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ECONOMIC EFFECTS OF INTEGRATION AND REFORM PROCESSES - PARTIAL EQUILIBRIUM APPROACH

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Abstract

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A dynamic mostly recursive synthetic partial equilibrium model is developed to assess the impacts of economic integration and reform processes on agriculture markets. The model was tested for the Macedonian (FYROM) agriculture. The impact multipliers prove that the complete system can adequately respond to the exogenous shocks as expected, given biological and economic constraints. Three alternative scenarios of FYROM accession to the European Union (EU) in 2015 were analyzed. Their results were compared to the baseline which assumed the continuation of production-coupled domestic agricultural policy and price paths similar to the EU price paths. In case of the price convergence scenario, the production of all agricultural products would increase and consumption would fall due to higher prices, except for pork where prices imply the opposite outcomes. In case of CAP scenario (new decoupled measures, larger agricultural budget) the production of all agricultural commodities except pork meat would increase. This would, in turn, lead to substantial increase of feedstuffs demands, whereas the increase in demands for meats would be marginal. Both scenarios occurring simultaneously would mainly result in the aggregated effects of individual scenarios with some minor differences due to sub-markets interactions.

Key words: agriculture, economics, markets, models, partial equilibrium model, integration effects
Abbreviations: AgMEMOD - Agricultural MEmber States MODelling; CAP - Common Agricultural Policy; CEEC - Central and Eastern European Countries; EU - European Union; FYROM - Former Yugoslav Republic of Macedonia; NMS - new EU member states; ROW - Rest of the World; SAPS - Single Area Payment Scheme

Introduction

Previous EU enlargements show that market integration is an extremely rapid process (Herok and Lotze, 2000). This is due to the creation of a free trade area between the EU and the candidate country as well as due to the process of legislative harmonization the applicant country is obliged to accomplish prior to the EU accession. The economic benefits of opening markets are therefore being experienced before the formal accession to the EU (Nello, 2002). Relations of candidate countries with the EU are therefore highly important, ensuring quicker transition process and paving the

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way to further development.

Country acceding EU presents a challenge in modelling of its agriculture sector. Data is usually of poor quality and difficult to obtain, which severely limits the extent to which the history can assist in the calibration or validation of an economic model, and econometric estimation based on time series data. Further, the candidate countries are most of the times still on the way to market economy, resulting in a variety of agricultural policies implemented.

A country's economic integration into the EU initiates comprehensive harmonization of political, economic and social affairs. Evidence from previous enlargements suggests that the speed of economic integration to the EU depends mainly on the level of economic and political development in the candidate country and the compatibility of its administration system with the European system (Preston, 1997).

A degree to which the economic environment changes after the economic integration to the EU varies among sectors and depends mainly on the pre-accession conditions, structural differences among candidate countries and the EU as well as on the activity's basic economic characteristics (Herok and Lotze, 2000; Tangermann and Josling, 1994; Hertel et al., 1997). Central and Eastern European countries (CEEC), Western Balkans candidate countries and Turkey are economies where agriculture still represents a relatively high share in the economy.

Modeling is a principal research concept for analyzing economic structure, quantitative assessment of political instruments and forecasting behavior due to altered circumstances (Intriligator, 1983). Literature offers, most commonly, market equilibrium models, which enable examining the behavior of economic agents in the course of price changes. In addition to the decision on theoretical approach, the model's performance depends upon the choice of estimation method and data. As for the latter, availability and reliability of official statistical data is highly important. The amount of data depends on the level of aggregation (i.e. country/ region, activity/ product) and the theoretical structure (i.e. homogenous/heterogeneous products). In the multi-regional models it is not only important to ensure a large amount of data but also their mutual consistency (van Tongeren et al., 2001).

From the agricultural sector modeling point of view, new EU member states (NMS) represent numerous challenges. All had central planned market economies, but they differ among each other in the role their private sector had. During the transition into market economy, these countries were faced with lengthy adjustments of the agricultural sector to the new market regulations. This process was accompanied by numerous changes of agricultural policies, sometimes *ad hoc*, introducing a variety of support schemes.

Data quality and their (public) availability vary across these countries. To sum up, there is an upper limit, which determines the extent to which it is possible to employ historical data for calibration and validation of economic models, while the econometric estimation is highly restricted if not impossible in most of the cases. In addition, decoupled support measures introduced in the last reform of Common Agricultural Policy (CAP) demands abolishment of production-coupled agricultural support measures in force prior to 2003, both in new and old member states (Binfield et al., 2005) as well as in candidate countries after the EU accession.

This paper presents a model of national agriculture following the AgMEMOD methodology (AGMEMOD Partnership, 2008). The model was tested to assess the consequences of possible Macedonian accession to the EU in 2015 on its agriculture markets. Further, the model was intended to test also the art of model-building in the conditions of scarce data.

Material and Methods

Modelling approach

The approach taken in this paper follows the one successfully developed by AgMEMOD Partnership (2008). A series of single equations representing national agricultural markets for grains (i.e. soft wheat, barley, maize) and livestock (i.e. cattle and beef, pigs and pig meat, sheep and sheep meat, milk) produce an inter-linked system that solves for commodity's net trade. Domestic prices are linked to EU prices by price transmission equations. Prices, along with policy instruments, determine the levels of production and consumption across commodities.

The AgMEMOD policy harmonization approach allows structured presentation of the CAP measures as well as of the pre-accession measures to reflect their production effects. Cross-commodities effects and biological constraints are also incorporated. Initial parameters are imposed because using time series estimation was not reasonable as either data was scarce or the time series too short.

General structure of template AgMEMOD country model is shown in Figure 1.

The aim of the AgMEMOD modelling effort was to build an EU aggregate model by combining country models, which were in turn generated by merging single commodity market sub-models (AgMEMOD Partnership, 2008). Rest of the World (ROW), macroeconomic variables and relevant policy measures (i.e. CAP) enter the models exogenously. The modeling "space" is thus defined by combining of two levels: country and commodity level.

Along the country level dimension, AgMEMOD coverage at present includes EU member state countries (except Malta) as well as two countries of the Western Balkan Region (Croatia and FYROM) and the two countries of the Black Sea Region (Ukraine and Russia). These countries are included either because they are on the road to the EU accession (Croatia and FYROM) or because they are important trade partners of the EU (Ukraine and Russia, especially cereals).

The non-EU country models are more stylized and simplified, however they still follow the gen-

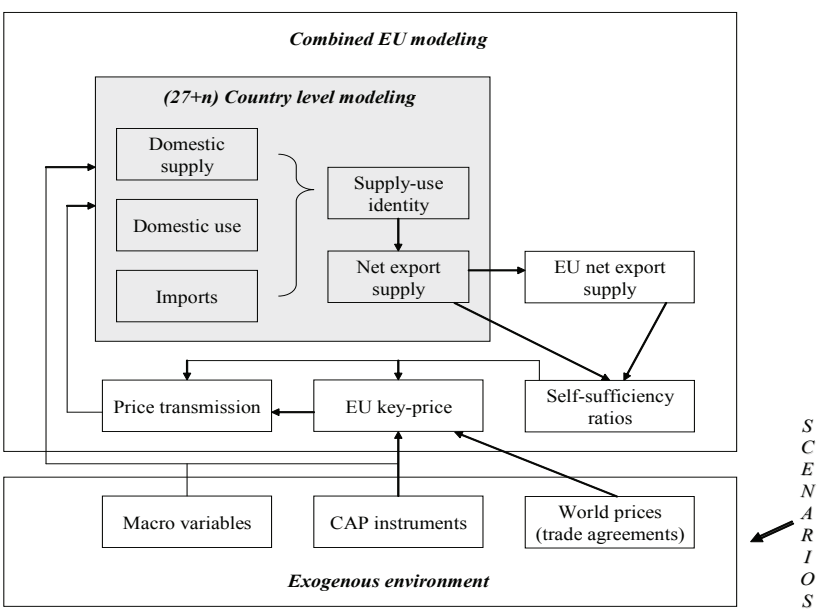

Fig. 1. General structure of template AgMEMOD country model (Esposti and Camaioni, 2007)

eral template rules of the EU country models and they can be fully combined with the EU country models.

The country level commodity sub-models are the elementary components of both the country and the EU combined AgMEMOD models. Any country model may include up to 35 commodities, however marginal markets of a country are usually excluded. These conventional dynamic partial equilibrium models include supply, demand, trade relations and price formation as shown in Figure 1. They define how, in any year, equilibrium is found within each commodity market reacting also to previous year outcome. The dynamic behavior is obtained through recursiveness; lagged endogenous variables enter as predetermined variables of the current period equilibrium.

Each commodity sub-model contains the behavioral response of economic agents to changes in prices, policy instruments and other exogenous variables as well as to previous year outcomes according to its recursive structure. The modeling system is solved for the given level of prices by balancing supply and demand of each product at both member state level and EU level.

Finally, through exogenous variables and model recursiveness out of sample projections of the model's endogenous variables are generated. Given the estimated or assumed model parameters, projections are obtained by feeding the model with projections of all the exogenous variables and imposing the market closure for any projected year. Different policy projections can be generated over a set of their alternative values by defining alternative policy scenario assumptions. The comparisons of endogenous variables projections across these alternative scenarios provide evidence on the impact of policy changes. For these basic characteristics AgMEMOD model is defined as a dynamic multi-country and multi-commodity partial equilibrium model (Hanrahan, 2001; Chantreuil et al., 2005; Esposti and Camaioni, 2007).

Commodity sub-models are linked with each other via supply or demand. The principal links between grains sub models as well as oilseeds and livestock sub-models operate via feed demand and input cost equations. The various grains and oilseeds sub-models are linked by substitution ef-

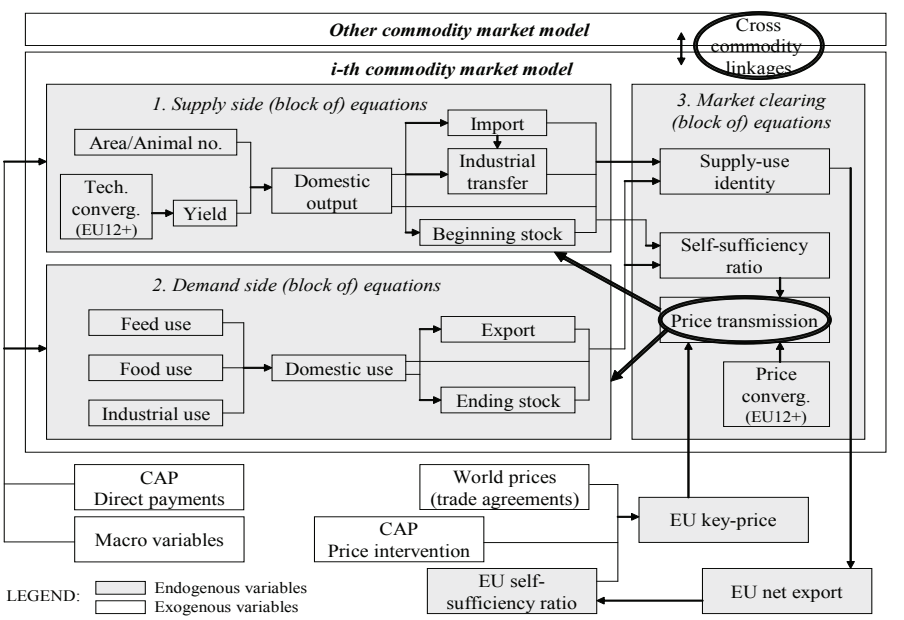

Fig. 2. General structure of AgMEMOD commodity sub-model (Esposti and Camaioni, 2007)

fects in both the demand and supply specifications. Dairy and beef sector sub-models are linked by the role of the dairy sector as a supplier of calves for beef production and female animals for slaughter. Different livestock sub-models are linked primarily through substitution effects in various meat demand equations. These cross-commodity relations may be quite complex and differ across countries (Hanrahan, 2001).

The AgMEMOD modeling strategy emphasizes to the maximum extent possible cross-country and cross-commodity effects due to external changes (i.e. policy change) in order to achieve a more realistic and complete presentation of how agri-food markets would react to such changes. Figure 2 summarizes the complex structure of a commodity market model. Nonetheless, commodity models are strongly stylized and in several cases possible additional uses, quality differentiation and other relevant cross-commodity linkages may not be modeled. This is necessary to maintain the country and EU-level model at an acceptable size in terms of number of equations.

As an example of functioning of the market the price/quantity space of pig meat model is shown in Figure 3, which provides more detail about the decision points in the pork agro-food industry. At the farm level the most important factor are sow numbers, which indirectly determine the largest portion of slaughter animals. At the retail level, consumer income and prices of competing meats, such as beef and sheep meat, determine the level of pork consumption. As beef and sheep meat prices increase per capita consumption of pork increases as well. In the price/quantity graphical representation the pig meat consumption curve shifts to the right. Net imports of pork close the market as price is exogenously determined.

The AgMEMOD policy harmonization approach is implemented at two levels – at the combined and country model level. The distribution among all three CAP payments envelopes (i.e., coupled, historical and regional) is calculated inside the country model. The national ceiling is calculated taking into account compulsory and voluntary modulation rate. Coupled payments for

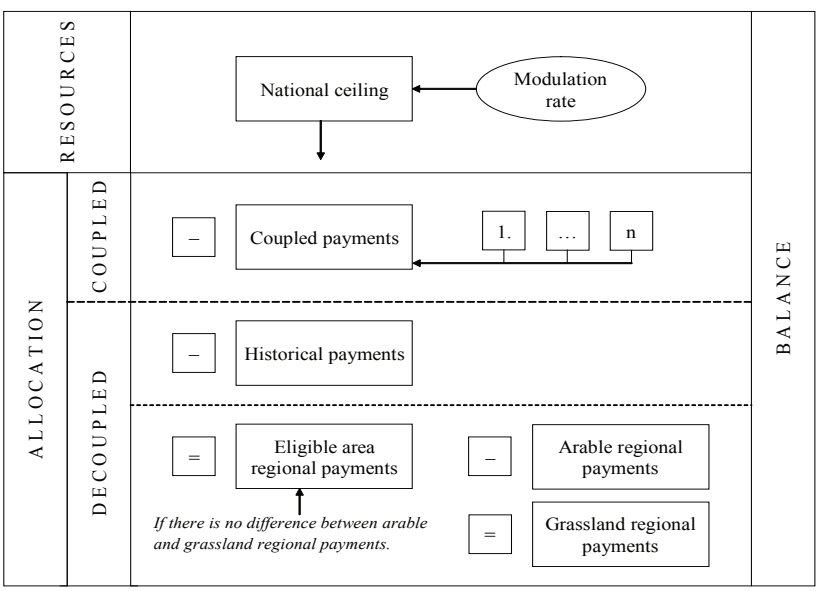

Fig. 3. Distribution of EU funds across envelopes in AgMEMOD model (Salputra and Miglavs, 2007)

different sectors are calculated using sector specific payments, reference amounts and premiums. By summing sector specific coupled payments, a coupled payments envelope in national ceiling is derived. Calculation of the historical payments envelope takes into account the amount of money devoted to this envelope for specific sectors. The regional payments envelope is derived as a residual of national ceiling, coupled payments envelope and historical payments envelope.

Scenario analysis

Baseline projections serve as a standpoint for forward-looking (*ex ante*) policy impact analysis. Baseline assumptions derive from Macedonian current status as a non-EU country. To simulate this, two key assumptions were made for Macedonian agriculture. First, country continues with its current production-coupled agricultural policy. Second, prices of Macedonian agricultural commodities follow the price path of their EU counterparts.

Three alternative scenarios are analyzed to examine the consequences of different circumstances Macedonian agricultural markets might face when integrating into EU. The aim of the first two scenarios is to account for the effects of the price convergence and CAP introduction respectively, while the third scenario captures the effects of both at once. The results of each scenario were compared to the baseline projections for the year 2020.

Holding all other variables unchanged, price convergence scenario assumes that Macedonian grains prices converge towards higher EU prices in the first two years of the accession, while prices of meats increase for the whole 5-year period with the exception of pig meat price. The latter converges 2 years, beginning a year before the EU accession (2014). Regardless of commodity, most of the catch up occurs in the first year(s) of price convergence. However, speed of price convergence also varies across commodities.

CAP scenario permits only changes in policy variables. That is, it introduces new (decoupled) policy measures and higher agricultural budget, both the consequence of Single Area Payment Scheme (SAPS) introduction at the expense of obligatory abolishment of existing domestic agricultural policy upon country accession to the EU in 2015. On a day of the accession to the EU national agricultural policy is replaced by CAP thus introducing regional based payments for arable, beef, sheep meat and milk producers. Contrary to the implemented national agricultural policy, these payments are production-decoupled, however only to a certain degree. Therefore they still significantly supplement market returns of the analyzed commodities, as they are, even in a decoupled form, in some cases significantly higher relative to the baseline.

The third alternative scenario is a merger of both previous scenarios; price and policy changes are allowed to change at the same time with no change in any other variable. Accession of FYROM to the EU in 2015 is assumed to affect both domestic price levels and agricultural policy. Prices of agricultural commodities, except price of pig meat, start converging to their higher EU price levels in 2015 with different speed and duration across the commodities. The EU membership is further reflected in the abolishment of national agricultural policy due to the CAP implementation.

Results and Discussion

On supply side, price and policy assumptions work hand in hand in case of any alternative scenario. The pig sector is an exception, since it is not subject to policy assumptions and because its price convergence suggests a decreasing domestic price of pig meat. Demand side of all agricultural commodities is primarily affected by price changes, while the impact of policy change is indirect. If the price convergence scenario had been implemented, the production of all agricultural products would increase and demands would fall. As mentioned, pig meat would be an exception: its lower price

Table 1
Baseline and scenario projections for Macedonian agriculture

	Historical data 2005-07 average	Baseline			Price conversion	CAP	Price conv. + CAP
		2010	2015	2020	2020	2020	2020
EU Prices	euro/t						
Soft wheat	146	180	188	181			
Barley	142	143	150	148			
Maize	148	166	170	161			
Beef	2645	2509	2909	3004			
Pig meat	1425	1477	1710	1836			
Sheep meat[1]	3373	3561	2692	3845			
Domestic Prices	euro/t				Percentage change from the baseline		
Soft wheat	146	159	166	160	3.78	-0.24	3.53
Barley	135	132	140	138	3.54	0.02	3.57
Maize	148	149	153	146	3.65	-0.02	3.63
Beef	1838	1895	2159	2229	9.99	-0.42	9.50
Pig meat	2047	1944	2160	2268	-12.49	-0.02	-12.50
Sheep meat	2343	2408	2501	2595	10.12	-0.75	9.28
Milk	259	266	268	266	7.09	-1.71	5.23
Reaction Price	euro/hectare (grains); euro/t (livestock)				Percentage change from the baseline		
Grains	28.9	67.3	77.9	92.7	-1.3	48.5	47.8
Beef	30	23	25	27	-3.9	2298.0	2266.0
Sheep meat	107	201	219	238	-2.3	175.8	173.1
Milk	7	27	27	27	-4.3	46.0	44.8
Production	1 000 tonnes				Percentage change from the baseline		
Soft wheat	281.8	326.5	342.0	338.1	1.53	2.55	4.13
Barley	126.2	138.4	138.2	140.3	1.33	2.92	4.31
Maize	138.0	147.6	150.8	148.9	1.42	2.54	4.00
Beef	140	142	140	143	2.97	2.97	5.96
Pig meat	139	144	155	167	-9.57	0.01	-9.56
Sheep meat	136	161	171	180	3.26	3.54	6.80
Milk	2594	2495	2739	3035	4.46	7.13	11.62
Net Imports	1 000 tonnes				Percentage change from the baseline		
Soft wheat	59.8	50.8	42.0	57.6	-13.22	-12.46	-25.92
Barley	9.0	-1.5	5.9	13.5	-48.77	5.07	-44.22
Maize	60.3	53.6	64.5	85.0	-8.42	2.01	-6.47
Beef	15.0	15.5	15.8	17.0	-12.79	-2.23	-14.99
Pig meat	7.1	6.9	6.3	5.7	48.88	-0.33	48.49
Net Export							
Sheep meat	2.8	5.1	5.5	5.9	14.16	10.33	24.47

Source: Own calculations
[1]Italian sheep meat price is more important in determination of domestic sheep meat price than the EU price therefore here we refer to Italian price instead of EU price.

would cause production to fall and consumption to rise.

Alternatively, in case of CAP scenario, assumed new (decoupled) measures as well as larger agricultural budget would result in the increase of production of all agricultural commodities. This would, in turn, lead to substantial increase of feedstuffs demands (i.e. barley and maize), while increase in demands for meats would be marginal. Price convergence scenario would result in substantially more net imports of pig meat and substantially less net imports of barley. On the other hand, implementation of SAPS would result in more net exports of sheep meat and slightly more net imports of feedstuffs. If both scenarios would occur simultaneously, all effects would mainly be aggregated results of both separate scenarios with some minor differences due to sub-markets interactions. The main results of the scenario analysis are summarized in Table 1.

Data limitations and the absence of studies (parameters) relevant to Macedonian agriculture limited building of the model. Statistical tests and econometric theory could not be applied. Yet, one of the main strengths of this model could be attributed to the fact that it was built, where possible, consistently with economic theory and its results validated by country experts.

Despite some problems, the impacts show that the model structure and parameters interact as intended in most cases, even in the conditions of scarce or poor quality data, which dictated the specification, estimation, validation and simulation phases of the modeling. The complete system can respond to exogenous shocks as a priori expected, given biological and economic constraints. Production response is constrained by area or breeding herd rather than immediate change in relative prices. Domestic use reacts as intuitively expected. Net trade is a difference between domestic production and consumption therefore its simulated values reflect all errors made in simulating the rest of the model.

Conclusions

A partial equilibrium national model of agricultural markets was developed to estimate integration and reform processes. Three alternative scenarios are applied to examine the effects on Macedonian agricultural markets in the event of joining the EU in 2015. Markets of interest included are soft wheat, barley, maize, cattle and beef, pig and pig meat, sheep and sheep meat and (partially) milk.

Model results can be summarized as follows:

- Price convergence scenario, assuming prices of agricultural commodities in the country move towards higher EU prices, shows increases in grain and livestock production. Consumers are adversely affected by higher prices. As production increases and consumption decreases, net imports decrease or net exports increase. The opposite occurs in pig sector as pig meat price converges towards lower EU price.
- The effects of introducing new decoupled (SAPS) payments and larger agricultural budget on production of grains and livestock products are similar to price convergence ones but the magnitudes are larger. Domestic use of meat products and soft wheat is almost unaffected, while in the case of feed grains it increases. Substantial increase in the domestic use of feedstuffs is because a result of increase in meat production. Net imports of feedstuffs and net exports of sheep meat increase, while net imports decrease for soft wheat and slightly for beef.
- Aggregate results indicate that grain and livestock producers benefit from higher domestic prices and CAP implementation. Changes in domestic use of grains are marginal and vary according to the type of grain (i.e. food or feedstuffs). Changes in meat domestic uses are significant and vary across meats. Net trade outcomes across commodities are almost identical as in price convergence scenario. The exceptions are net imports of soft wheat and net exports of sheep meat, where

each separate scenario strengthens their net trade position.

Further changes of key behavioral equations (e.g., equations of prices, grain area, breeding herd and slaughter animals) in terms of their structure and/or parameters are recommended if the model is to be applied for more detailed policy analysis. In fact, a model of this type needs to be used in order to be improved. There may be a need to include more commodities, to increase the level of detail the existing commodities are modeled (e.g., dairy products), and to enable formulation of different types of policy measures possible in the next CAP reforms.

More analysis of external impacts such as macroeconomic factors could also be an area for further model improvement. Further, running different and more complex scenarios could also reveal weaknesses of the model. Finally, data availability and quality will most probably improve in the future, and this will enable significant improvements of the presented model.

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