a refund of excise duty to producers and the abolition of excise duty on alternative motor fuel and biodiesel scenarios (The "Returning excise duty", The "Cancelling excise duty") will have a positive impact on the development of all kinds of biofuels in Ukraine. The choice of a particular scenario for the development of the biofuel market or a combination of several scenarios will depend on the possibilities of the state budget, political will, and other factors.

It should be noted that the development of the bioethanol, MTA, biodiesel, and biodiesel based sectors in Ukraine requires both direct support from producers and tax preferences in the form of abolition of excise duty or the return of excise duty on the above products for a certain period to adjust and expand their production, and therefore to achieve the indicative goal of using 10% of liquid biofuels in transport.

The main instruments that contribute to the increase in demand for liquid motor biofuels are the introduction of a mandatory rate of blending biofuels in diesel and gasoline (blending), compliance with the requirements for the share of use of liquid biofuels in Ukraine by 2020 in the total consumption of motor fuels.

But it is worth noting that when conducting the research, we came across with the following limitations of the analysis: many assumptions due to lack of official statistical data, a limited number of observations (throughout 2010-2017), difficulty in the regression's estimation, and as a result, carefulness in the interpretation of the market simulation results.

The next steps of our research will become the implementation of other biofuel markets (biogas market) in AGMEMOD, statistical estimation of the respective equations; involvement of biofuel market experts (i.e., stakeholders) in the review of simulation results.

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