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## Challenges for Modelling CAP 2014–2020 within CGE Model Framework

**Abstract:** The paper discusses various approaches to modelling measures of the Common Agricultural Policy (CAP) within a computable general equilibrium (CGE) framework for the new budgetary period 2014–2020. The task of modelling such a complex policy as the CAP with the use of CGE is not easy at least for three reasons. First, the policy itself is very complex – Pillar 2 alone includes about 17 very heterogeneous measures, which differ in terms of implementation and eligibility criteria. Pillar 1 measures are not targeted (in terms of goods and services that may be bought with these funds) and thus the assessment of their impact requires additional knowledge on how they were spent. Second, although CGE models represent all sectors of the economy, yet they normally do not characterise individual sectors with such a precision as would be desired for modelling the nuances of the individual CAP measures. Third, the CAP evolves towards less tangible measures (risk management, quality improvements, conditionality based on environmental requirements), and towards increasing role of non-marketed goods (provision of public goods, environmental amenities, food safety). There is also an increasing role of human capital manifested by e.g. bottom-up approaches or co-operation measures. They, however, are difficult to grasp by the CGE models since they are not directly observed or linked to the exogenous variables controlled in this types of models. While taking all the challenges into account and relying on a literature review the article presents some solution and makes suggestions for possible ways of modelling new CAP 2014–2020 within CGE modelling framework which may be useful in the policy evaluation.

**Key words:** evaluation of agricultural policy, CGE, modelling CAP 2014–2020.

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## 1. Introduction

Changes in the Common Agricultural Policy for the budgetary period 2014–2020 are creating new challenges for scientific modellers who aim to evaluate the new policy. Here we present a way to handle them within Computable General Equilibrium (CGE) models. CGE models owe their name to a particular specificity. First, they are “general”, because they imitate the behaviour of all economic operators. They are “computable”, because they generate results expressed in numbers. Finally, they are “equilibrium” models, because the price mechanism always leads all markets (except the labour market) to equalization of supply and demand (Dixon, Parmenter, Amman et al. 1996). Their detailed and consistent database is based on input-output tables (IO) and social accounts matrices (SAMs). Leon Walras is known as the father of the theory of general equilibrium, who formalized a theoretical general equilibrium model. Then, in the 1930s, Wassily Leontief created an input-output table, which served to create a matrix of social accounts. CGE models reflect the structure of the entire economy at one point in time. They are based on thousands of systems of equations, which are solved simultaneously and they explicitly capture the behaviour of industries, households, investors, government and exporters. They allow to capture not only the direct impact of the CAP, but also multiplier effects, taking into account also other sectors of economy. CGE models are based on the optimization carried out by economic agents. Besides optimization, at least a few other features that distinguish them from competitive solutions can be mentioned. Taking into account both the demand and the supply side as well as the changes in the price level distinguishes them, above all, from partial equilibrium and input-output models. CGE models are strongly grounded in theory, they are based on the relationships in space rather than time and, unlike macro-econometric models, do not require long time series data. They also include more detailed data on the industry structure than macro-econometric models. The CGE models are used for policy evaluation by many international institutions (OECD, World Bank, IMF, European Commission, etc.). There are also many studies giving overview of the policy evaluations with use of the CGE models, to mention only Fossati and Wiegard (2002) or Horridge et al. (2005). The CGE models proved also very useful in the evaluation of various agricultural and environmental policies (e.g. OECD 2002, 2015).

The main modifications after the new reform of the CAP Pillar 1 (direct payments) include: new basic payments scheme (BPS), reduction of direct payments, new possibility of shifting funds to Pillar 1 from Pillar 2 and the other way round, new “greening” requirements towards direct payments and greening equivalents between Pillars. Three main changes regarding Pillar 2 which has

impact on modelling are: replacement of the former 4 axes by 6 priorities of rural development, which creates a challenge of non-consistency with previous budgetary periods' classification; adding two new types of measures – the risk management and co-operation; and third, more integrated approach which allows support of a project by more than one measure and fund, which makes an evaluation of a particular measure/policy or project more problematic. The objective of the article is to present some solutions and suggestions for possible ways of modelling new CAP 2014–2020 within CGE modelling framework, which may be useful in the policy evaluation.

## 2. Main challenges of modelling Pillar 1 post-2013

In September 2013 the consensus was achieved by three parties: European Commission, European Parliament and European Council which paved the way for Pillar 1 post 2013 (EC 2013a). There are several new features of Pillar 1 which generate new challenges for modelling CAP within CGE framework. The main changes in the system of direct payments include: new BPS, which is a mix of various voluntary and obligatory types of payments; reduction of direct payments (which replaces the old modulation scheme), new possibility of shifting funds between Pillars, new “greening” requirements towards direct payments and greening equivalents between Pillar 1 and Pillar 2. The section below provides more details about selected challenges and avenues for modelling Pillar 1 for CAP 2014–2020.

### 2.1. Complexity and flexibility of direct payments

In the new budgetary perspective, the Member States have a choice of shifting funds between the Pillars, and especially increasing Pillar 1 payments by shifting funds from Pillar 2. The main challenge with modelling those shifts lays in more flexible but also more complex composition of direct payments. The proposed Basic Payment Scheme (BPS) consists of several components in order to better target the agricultural problems. However, the components are more diverse in their nature than Single Farm Payments (SFP) or Single Area Payment Schemes (SAPS) and, in addition, some are obligatory and some voluntary. Thus, each Member State may compose its direct payments based on the following types of payments (EC 2013a):

- a) a **basic payment** for farmers;
- b) a payment for farmers observing agricultural practices which are beneficial for the **climate and the environment** (at least 30% of national envelope);
- c) a voluntary payment for farmers in **areas with natural constraints** (up to 5% of national envelope);

- d) a payment for **young farmers** who commence their agricultural activity (up to 2% of national envelope);
- e) a voluntary **coupled support scheme** (up to 15% of national envelope);
- f) a voluntary simplified scheme for **small farmers** (up to 10% of national envelope);

and in specific cases:

- g) a crop specific payment for cotton;
- h) a framework to enable Bulgaria, Croatia and Romania to complement direct payments.

Hence, allocation of national envelopes for direct payments can vary substantially among the Member States. Although all of them are declared as decoupled or area payments (EC 2013a, p. 148) it is clear that their impact may differ substantially – we can well believe that support for small farmers via direct payments may rather lead to extensification of production, while support for young farmers via direct payments may increase investment. Hence, more micro-evidence is needed in order to model those payments in appropriate way. So it is more complex than in the previous period, when distinguishing the degree of decoupling was the main challenge. All in all, shifting of Pillar 2 funds to Pillar 1 requires first: ex-ante assumptions or ex-post knowledge on how the funds are distributed among the composition of BPS (or SAPS, for Member States which are still allowed to continue the system up to 2020). Second, modellers need to take into account that Pillar 1 funds do not require 25% of co-financing, so the shift reduces the national budget contribution, hence it influences the shock composition and may have an impact on closure in the model.

As for modelling the shift in opposite direction – from Pillar 1 to Pillar 2 – many studies were conducted before (e.g. Psaltopoulos et al. 2012; Hyytiä 2013; Nowicki et al. 2009; Zawalińska 2011) and the challenge stands mainly in the fact that it is difficult to predict ex-ante shares of funds going to particular measures, as they are demand driven, and also in modelling of very diversified and “soft” measures (i.e. non-investment measures). The studies usually assumed the same shares of the measures within Pillar 2 after shifting Pillar 1 funds or purposely directed the amount of funds to the Pillar 2 measures of their choice.

## 2.2. Degressivity (reduction of direct payments)

In the current budgetary period “Member States shall reduce the amount of payments to be granted to a farmer in a given calendar year by at least 5% for the part of the amount exceeding EUR 150,000” (EC 2013a). Hence, the reduction is mandatory but only the basic payment or single area payment is counted in this

ceiling, the green payment is excluded, and in addition farms can deduct salary costs including wages paid to the farmer to arrive at the relevant amount (Matthews 2013). Hence, there is a minimum limit of degressivity but the upper bound is left open.

Member States can voluntarily increase the rate of reduction on amounts over €150,000, up to and including 100%, meaning that €150,000 could be the maximum amount that could be paid to any one farmer as a basic payment after deduction of salary costs. Member States which opt for the redistributive payment do not have to apply the mandatory reduction, provided they use at least 5% of their national envelope for the redistributive payment (Matthews 2013). The funds released stay with each Member State and will be recycled to rural development programmes without any need for co-financing.

From the modelling point of view this policy can be approached as in studies analysing modulation, because in fact degressivity replaces the old modulation policy, which after the 2008 Health Check reduced payments above EUR 5,000 by 10% in 2013 and payments over EUR 300,000 by 14% (Matthews 2013). The difference between the degressivity and modulation is, however, the following: the percentage reduction is lower, it has to be remembered that it applies only to the basic payment after salary costs. The new policy leads to less equal distribution of payments than modulation but the degree of inequalities is conditional on the mechanism of internal convergence, whether or not a Member State opts for the redistributive payment and for additional voluntary degressivity (Matthews 2013).

The most comprehensive study tackling modulation, which can also be used for analyses of degressivity, is by Nowicki et al. (2009) where modulation is modelled via a set of linked models – economic models: LEITAP (CGE model), ESIM, FES, CAPRI (PE model) and land use allocation model Dyna-CLUE. The difficulties, however, remain similar in terms of data and impact evidence. While reducing direct payments is pretty straightforward, modelling the distribution of the funds among Pillar 2 measures remains a challenge. This is both due to methodological issues (how to translate precise measures directed to farmers into general economic models working on sectors and regions), and due to data issues – lack of evidence on how the RDP funds are working in practice, and on how they are spent.

### 2.3. Greening component and equivalents

The EC has proposed three mandatory “greening” activities which need to be implemented at farm level: permanent grassland, crop diversification, and Ecological Focus Areas. The requirements related to greening are (EC 2013a):

- a) permanent grassland (PG): Member States shall designate permanent grasslands that are environmentally sensitive and that need strict protection, including in peats and wetlands. The ratio of the land under permanent grassland in relation to the total agricultural area declared by the farmers may be reduced, but not more than 5% compared to a reference ratio established in 2015.
- b) crop diversification: if arable land of the farmer covers between 10 and 30 hectares there shall be at least two different crops on that arable land and the main crop shall not cover more than 75% of that land. For more than 30 hectares there shall be at least three different crops and the main crop shall not cover more than 75% of that arable land and the two main crops together shall not cover more than 95%. Farms up to 10 ha are exempted.
- c) Ecological Focus Areas (EFAs): areas equivalent to at least 5% (after 2016 an increase to 7% will be considered) of a farmer's eligible land is used for ecological purposes<sup>1</sup>. Habitats and features that would be eligible to fulfil the EFA requirement may include: fallow lands, terraces, landscape features, buffer strips, and areas afforested under Pillar 2.

Further details concerning all the conditions are defined by the EC under the implementing legislation. Organic producers receive a “greening” top-up without having to implement these measures. Farmers whose farms are covered by Natura 2000 scheme or by the Wild Birds Directive are required to carry out the activities to a level where they are compatible with the management requirements of those sites. Farmers that apply for the small farmers' scheme are exempt from the “greening” requirements.

The greening of the CAP within CGE can be analysed as it was done within the CAPRI partial equilibrium model (see e.g. Wąs et al. 2013). However, an additional difficulty in modelling the “greening” in the new budgetary perspective is that there are ‘greening equivalents’ introduced to the policy. It means that certain environmental practices provided by farmers e.g. within the environmental measures of Pillar 2 are treated as equivalents to the “greening” requirements under Pillar 1. Those equivalents are justified at the policy level by avoidance of double funding as farmers cannot be paid twice for the same services.

From the modelling point of view it poses higher difficulty, as one has to be careful if certain environmental services are modelled under Pillar 1 or Pillar 2. Those very detailed environmental requirements at farm level impose challenge in modelling CAP within economy-wide models as CGEs, where single farmers are not represented and regional aggregation may be difficult because there may be several

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<sup>1</sup> However, permanent grassland is excluded from the calculation.

combinations of greening requirements fulfilled by a mix of Pillar 1 requirements and Pillar 2 measures.

One way to analyse the greening with the use of CGE models is by linking the model to some other type of farm model. Linking CGE with the partial equilibrium model has already some tradition, and has so far been carried out in three ways (see Törmä et al. 2010). First, by sequential implementation of scenarios, where one model's outcome serves as input for the subsequent model runs (done in Scenar2020, SENSOR). Second, by the systematic, iterative calibration of structural model parameters as in SEAMLESS project (Jansson et al. 2009) and CAPRI-RD project (Britz 2012). The advantage of this approach is that it ensures the harmonized simulation behaviour of both models for matching endogenous variables. Third, by the direct combination of partial equilibrium model and economy wide data from EuroStat to generate a database compatible with GTAP, but with a higher degree of detail for the agricultural sector as done by the European Commission's Institute for Prospective Technological Studies (AgroSAM, Mueller et al. 2009). The main advantage of this approach is the easy implementation of policy shocks at farm level. Otherwise, it is very difficult to implement e.g. the shocks concerning greening in CGE model because greening means "requirements" (not payments) and is implemented at the farm level (not total cultivated hectares or total sector). CGE models need to have a very detailed land function representation with all involved types of land and disaggregated data at least at NUTS3 level (to follow rural-urban typology of EUROSTAT and OECD) as well as a representation of various agricultural crop activities. It is feasible based on a reach agricultural and regional database as e.g. database of the CAPRI model.

### 3. Challenges of modelling RDPs for 2014–2020

Rural development policy has changed in many aspects post 2013, which causes some challenges for scientific modellers as well. First, the former 4 axes (axis 1: competitiveness, axis 2: environment, axis 3: rural economy and quality of life, axis 4: LEADER) have been replaced by 6 priorities of rural development<sup>2</sup> which makes classification of measures more complex than previously because

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<sup>2</sup> The new priorities are: (1) fostering knowledge transfer and innovation in agriculture, forestry, and rural areas; (2) enhancing farm viability and competitiveness of all types of agriculture in all regions and promoting innovative farm technologies and sustainable management of forests; (3) promoting food chain organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture; (4) restoring, preserving and enhancing ecosystems dependent on related to agriculture and forestry; (5) promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors; (6) promoting social inclusion, poverty reduction and economic development in rural areas (EC 2013b).

one measure can fulfil the goals of more than one priority while formerly one measure was fulfilling goals of only one axis. Secondly, even though most of the Pillar 2 measures proposed are similar to those in the previous programming period (so their modelling was usually tested), there are 2 types of brand new measures in the EU policy – those related to managing risk and to co-operation. The first one, “risk management” measure (Article 37) includes “crop, animal, and plant insurance” (Article 38), “Mutual funds for adverse climatic events, animal and plant diseases, pest infestations and environmental incidents” (Article 39), and “Income stabilisation tool” (Article 40). The second one focuses on various types of activities under the umbrella of “co-operation” (Article 36) (EC 2013b). It is related to different actors in agriculture and food chain. Both new measures belong to a kind of “soft” measures, which do not involve large amount of funds but still may significantly change the incentive of the beneficiaries. Thirdly, more integrated approach to rural funds means, among others, that integrated projects are allowed involving support under more than one measure and fund. It obviously makes the evaluation of impact of particular policy more complex if it only partially supports the project – the impact has to be attributed to all the policies involved.

The section below provides more details concerning some selected challenges and avenues for modelling RDP post-2013.

### 3.1. Enhanced risk management toolkit

The EC (2013c) proposed Article three different types of actions under the *Risk management* measure (Article 37):

- a) financial contributions paid to premiums for crop, animal and plant insurance against economic losses to farmers caused by adverse climatic events, and animal or plant diseases, or pest infestation, or an environmental incident (Article 38);
- b) financial contributions to mutual funds to pay financial compensations to farmers, for economic losses caused by adverse climatic events or by the outbreak of an animal or plant disease or pest infestation or an environmental incident;
- c) an **income stabilisation tool**, in the form of financial contributions to mutual funds, providing compensation to farmers for a severe drop in their income.

As for modelling risk management it can be linked to evaluation of impact of certain natural accidents which has economic impact on the agricultural sector. Modelling of economic and natural disasters has a long tradition within CGE framework and a vast literature exists on applying especially Australian models (e.g. Monash, TERM, etc.) and American models (e.g. GTAP). For example Dixon and



Rimmer (2010) revealed that the best way to mimic crisis and economic losses in the economy (avoiding unrealistically high prices and real depreciation of domestic currency) was to assume excess capacity in the affected industries. In a similar way, other studies on natural disasters such as drought, modelled the no-rain accident as an excess capacity in downstream processing sectors affected by drought as that modelled farm output prices hike and economy-wide effects of the events are more realistically represented – see e.g. Wittwer and Griffith (2011); Horridge, Madden, Wittwer (2005) or Kuik and Gerlagh (2005).

Hypothetically, the compensation to farmers could be implemented analogically to counter-cyclical payments (i.e. those paid under Farm Bill in the USA). This category is well defined within Producer Support Estimate – PSE (OECD) classification as E1 – Counter Cyclical Payments (CCP). There are several studies on modelling CCPs within CGE framework available from the US literature (e.g. Hanson and Somwaru, 2003), which can provide the insight into the modelling of those measures in the EU. The review of that literature shows that CCPs are usually more distortive in terms of their impact on farm capital and farm output than SFPs (Mary 2013a).

### 3.2. New co-operation measures

*Co-operation* (Article 36) is a new measure in CAP 2014–2020. Support under this measure is granted in order to promote various forms of co-operation involving at least two entities, and in particular (EC 2013b):

- a) co-operation approaches among different actors in the agriculture and food chain, the forestry sector and actors who contribute to achieving the objectives and priorities of rural development policy, including producer groups, cooperatives and inter-branch organisations;
- b) the creation of clusters and networks;
- c) the establishment and operation of operational groups of the European Innovation Partnership for agricultural productivity and sustainability.

The problem with modelling this type of measure within CGE framework is that it covers extremely diverse actions and there is a vast variety of eligible costs supported under this measure – from business plans, strategies, to running costs of co-operation, direct costs of specific projects linked to the implementation of a business plan, among other things. Hence, probably the most convincing way to model this measure would be to treat it as “transfer of knowledge” as it is an ultimate goal of this measure rather than group the measures into some subcategories. The “transfer of knowledge” could be measured as concentration of R&D in certain regions and be linked to economic growth according to the theory of endogenous growth (Lucas 1988; Romer 1990).

There are CGE models built in the link between some notion of knowledge and growth, including the Polish TERM model (POLTERM)<sup>3</sup>. In the dynamic POLTERM model, the R&D expenditures by industry, government and households are treated as investment into the stock of knowledge. Following the method used by the American Bureau of Economic Analysis (Sliker 2007; Bernat 2007), stock of knowledge is calculated using the perpetual inventory method.

Another CGE model – RHOMOLO – has an economic growth depending positively on investments in R&D and education, linked through total factor productivity (TFP) (Brandsma et al. 2011; Brandsma and Kancs 2015). By investing in R&D and education each region is able to catch-up faster with the region technological leader and better adopt its technologies. The authors proposed to use an estimated logistic function that would allow for the estimation of a critical human capital level that applies across regions. Investment in R&D in regions below that level would be expected to have no impact on regional TFP; investment in R&D in regions above that level would have a catching-up effect depending on the distance to the technology frontier.

Another example of the model which tackles such intangible policy instruments as promoting R&D, human capital development, entrepreneurship policies or more intensive public/private collaborations, is the GMR model system by Varga et al. (2009). The authors measure new technological knowledge by patent counts spatially allocated according to the addresses of inventors; human capital, by the number of people that have attained at least a university degree; the proxy for social capital is the share of population over total population that has taken part at least once in the last 12 months in social activities. They are all linked to TFP in the regions. The idea behind the estimated model is that human capital and accumulated technological knowledge are the main inputs to regional productivity.

It is worth mentioning, however, that most empirical studies analysing the impact of total CAP subsidies on efficiency and productivity (with use of Stochastic Frontier and Data Envelopment Analysis – DEA) reported, however, the negative impact of CAP measures on TFP (e.g. Zhu and Oude Lansink 2010; Latruffe 2010). Another study by Mary (2013b), applied a generalised method of moments (GMM) system<sup>4</sup> and revealed that among various farm subsidies, only those subsidies have significantly negative impacts on TFP which are fairly automatic, such as set-aside premiums and Less Favoured Areas (LFA) payments. On the contrary, more targeted

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<sup>3</sup> The work based TERM version extended over R&D module has not yet been published but is undergoing a revision process in a scientific journal.

<sup>4</sup> Based on French crop farms sample from FADN over the period between 1996 and 2003.

subsidies such as investment subsidies, agri-environmental payments, crop area payments, showed no significant impact on productivity.

So it would be interesting and desirable to carry out a study on impact of the co-operation measure on TFP with the use of the CGE model by implementation to the model of the endogenous growth theory. Following the theory, one would need to model (positive) externalities and spillover effects of a knowledge-based economy which will lead to economic development.

### 3.3. Better integration and co-ordination of CAP with other EU policies

Since EU policies have become more integrated, which is assured by the establishment of the Common EU Strategic Framework for all funds at the EU level and Common National Strategic Framework for all EU funds at Member States level, it is vital to be able to model the integrated impact of the EU policies on rural areas, where not only CAP but also other policies' funds operate. Then, the impact of some measure or investment has to be attributed to each of the policy involved.

CAP was the first common European-wide policy, which paved the way for European integration in other policy areas. However, Thomson and Psaltopoulos (2004) showed that the term “integration” – although widely advocated in EU's agricultural and rural development policy – seldom is precisely defined in official and other documents. At first, “integration” was introduced in this field within the EU in 1981 together with launching the ‘Integrated Development Programmes’ (Delgado and Ramos 2002). However, over the time, the term lived to see different interpretations depending on the context.

From the *financial* point of view the “integration” is usually understood as a possibility to combine different funds and policies (Thomson and Psaltopoulos 2004). In the past they were Cohesion Policy – European Regional Development Fund (ERDF), European Social Fund (ESF) – and Common Agricultural Policy (EAGGF Guidance Section). Post 2013 the multi-funding projects are available within: rural development policy financed by European Agricultural Fund for Rural Development (EAFRD), cohesion policy (financed by ERDF; Cohesion Fund, and ESF) and the maritime and fisheries policy (financed by European Maritime and Fisheries Fund). As a result, a few challenges arise. First, the intervention schemes compete with each other if their goals overlap (although double funding is of course avoided between the funds) and different rules for obtaining the funds within different policies cause crowding out of less friendly or more demanding measures. For example, creating new jobs in rural areas can be achieved both by establishing micro-enterprises from Rural Development Programs as well as from Human Capital Operational Programme when both have different rules (e.g. VAT

is not eligible cost in the former but may be an eligible cost in the latter) which differentiate their efficiency a priori.

From the *administrative* point of view, “integrated” means that the policies should be designed, approved, monitored and evaluated in a consolidated manner (Thomson and Psaltopoulos 2004). However, so far the Common Framework for Monitoring and Evaluation existed for Rural Development Programs while the other programmes e.g. under ERDP had diversified criteria. The new common monitoring and evaluation framework (CMEF) assess the performance of the CAP and its main instruments (i.e. direct payments, market measures, rural development measures and the application of cross compliance) building on and maximising synergies between monitoring and evaluation tools. Provisions for this system are laid down in Article 110 of the Commission proposal for a regulation of the European Parliament and the Council on the financing, management and monitoring of the common agricultural policy (EC 2013c).

From the *institutional* point of view, “integration” can be understood as consolidation of various policies within one institution (Thomson and Psaltopoulos 2004). That means the establishment of ministries which no longer deal with a single sector policies but with several related ones. Good example is DEFRA – Department for Environment, Food & Rural Affairs within the UK government services – which manages and integrates competences of usually separate ministries for agriculture, rural development and environment. In many Member States the agricultural policy is nowadays handled by ministries which are in charge of more than one policy, e.g. Ministry of Food, Agricultural and Consumer Protection (Germany), Ministry of Agriculture, Natural Resources, and Environment (Cyprus), Ministry of Life (Austria), Ministry of Food, Agriculture and Fisheries (Denmark).

Last but not least, from an *economic* point of view, the attraction of “integrated” policy approach is two-fold. First, by forcing choices to be made together it promotes more equal marginal costs and/or benefits between the sectors. Second, integration increases the net benefits of policy action by reducing expenditure on conflicting policy-encouraged actions and by encouraging synergies and complementarities between different sectors – see Thomson and Psaltopoulos (2004).

All in all, a lot of questions have to be addressed in modelling integrated approach. In particular, how to evaluate the impact of each policy when they co-exist on the same territory? How to evaluate policies which have different access rules – e.g. beneficiaries may achieve similar goals with measures from different policies (funds) having different rules. Even more challenging is to assess the synergy and deadweight effects among the policies and Funds financing those policies, which differ in “initial conditions” – eligibility rules, target groups, requirements related to the settlements, ways of evaluation of the money spent.

### 3.4. Modelling “integrated” impact of EU policies

Generally, the integrated impact follows the philosophy of the place-based approach (as postulated by Barca 2009) to modelling development of the regions due to EU policies, and in particular rural and regional policies. This means that the main question of interest is how certain territories (rural areas) benefit from all funds implemented there at the same time?

There can be a wide range of interventions from various policies (economic, environmental, social, technological, etc.) so the key question is how to measure such a complex impact with the use of economic CGE models? It seems that either more sophisticated models are needed or integrated models have to be applied. As Thomson and Psaltopoulos (2004) claim, “static” techniques of economics such as input-output and/or economic-based models are not suitable any longer. Instead, they advocate “combined” multisectoral and dynamic approach (e.g. dynamic CGE models) to explore the effects of policy interventions on the targeted-area economies. However, another way would be to link different types of models together. Then, weaknesses or inabilities of some types of models are replaced by strengths of other types of models (e.g. linking CGEs with partial equilibrium models and Dynamic Stochastic General Equilibrium models, engineering models, etc.). Some examples of hybrid or linked models are described by Britz (2012), Nowicki et al. (2009), Jansson et al. (2009), Törmä et al. (2010), LSE (2011).

The study of integrated impacts also means that models need to grasp typical regional phenomena in greater details, with respect to agglomeration, spatial knowledge spillovers, interregional trade, and migration. One example of such hybrid approach to tackle this problem is GMR-Europe model system applied to the assessment of impact of the Single Market on Cohesion (LSE 2011). The GMR system combines approaches frequently applied in policy impact models (CGE and DSGE modelling) with techniques that are adopted in econometric studies (modelling of regional knowledge production) and it links two CGE models. One of them has been used for the impact assessment of human capital related measures. The other CGE model (RegEU) has been used for the assessment of investment types of measures that are related to fixed capital formation.

Another conglomerate is CAPRI-RD system (Britz 2012). The system comprises two types of models: partial equilibrium model CAPRI (with its supply, market and farm modules) and regional CGEs (computable general equilibrium models) in RegCgeEU+ model (Britz 2012; Britz and Witzke 2012). They both cover all NUTS2 regions of the EU-28. The two models complement each other based on their comparative advantages. For example, the level of sectoral aggregation is always higher in CGEs than in PE models – here CAPRI features 36 crops

and 16 animal husbandry activities, whereas agriculture is but one aggregate in RegCgeEU+. On the other hand, the latter features additional 10 sectors apart from agriculture (i.e. forestry, other primary production, food processing, manufacturing, energy, construction, trade and transport, hotels and restaurants, education and other services) in each of the regions. Thus, it allows for more holistic depiction of the rural economies and for investigating the impact of CAP in all sectors out of agriculture. Thanks to this approach, policy tools addressed to broader rural economy and non-agricultural sectors (partial component of Pillar 2 and the majority of support within Cohesion policy) can be modelled via shocks starting in CGE with impact on detailed agricultural variables produced in partial equilibrium model. At the same time, specifically agricultural measures (Pillar 1 and some significant part of Pillar 2) can be modelled via shocks starting in partial equilibrium models but their effects can be further studied across the whole regional economy via their link with CGEs. Regions are defined at NUTS 2 level (Törmä and Zawalińska 2010; Britz 2012).

#### 4. Conclusions

The paper discussed various approaches to modelling measures of the Common Agricultural Policy (CAP) within a computable general equilibrium (CGE) framework. The key challenges for modelling were identified which can be summarised as follows.

Modelling Pillar 1 post-2013 brings challenges resulting from more complex composition of direct payments within Basic Payments Scheme and interactions of Pillar 1 with Pillar 2 payments – due to greening equivalents and flexible shifts between the Pillars. In creating the closure and shock statements one needs to take into consideration that funds shifted from Pillar 2 to Pillar 1 do not require public co-financing but in the other way round, they require contribution from national budget and/or beneficiaries. So those details on financing sources should be grasped by closure rules since they greatly affect the results.

The most controversial issue in modelling Pillar 2 within CGE framework used to be grouping of the vast variety of RDP measures in some manageable and fairly homogenous clusters. In the 2014–2020 budgetary period the additional challenges arise from new types of non-investment measures, such as risk management and co-operation, which were not evaluated within CGE framework for the EU before.

Since most of the measures of Pillar 1 and Pillar 2 are implemented as area payments (per hectare payments) and various additional requirements on the land are imposed it seems critical not only to have the land as a separate input in the model (next to capital and labour) but also a representation of various land types in

agricultural sector. The types could represent LFA areas, Natura 2000 areas, High Nature Value (HNV) areas, areas representing different types of soil quality, etc.

Since CAP 2014–2020 is more focused on measures enhancing knowledge transfer, human capital improvements, quality of products, and is expected to contribute to innovations, the CGE model should be enhanced over endogenous growth theory. Then knowledge transfer and enhancement of human capital could be related to investments in R&D and education, linked through total factor productivity (TFP) and this way it would be linked to economic growth.

Due to growing concern about CAP's not only economic but also environmental, social and other impact, it is worth considering linking CGE models with other types of models to grasp those new aspects. The possibilities are for example: partial equilibrium models such as CAPRI, land use models such as CLUE, engineering-economic models such as SAFIRE, some environmental models, etc. That would have several advantages, because not only the results would have multi-dimensional character but also the implementation of shock could be more precise due to using the models' best abilities.

Since CAP is more integrated now with the place-based approach (Barca 2009) and interacts with other regional and local policies, the modelling approaches should be able to tackle region specific effects. Hence, the CGE models would benefit from building in features which would grasp typical regional effects as indicated by new economic geography, in particular: agglomeration effects, spatial knowledge spillovers, interregional trade, and migration.

To conclude, there is still a large scope for research on improving the modelling of the CAP. Researchers so far have clearly put lots of effort in trying to adjust their models to feature the CAP impact as best as possible. In addition, the vast heterogeneity associated with the design and application of both Pillars across the EU has still not been discovered. Contextual factors are not always known but they in fact determine how measures operate and how they affect the economies. Good models should be able to feature them as well. We still know too little on what is going on with funds from the policy at the micro level. Without that knowledge the studies may not go very far into any macro level inference. So one way further research should go is in the direction of extending that knowledge and complementing CGE analyses with micro-level fundamentals.

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## Wyzwania w odwzorowaniu Wspólnej Polityki Rolnej 2014–2020 w modelach równowagi ogólnej

**Streszczenie:** Artykuł pokazuje wyzwania związane z modelowaniem ekonomicznych skutków Wspólnej Polityki Rolnej (WPR) z okresu budżetowego 2014–2020 za pomocą modeli równowagi ogólnej (CGE). Modelowanie tak różnorodnej polityki jak WPR z wykorzystaniem modeli CGE nie jest trywialnym zadaniem, co najmniej z trzech powodów. Po pierwsze, wpływa na to duża liczba i zróżnicowanie narzędzi, jakimi posługuje się ta polityka. Już sam filar 2 proponuje ok. 17 działań obwarowanych szczegółowymi wymaganiami. O ile jednak w większości wsparcie w ramach filara 2 jest ukierunkowane – określone są dobra i usługi, na które fundusze te są faktycznie przeznaczone – o tyle środki z filara 1 są wydatkowane przez beneficjentów dowolnie, zatem ocena ich wpływu wymaga dodatkowej wiedzy na temat ich docelowego przeznaczenia. Po drugie, modele CGE wprawdzie odzwierciedlają wszystkie sektory gospodarki, ale w związku z tym rzadko z taką precyzją jak to jest możliwe w modelach jednosektorowych. Często więc mają problemy z uchwyceniem niuansów poszczególnych działań WPR i wymagają jakichś uproszczeń czy agregacji. Po trzecie, WPR ewoluje w kierunku takich narzędzi, których siła oddziaływania zależy nie tyle od wielkości przeznaczonych na nie funduszy, ile od mechanizmów, które wymuszają na beneficjentach zmiany zachowań. Ponadto idą w kierunku zwiększenia roli rolnictwa niezwiązanej z produkcją (np. dostarczanie dóbr publicznych) oraz szczególnej roli kapitału ludzkiego (podejście oddolne, środki przeznaczone na współpracę i networking). Takie działania są trudne do uchwycenia przez modele CGE, gdyż nie są bezpośrednio powiązane ze standardowymi zmiennymi tego typu modeli. Biorąc wszystkie wyzwania pod uwagę i opierając się na przeglądzie literatury, artykuł przedstawia możliwe rozwiązania tych problemów, co powinno ułatwić ewaluację nowej WPR 2014–2020 za pomocą modeli typu CGE.

**Słowa kluczowe:** ewaluacja polityki rolnej, modele równowagi ogólnej, modelowanie WPR 2014–2020.

