



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

# **Impacts of the 2013 CAP reform on the EU farming sector: An assessment using a microeconomic farm model**

Maria Espinosa<sup>1</sup>, Kamel Louhichi<sup>1,2</sup>, Angel Perni<sup>1</sup>, Pavel Ciaian<sup>1</sup>, Sergio Gomez y Paloma<sup>1</sup>

<sup>1</sup>European Commission, DG Joint Research Centre

<sup>2</sup>INRA – UMR Economie Publique, Thiverval-Grignon, France

*Selected Paper prepared for presentation at the 2017 Agricultural & Applied Economics Association  
Annual Meeting, Chicago, Illinois, July 30-August 1*

*Copyright 2017 by Maria Espinosa, Kamel Louhichi, Angel Perni, Pavel Ciaian and Sergio Gomez y Paloma. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.*

# Impacts of the 2013 CAP reform on the EU farming sector: An assessment using a microeconomic farm model<sup>1</sup>

Maria Espinosa<sup>1</sup>, Kamel Louhichi<sup>1,2</sup>, Angel Perni<sup>1</sup>, Pavel Ciaian<sup>1</sup>, Sergio Gomez y Paloma<sup>1</sup>

<sup>1</sup>European Commission, DG Joint Research Centre

<sup>2</sup>INRA – UMR Economie Publique, Thiverval-Grignon, France

## Abstract

*This paper analyses the impact of the new direct payments (DPs) system introduced by the 2013 CAP reform on EU farming sector. We apply the EU-wide individual farm level model (IFM-CAP) which allows capturing farm specific implementation of DPs and assessing their distributional effects. Simulation results show that although the 2013 CAP reform succeeded to partially harmonize DPs between MS, relatively strong differences in DPs still remain in place. An important result of the 2013 CAP reform is also internal convergence of DPs within MS. The 2013 CAP reform reduced inequality of DPs as measured by the Gini coefficient from 0.581 to 0.561. The farm income decreases by around 1.3% at EU level due to the introduction of the new DPs. Around 60% of farms loose, whereas the remaining 40% of farms gain from the reform in EU-27. Small farms benefit, while large farms lose from the 2013 CAP reform.*

**Key words:** CAP reform, IFM-CAP farm model, direct payments, income distributional effects

## 1. Introduction

In 2013 the Common Agricultural Policy (CAP) underwent substantial reform with the aim to create a more equitable, green and market-oriented support system. The two main elements of the 2013 reform are: (i) the implementation of a new system of direct payments (DPs) and (ii) the introduction of the so-called CAP greening measures (EU 2013; European Commission 2013; European Commission 2016).

The main aim of the new system of direct payments is to partially eliminate the disparities in the level of direct payments received by farms both within and between EU Member States (MS) (internal and

---

<sup>1</sup> The authors are solely responsible for the content of the paper. The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

external convergence). Prior to the reform, farmers in old Member States (OMS)<sup>2</sup> received higher payments than farmers in New MS (NMS). In addition, farmers that had historically high coupled direct payments (i.e. before the introduction of the decoupled payments by the previous 2003 CAP reform), received higher per hectare decoupled payments than other farms. To reduce the disparities in DPs between farms, the 2013 CAP reform provides a menu of possible options to implement the new system of direct payments. MS could choose the exact reform strategy and the degree (full versus partial) of harmonization of the per-hectare decoupled payments. Further, in order to generate a more equitable distribution of direct payments between farms, MS could choose the implementation of additional direct payment measures such as (i) a "redistributive payment" which shifts support from larger farms to smaller ones, (ii) coupled support, (iii) the small farmer scheme, and (iv) payments in areas with natural constraints (EU, 2013).

The second key element of the 2013 CAP reform is the introduction of CAP greening measures. The CAP greening includes measures that are obligatory for farmers who wish to receive the full direct payments. The aim of CAP greening is to enhance the environmental performance of farming sector by incentivizing them to adopt agricultural practices beneficial for the climate and the environment. In other words, the main reason behind the introduction of CAP greening is to foster the provision of environmental public goods from agriculture to the society in return for receiving direct payments. (EU 2013).

Given that the 2013 CAP reform has introduced profound changes to the support system, the key policy question is whether this reform will lead to a more equitable distribution of direct payments among farms and to what extent it impacts agricultural production and the distribution of farm income (i.e. who are the losers and who are the beneficiaries of the reform). Answering these questions provides evidence on whether the CAP reform achieves its objectives of providing a more effective and efficient CAP through more targeted and equitable direct payments.

Following these policy questions, the main objective of this paper is to analyse the impacts of the new direct payment system (including the CAP greening) on EU farms using the EU-wide microeconomic farm model – IFM-CAP (Individual Farm Model for Common Agricultural Policy Analysis). The key advantage of IFM-CAP is that it models individual farms in the EU which allows capturing the impacts of the new direct payment effects as introduced by the 2013 CAP reform. Both the pre-reform and post-reform direct payments are farm specific. The same holds for CAP greening. Because the CAP greening targets land allocation at farm level implying that their uptake and impacts largely depend on farm-specific characteristics (size, specialisation, localisation, etc.). These characteristics of DPs require application of a micro level model such as IFM-CAP in order to model and identify the impacts of all relevant elements

---

<sup>2</sup> OMS (also referred to as EU-15) includes the following EU Member States: Belgium, Luxembourg, Denmark, Germany, Austria, the Netherlands, France, Portugal, Spain, Greece, Italy, Ireland, Finland, Sweden and United Kingdom. New MS (NMS) (also referred to as EU-12) includes the following EU Member States: the Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Slovenia, Slovakia, Cyprus, Malta, Bulgaria and Romania. EU-27 includes all EU Member States except for Croatia. Croatia is not considered in this paper because it is not modeled in IFM-CAP.

of the 2013 CAP reform. Previous applications of the model have assessed the effect of the crop-diversification measure (Louhichi et al. 2017b) and the greening measures (Louhichi et al. 2017a). To the best of our knowledge, this is the first paper providing a comprehensive analysis of EU-wide microeconomic impacts of the 2013 CAP reform.<sup>3</sup>

The paper is structured as follows. The next section provides an overview of the 2013 CAP reform, which is followed by a section presenting the IFM-CAP model. The fourth section presents the scenarios simulated in the paper. The fifth section describes the simulated results. The final section draws the main conclusions and policy implications.

## **2. The EU-CAP: from past reforms to current policy**

The CAP has undergone several major reforms since 1992, characterized by a move away from the price support towards direct payments to farmers (Pillar I) and to payments for environmental services and rural development programmes (Pillar II). In this paper, we focus on the implementation of Pillar I (i.e. direct payments). In particular, the 1992 reform introduced coupled area and animal payments. These coupled payments replaced the previous price intervention mechanism. The 2003 CAP reform has progressively decoupled these payments from production and introduced decoupled payments, represented by the Single Payment Scheme (SPS) and the Single Area Payment System (SAPS). The decoupled payments are now by far the largest component of the CAP budget. The 2013 CAP reform maintained the decoupled payments as the major policy instrument in the current financial period 2014–2020, but linked them more closely with the provision of public goods and externalities (i.e. via *greening* measures) (EU 2013).

The 2013 CAP reform introduced various changes that modify the value of direct payments (i.e. coupled and decoupled payments) and their implementation. First of all, the CAP reform was negotiated at the time when EU and global economy faced severe economic and financial crisis. These economic pressures affected the financial resources allocated to CAP. The overall CAP budget (including the DP budget) was reduced because of the fiscal austerity pursued within the EU.

An important element of the 2013 CAP reform that alters the availability of funds for direct payments is the possibility of MS to transfer funds between DPs (Pillar I) and RDP (Pillar II). MS may transfer up to 15% of the annual ceiling for direct payment to Pillar II or *vice versa*. MS with the average DPs per hectare below 90% of the EU average are allowed to transfer up to 25% of the RDP to DPs (EU 2013; European Parliament 2015).

An additional element of the 2013 CAP reform that changes the allocation of direct payments between MS is the external convergence of DPs. The aim of the external convergence is to rebalance the CAP support among MS. The external convergence partially harmonizes the payments among MS; they are adjusted either upwards or downwards to bring them closer to the EU average level. More specifically,

---

<sup>3</sup> The exception is the paper of Espinosa *et al.* (2017) which assesses the effects of the new decoupled payments on farm income. However, this paper assumes fixed production structure; the analyses are not based on model simulations. Further, Espinosa *et al.* (2017) does not consider coupled payments and CAP greening in the analyses.

the national budgets of MS where the average payment (in EUR per hectare) is below 90% of the EU average are gradually increased (by one third of the difference between their current rate and 90% of the EU average). This convergence is financed proportionally by MS that have payment levels above the EU average level (EU 2013).<sup>4</sup> Due to the external convergence, all the NMS (with the exception of Cyprus, Malta and Slovenia) have observed an increase in their direct payments; while the OMS (with the exception of Spain and Portugal) have registered a reduction of their DPs (Anania and Pupo D'Andrea, 2015).

### **2.1. Decoupled payments**

Two types of decoupled payments were implemented in the European Union in the pre-reform period: the Single Payment Scheme (SPS) and the Single Area Payment Scheme (SAPS). Both types of decoupled payments were introduced by the 2003 CAP reform.

Under the SPS each farm, was allocated an amount of SPS entitlements. Farms can receive SPS payments if they have both entitlements and an equal amount of eligible land. The SPS payments are linked to land because, in the absence of land, farms cannot activate the SPS entitlements. However, the SPS is not linked to a specific land area – the SPS entitlements can be activated by any eligible farmland in the region.

When implementing the SPS, MS could choose between three different SPS implementation models: the historical model (HM), the regional (flat-rate) model (RM), and the hybrid model (HYM). Under the historical model, the SPS is farm-specific and equals the support the farm has received in the “reference” period, i.e. when coupled subsidies were given. Under the regional model, an equal per hectare payment is granted to all farms in a given region. The hybrid model is a combination of historical and regional models. The key difference between the three models is the unit value of entitlements. Under the historical and hybrid models, the value of entitlement varies between farms (stronger in the former than in the latter), whereas under the regional SPS model, all farms in a region have entitlements with the same unit value. The hybrid model has two versions: static or dynamic. MS implementing the dynamic hybrid model (DHYM) gradually move to a fully regional (flat-rate) model, whereas MS implementing the static hybrid model (SHYM) maintain the payment variation across farms (i.e. the regional and the historical shares do not change over time).

The SAPS is implemented only in NMS. A key difference between the SAPS and the SPS is the area eligible for the payment. Under the SAPS, the entire eligible area that farmers use can receive a payment per hectare; there are not entitlements as in the case of the SPS. Another key difference between the SAPS and the SPS is the value of the per hectare payment. Under the SAPS, all farms in a given MS (or region within a MS) receive an equal per hectare payment (i.e. flat-rate payment), whereas under the SPS, the payment value could differ depending on the type of the SPS model a MS implemented.

---

<sup>4</sup> According to the CAP regulation, the average direct payment per hectare in a MS cannot be lower than 196 Euros/ha (in nominal prices).

Farm eligibility for the decoupled payments is subject to cross-compliance. Each farm that receives the SPS/SAPS must comply with the Statutory Management Requirements (SMR), and maintain land in Good Agricultural and Environmental Condition (GAEC). The SMR are based on EU regulations in the fields of environment, public, animal and plant health, and animal welfare. The GAEC includes a set of standards requiring farmers to ensure the soil protection, the maintenance of soil organic matter and soil structure, and the safe-guarding of landscape features and habitats.

The key changes introduced by the 2013 CAP reform to decoupled payments can be summarized as follows (EU 2013; European Commission 2015, 2016):

1. *Internal convergence of decoupled payments*: The 2013 CAP reform aims to eliminate or reduce the heterogeneity of per hectare payments that farmers receive in a region or MS. This concerns MS that implemented the historical SPS model or the static hybrid SPS model prior to the reform. Other schemes allocated flat-rate payments prior to the reform (i.e. SAPS, regional SPS model or dynamic hybrid model that moved to a flat-rate) and thus are not subject to the convergence requirements. MS could choose either to apply (i) full convergence (i.e. introduction of flat-rate) or (ii) partial convergence.

Under the full convergence, an equal per hectare payment is granted to all farms in a given region. This is similar to the regional SPS model or the SAPS implemented prior to the reform. MS could choose either to introduce a flat-rate payment in the first year of the reform implementation (i.e. in 2015) or to introduce a gradual harmonization of payments where the full convergence would be reached the latest by 2019 / 2020.

Under the partial convergence, the payment heterogeneity across farms is reduced, but is not completely eliminated. The mechanism of the partial harmonization consists of reducing the unit value of payments to farms with higher value and increasing the unit value payments to farms with lower values. More specifically, farms receiving less than 90% of the regional/national average rate are granted a higher value payment with a guarantee that the decoupled payment is not lower than 60% of the national/regional average. The increase in payments is financed by proportionally reducing the payments available to farmers receiving more than the regional/national average, with an option for MS to limit the maximum loss of 30% relative to pre-reform payments. Similar to the full convergence, MS may introduce the partial convergence in the first year of the reform implementation in 2015 or gradually until 2019.

2. *Redistributive payment*: The redistributive payments aims to increase the support for small and medium-sized farms by granting a higher payment value for the first 30 hectares (or up to the average farm size if higher than 30 hectares) than for the rest of farm area. MS can allocate up to 30% of the decoupled payments budget for the redistributive payments. Note that redistributive payment is a voluntary instrument.
3. *Reduction and capping of decoupled payments* aims to reduce the decoupled payments for the largest farms. Similar to redistributive payments, the capping aims to generate a more equitable distribution of DPs between farms. MS are required to reduce (*degresivity*) decoupled payments, by at least 5% for payments above €150,000. MS can increase the 5% rate up to 100%

therefore leading to the capping of payments.<sup>5</sup> MS are exempted to apply the payment reduction if they implement the redistributive payments, and these absorb more than 5% of the direct payments.

4. *Entitlement allocation*: the MS that implemented SPS in the pre-reform period can choose (i) to maintain old (pre-reform) entitlements or (ii) to allocate new entitlements based on the eligible area in the first year of reform implementation (i.e. in 2015) to farms which were eligible for DPs in 2013. For the first option, MS could impose additional restriction that the number of entitlements does not exceed the eligible area in 2015. For the second option, MS could limit the allocated entitlements to the minimum between the eligible area in 2013 and the declared eligible area in 2015. Further, for both options MS could choose to allocate fewer entitlements for grassland (i.e. to apply the reduction coefficient) or to exclude land cultivated with vineyards and greenhouse. Alternatively, MS could grant new entitlements to farmers that were not eligible to receive DPs under the old system (in 2013) such as vegetable producers, vineyards producers, etc.
5. The reform allows application of SAPS. MS applying SAPS in the pre-reform period have decided to extend the use of this system until 2020.
6. *CAP greening*: The reformed CAP imposes a stronger linkage of the decoupled payments to “agricultural practices beneficial to the climate and environment” through three CAP greening measures: crop diversification, maintenance of permanent grassland and ecological focus area (EFA). Under the crop diversification, the cultivation of the arable land needs to include at least two different crops on farms cultivating between 10 and 30 hectare of the arable land and at least three crops on farms with a larger arable area. The main crop should not exceed 75% of arable land, and the two main crops should not exceed 95% of the arable area. Under the maintenance of the permanent grassland, farms are required not to convert and to plough the permanent grassland. The EFA measure requires farms larger than 15 hectares to allocate at least 5 % of farms' eligible area (excluding the areas under grassland) to the ecological focus area. The areas that qualify as an ecological focus area include the fallow land, terraces, landscape features, buffer strips, the green cover, among others.

The CAP greening takes up 30% of the total direct payment funds. The conditions are similar to cross compliance but more demanding than the cross-compliance requirements. Not respecting these requirements may lead to a reduction or a full loss of the decoupled payments.

## **2.2. Coupled payments**

Coupled direct payments (CDP) are linked to a specific production activity and take the form of area payment granted to a particular crop or per head in the case of livestock. CDP were introduced by the MacSharry reform in 1992 and were further increased by Agenda 2000. The 2003 CAP reform significantly reduced CDP by introducing the decoupled payments. However, even with the decoupled payments introduction, MS could maintain a certain share of direct payments coupled to crop or animal production instead of disbursing them as decoupled payments.

---

<sup>5</sup> Funds generated from the payment reduction and capping are be shifted to Rural Development Programme (Pillar II).

According to the 2013 CAP reform, MS can allocate to CDP up to 15% of the total national direct payment budget of decoupled payments (European Parliament 2015).

The 2013 CAP reform extended the availability of the coupled payments. However, there are imposed strict budgetary ceiling for funds that can be allocated to coupled payments. CDP cannot account for more than 8% of the direct payment funds in MS that provided coupled support in the pre-reform period, and they cannot exceed 13% limit if the pre-reform coupled support was higher than 5%. If the share in the pre-reform period exceeded 10%, the MS may allocate more than 13% of its national ceiling to coupled support provided that the European Commission gives its explicit authorization. Furthermore, the share of direct payments allocated to CDP may be increased by an additional 2% for the support granted to protein crops (EU 2013; European Parliament 2015, 2016).

### ***2.3. Expected impacts of the 2013 CAP reform***

Overall, the 2013 CAP reform provides a menu of possible options for implementing direct payments. MS could choose the exact reform strategy from a pre-defined set of options leading to a large heterogeneity in its implementation between countries. The MS choices on the reform implementation may have a potentially strong income distribution effects among farms. According to the FADN (Farm Accountancy Data Network) data, the contribution of direct payments in the farm net value added was about 31%, ranging from 72% in Finland to 12% in the Netherlands (EU Farm Economics Overview, 2012). This implies that a drastic reduction of direct support may strongly impact the viability of certain farms in the EU

Decoupled payments (SPS and SAPS) are the main support measure by representing more than 90% of the total DPs. This implies that the changes introduced to their implementation will derive the total impact of the new direct payments on farming sector (particularly on farms' income). Particularly strong income distribution effects are expected to be caused by the internal convergence of decoupled payments through the adoption of the partial or full convergence of payments in MS which implemented (historical) SPS in the pre-reform period. This is because the internal convergence leads to the reallocation of payments from farms with high value hectare payment to farms with low value payments. Important income distribution effects are expected to be also caused by the redistributive payment and the capping because these measures tend to transfer payments to small farms at the detriment of large farms.

Farmers are also expected to be affected by the overall change of the DP budget (including decoupled payments). First, the 2013 CAP reform leads to a partial convergence of direct payments between MS (i.e. external convergence) which will cause farms in MS with high hectare payments to loose, while farms in MS with low payments to gain. Given that OMS have higher payments per hectare than NMS, the external convergence is expected to decrease payments to farms in OMS to the benefit of farms in NMS. Second, MS can reallocate the CAP budget between direct payments and RDP support (Pillar II). Many NMS decided to transfer resources from RDP support to the DP envelope, whereas several OMS do the reverse. Finally, farms are expected to be also affected by the DPs reduction because of the overall EU budget cut. The overall impact of the DP change on farms depends on the size of each of the

three factors (external convergence, reallocation between DPs and RDP, decrease in overall budget). However, farmers in most NMS are expected to be positively affected by the DP budgetary change because the external convergence and the reallocation of payments between pillars increase the hectare value of DPs which is expected to offset the DP cut effect. The reverse is valid for farms in most OMS.

An important element of the reform is the introduction of greening measures. The evidence shows that CAP greening has heterogeneous impact across farms. Note, that only farms in breach of greening requirements are affected by CAP greening. For example, only farms specialized in less than three crops, farms without EFA eligible area (e.g. a fallow land) or farms which converted a significant share of arable land into grassland need to adjust land allocation due to greening introduction. Some farms do not need to adjust to 'greening' requirements. This is the case, for example, if farms' production structure is already sufficiently diversified, if they have no incentive to convert grassland to other uses, or if they have sufficient EFA eligible area. According to Louhichi et al. (2017a), only around 30% of farms are affected by CAP greening in EU, whereas the rest of farms (70%) do not need to adjust their land allocation to 'greening' requirements. At the aggregate MS or at the regional level, the existing evidence shows that the impact of the CAP greening on the farm performance (productivity, income) is rather small (Louhichi et al. 2017a; Solazzo and Pierangeli 2016; Gocht et al. 2017). For example, according to Louhichi et al. (2017a), CAP greening leads to only around 1% decrease in income and production in EU. Similar magnitude of the effects of CAP greening were reported by other studies (e.g. Solazzo and Pierangeli 2016; Gocht et al. 2017).

### **3. Methodological approach**

#### **3.1. The IFM-CAP model**

To analyse the impact of the 2013 CAP reform, we use the IFM-CAP model. The IFM-CAP model is a farm level model designed for the economic and environmental analysis of the European agriculture. The main advantage of IFM-CAP is that it models individual farms in the EU which allows capturing the farm heterogeneity to a sufficient degree to model the impacts of the new direct payment effects as introduced by the 2013 CAP reform. The micro level detail of IFM-CAP is important because both the pre-reform and post-reform direct payments are farm specific in many MS (e.g. in MS with historical SPS model in the pre-reform period or in MS with partial convergence of decoupled payments in the post reform period). The direct payments that each farm receives after reform depends on the pre-reform payment level of the farm (i.e. depending on the implemented model: historical SPS model, hybrid SPS model, SAPS, regional SPS model) and the post-reform payment scheme implemented in a given MS (e.g. partial convergence versus full convergence). Further, the CAP greening targets land allocation at farm level implying that their uptake and impacts largely depend on farm-specific characteristics (size, specialisation, localisation, etc.). This poses challenges for policy evaluation and raising the need for the application of a micro model. The advantage of IFM-CAP compared to other models used for CAP impact

analysis (e.g. CAPRI, Britz and Witzke 2014) is its EU-wide geographical coverage that allows simulation of policy impacts across all EU farming systems and regions (Louhichi et al. 2017a; Louhichi et al. 2017b).

The IFM-CAP model is a static positive mathematical programming model, which builds on the FADN (Farm Accountancy Data Network) data, and is complemented by other relevant EU-wide data sources. IFM-CAP assumes that farmers maximise their expected utility at given yields, product prices and production subsidies, subject to resource (arable and grass land and feed) endowments and policy constraints such as CAP greening restrictions (Louhichi et al. 2017a). Farmers expected utility is defined following the mean-variance (E-V) approach (Markowitz, 2014) with a CARA (Constant Absolute Risk Aversion) specification (Pratt, 1964). According to this approach, expected utility is defined as expected income and the associated income variance. Effectively, it is assumed that farmers select a production plan which minimises the variance of income caused by a set of stochastic variables for a given expected income level (Hazell and Norton, 1986).

Farmer's expected income is defined as the sum of expected gross margins minus a non-linear (quadratic) activity-specific function. The gross margin is the total revenue including sales from agricultural products and direct payments (coupled and decoupled payments) minus the accounting variable costs of production activities. Total revenue is calculated using expected prices and yields assuming adaptive expectations (based on past three observations with declining weights). The accounting costs include costs of seeds, fertilisers and soil improvers, crop protection, feeding and other specific costs. The quadratic activity-specific function is a behavioural function introduced to calibrate the farm model to an observed base year situation, as usually done in positive programming models. This function intends to capture the effects of factors that are not explicitly included in the model, such as farmers' perceived costs of capital and labour, or model misspecifications (Paris and Howitt, 1998; De Frahan *et al.*, 2007; Heckelej, 2002).

Regarding the income variance, we opted for considering uncertainty in revenues, but without differentiating between sources of uncertainty (Arribas *et al.*, 2017).

IFM-CAP is calibrated for the base year 2012 using cross-sectional analysis (i.e. multiple observations) and Highest Posterior Density (HPD) approach with prior information on NUTS2<sup>6</sup> supply elasticities and dual values of resources (e.g. land rental prices). The calibration to the exogenous supply elasticities is performed in a non-myopic way, i.e., we take into account the effects of changing dual values on the simulation response (for more details see Louhichi et al. 2017a).

### **3.2. Data**

The primary data source used to parameterize IFM-CAP are individual farm-level data from the Farm Accountancy Data Network (FADN) database complemented by other external EU-wide data sources such as FSS, CAPRI database and Eurostat<sup>7</sup> (for more details see Louhichi et al. 2017a). The FADN is a

---

<sup>6</sup> NUTS2 refers to regions belonging to the second level of the Nomenclature of Territorial Units for Statistics of the European Union.

<sup>7</sup> Most of these external data are not directly used in the model, but used as an input (i.e. prior information) in the estimations.

European system of farm surveys that take place every year and collect structural and accountancy information on EU farms, such as farm structure and yield, output, inputs, costs, CAP subsidies, income, and financial indicators. The FADN data is unique in the sense that it is the only source of harmonized (the bookkeeping principles are the same across all EU Member States) and representative farm-level micro-economic data for the whole EU. Farms are selected to take part in the survey based on stratified sampling frames established for each EU region based on farm specialization and economic farm size. The FADN survey does not, however, cover all farms in the EU, but only those which are of a size allowing them to rank as commercial farms..

IFM-CAP uses as base year FADN for 2012. All farms represented in the 2012 FADN sample (83 292 farms) are included in the model. For each farm, the following variables are derived from FADN: levels (hectares or number of animal heads), yields, product prices for all crop and animal activities, available farmland (utilized agricultural area, arable land and grassland), rental prices and coupled and decoupled subsidies. However, in order to improve the model parameterisation, past observations (2007-2012) on yields, prices and input costs for these farms are also exploited.

Data on unit input costs of crops, animal feeding and sugar beet quota are not directly available in the FADN database, but are estimated based on FADN data combined with external data sources (for more details see Louhichi et al. 2017a).

#### **4. Scenarios**

We simulate two scenarios: a baseline (reference) scenario and the 2013 CAP reform scenario (also referred to as “policy scenario”). The baseline scenario assumes the pre-reform CAP. It defines the baseline development of the farming sectors and thus serves as a comparison point for the counterfactual comparison of the policy scenario.<sup>8</sup>

As IFM-CAP is a comparative static supply model that does not take into account the dynamics of market developments and market inter-linkages (price feedbacks), the baseline construction relies on an external baseline. In this paper, we use CAPRI projections for the year 2025 to construct the IFM-CAP baseline scenario. Similar to the assumption in IFM-CAP, CAPRI baseline projections are also based on the implementation of the pre-reform CAP. One important feature of the CAPRI baseline is that it is developed in conjunction with the European Commission (EC) baseline. The EC constructs medium-term projections for the agricultural commodity markets on an annual basis. The projections present a consistent set of market and sectoral income prospects elaborated on the basis of specific policy and macroeconomic assumptions (Himics, et al., 2013; Britz and Witzke, 2014).

Three assumptions are thus adopted: (i) a continuation of the previous CAP up to 2025; (ii) an assumed inflation rate of 1.9 % per year for input costs as in CAPRI baseline; and (iii) an adjustment of baseline prices and yields using growth rates from the CAPRI baseline. The regional yield growth attempts to capture both technical change and input intensification effects and the regional price growth represents nominal price projection. As the CAPRI growth rates of yields and prices are defined at NUTS2 level, we

---

<sup>8</sup> Note that the RDP payments are not considered .

impose the same growth rate on all farms belonging to the same NUTS2 region. All the other parameters (e.g. farm resource endowments and farm weighting factors) are assumed to remain unchanged up to 2025.

The baseline information on the pre-reform decoupled payments are based on the farm level FADN data for base year 2012. This allows us to capture the farm level heterogeneity of the pre-reform decoupled payments as determined by the implemented scheme in a given MS (Table 1). This is particularly important for MS that implemented historical or static hybrid SPS models in the pre-reform period where the hectare value of decoupled payments vary between farms within a region or MS, For the coupled support we consider the average unit payment per crop/livestock in each NUTS2 region calculated based on the 2012 FADN data. This assumption is applied to be able to generate the values of coupled support for alternative activities because they are not observed in the base-year. This approach of deriving the coupled support ensures a more homogenous treatment of observed and alternative activities.

The policy scenario considers the MS specific implementation of direct payments and the restrictions related to the greening measures. To obtain farm specific decoupled payments, the 2012 FADN base-year data were adjusted by considering their planned implementation in each MS in 2019<sup>9</sup> as summarized in Table 1. Data on VCS at regional level is collected from CAPRI database. Following the EU regulation, we assume full compliance of the three greening measures without allowing farmers to trade-off between income reductions with full compliance versus direct payment reduction as a consequence of a partial or full non-compliance. A more detailed description of the greening measures and how they are modeled in the IFM-CAP are described in Louhichi et al. (2017a). Finally, we consider the unitary values of coupled payments as planned to be implemented by MS in 2019..

## 5. Results

Before analyzing the results, it is important to recognize that the FADN is representative only for commercial farms. FADN is not representative for the whole agricultural sectors as many small non-commercial farms are not included in the FADN survey. As a result, the direct payments (coupled and decoupled) may be under- or over-represented in the baseline and in the policy scenario. In addition, in both scenarios the land allocation and the number of animals may change causing a modification in the total value of coupled subsidies aggregated at MS level potentially leading to their over or under-representation.

Table 2 reports under- or over-representation of the direct payments. The second and third columns show the actual national ceilings in 2013 (corresponding to the baseline) and in 2019 (corresponding to the policy scenario). The fourth column shows the change in direct payments between 2013 and 2019. According to these data, 16 MS experience a decrease in DPs, while in 10 MS they increase.<sup>10</sup> On aggregate in EU-27, the reform decreases direct payments by approximately 8%. This change of direct

---

<sup>9</sup> Note that 2019 is target year for achieving the internal (partial or full) convergence decoupled payments in MS which implemented historical SPS model in the pre-reform period.

<sup>10</sup> Belgium and Luxembourg are presented as the same MS

payments is due to the combination of three factors: the external convergence of the direct payments, the reallocation between direct payments and RDP, and the decrease in the overall CAP budget.

The last three columns in Table 2 report the difference between direct payments represented in IFM-CAP and their actual national ceilings for the baseline, the policy scenario and the difference between them. On average in EU-27, direct payments are under-represented in IFM-CAP by 11% in the baseline and by 3% in the policy scenario. These results are relatively heterogeneous across MS. A significant DP under-representation (more than 20%) in baseline is observed in Cyprus, Latvia and Malta and in the policy scenario in Malta, Portugal, Slovakia, Spain and UK. For the analysis of the simulated results important is the difference in the DP under/over representation between the baseline and the policy scenario. If in both scenarios the under/over representation is the same or similar then it has no implication for the simulated results. As Table 2 shows, the difference of DP under-representation between the baseline and policy scenarios is around -8% at EU-27 level implying that under-representation is stronger in the former than in the latter scenario. In most MS the difference is less than 15%. Only in France, Finland and Portugal this value is higher than 20%. In Greece and United Kingdom the difference is -17% and -19%, respectively.

This relatively sizable under-representation of DPs in IFM-CAP needs to be taken into account when interpreting the simulation results. A key cause of DP under representation is the fact that non-commercial farms are not included in IFM-CAP. Thus, the simulation results reported in this paper show how the commercial farms are affected by the 2013 CAP reform. In other words, our analysis is valid only for commercial farms. Other cause of the discrepancy between the actual and IFM-CAP direct payments is the under /over representation of certain activities in FADN. The stratification of the FADN sample is constructed based on farm typologies (production specialization and economic farm size) and region and not by production activity. This problem concerns mainly coupled payments because their allocation is linked to the level of specific crop area or animal numbers. This problem has implications for the aggregated values of DPs at MS or regional level in IFM-CAP. They may not be fully comparable between the baseline and the policy scenario if the under/over representation of direct payment is not accounted for. However, the distributional simulated effects at farm level are less susceptible to the under/over representation problem of certain activities in FADN.

#### *4.1 External and internal convergence of DPs*

Figure 1 presents the average direct payment per hectare by MS in the baseline and in the policy scenario. In the sample represented in IFM-CAP, the average DP is 257 Euro per hectare in baseline in EU-27 decreasing by 4.7% (to 245 Euro/ha) in the policy scenario. Twelve MS (mostly from OMS) register a reduction in the DPs, while fourteen MS (mostly from NMS) experience an increase in DPs. Actually, the 2013 CAP reform increases DPs in many MS with DPs below the EU average, whereas in most MS with DPs above the EU average they decrease. These results are in line with one of the main goals of the 2013 CAP reform to have a fairer distribution of DPs among MS (i.e. external convergence). However, as

Figure 1 shows the 2013 CAP reform did not succeed to fully eliminate differences in DPs between MS. Still a strong variation in DPs between MS persists after the reform; DPs vary between around 100 Euro/ha in Spain and Portugal and around 450 Euro/ha in Greece.

The fact that the value of DPs increase (decrease) in the policy scenario relative to baseline in some MS with the DP payment lower (higher) than the EU-average is explain by the larger (smaller) under (over)-representation of DPs in baseline compared to the policy scenario shown in Table 2. For example, according to the policy objective, the hectare value of DP should decrease in Greece due to CAP reform. However, because IFM-CAP under-represents DPs more in the baseline than in the policy scenario, the 2013 CAP reform increases the unit value of DP in Greece.

Another main aim of the 2013 CAP reform is the internal convergence of decoupled payments across farms within a region or MS. The box-plot in Figure 2 shows the distribution of the decoupled payments per-entitlement<sup>11</sup> across farms and by MS in baseline (panel a) and the policy scenario (panel b). The bottom line of each box represents the 25<sup>th</sup> percentile, the top the 75<sup>th</sup> percentile and the line in the middle represents the 50<sup>th</sup> percentile of farms. The whiskers represent the lowest observation within 1.5 Interquartile Range (IQR) of the lower quartile and the highest observation is within the 1.5 IQR of the upper quartile. The round points represent the mean of decoupled payments per entitlement.

It is important to note that in some MS (United Kingdom, Portugal), a small proportion of farms have very low unit value of decoupled payments which leads to a very low mean value in the baseline, but has little impact on the median. Second, the unit value of decoupled payments should be homogenous in baseline in MS applying SAPS. However, there are some variations as reflected in the box plot figure (especially in Cyprus and Latvia) (Figure 2, panel a). This is probably due to imprecision in farmers reporting when completing the FADN survey.

In line with expectations, Figure 2 shows that the implementation of the 2013 CAP reform leads towards a more uniform unit value of decoupled payments in almost all MS. The strongest effect is observed in OMS where decoupled payments were most heterogeneous between farms in the pre-reform period due to the application of (historical and static hybrid) SPS. MS that introduce full convergence of decoupled payments (flat rate) experience the largest convergence rate of decoupled payments (e.g. the Netherlands). The exceptions are Finland, United Kingdom and Germany where the flat rate is differentiated by regions. In addition, Germany applies the redistributive payment which introduces payment heterogeneity between small and large farms. In MS applying partial convergence, there is heterogeneity in the decoupled payments in the policy scenario, however, it is still less pronounced than under the pre-reform CAP (baseline). Further, the figure shows that, the CAP reform requirement that the value of payment entitlement cannot be lower than 60% of the MS average (or regional average depending on the implementation) reduces the number of farms with low payment value (i.e. it has a substantial effect on the distribution of the payments in the lower whisker of Figure 2, panel b).

In NMS the impact of the 2013 CAP reform on decoupled payment harmonization is smaller because most of them had homogenous payments (i.e. SAPS) already in the pre-reform period. In fact, in some

---

<sup>11</sup> In MS which implement SAPS the decoupled payments are calculated per total agricultural area because under SAPS there are no entitlements.

NMS decoupled payments become slightly more heterogeneous. Bulgaria, Romania and Lithuania apply the redistributive payment in the post-reform period which creates some heterogeneity in the decoupled payments among farms (i.e. between small and large farms) in the policy scenario (Figure 2).

In order to assess the overall distributional effects of the 2013 CAP reform for DPs, we represent the Lorenz Curve and estimate the corresponding Gini coefficients for both the baseline and the policy scenario (Figure 3). These curves show the cumulative proportion of direct payments received by farmers (y-axis) relative to the cumulative proportion of beneficiaries (x-axis). The 45 degree line (the dot line in Figure 3) represents a perfectly equitable distribution of DPs. The figure shows that DPs are relatively unequally distributed among the commercial farms in EU-27. Around 80% of farms receive approximately 21% of DPs in baseline. Or reversely, 20% of farms receive 79% of DPs in baseline. The 2013 CAP reform partially reduces this disparity in payments distribution. The Gini coefficient reduces from 0.581 in the baseline to around 0.561 in the policy scenario.

#### *4.2 Production effects*

The production effects are driven by changes in coupled payments and by the introduction of CAP greening. The decoupled payments are delinked from farm production decisions and hence the changes made by the 2013 CAP reform do not affect production levels in the policy scenario relative to baseline. The coupled payments are expected to have mixed impacts across farms and regions depending on the change in payment values. Production is expected to increase in regions where crop and animal sectors experience an increase in coupled payments. The reverse is valid in regions in which coupled payments are reduced in the CAP reform. The impact of the CAP greening is farm specific and it depends on baseline land allocation (i.e. it depends on the extend it is in breach with the greening requirements). In the case of the crop diversification measure, the production of crops that have a large land share in baseline will tend to decrease, whereas the production of crops with a low land share will tend to increase as a result of the diversification measure. The EFA measure is expected to stimulate production of eligible crops for this greening measure. The grassland measure is expected to have a negative impact on arable crop production and it may stimulate livestock production (Louhichi et al. 2017a). The overall impact of the 2013 CAP reform on production is a combined effect of the decoupled payments and CAP greening which implies a potential strong heterogeneity of the effects across farms and regions.

Figure 4 depicts aggregate production changes by sector for EU-27. The simulation results suggest that the 2013 CAP reform has relatively limited effects on production. At EU level, the reform will decrease the production of oilseeds (-1.04%), vegetables and permanent crops (-2.11%), cereals (-3.18%) and other arable field crops (-6.45%), whereas it will increase animal production (+0.74% meat; +0.35% other animal products) and fodder crop activities (+1.28%).

#### *4.2 Income effects<sup>12</sup>*

Although the production effects are rather limited, the new changes introduced in the DPs (particularly to decoupled payments) by the 2013 CAP reform may have important implications for European

---

<sup>12</sup> The income is calculated as the difference between total revenues (production sales and subsidies) and variable costs (e.g. expenditures on fertilizers, pesticides, seeds, feeding).

farmers' income. To provide a comprehensive analysis, we present the expected changes in income caused by the 2013 CAP reform at different levels – at MS level, by farm specialization and economic farm size and the distribution across farm population – in Figure 5, Figure 6, Table 3 and Table 4.

At EU-27 level, the results show that the potential decrease in income due to the implementation of the 2013 CAP reform is about -1.30%. The income effects are heterogeneous across MS. Consistent with subsidy changes, most NMS gain from the 2013 CAP reform which is driven by the external convergence of DPs between MS. (Figure 5, Table 3). The largest income gain is observed in Romania (14.6%), Lithuania (7.5%), Bulgaria (7.4%) and Poland (6.0%). The reform causes income loss in most MS with largest negative income change occurring in Finland (-7.8%), Portugal (-7.9%) and the Netherlands (-4.1%). Note that due to the under-representation of DPs in the baseline compared to the policy scenario (Table 2), the actual income decrease may be slightly larger than that one reported in Table 3 for EU-27. Due to the under/over representation of DPs, at MS level the actual income effects are likely more adverse than those reported in Table 3 in particular in France, United Kingdom, Greece, Italy, Latvia or Malta. Reversely, in Finland, Portugal, Spain, the Netherlands and Austria the actual income changes are likely more favourable than those reported in Table 3. In other MS the implication of the under/over representation of DPs is rather small.

By farm specialization, the most negatively affected farms in EU-27 are the *specialist in other field crops* (-6.68%) and *specialist in olives* (-3.60%), while farms specialized in *mixed livestock* (1.32%) and *specialist sheep and goats* (+2.27) will experience increases in their income (Table 4, panel b). In general, small farms benefit, while large farms lose from the 2013 CAP reform. Income in small farms with economic size between two and 15 thousands Euros increases between 1.9% and 18.4%. Income of large farms (larger than 100 thousands Euros) drops between 1.5% and 5%. Medium sized farms (between 15 and 100 thousands Euros) are less affected by the reform with their income change varying between -0.7% and 0.3% (Table 4, panel b).

Figure 6 shows the distribution of the per hectare income change in the policy scenario relative to baseline across all individual farms represented by FADN for EU-27 (i.e. the total number of farms in the EU-27 is equal to 100). This figure is constructed by sorting (on vertical axes), in increasing order, all the farms according to the size of the income change (shown on horizontal axes) until all farms (100%)<sup>13</sup> are reported. Approximately 60% of all farms gain, whereas the rest of farms (around 40%) lose income due to the 2013 CAP reform. This result is consistent with income effects reported by economic farm size in Table 4 (panel b) which showed that small farms tend to gain from the reform while large farms lose. Because small farms are disproportionately more in numbers than large farms, majority of farms (i.e. 60%) gain from the reform as displayed in Figure 6. Most of the adversely affected farms (20%) have an income decrease between 500 and 50 Euros per hectare. For most of the gaining farms (38%), the income increase is in an interval ranging from 50 to 500 Euros per hectare.

## 6. Conclusions

---

<sup>13</sup> Note that we apply FADN farm weights to represent farm population in the figure.

This paper presents the impact of the 2013 CAP reform on EU farming sector. The particular focus of this paper is the changes introduced to direct payments. The 2013 CAP reform provides a menu of possible options for implementing direct payments. Member States (MS) could choose the exact reform strategy from a pre-defined set of options leading to a large heterogeneity in implementation details between countries. We apply the IFM-CAP model in order to capture farm level effects of the 2013 CAP reform. The farm level detail of IFM-CAP is important because both the pre-reform and post-reform direct payments are farm specific in most MS.

From a policy perspective, the main finding of our paper is that in line with the policy objective, the 2013 CAP reform succeeded to partially harmonize DPs between MS. With some exceptions, the beneficiaries from the partial harmonization are mainly farms from NMS in detriment of farms from OMS. Despite the elimination of some disparities of DPs, still the 2013 CAP reform preserves a strong variation of DPs between MS varying between around 100 Euro/ha in Spain and Portugal and 450 Euro/ha in Greece.

An important intend of the reform is also the internal convergence of DPs within MS. The distribution of the payments in each MS (presented in the form of box-plot) show that there is a greater confluence of unitary value of decoupled payment.

At EU level as represented by the Gini coefficient, the 2013 CAP reform reduced the DPs inequality from 0.581 to 0.561. The inequality reduction is driven by changes introduced to decoupled payments. The 2013 CAP reform introduced more uniform distribution of decoupled payments between farms in most MS. The strongest effect is observed in OMS where decoupled payments were most heterogeneous between farms in the pre-reform period due to the application of SPS. MS that introduce full convergence of decoupled payments (flat rate) experience the largest convergence rate of decoupled payments. MS applying partial convergence of decoupled payments, the heterogeneity of decoupled payments is not eliminated by the reform, however, it is still less pronounced than under the pre-reform CAP. In NMS the impact of the 2013 CAP reform on decoupled payment harmonization is smaller because most of them had homogenous payments (i.e. SAPS) already in the pre-reform period. However, the possibility to apply the redistributive payment, it led to some heterogeneity of decoupled payments after the reform in some MS.

The impact of the 2013 CAP reform on farm income is rather limited at the aggregate EU level decreasing by 1.3%. The income change at MS level varies between -8% and 15%. At the individual farm level the income effects could be more pronounced. Overall, around 60% of farms loose, whereas the remaining 40% of farms gain from the reform in EU-27. The simulation results suggest that small farms benefit, while large farms lose from the 2013 CAP reform. Production is also not altered significantly by the 2013 CAP reform. The sectoral production changes in EU-27 vary between 1.3% and -6.5%. Again, at the individual farm level the production impacts could be more pronounced.

In light of these findings, results suggest that the next CAP reform should focus on one major issue. Despite the increase in the Gini coefficient and the fact that small economic size farms are clear winners from the 2013 CAP reform, it is still needed to reduce the inequality in the distribution of Direct Payments. This rebalancing could be achieved by imposing further convergence (the extreme would be

to introduce an EU-wide flat rate) restricting the coupled support or the capping direct payments when it exceeds a certain threshold.

These findings have to be considered, however, with some caution on account of the model's assumptions. First of all, the relatively sizable under-representation of DPs in IFM-CAP in baseline compared to the scenario needs to be taken into account when interpreting the simulation results. A second potential caveat in our analysis is that we do not consider all the specific eligibility criteria (eg maximum and minimum number of animals that could benefit from a specific coupled support in each farm) for the allocation of coupled subsidies. Indeed, these criteria are very heterogeneous even among European regions so that it is not straightforward to explicitly modelling them.

A careful analysis of each of these limitations is needed to test the robustness of these results and to provide a complete picture of the EU-wide impact of the 2013 CAP reform. Despite these limitations, this paper highlights the impacts of the 2013 CAP reform by providing finer farm level policy analysis at EU-wide scale and thus has strong potential to contribute to the policy debate on the efficacy of CAP in achieving its objectives.

## References

- Anania, G.; Pupo D'Andrea, M.R. (2015). The 2013 reform of the Common Agricultural Policy, in J. Swinnen (ed.), *The Political Economy of the 2014-2020 Common Agricultural Policy: An Imperfect Storm*, CEPS Paperback, Centre for European Policy Studies, Brussels.
- Arribas I., Louhichi K., Perni Á., Vila J., Gómez-y-Paloma S. (2017) Modelling Farmers' Behaviour Toward Risk in a Large Scale Positive Mathematical Programming (PMP) Model. In: Tsounis N., Vlachvei A. (eds) *Advances in Applied Economic Research*. Springer Proceedings in Business and Economics. Springer, Cham
- Britz, W., Witzke, H.P. (2014). CAPRI model documentation. Institute for Food and Resource Economics. University of Bonn. Retrieved February 8, 2016, [http://www.capri-model.org/dokuwiki/..%5Cdocs%5CCAPRI\\_documentation.pdf](http://www.capri-model.org/dokuwiki/..%5Cdocs%5CCAPRI_documentation.pdf).
- Espinosa, M., Louhichi, K. and S. Gomez y Paloma. (2017). Does the post-2013 CAP reduce the disparities in the distribution of decoupled payments across Europe? In: Mishra A., Viaggi D, Gomez y Paloma S.(eds). *Public Policy in Agriculture: Its Impact on Labor Supply and Household Income*. Routledge Press. Forthcoming
- EU (2013). Regulation No 1307/2013 of European Parliament and the Council Establishing Rules for Direct Payments to Farmers under Support Schemes within the Framework of the Common Agricultural Policy and Repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/2009. *Official Journal of the European Union* L 347/608.
- European Commission (2016). *Direct Payments: Basic Payment Scheme*. European Commission, Directorate for Agriculture and Rural Development (DG AGRI), Brussels.

- European Commission (2015). Direct payments post 2014 Decisions taken by MS by 1 August 2014 - State of play on 07.05.2015-, European Commission, DG Agriculture and Rural Development. [http://ec.europa.eu/agriculture/direct-support/direct-payments/docs/implementation-decisions-ms\\_en.pdf](http://ec.europa.eu/agriculture/direct-support/direct-payments/docs/implementation-decisions-ms_en.pdf)
- European Commission (2013). Overview of CAP Reform 2014–2020, Agricultural Policy Perspectives Brief No 5, December, European Commission, Brussels.
- European Parliament (2015). Implementation of the First Pillar of the CAP 2014 – 2020 in the EU Member States. Committee on Agriculture and Rural Development, European Parliament.
- European Parliament (2016), ‘First pillar of the common agricultural policy (CAP): II—Direct payments to farmers’, Fact sheets on the European Union, European Parliament.
- De Frahan, B., Buysse, J., Polomé, P., Fernagut, B., Harmignie, O., Lauwers, L., Van Huylenboreck, G. and Van Meensel, J. (2007). Positive Mathematical Programming for Agricultural and Environmental Policy Analysis: Review and Practice. In: Weintraub, A., Romero, C., Bjørndal, T., Epstein, R., Miranda, J., eds., Handbook of Operations Research in Natural Resources. International Series in Operations Research and Management Science 99(1): 129-154.
- Gocht, A., P. Ciaian, M. Bielza, J.M. Terres, N. Röder, M. Himics, G. Salputra (2017). "EU-wide Economic and Environmental Impacts of CAP Greening with High Spatial and Farm-type Detail." *Journal of Agricultural Economics*, Forthcoming.
- Hazell, P.B.R. and Norton, R.D. (1986). *Mathematical Programming for Economic Analysis in Agriculture*. MacMillan Publishing Company, New York.
- Heckelei, T. (2002). *Calibration and Estimation of Programming Models for Agricultural Supply Analysis*. Habilitationsschrift an der Landwirtschaftlichen Fakultät der Rheinischen Friedrich-Wilhelms-Universität, Bonn.
- Himics, M., Ciaian, P., Van Doorslaer, B., Salputra, G. (2013). Management guidelines for the CAPRI baseline. CAPRI-RD Deliverable D4.8.
- Louhichi, K., P. Ciaian, M. Espinosa, A. Perni and S. Gomez y Paloma (2017a). “Economic Impacts of CAP greening: An Application of an EU-wide Individual Farm Model for CAP Analysis (IFM-CAP).” *European Review of Agricultural Economics*, Forthcoming.
- Louhichi, K., P. Ciaian, M. Espinosa, A. Perni and S. Gomez y Paloma (2017b). “Does the crop diversification measure impact EU farmer's decisions?. An assessment using an Individual Farm Model for CAP analysis (IFM-CAP)” *Land Use Policy* 66: 250-264.
- Paris, Q., and Howitt, R.E. (1998). An Analysis of Ill-posed Production Problems Using Maximum Entropy. *American Journal of Agricultural Economics*, 80(1): 124-138.
- Markowitz, H. (2014) ‘Mean–variance approximations to expected utility’, *European Journal of Operational Research*, 234: 346–355.
- Solazzo, R. and Pierangeli F. (2016). "How does greening affect farm behaviour? Trade-off between commitments and sanctions in the Northern Italy." *Agricultural Systems* 149: 88–98.



Figure 1. The average direct payments by MS (EUR/ha)

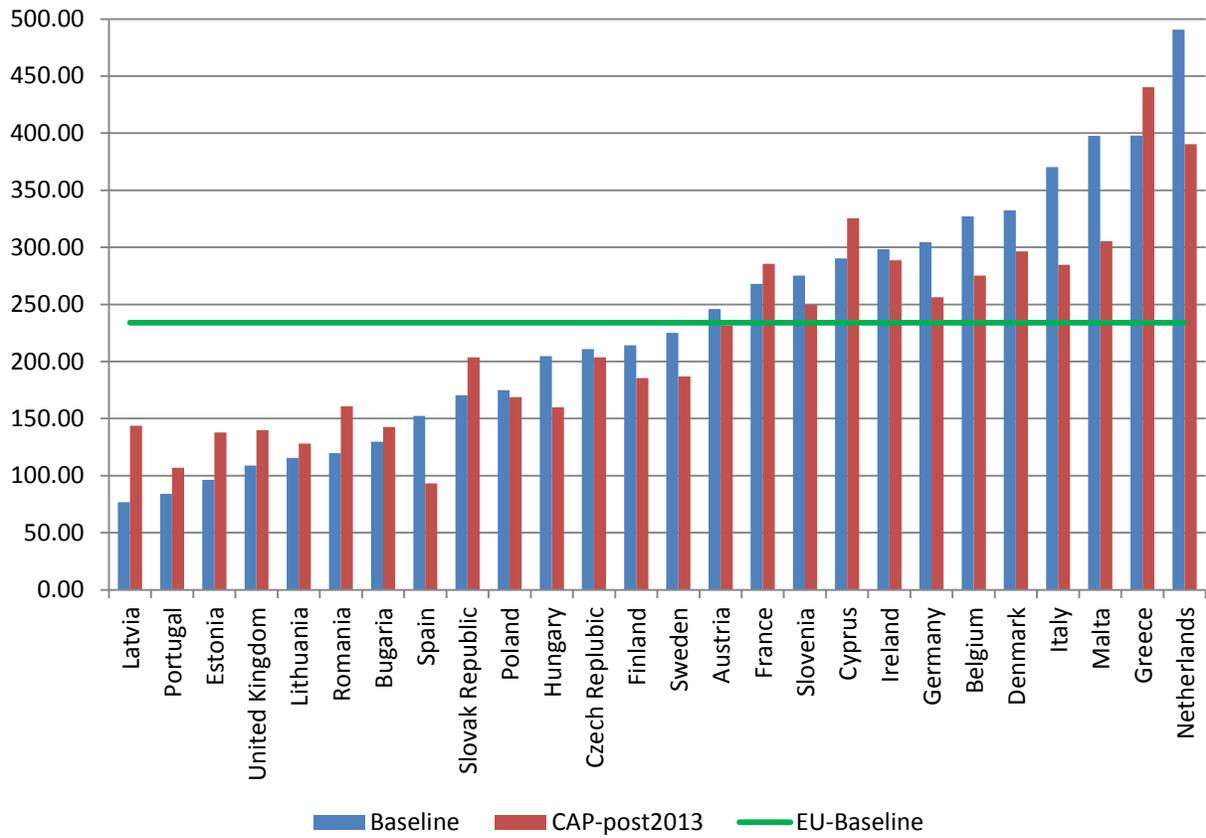
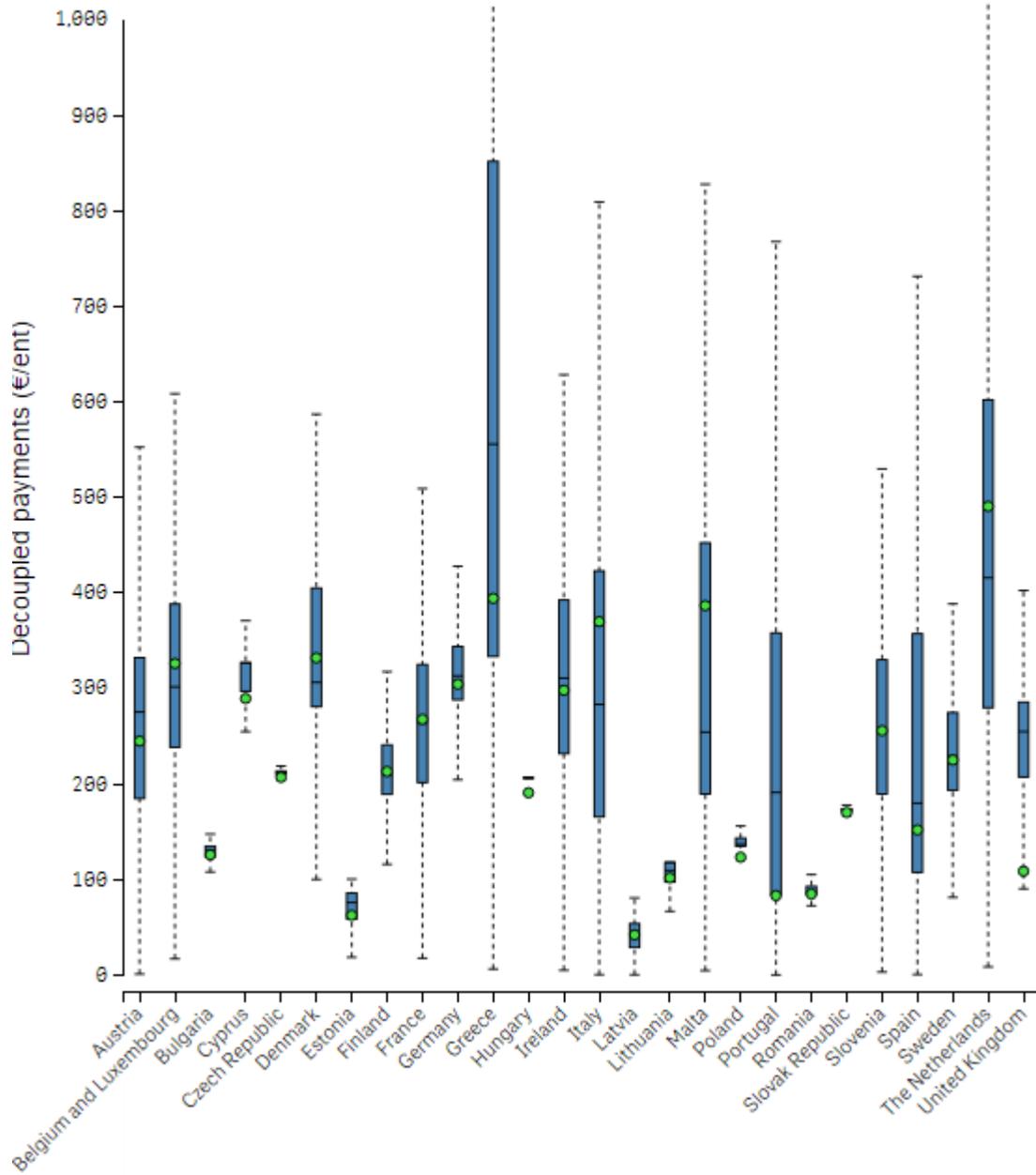


Figure 2. The distribution of the decoupled payments across farms and by MS(EUR/ha)

a) Baseline



**b) 2013 CAP reform scenario**

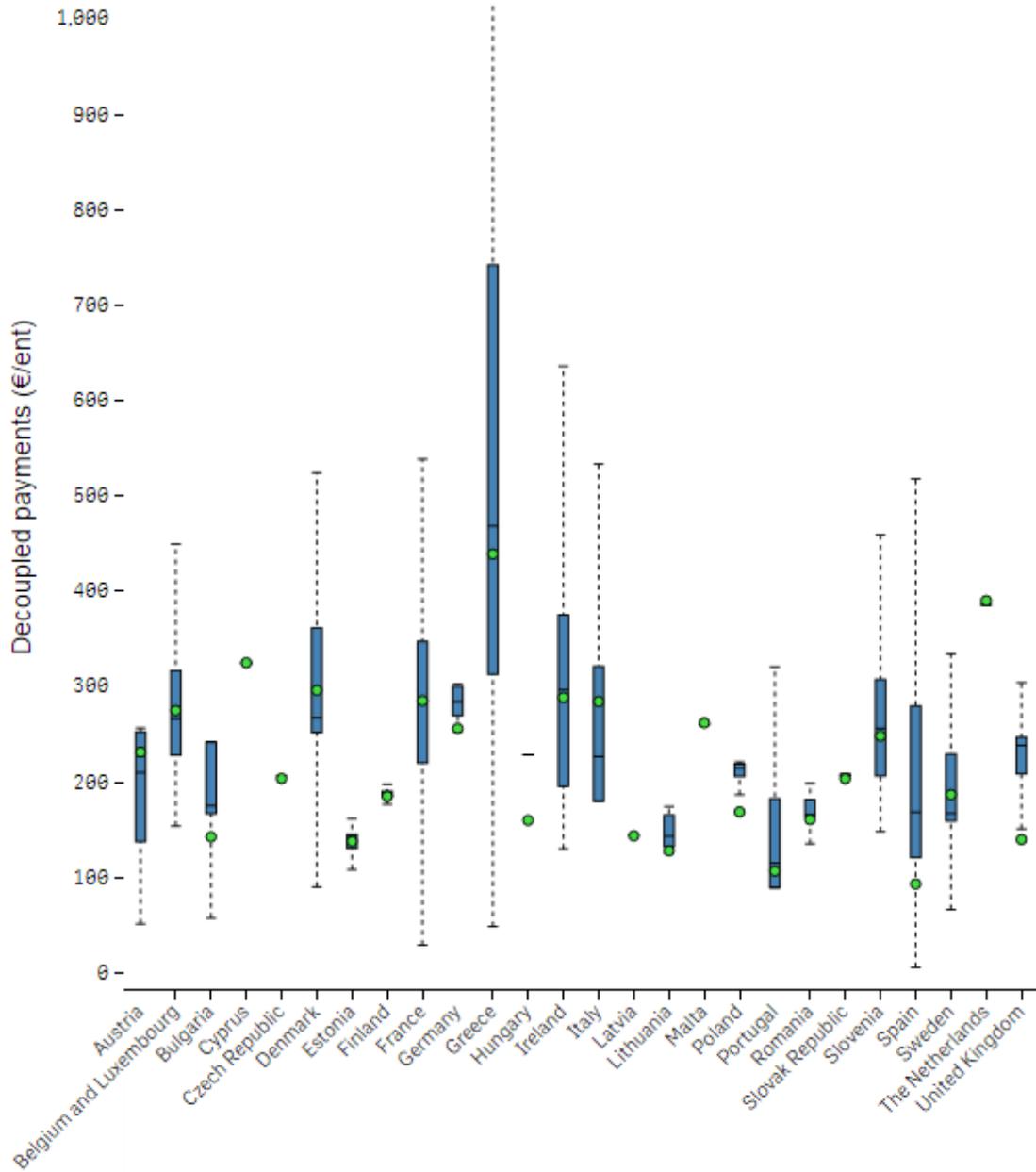
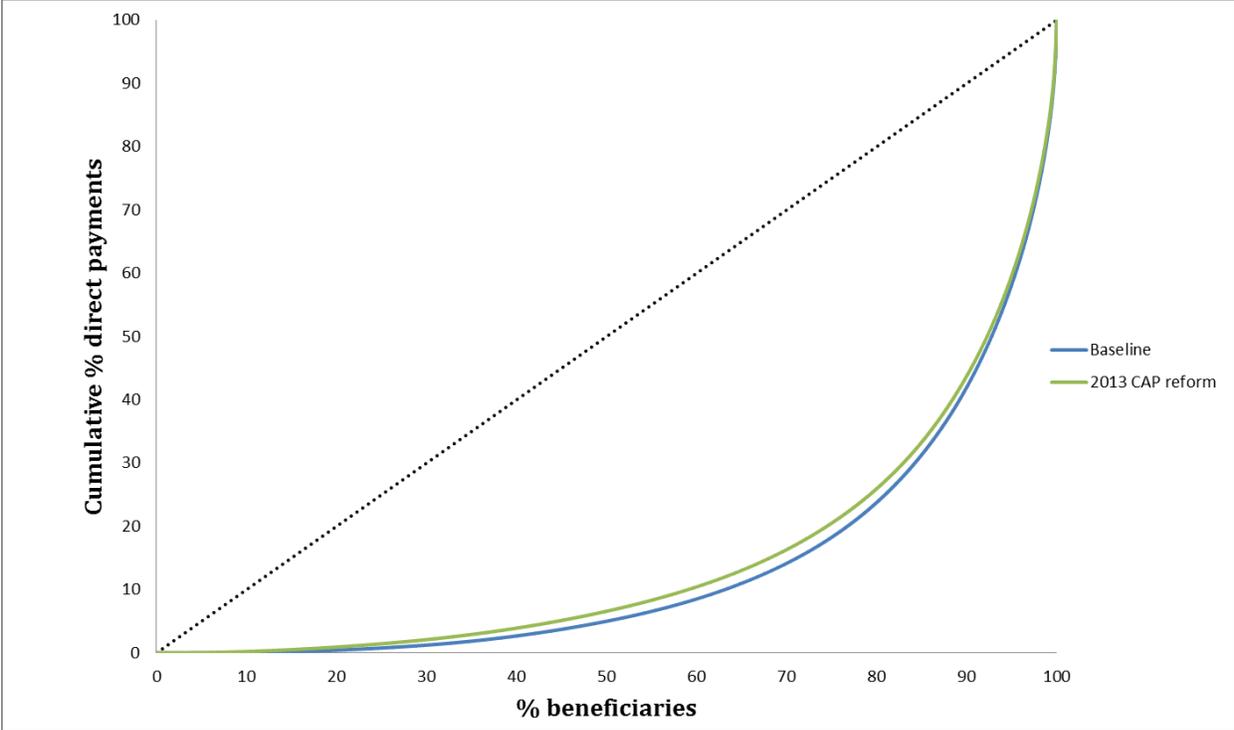


Figure 3. The curve Lorenz for direct payments in EU-27



**Figure 4. The impact of the 2013 CAP reform on production by sector in EU-27 (% change relative to baseline)**

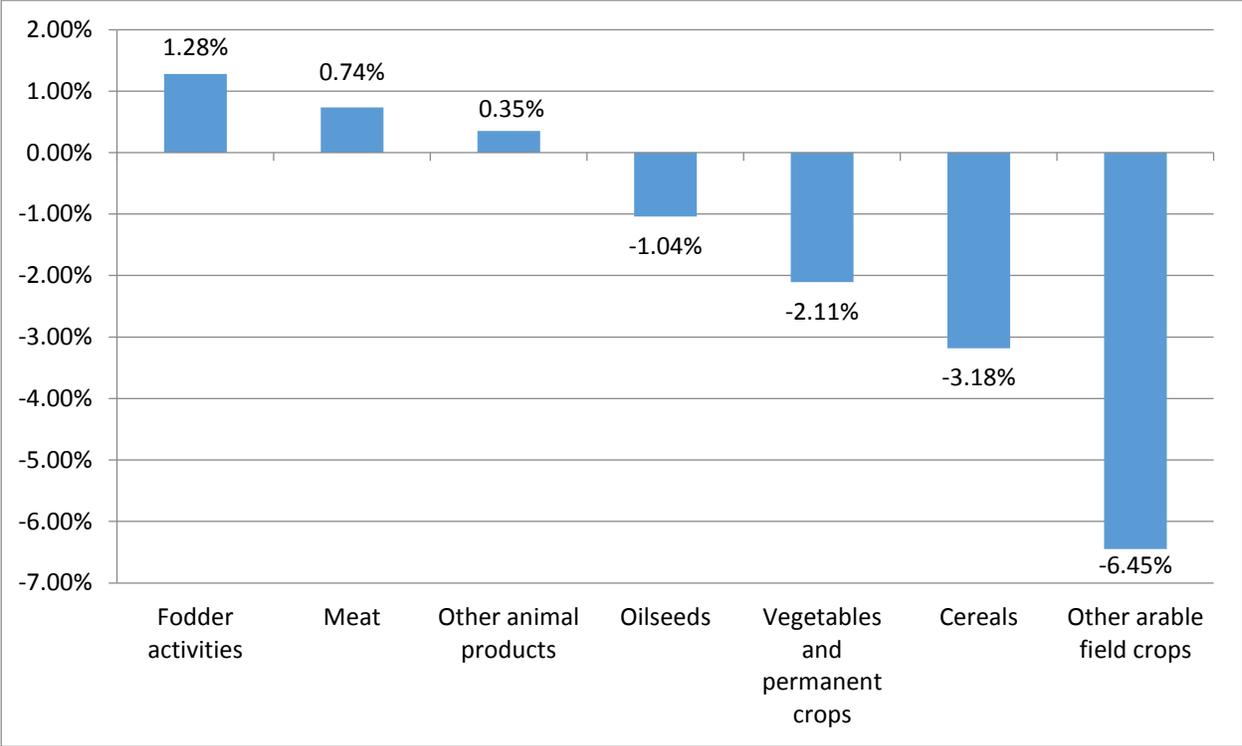


Figure 5. The impact of the 2013 CAP reform on farm income by MS (% change relative to baseline)

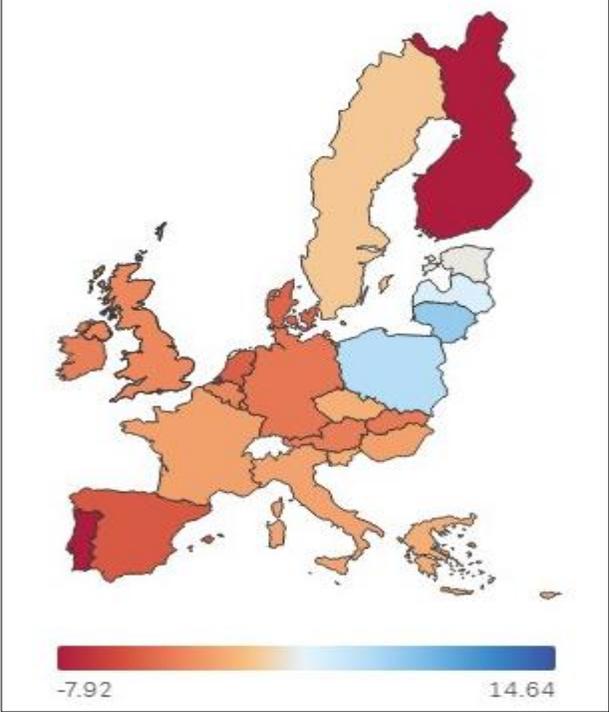
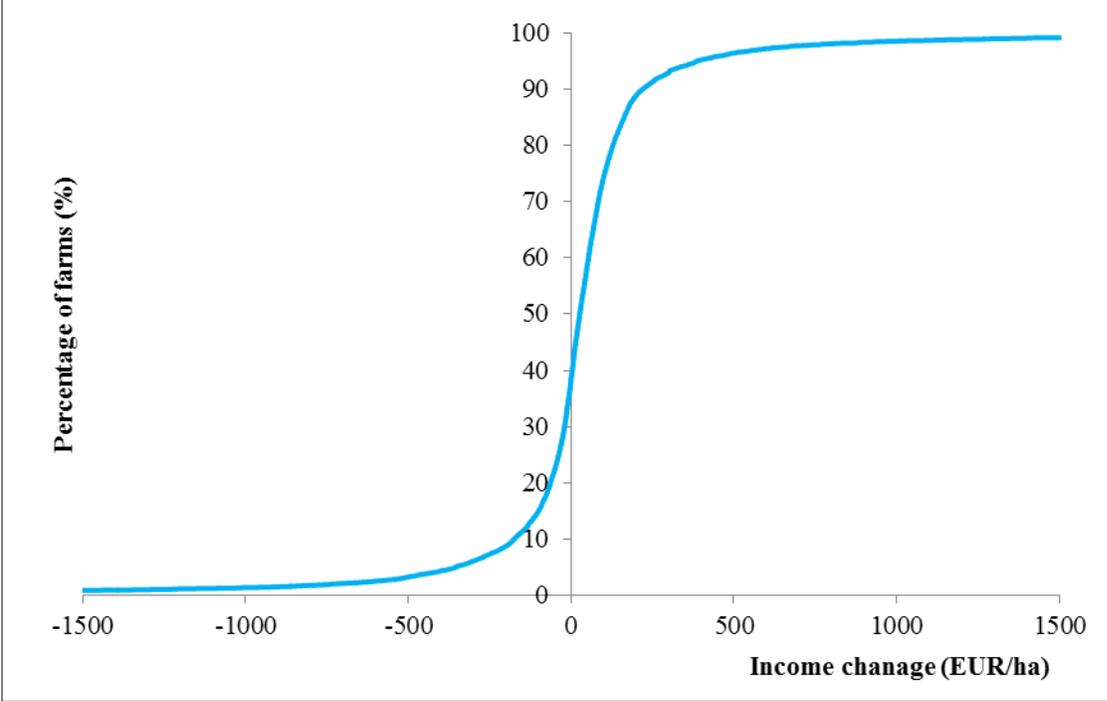


Figure 6. The distribution of the per hectare farm income change across farm population in EU-27



**Table 1. Implementation of decoupled payments by MS**

MS	Pre-reform model	Internal convergence			Redistributive payment			Capping		
		Model	% of decoupled payments	Territorial implementation	First hectares eligible (ha)	EUR/ha	% of decoupled payments	Thresholds (1000 EUR)	Reduction rate (%)	
Belgium	WL	HM	PC	29.9	NM	30	115	17	150	100
(BL)	FL	HM	PC	56.8	NM				150	5
Bulgaria (BG)		SAPS	SAPS	47		30	77	7	150/300	5/100
Czech Republic (CZ)		SAPS	SAPS	54.8					150	5
Denmark (DK)		SHYM	PC	65	NM				150	5
Germany (DE)		DHYM	FR2015	62.1	RM*	1-30 /30-46	50/30	6.9		
Estonia (ES)		SAPS	SAPS	65.3					150	5
Ireland (IR)		HM	PC	67.8	NM				150	100
Greece (EL)		HM	PC	60	RM				150	100
Spain (ES)		HM	PC	56	RM				150	100
France (FR)		HM	PC	34	RM	52	25	20		
Croatia (HR)		HM	PC	43	NM	20	34	10		
Italy (IT)		HM	PC	58	NM				150/500	50/100
Cyprus (CY)		SAPS	SAPS	61.1					150	5
Latvia (LV)		SAPS	SAPS	55.1					150	5
Lithuania (LT)		SAPS	SAPS	38.3		30	50	15		
Luxembourg (LU)		SHYM	PC	68	NM				150	5
Hungary (HU)		SAPS	SAPS	54.8					150/176	5/100
Malta (MT)		RM	FR2015	34	NM				150	5
Netherlands (NL)		HM	FR2019	67.5	NM				150	5
Austria (AT)		HM	FR2019	65.9	NM				150	100
Poland (PL)		SAPS	SAPS	46		0-3/3-30	0/41	8	150	100
Portugal (PT)		HM	PC	47	NM				150	5
Romania (RO)		SAPS	SAPS	51		0-5/5-30	5/45	5		
Slovenia (SI)		RM	PC	54	NM				150	5
Slovak Republic (SK)		SAPS	SAPS	56.4	NM				150	5
Finland (FI)		DHYM	FR2019	49	RM				150	5
Sweden (SE)		SHYM	PC	55.4					150	5
	NI	SHYM	PC	68	NM				150	100
United Kingdom (UK)	EN	DHYM	FR2015	68	RM				150	5
	SC	HM	FR2019	61.8	RM				150/600	5/100
	WA	HM	FR2019	68	NM	54	128		150/200/250/300	15/30/55/100

Source: European Commission (2015)

WL=Wallonia; FL=Flanders; NI=Northern Ireland;SC=Scotland; WA=Wales; HM= historical SPS model; SHYM: static hybrid SPS model; DHYM: dynamic hybrid SPS model; RM: regional SPS model; PC=Partial Convergence; FR2015=Flat Rate by 2015; FR2019=Flat rate by 2019; SAPS=Single Area Payment Scheme; NM=National Model; RM=Regional Model. \*In Germany the regional model will change to a national one in 2019.

**Table 2. Comparison of national ceilings and IFM-CAP Direct Payments in baseline and policy scenario**

MS	National ceilings			IFM-CAP comparison		
	2013 (1000 EUR)	2019 (1000 EUR)	% change	Baseline (% change to 2013 ceilings)	Policy scenario (% change to 2019 ceilings)	Difference between baseline and policy scenario (%)
Austria	751606	691738	-8.0	-4.7	-14.3	9.6
Belgium	651939	515289	-21.0	-5.2	-3.6	-1.6
Bulgaria	580087	796292	37.3	-3.3	-2.5	-0.8
Cyprus	53499	48643	-9.1	-43.3	-35.5	-7.8
Czech R.	909313	861698	-5.2	-17.7	-6.0	-11.7
Denmark	1049002	818757	-21.9	11.8	6.2	5.6
Estonia	101165	143966	42.3	-2.1	-2.9	0.7
Finland	570548	524631	-8.0	14.7	-14.1	28.9
France	8521236	7189541	-15.6	-13.5	16.5	-30.0
Germany	5852908	4792567	-18.1	-11.3	-6.7	-4.6
Greece	2216533	1834618	-17.2	-18.2	-1.2	-17.0
Hungary	1318975	1342867	1.8	-7.2	-10.9	3.7
Ireland	1340869	1211066	-9.7	-6.3	-2.7	-3.5
Italy	4370024	3704337	-15.2	-6.1	7.9	-14.1
Latvia	146479	280154	91.3	-24.3	-10.9	-13.4
Lithuania	380109	517028	36.0	-16.4	-14.8	-1.6
Malta	5102	5244	2.8	-36.8	-23.7	-13.1
Poland	3044518	3450512	13.3	-17.6	-5.8	-11.8
Portugal	605962	599355	-1.1	-8.8	-31.5	22.7
Romania	1264472	1903195	50.5	4.3	6.7	-2.4
Slovakia	388176	451659	16.4	21.1	7.9	13.2
Slovenia	144236	134278	-6.9	-8.0	1.5	-9.5
Spain	5139444	4893433	-4.8	-12.8	-25.6	12.7
Sweden	770906	699768	-9.2	-15.7	-10.9	-4.9
Netherlands	897751	897751	0.0	-7.9	-19.3	11.3
United Kingdom	3987922	3205243	-19.6	-23.8	-4.4	-19.4
<b>EU-27</b>	<b>45062781</b>	<b>41513630</b>	<b>-7.9</b>	<b>-11.3</b>	<b>-3.0</b>	<b>-8.3</b>

Source: National ceilings are extracted from Regulations 73/2009 and 1307/2013; IFM-CAP comparison is calculated by comparing direct payments in IFM-CAP model and the national ceilings.

**Table 3. The impact of the 2013 CAP reform on farm income by MS (% change relative to baseline)**

Member State	Income change (%)
Austria (AT)	-2.63
Belgium and Luxembourg (BL)	-2.32
Bulgaria (BG)	7.43
Cyprus (CY)	-0.55
Czech Republic (CZ)	-0.15
Denmark (DK)	-3.84
Estonia (EE)	2.73
Finland (FI)	-7.82
France (FR)	-0.96
Germany (DE)	-2.99
Greece (EL)	-0.21
Hungary (HU)	-0.89
Ireland (IR)	-2.61
Italy (IT)	-0.78
Latvia (LV)	3.93
Lithuania (LT)	7.49
Malta (MT)	0.76
Poland (PO)	6.04
Portugal (PT)	-7.92
Romania (RO)	14.64
Slovak Republic (SK)	-2.78
Slovenia (SV)	-0.28
Spain (ES)	-4.43
Sweden (SE)	1.06
The Netherlands (NL)	-4.09
United Kingdom (UK)	-2.19
EU-28	-1.31

**Table 4. The impact of the 2013 CAP reform on farm income by farm type in EU-27 (% change relative to baseline)**

**a) Farm specialization**

Farm Specialization	Income change (%)	Std. Dev.
Mixed crops	-1.00	0.08
Mixed crops and livestock	-2.08	0.13
Mixed livestock	1.32	0.11
Permanent crops combined	0.18	1.98
Specialist cattle	-1.47	0.62
Specialist COP	-0.13	0.08
Specialist granivores	-1.34	0.25
Specialist horticulture	-2.32	0.06
Specialist milk	0.39	0.07
Specialist olives	-3.60	0.05
Specialist orchards - fruits	0.67	0.06
Specialist other field crops	-6.86	0.08
Specialist sheep and goats	2.27	0.49
Specialist wine	1.03	0.05

**b) Economic farm size**

Farm Size (in thousands €)	Income change (%)	Std. Dev.
2 - < 4	18.39	0.17
4 - < 8	7.75	0.10
8 - < 15	1.93	0.08
15 - < 25	-0.38	0.12
25 - < 50	0.30	0.10
50 - < 100	-0.72	0.10
100 - < 250	-2.06	0.05
250 - < 500	-2.45	0.06
500 - < 750	-1.48	0.04
750 - < 1 000	-1.69	0.05
1 000 - < 1 500	-2.24	0.06
1 500 - < 3 000	-4.86	0.06
>= 3 000	-4.14	0.07