Cap towards 2020 and the cost of political choices: The case of Emilia-romagna region

CAP TOWARDS 2020 AND THE COST OF POLITICAL CHOICES: THE CASE OF EMILIA-ROMAGNA REGION

Abstract

The paper assesses the different schemes of regionalisation and greening implementation according to both the preliminary proposals presented to the Trilogue and the CAP Reform adopted on 16 December 2013. The objective is to compare the different potential impacts on production (land use) and on the economic revenue of farm holders in the Emilia-Romagna region (Italy). The assessment is performed by a regional Positive Mathematical Programming (PMP) model and is carried out for single farms appearing in the Farm Accountancy Data Network (FADN) data. Sampling weights are used to make the simulation results consistent with the production structure of the region. The findings confirm a big weakening in what would have been the impact of the Commission's proposal. In terms of lower gross margin incurred by farmers for fulfilling the greening requirements in the final CAP scenario, the model estimates a reduction corresponding to 20 €/ha. The greatest economic effects of the new CAP appear to be mainly due to the redistribution of direct payments.

Keywords: CAP reform, Regionalisation, Internal convergence, Greening, Positive Mathematical Programming (PMP)

JEL Classification codes: C61, Q12, Q18

1. Introduction

Following a first reading agreement with the European Parliament, the Council of EU Agriculture Ministers formally adopted the Common Agriculture Policy (CAP) reform package on 16 December 2013. The package sets out the rules for the implementation of the First Pillar for European farms in the next seven-year period. The new CAP is characterized by a high level of flexibility that allows Member States (MSs) to calibrate CAP measures in relation to their specific objectives. The effects of the new reform at territorial and sector level may, therefore, differ according to decisions taken by each Member State on matters such as the criteria of

regionalization, convergence[1] of direct payments and implementation of greening measures. The European Commission adopted the first packages of delegated acts and implementing acts of CAP Reform between March and June 2014. The packages support the four basic acts adopted in 2013 by the European Parliament and the Council, and allow Member States to draft national legislation for implementation of the new Common Agricultural Policy.

The CAP reform should not be considered as simply a "continuation" of the old policy; it in fact provides new policy tools appropriate for the challenges of European society today. The main challenges are to improve the sustainability of the agricultural sector, and various levels of action have been identified; economic (including food security), environmental (relating to resource efficiency, soil and water quality and threats to habitats and biodiversity) and territorial. Since the role of the CAP is to provide a policy framework that supports and encourages producers to address these challenges while remaining coherent with other EU policies, this translates into three long-term CAP objectives: viable food production, sustainable management of natural resources and climate action and balanced territorial development (European Commission, 2013a).

Since publication of Regulation (EU) 1307/2013, the lengthy debate in academic and farming circles on how best to pursue these objectives has been replaced by preliminary assessments of the new CAP which consider the economic and environmental implications for farm competitiveness at regional level. The new CAP in fact represents a compromise between members of the Trilogue (the European Commission, the European Parliament and the Council) and it establishes political mechanisms which will regulate farm subsidies and affect farmer behavior for the next seven years. Highest levels of concern regard the rules on the Green Direct Payment (greening) because of their potential impact on farm production strategies and environmental performance. While Single Farm Payments (SFP) do not directly influence production choices, greening measures force farmers to take production decisions on land allocation and sustainable production methods on the basis of costs and market dynamics. For individual farms, making production decisions considering farm structure and local markets dynamics is a sensitive issue. The Commission itself recognizes the difficulty of representing the effects of greening for the different types of farms across different farming areas of Europe (Langrell and Vard, 2013).

The scientific community has developed several models to assessing the economic impacts of environmental measures included in the CAP at regional level (Jayet et al., 1992; Jayet, 2012; Lacroix and Thomas 2011; Godard et all, 2005; Laouhichi et al., 2010; Röhm and Dabbert, 2003; Zimmerman and Heckelei, 2009).

[1] Reg. EU No. 1307/2013 (Art. 25) establishes that each Member State shall calculate the unit value of payment entitlements by dividing a fixed percentage of the national ceiling by the number of payments at national or regional level (regionalization) and each current farm payment will be adjusted progressively to reach a uniform level for all farms in a given region in 2019 (internal convergence).

Usually, the analysis of the agri-environmental measures are based on aggregated data at the expense of important information regarding farm characteristics (Hazell and Norton, 1986; Peerlings and Polman, 2008; Efstratoglou et al., 2011). The methodology more used to represent in a detailed manner the farm characteristics (i.e. economic objective, resource availability, production set and activity constraints) is the mathematical programming (Paris, 2011). The main limitation of applying this approach at a regional level is that for evaluating the responses of a wide group of farms towards new market and policy scenarios, a huge amount of information is needed, such as all the specific information about the agronomic and resource relationships that distinguish each farming system. Therefore, reasons of cost, timing and information availability make difficult the use of this approach for individual evaluation, requiring researchers to opt for more aggregated models and sacrifice the analysis realism (Topp and Mitchell, 2003; Acs et al., 2008; Arfini et al., 2013). At the same time, the concerns about the effectiveness of the agricultural policies and their ability to reach the expected objectives have boosted the demand by policy makers for economic tools addressed to in-depth regional ex-ante and ex-post analysis (Arfini, 2005).

During the last decade, the most relevant methodology for evaluating the effects of the CAP instruments on the dynamics of the agricultural activities and farm economic variables, both for ex-post and ex-ante analysis, is the Positive Mathematical Programming (PMP) (Heckelei et al., 2012; Paris and Howitt, 1998). The main contribution of this methodology to agricultural economics is due to its capacity to use, at the greatest level of extent (i.e. detail) the information included in the agricultural statistical data. This methodology can provide clear, understandable and, thus, useful results to policy makers responding to a large spectrum of policy analysis needs. Thanks to its capacity to reproduce the farmer's behavior, PMP can be applied also in contexts poor of information, as usually happen with agricultural database, without the need to know all the farming system specificities.

This paper focuses on the effect of three different CAP rules on farm decision outcomes in land allocation: i) "convergence", ii) "regionalisation" of direct payments and iii) three greening obligations set out by the reform proposals as: crop diversification, maintenance of permanent grassland and establishment of the Ecological Focus Areas (EFA). In order to compare the different potential impacts on production (land use) and economic wellbeing on farms located in the plain of Emilia-Romagna region (Italy), the paper evaluates different hypotheses of convergence of direct payments and greening implementation according to both the preliminary proposals elaborated separately by Commission, Council and Parliament, and the CAP Reform approved by the Council. The assessment of the CAP reform post-2013 is made by a model based on PMP. The farms covered by the assessment exercise appear in the Italian FADN database 2011, the evaluation is carried out at farm level and regional representativeness is achieved using the FADN weighting

system. The PMP model provides a wide set of information on the modification of land use and the effects on the farm economic variables, which will help policy makers and stakeholders understand the dynamics introduced by the revision of the current CAP mechanisms.

2. Direct payments and greening in the CAP Post-2013

Key strategic objectives of the new CAP are sustainable food production, balanced territorial development, crop diversification and the sustainable management of resources. The objective is to ensure the production of public goods and counter the effects of climate change (Hart and Little, 2012; Matthews, 2012). Direct payments continue to be the main support instrument for EU farms and the Commission has opted for the regionalisation and internal convergence of direct payments (EC, 2011a) in order to make the distribution of funds between Member States and between regions and farms more fair and equitable.

Unlike the Commission proposal, both the Council and Parliament stressed that Member States should be allowed to differentiate the unit value of payment entitlements even after 2019, taking historical factors into account. However, in the Trilogue negotiation, this possibility was subject to the constraints that no payment entitlements in 2019 have a value lower than 60% of the average value. Moreover, during the Trilogue, it was proposed an internal convergence mechanism similar to the external convergence between Member States (Irish model): farmers with payments below 90% of the national average payment per hectare will have their payments raised by at least one third of the difference between their current payment and 90% of the national average by 2019, with a minimum payment of 60% of the national average per hectare by 2019. Another derogation from the Parliament and Council, introduced in the final agreement, concerns the differentiation for green payment as a share of the basic payment. Therefore, the application of the convergence of direct payments has become much more flexible in the final agreement compared to the Commission proposal (Appendix A).

In the final regulation those Member States that currently maintain allocations based on historic references may choose from different options: according to the regionalisation criteria chosen they may take a national or a regional approach, and they can choose between achieving a regional/national rate by 2019, or applying the Irish model convergence. The amounts available to farmers receiving more than the regional/national average will be adjusted proportionally, with an option for Member States to limit any "losses" to 30% (EC, 2013b).

The effects of redistribution depend on the criteria used to define “homogeneous regions” and the method of convergence. The regionalisation process may be based on existing “administrative regions” or other territorial divisions taking into account objective criteria such as altitude, agrarian

regions or intensity of production. A further possibility, chosen by Italy, is to consider the whole country as a single region. With regard to the convergence of direct payments, Italy has opted for partial convergence based on the Irish model. Italy will also apply by 2019 the optional maximum 30% loss on convergence compared with the initial unit value established in 2015. Among other Member States with current allocations based on historic references, also Belgium, Greece, Spain, Luxembourg and Portugal have chosen the same convergence mechanism of Italy (Irish model and maximum 30% loss). France and Ireland have chosen different criteria of partial convergence while Austria, Netherlands and UK have opted for the flat rate in 2019 (in 2021 for Northern Ireland). Most of these countries have chosen, as Italy, to apply the regionalization at national level (single region) while Greece, Spain, France and UK have opted for the regional application (Copa-Cogeca, 2015).

In the CAP Reform, direct payments comprise different components, mainly basic payments such as direct support for farmer income and green payments. In order to finance the green payments, Member States will use 30% of their annual national ceilings. Indeed the European Commission has emphasized the growing need for green agriculture, which guarantees the conservation of biodiversity, the maintenance of soil fertility and the conservation of water resources and is also buffering agent against climate change (European Commission 2013b, Council of the EU 2013a and 2013b). The greening measures are to be applied from January 2015 by farmers entitled to receive the basic payment, with the exception of units of the holding used for organic production, entitled *ipso facto* to the green payment. Italy has chosen to apply the greening payment as a percentage of the total value of the payment entitlements (individual greening), rather than a flat rate[2]. Also the other MSs with current allocations based on historic references have chosen to apply the individual greening, except for Luxembourg which has opted for flat rate.

The Commission's proposal was in part accepted in the final reform, which contains greening measures in four articles (EP and Council of the EU, 2013). Article 43 lays down the general rules and criteria for receiving green payments. The next three articles set out in detail the obligations related to the greening measures: Article 44 covers diversification of production for improvement of biodiversity; Article 45 covers the maintenance of permanent grasslands and Article 46 the definition of Ecological Focus Areas (EFA).

Greening was one of the major areas of discussion between the Commission, the Parliament and the Council (Matthews, 2013).

With reference to the exclusion criteria, the CAP reform includes a "greening equivalence" system for environmentally friendly farming practices that yield an equivalent level of benefit for

2 For farmers not meeting greening requirements, penalties are set. These penalties could reach 100% of the "greening" payment in 2015 and 2016 and they will increase to 120% (2017) and 125% (2018).

the environment compared to the greening measures. Regarding crop diversification the CAP reform sets, as proposed by the amendments of Parliament and Council, the application threshold of 10 ha and the percentages of the main crop as 75% and 95% (two main crops). Exemption criteria were also based on Parliament and Council proposals, so that farms with over 75% permanent grassland or fodder (as well as underwater crops), where the remaining arable area did not exceed 30 ha, are exempted. With regard to permanent grassland, in the final regulation, the ratio of areas of permanent grassland over the total agricultural area (at the national, regional or farm level) must not fall by more than 5%. In line with the amendments proposed by Parliament and Council, the CAP reform establishes the EFA at 5%[3] level for farm over 15 ha of arable crops with the exemption, as for diversification, of farms specialised in grassland, fodder or underwater crops.

The final document of the Trilogue is clearly a political compromise. Our research therefore sets out to investigate the extent of this compromise and measure differences between the proposals made by the different European Institutions.

3. Methodology and data

Many authors have evaluated the impact of the past CAP reforms on farmer behaviour with the aim of identifying the relationship between the level of public support and the farm production responses (Chakir et al., 2007; Arfini, 2005; Judez et al. 2001; Buysse et al., 2007a; Blanco et al., 2008; Lansink and Peerlings, 1996; Viaggi et al., 2011). The impact of agri-environmental measures on farm decisions has however been less thoroughly investigated, and mainly through the application of mathematical programming techniques (Arfini and Donati, 2013; Czekaj et al., 2013; Galko and Jayet, 2011; Louhichi et al., 2010; Janssen et al., 2010; Buysse et al., 2007b; Röhm and Dabbert, 2003) and econometrics (Schulz et al., 2014; Espinoza-Godet et al., 2010; Kleinhanss et. al., 2007; Reinhard et al., 1999; Bonnieux et al., 1998).

The assessment of the policy proposals and the final CAP reform at regional level is based on a sample of 460 farms located in the lowland area of Emilia-Romagna. This is one of the most specialized agricultural areas of northern Italy, and is thus representative of the intensive agricultural model common to all regions of northern Italy. It is the site of many of the agricultural and environmental problems that EU agricultural reform aims to replace with a more sustainable financial and environmental model. Data for Emilia-Romagna were collected from the Italian Farm Accountancy Data Network (FADN) for the accounting year 2011 and describe the following variables: land use, yield, output prices and variable costs per activity at farm level. FADN is an annual survey established in 1965 by EU Council (Council Regulation 79/65/EEC) aims to collect

[3] It also allows for raising the percentage to 7% after assessment by the Commission and subsequent codecision by the Parliament and Council.

wide economic and technical information on EU farms for evaluating the effects of the agricultural policies on the EU agriculture. The data, collected by each EU Member State from its own farm sample following the criteria fixed by the Council Regulation (EC) No. 1217/2009, flows into an harmonized EU database held by the Directorate General of Agriculture at European Commission. FADN provides the weights associated to each sampled farm allowing the inference to the universe. According to the FADN weighting system, the Emilia-Romagna sample considered in this study represents 31,310 farms. Unlike the European FADN, the Italian dataset provides also information about specific variable costs per activity. Data on CAP payments was extracted in order to estimate the internal convergence of direct payments while other descriptive variables on farm status (e.g. organic or conventional farming) were used to identify greening requirements and exclusions. Policy assessment was carried out at farm level (for each farm holder) and weighted by the FADN weighting system in order to infer at regional level and make the simulation results more consistent with farm typologies and agricultural production systems of the area (Solazzo et al., 2014; Council of the EU, 2009a).

Methodologically, the impact of different policy scenarios was evaluated using a model based on Positive Mathematical Programming (PMP) (Howitt, 1995; Paris and Howitt, 1998; Paris and Arfini, 2000). PMP has proved effective in assessing the impact of agricultural policy at both national and European level (Arfini and Donati, 2011; Heckelei et al., 2012).

The PMP model applied in this study is a farm model, in the sense that the infeed statistical data and the model outcomes are both farm-specific. The farm-level assessment is particular relevant since the CAP constraints modify the individual behavior. The greening measures and the payment redistribution may affect in a very different way similar farms that are located in the same geographical area. Original farm data aggregation would have decreased the realism of the simulations, because we would have applied the model on theoretic farms losing the major benefit of FADN, i.e. the representation of the European farm diversity. Most of the PMP models adopted to assess CAP reforms are used with an aggregated data structure (Heckelei et al., 2012). Recently, Waş et al. (2014) proposed an optimization model expanded with a non-linear cost function from the original Howitt's PMP approach was used in order to shows the impact of greening on Polish farms. In this respect, to capture appropriate exogenous market effects, the authors used a model based on CAPRI (Gocht and Britz, 2011) with aggregated input data. An attempt to use the FADN information at the maximum level of detail to evaluate the greening effect in Netherland is provided by the analysis of Boere and van Kooten (2015), where representative individual FADN farms are part of a crop allocation model calibrated using PMP. As stated above, we decided therefore to implement a model able to evaluate the impact of the greening mechanisms (exclusion criteria

included) and the payment convergence farm-by-farm for getting the most realistic picture of the new CAP effects on the Italian farms.

In this research the PMP model covered two sets of activities for all farms: realized activities *r* (for *r=1,2,…,R*) and latent activities *l* (for *l=1,2,…,L*). Latent activities are processes present in the sample because at least one farm production plan includes them. Even where they are not actually activated, they are processes which can be considered as components of the production possibilities (Donati and Arfini, 2013).

The model, for each farm, assumes that $\mathbf{x}_r$ is the vector of the realized output quantities and $\mathbf{x}_l$ the vector of latent output quantities.

The first PMP phase maximizes the gross margin (GM) for all the single farms as follows:

$$\max_{\mathbf{x}_r \geq 0, \mathbf{x}_l \geq 0} GM = (\mathbf{p}_r - \mathbf{c}_r)'\mathbf{x}_r + (\mathbf{p}_l - \mathbf{c}_l)'\mathbf{x}_l \qquad (1)$$

where $\mathbf{p}_r$ and $\mathbf{p}_l$ represent the vectors of actual output prices and latent output prices respectively, while, $\mathbf{c}_r$ and $\mathbf{c}_l$ the vectors of the exogenous specific costs (from the Italian FADN) for both realized and latent activities. The objective function (1) is subject to the following constraints:

$$\mathbf{A}_r\mathbf{x}_r + \mathbf{A}_l\mathbf{x}_l \leq \mathbf{b} \quad (\mathbf{y}) \qquad (2)$$

$$\mathbf{x}_r \leq \bar{\mathbf{x}}_r + \varepsilon \quad (\boldsymbol{\lambda}_r) \qquad (3)$$

$$\mathbf{x}_l \leq \bar{\mathbf{x}}_l + \varepsilon \quad (\boldsymbol{\lambda}_l) \qquad (4)$$

Where, constraint (2) identifies the relationship between the total demand for input for production of $\mathbf{x}_r$ and $\mathbf{x}_l$, and the total input supply. The shadow prices of the binding farm resources **b** are represented by vector **y**. In the present analysis, the observed farm land is the unique constrained input we impose inside the model. The observed quantity levels for realized and latent activity are known and correspond to $\bar{\mathbf{x}}_r$ and $\bar{\mathbf{x}}_l$ respectively. Constraints (3) and (4) are the PMP calibrating constraints, while $\boldsymbol{\lambda}_r$ and $\boldsymbol{\lambda}_l$ are the dual values of the realized and latent activities and represent the implicit marginal costs of the activities (the hidden costs). The data on latent crops for prices, specific costs and yields are gathered from other farms in the Emilia-Romagna plain area sample.

The problem related to the new agricultural activities in mathematical programming for policy impact assessment was firstly addressed by the study of Röhm and Dabbert (2003), which developed PMP model including the so-called "variant activities". A variant activity is an agricultural process that can be divided into more processes, to take into account, for instance, different cultivation technologies for a given crop. Under this approach, each activity is subjected to

two types of calibrating constraints: one for each crop and one for the different variants of the same crop. The objective of their model was to implement European-style agrienvironmental programs into regional models for obtaining more realistic results then the standard PMP approach (Howitt, 1995). Based on this framework, some studies on the evaluation of the CAP's first pillar (mainly focused on the effect of coupled and decoupled payments) on the on the cropping patterns (Blanco et al., 2008; Judez et al., 2008) and on the deficit irrigation techniques (Severini and Cortignani, 2008) propose PMP models where the activities not present in the observed situation are considered in the predictive evaluations. Unlike the Röhm and Dabbert's approach, the PMP model used in this analysis does not consider possible technological variants for each crop, but proposes a method for providing to each investigated farm a complete activity basket using the latent information estimated during the calibration phase. This economic information enables farmers to change the production processes if it is economically convenient, shifting current production to a new configuration where new crops might appear (Arfini and Donati, 2013).

This first phase of PMP yields two sets of information (realized and latent crops) for use in the second phase, where a non-linear cost function referred to the whole sample of farms is estimated. We choose the following quadratic cost function:

$$\frac{1}{2}\left[\bar{\mathbf{x}}_r \quad \bar{\mathbf{x}}_l\right]\mathbf{Q}_{rl}\begin{bmatrix}\bar{\mathbf{x}}_r\\ \bar{\mathbf{x}}_l\end{bmatrix} \tag{5}$$

where matrix **Q** is symmetric positive semidefinite and includes parameters to be estimated by appropriate methods. In this work, the parameters are estimated by the maximum entropy approach (Paris and Howitt, 1998) considering the following relationship[4]:

$$\begin{bmatrix}\mathbf{c}_r\\ \mathbf{c}_l\end{bmatrix}+\begin{bmatrix}\boldsymbol{\lambda}_r\\ \boldsymbol{\lambda}_l\end{bmatrix}=\begin{bmatrix}\bar{\mathbf{x}}_r\\ \bar{\mathbf{x}}_l\end{bmatrix}\mathbf{Q}_{rl} \tag{6}$$

The parameters of the **Q** matrix provide information about the substitution and complementarity relationships between all the observed activities in the whole sample and, thus, between realized and latent activities (Arfini and Donati, 2013; Paris and Howitt, 1998).

The new non-linear cost function estimated by using the maximum entropy technique is used in the third phase of PMP to calibrate the observed situation without the calibrating constraints:

$$\begin{aligned}\max_{\mathbf{x}_r\geq 0,\mathbf{x}_l\geq 0} \quad & \mathbf{p}_r'\mathbf{x}_r+\mathbf{p}_l'\mathbf{x}_l-\frac{1}{2}\left[\mathbf{x}_r \quad \mathbf{x}_l\right]\mathbf{Q}_{rl}\begin{bmatrix}\mathbf{x}_l\\ \mathbf{x}_l\end{bmatrix}\\ S.t. \quad & \mathbf{A}_r\mathbf{x}_r+\mathbf{A}_l\mathbf{x}_l\leq\mathbf{b}\end{aligned} \tag{7}$$

[4] The weights for calculating the support values for the maximum entropy estimation have identified five probability points. More specifically the weight for the diagonal elements are: 0, 1.5, 2.1, 3, 3.5; for the lower triangular elements: -1.7, -0.5, 0, 0.5, 1.7; and for the deviation terms: -130, -60, 0, 60, 130.

The calibrating technique proposed in the paper ensures that the dual value associated to the structural constraint (the land) in the first phase (1)-(4) is equal, by construction, to the dual value identified in the third PMP phase (7), where the model is solved without calibrating constraints.
At this stage, all the information about latent activities is incorporated into a model which shows that the changes in land allocation can thus be applied to evaluate policy scenarios.
The PMP model (7) estimates the effects of the various proposals for redistribution of direct payments (Appendix A) and reproduces in a very detailed form all constraints and specific conditions of the greening measures (Appendix B), presented to the Trilogue as well as the final CAP reform.
The Regulation (EU) 1307/2013 specifies that all farmers entitled to a payment under the basic payment scheme or the single area payment scheme shall follow the agricultural practices beneficial for the climate and the environment on all their eligible hectares. So in the model, all farms must move to compliance with the greening measures, if they do not already comply or if they are not covered by the exclusion criteria. Farm activities were aggregated for the purposes of the research, but the definition of "crop" provided by Articles 4 and 44[5] of Regulation (EU) 1307/2013 was used to analyze the exclusion criteria for the greening measures and the diversification constraint. It was not however possible to consider separately winter and spring crops belonging to the same genus. Regarding to the maintenance of permanent grassland, the threshold of 5% has been introduced at the farm level in the modelling. This is because, although Italy has chosen the application at national level, as established by Regulation (EU) 1307/2013 (Article 45, paragraph 3) if this threshold is breached, the obligations to reconvert land to permanent grassland will be imposed by Member State at holding level.

In order to estimate the land already qualified for EFA in the observed scenario (Baseline), the percentage of fallow land and areas of permanent crops with 20-250 trees per hectare (only in the Council scenario) was used. In the evaluation scenarios, farms may relocate surface left fellow, with a land management cost of 200 €/ha, in order to meet the EFA constraint. It was not however possible to estimate the surface utilized for other landscape features qualifying as EFA because this information is not present in the FADN Database. For a mathematical representation of the greening constraints in the model, see Appendix C.

Regarding to the payment redistribution, the model assumes a reduction of 10.3% in the ceiling for Emilia-Romagna, in line with the cut estimated for the whole of Italy, which will decrease the national budget from 4.1 billion euro in 2013 (Council of the EU, 2009b) to 3.7 billion 2019 (EP

[5]According the Article 44 a "crop" means: (a) a culture of any of the different genera defined in the botanical classification of crops; (b) a culture of any of the species in the case of Brassicaceae, Solanaceae, and Cucurbitaceae; (c) land lying fallow; (d) grasses or other herbaceous forage.

and Council of the EU, 2013). In the model, the ceiling is divided into two components: basic payment scheme (70%) and green payment (30%).

The Commission scenario simulates a flat rate of payment per hectare at regional level (303.6 €/ha, of which 91.1 €/ha of green payment) while the EP and the Council scenarios introduces different mechanisms of internal convergence for basic payment (Appendix A): i) for the European Parliament, the model applies a limit to the reduction (max -30%) for current farm payments higher than the regional average; ii) the Council scenario introduces a system of recovery for payments under regional average, based on the "Irish model" (recovery of 1/3 of the difference for 90% of average support at regional level and minimum payment of 60%). The final CAP scenario applies both the reduction limit of 30% and the "Irish model" for the internal convergence, while the green payment is calculated as a share of the total value of the farm basic payment entitlements (Reg. (EU) No 1307/2013).

4. Simulation results

The policy scenarios introduced into our model are the Baseline, the Commission proposal, the Council Proposal, the Parliament Proposal and the Final agreement represented by Regulation 1307/2013. The Baseline scenario reproduces the situation observed in 2011, after the Health Check, which completed decoupling of direct payments and updated modulation. As noted above, PMP yields economic and productive information by modeling individual farms. For reasons of economy, however, results of the various policy scenarios are shown as aggregates.

Considering land use by activity, including EFA, the most significant result (Table 1 and Figure 1) is that the final CAP reform scenario guarantees small changes in land allocation, with a lower surface reduction for extensive crops than the Parliament proposal and, particularly, than the Commission proposal.

These calculations yield important information on new land use and the economic impact on the local agricultural system. Extensive crops, particularly maize and other cereals, will see a significant reduction. Profit from these crops is low, so in order to meet the greening constraints the farmer "reduces" these crops in the production plain in favor of more profitable crops. Also Boere et al., in their study on Netherlands farms, confirm that the EFA requirements will lead to a relatively larger use of the most profitable crops, hence reducing the amount of land devoted to cereals.

This represents a change from the trend of recent reforms. Moreover, many of these extensive crops are grown using industrial techniques with little rotation, in what is almost monoculture.

On the other hand, industrial crops in Emilia-Romagna such as tomatoes already adhere to quality systems which provide for crop rotation. This neutralises the cost of introducing additional diversification constraints. Alfalfa, which showed the biggest decline in the Commission scenario, is very little affected by alternative greening scenarios, due to the exclusion from the greening constraints of farms with over 75% of their land utilized for grassland and fodder crops. Due to the introduction of these exclusion criteria also milk production suffers a significant reduction only in the first scenario (Commission proposal), while in the other scenarios the production remains stable. Also results of Cortignani et al. (2014), on another Italian region (central-west Sardinia), confirm that dairying farms already have a large part of their area devoted to the cultivation of corn for livestock feed, and thus easily reach and exceed the threshold for excessive specialization culture.

Table 1
Changes in production according to greening measures proposed to Trilogue and final CAP agreement – Emilia-Romagna (plain)

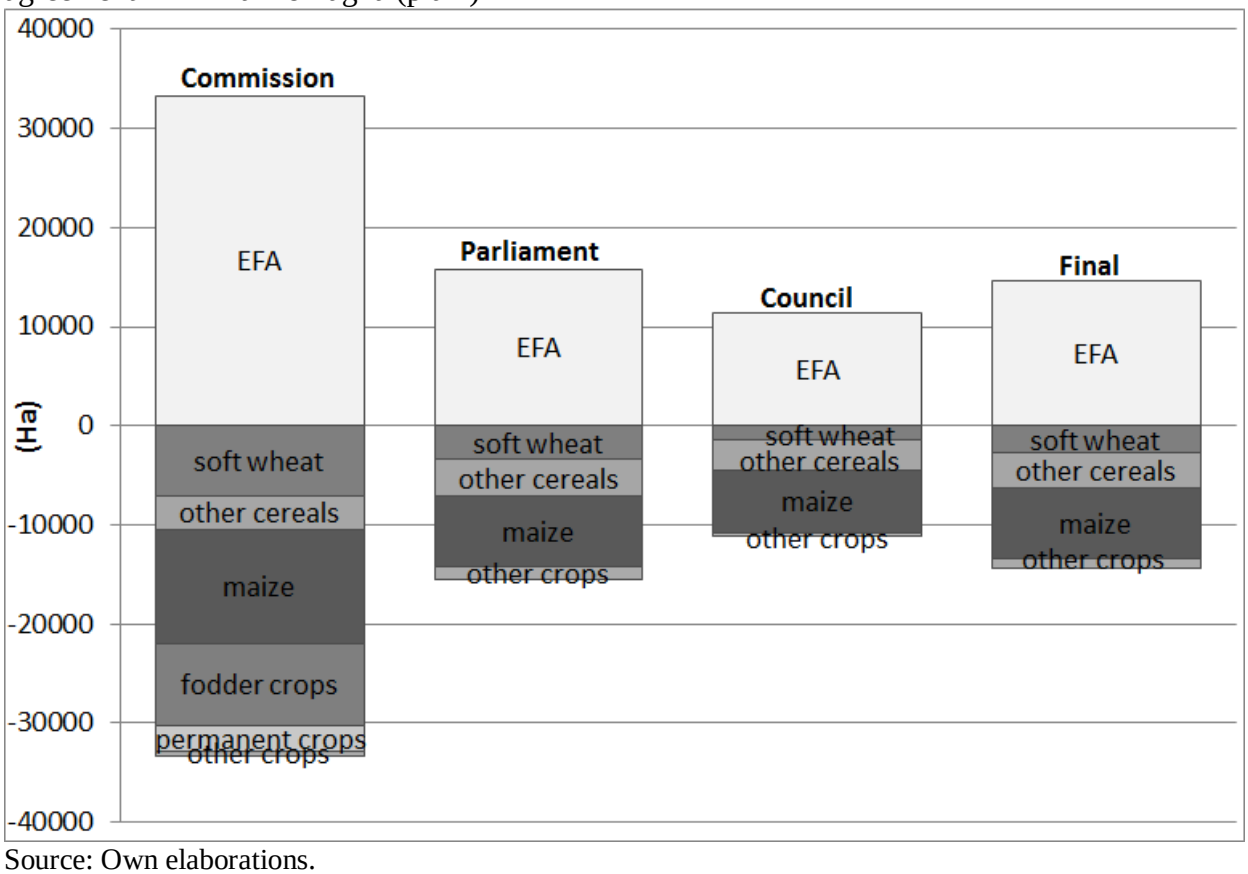
	(Ha)					var. % compared to Baseline			
Crops/livestock	Baseline	Commission	Parliament	Council	Final	Commission	Parliament	Council	Final
durum wheat	28,269	28,216	27,572	28,008	27,770	-0.2	-2.5	-0.9	-1.8
soft wheat	92,446	85,405	89,082	90,989	89,737	-7.6	-3.6	-1.6	-2.9
barley	8,438	7,808	8,099	7,997	7,971	-7.5	-4.0	-5.2	-5.5
maize	120,652	109,071	113,557	114,436	113,497	-9.6	-5.9	-5.2	-5.9
other cereals	29,559	26,845	26,813	27,180	26,991	-9.2	-9.3	-8.0	-8.7
onion	3,143	3,142	3,138	3,148	3,142	0.0	-0.1	0.2	0.0
carrot	1,441	1,429	1,435	1,439	1,437	-0.8	-0.4	-0.1	-0.3
potato	3,960	3,938	3,932	3,940	3,937	-0.6	-0.7	-0.5	-0.6
processing tomato	19,546	19,199	19,309	19,328	19,322	-1.8	-1.2	-1.1	-1.1
other hortic.	12,247	11,428	11,808	11,947	11,848	-6.7	-3.6	-2.4	-3.3
sugarbeet	21,273	20,696	20,901	20,974	20,934	-2.7	-1.7	-1.4	-1.6
oilseeds	28,077	28,043	27,846	27,953	27,837	-0.1	-0.8	-0.4	-0.9
permanent crops	80,703	78,705	80,703	80,703	80,703	-2.5	0.0	0.0	0.0
silage	5,710	5,657	5,620	5,639	5,633	-0.9	-1.6	-1.2	-1.3
alfalfa	70,330	62,097	70,059	70,535	70,278	-11.7	-0.4	0.3	-0.1
other crops	3,880	4,400	3,932	3,958	3,946	13.4	1.4	2.0	1.7
perm. grassland	10,406	10,729	10,452	10,439	10,442	3.1	0.4	0.3	0.3
left fallow	1,500	1,500	1,500	1,500	1,500	0.0	0.0	0.0	0.0
dairy cows (number)	100,289	88,917	100,198	100,228	100,217	-11.3	-0.1	-0.1	-0.1
							(% of UAA)		
EFA (new land left fallow)		*33,272*	*15,820*	*11,465*	*14,653*	*6.1*	*2.9*	*2.1*	*2.7*
Total UAA	541,579	541,579	541,579	541,579	541,579				

Source: Own elaborations.

In the final scenario, total EFA in the plain of Emilia-Romagna add up to about 14,500 ha. This figure is much lower than the over 30,000 ha estimated for the Commission proposal and higher than the approximate 11,500 ha of the Council proposal. As observed by Baldock and Hart (2013),

also in Europe it is estimated that many arable farms already have around 3-4% of land that would qualify as EFA. Vanni at al. (2013) confirm that the final form of greening, compared to the first Commission proposal, has considerably diminished its potential in promoting sustainable practices on a large scale, since it will affect quite a small percentage of holdings in Italy: less than 7% of Italian farms are potentially affected by diversification or EFA requirements and only 2.2% must comply with both obligations. Anyway, these new measures could significantly impact on some highly speclialised sector. Therefore at least referring to these sectors, the "greening" of the CAP, as highlighted by Cantore (2013), might reduce production in the European Union, leading to increase in prices of agricultural products.

Figure 1
Ecological Focus Area according to the proposals presented to the Trilogue and the final CAP agreement – Emilia-Romagna (plain)



Source: Own elaborations.

The final CAP reform scenario is noticeably "milder" than the initial Commission proposal in terms of production choices. For all farms, including those not subject to the EFA constraint, the December 2013 reform should limit economic losses to 1.5% at the first level gross margin (the difference between gross saleable production and total variable costs) (Table 2). This reduction is slightly larger than would have been entailed by the Council proposal (-1.2%) but smaller than that

entailed by the Parliament proposal (-1.7%) and markedly smaller than that entailed by the Commission proposal (-5%). The average cost of greening, calculated as lost income, for farms in the Emilia-Romagna plain, has fallen from the 70 €/ha in the Commission scenario, to "only" 21 €/ha in the final CAP scenario. Limiting the analysis to farms obliged to provide EFA by the final CAP reform, the gross margin is subject to a bigger reduction, reaching 35 €/ha, corresponding to -4%. The results reached by Heinrich (2012) on 18 farm types in Germany, show that, also in the first Commission proposal, the share of direct payments devoted to the greening measures was a strong incentive to undergo the scheme and only farms with high gross margin might turn down the support.

The reduction of payments, due to the convergence of the basic component and to the distribution of the green payment, reaches almost 13% in the final scenario. Therefore, the overall impact of greening constraints and payments redistribution is about 70 €/ha for the analysed sample.

Table 2
Impact of greening (I level gross margin) and payment redistribution (II level gross margin) on main economic variables – Emilia-Romagna (plain)

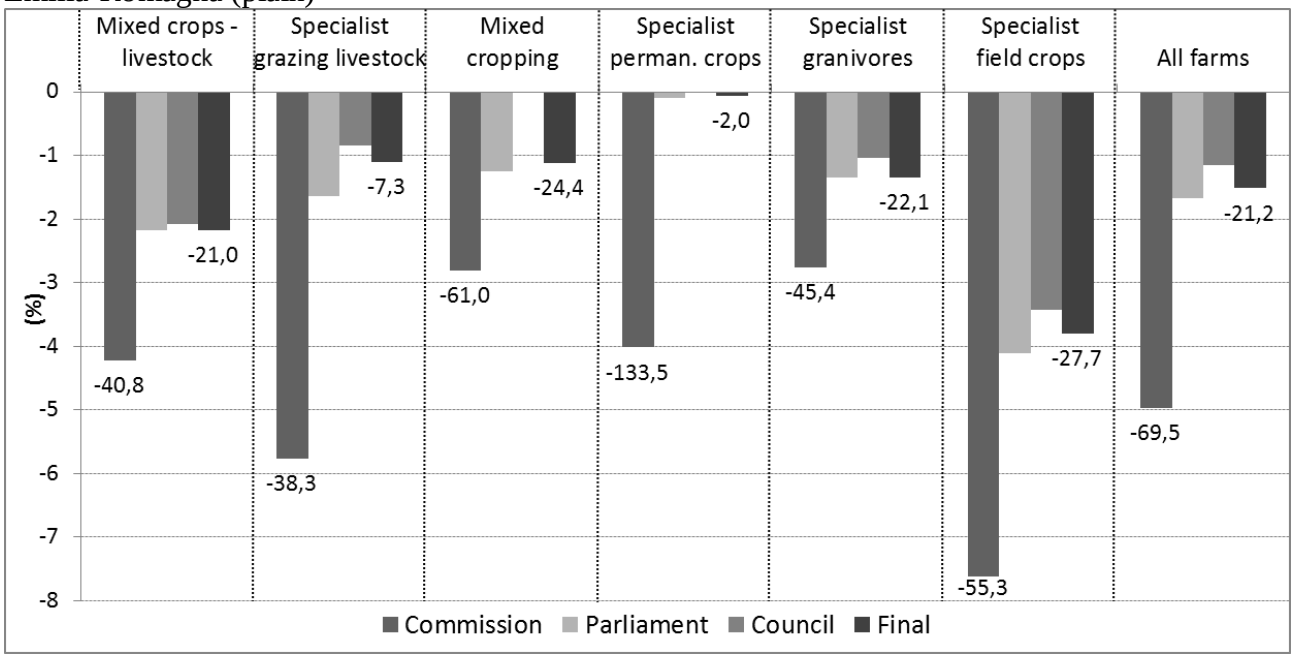
	Baseline	**Commiss.**	**Parliam.**	**Council**	**Final**	**Commission**	**Parliament**	**Council**	**Final**
	(Euro/ha)	(Euro/ha)				Var. % compared to Baseline			
Gross saleable prod.	3.326	3.144	3.272	3.287	3.276	-5.5 %	-1.6 %	-1.2 %	-1.5 %
Variable costs	1.930	1.817	1.900	1.907	1.902	-5.8 %	-1.6 %	-1.2 %	-1.5 %
GM I level [(a)] (greening)	***1.396***	***1.326***	***1.373***	***1.380***	***1.375***	***-5% (-70 €/ha)***	***-1.7% (-23 €/ha)***	***-1.2% (-16 €/ha)***	***-1.5% (-21 €/ha)***
Payments	377,3	303,6	318,3	323,0	329,1	-19.5 %	-15.6 %	-14.4 %	-12.8 %
GM II level [(b)] (green.+ payments)	***1.773***	***1.630***	***1.691***	***1.703***	***1.704***	***-8.1% (-143 €/ha)***	***-4.6% (-82 €/ha)***	***-4% (-70 €/ha)***	***-3.9% (-69 €/ha)***

[(a)] Difference between gross saleable production and total variable cost
[(b)] Sum of I level gross margin and payments
Source: Own elaboration.

Using the PMP model also yields production specialization data (Figure 2). The negative economic impact of greening proves to be bigger for farms specialized in field crops and livestock farms. This is partly because some such farms show a low number of production processes, with some cases of monoculture, and large arable crop areas. Most are thus subject to the diversification constraint and the obligation to provide EFA. It is important to note the big mitigation of the impact of greening demanded by the Parliament and Council. This halved the fall in gross margins that would have occurred for all types of farm in the initial Commission proposal. In the final form, green payments appear to compensate for lower profits in the Emilia Romagna plain, except for some very large farms highly specialized in certain sectors.

The results achieved are consistent with the paper by Cimino et al. (2014) that, analyzing 16 representative farms in Italy, show a differentiated impact of the greening according to the characteristics of farms and their specialisation, with stronger economic impacts especially for the highly specialised farms of maize production in Northern regions. Also in the paper by Wąs et al. (2014) on Polish farms, based on a PMP model, the restrictions resulting from the implementation of the greening mechanism put more pressure only on relatively small groups of very large farms, mainly specialized in field crops and pig farms with an area above 30 ha of arable land. Boere et al. (2015) confirm the limited impact of greening in the final form, stressing that for farms of all sizes in Netherlands the green payment appears to compensate for lower revenues caused by set-aside of land.

Figure 2
Impact of greening on Gross Margin per farm (in €/ha) by Farm Type (FT)
Emilia-Romagna (plain)

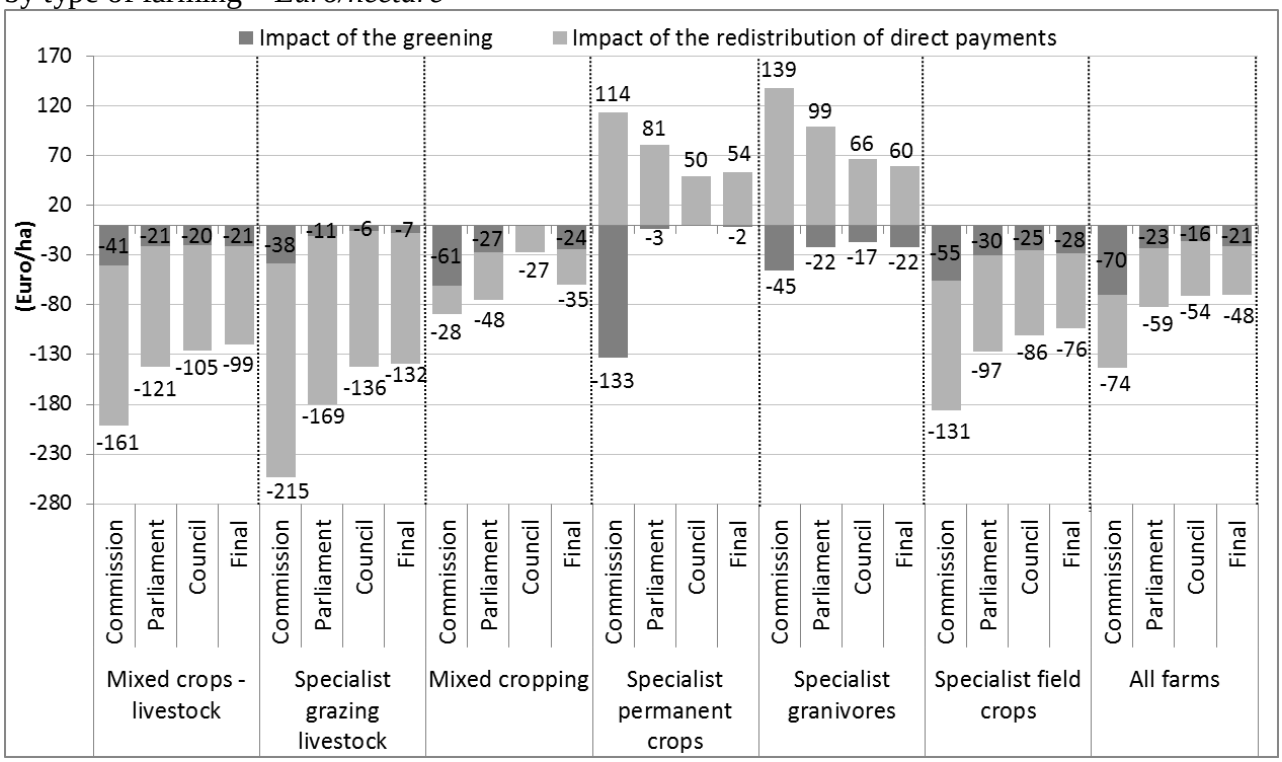


Note: The length of the bars refers to the percentage variation. The figures report the change in absolute value of the Gross Margin (€/ha).
Source: Own elaboration.

This research focuses mainly on the effects of greening policy, but it is clear that its "depressing" effect could be amplified or compensated by the new system of regionalisation and redistribution of direct payments. Considering the internal convergence mechanisms as described in Section 3, it is also possible to predict the significant redistributive action of direct payments over different FTs. The effects of payment redistribution are calculated for each farm and do not affect production decisions, since the mechanism of convergence is substantially applied to decoupled payments in the baseline. The results on payments redistribution are then added to the greening effects estimated by the PMP model in order to analyze the overall impact of the reform. In the final

scenario, the level of CAP payments in the Emilia-Romagna plain area falls by an average of 12.8% (hypothesizing a ceiling cut at regional level of 10.3%), and the second level gross margin falls by 3.9% (Table 2). The overall cost of the reform, greening plus regionalisation/redistribution of CAP payments, thus amounts to 70 €/ha (Figure 3).

Figure 3
Breakdown of reform impact (greening and direct payment redistribution) on farm Gross margins by type of farming – *Euro/hectare*



Source: Own elaboration.

There are some interesting aspects to note. Firstly, the impact of the regional criterion is greatly mitigated; the payment reduction to farms in plain areas is halved compared to the Commission's initial flat rate proposal. In addition, there is redistribution effect among FTs. On the Emilia-Romagna plain, farms specialized in grazing livestock and field crops see a significant reduction in II level gross margins (slightly above 100 €/ha) while farms specialized in permanent crops and granivores see an overall increase in gross margins (See Appendix D). Clearly these are the farms which at the baseline received low levels, or in many cases zero, CAP payments and which benefit from the new distribution of payments. For farms breeding granivores affected by greening constraints, the increase in payment per hectare more than compensates for the loss of income caused by new environmental requirements.

5. Conclusions

The three long-term objectives of the new CAP reform are related to economic, environment and territorial factors: viable food production, sustainable management of natural resources and climate action and balanced territorial development. One of the main CAP post-2013 goals, making the CAP greener to improve farm environmental performance, was however partially diluted during the drafting process and Trilogue negotiations. In the final agreement, greening measures were weaker than in the initial Commission proposal.

In order to examine this issue, the paper presents a comparative analysis at farm level of the potential impacts on production and profit levels of the different reform proposals and the final agreement. The analysis is carried out on farms located in the lowland area of Emilia-Romagna region. Despite extensive revision of the Commission proposal made by the Council and the Parliament, the new CAP will still produce considerable changes in the distribution of direct payments, in the eligibility criteria for obtaining farm payments, and in production decisions and farm income.

The assessment of CAP presented in this paper confirms the strong economic impact that the Commission's proposals would have had, and considers the changes in this scenario proposed by the Council and the Parliament. It finds that the biggest economic effects of the new CAP will be mainly due to the redistribution of direct payments rather than the three greening measures. In all scenarios considered, the economic impact of greening appears low. The model estimates a reduction of 20 €/ha in gross margin earned by farmers as a result of the greening requirements in the final CAP scenario. Limiting the analysis to farms obliged to provide EFA by the final CAP reform, the gross margin reduction reaches 35 €/ha. Much bigger reductions, especially for farms specialized in arable crops and livestock breeding, are caused by the distribution of 70% of the regional ceiling as basic payment, which is a mechanism of partial convergence.

From a production point of view, the Trilogue agreement helps to maintain a status quo that would have been severely challenged by the greening model drawn up by the Commission. The original model would have resulted in much more significant changes in production plans.

The first draft of the Commission's proposal was presented as an attempt to characterize CAP 2014-2020 as more strongly oriented to the production of public goods and fairer in terms of area and FT. The final CAP reform is very close to the positions of the Council and the Parliament, and constitutes a significant mitigation or ‘softening’ of the original draft. Indeed, Commission proposals were significantly dissimilar to the current CAP 2007-2013 while the European Parliament and Council proposals as well as the final agreement were closer to farmer interests. The contribution made by the Parliament appears somewhat surprising: although the Council, representing national governments, was expected to be close to farm lobbies, it was not expected

that the Parliament would opt to protect producer interests and for a less environmentally friendly strategy than the Commission.

The scenario currently facing Europe today is therefore more conservative. It will however enable farms to better withstand repercussions of the current economic crisis, which is also badly affecting farming. It remains to be seen whether environmental and redistribution reforms by the Commission have been halted or simply postponed.

Appendix A. Institutions' position on internal convergence of payment entitlements

	European Commission (October 2011)	Eupopean Parliament (March 2013)	Council of EU (March 2013)	Final CAP (December 2013)
Territorial level	*national or regional*	*national or regional*	*national or regional*	*national or regional*
General rule (Subjects)	**All Member States**	**All Member States**	**All Member States**	**All Member States**
Aim	All payment entitlements shall have a uniform unit value	All payment entitlements shall have a uniform unit value	All payment entitlements shall have a uniform unit value	All payment entitlements shall have a uniform unit value
	From claim year 2019 at the latest	From claim year 2019 at the latest	From claim year 2019 at the latest	From claim year 2019 at the latest
Duration	6 years (from 2014 claim year)	6 years (from 2014 claim year)	6 years (from 2014 claim year)	5 year (from 2015 claim year)
Derogations (Subjects)	**Member States with SFP**	**Member States with SFP**	**All Member States**	**Member States with SFP**
Aim	Differentiate entitlem. value (2014-2018)	Differentiate entitlements value after 2019(*)	Differentiate entitlements value after 2019(*)	Differentiate entitlements value after 2019(*)
	All payment entitlements shall have a uniform unit value (2019) (*)	Options for Member States (2019): - all entitlements have a uniform unit value - max deviation 20% from average unit value - max decrease -30% compared to 2014(*) All entitl. have a uniform unit value (2021)	Options for Member States (2019): - all entitlements have a uniform unit value - max deviation 20% from average unit value - deviation % max or min from average$_{2019}$ (min value at least 75% of average)	Options for Member States (2019): - all entitlements have a uniform unit value - unit value no lower than 60 %$_{2019}$ of the average(*) - max decrease -30% compared to 2015(*)
Calculation criteria: % of basic payment (BP)	40% unit value (€/ha) 60% historic ref., when BP<SFP$_{2013}$	10% unit value (€/ha) 90% historic ref., when BP<SFP$_{2013}$(*)	10% unit value (€/ha) 90% historic ref., when BP<SFP$_{2013}$(*) or 90% historic ref., when BP<SAPS$_{2009\text{-}2013}$	100% of BP linked to historic ref. (*)
	-	Unit value <90 % of the national (regional) average value increase by 1/3 of the difference between unit value and 90 % of average.	Unit value <90 % of the national (regional) average value increase by 1/3 of the difference between unit value and 90 % of average(*)	Unit value <90 % of the national (regional) average value increase by 1/3 of the difference between unit value and 90 % of average(*)
		Green payment calculated as a share of the value of the farm basic payment entitlements	Green payment calculated as a share of the value of the farm basic payment entitlements	Green payment calculated as a share of the value of the farm basic payment entitlements(*)
Criteria for contributions		proportional	proportional	on the basis of objective and non-discriminative criteria to be determined by MSs

(*) Convergence options included into the model

SFP (Single farm payment scheme)

SAPS (Single Area Payment Scheme)

Source: Pierangeli and Solazzo (2013), elaborations on Commission proposal (COM 2011 (625)), amendments proposed by EP (2013) and Council of the EU (2013a), CAP reform approved (Reg. (EU) No 1307/2013).

Appendix B. Greening scenarios and constraints included into the model

Measure	European Commission	European Parliament (March 2013)	Council of EU (March 2013)	Final CAP (December 2013)
1. Diversification (arable land)	**> 3 ha: 3 crops**	**10-30 ha: 2 crops** **> 30 ha: 3 crops**	**10-30 ha: 2 crops** **> 30 ha: 3 crops**	**10-30 ha: 2 crops** **> 30 ha: 3 crops**
Limits for crops	> 5% and < 70%	2 crops: < 80%(main crop) 3 crops: < 75%(main crop) < 95% (2 main crops)	2 crops: < 75% (main crop) 3 crops: < 75% (main crop) < 95% (2 main crops)	2 crops: < 75% (main crop) 3 crops: < 75% (main crop) < 95% (2 main crops)
Exception	entirely used for grass production, left fallow or crops under water	if > 75% permanent grassland or permanent pasture or used for the production of grass of other forage or cultivated with crops under water and the remaining eligible agricultural land < 50 ha	- if > 75% (eligible agricultural area) is grassland or cultivated with crops under water - if > 75% (arable land) for production of grass or other herbaceous forage, land laying fallow or entirely cultivated with leguminous crops	- if entirely cultivated with crops under water - if > 75% (eligible agricultural area) is grassland or used for production of grass or other herbaceous forage or cultivated with crops under water and the remaining arable area < 30 ha - if > 75% (arable land) for production of grass or other herbaceous forage, land laying fallow and the remaining arable area < 30 ha
2. Permanent grassland	**Maintenance of permanent grassland and permanent pasture**			
Maximum conversion	5% (at farm level)			
3. Ecological Focus Area	**7%**	**5%**	**5%**	**5%**
Excluded area	Permanent grassland/pasture	Permanent grassland/pasture and permanent crops	Permanent grassland/pasture	Permanent grassland/pasture and permanent crops
Mandatory	all farms	> 10 ha (arable land)	> 15 ha (eligible agricultural area excluding areas under permanent grassland/pasture)	> 15 ha (arable land)
Exception		- if > 75% permanent grassland or permanent pasture used for the production of grass or other forage or cultivated with crops under water and remaining eligible agricultural land < 50 ha	- if > 75% (eligible agricultural area) is grassland or cultivated with crops under water - if > 75% (arable land) for production of grass or other herbaceous forage, land laying fallow or entirely cultivated with leguminous crops	- if > 75% (eligible agricultural area) is grassland or used for production of grass or other herbaceous forage or cultivated with crops under water and the remaining arable area < 30 ha - if > 75% (arable land) for production of grass or other herbaceous forage, land laying fallow or used for cultivation of leguminous crops and the remaining arable area < 30 ha
EFA	- land left fallow	- land left fallow	- land left fallow - areas of permanent crops (20-250 trees per ha)	- land left fallow
Entitled IPSO FACTO to the greening component	**organic farms**	**- organic farms** **- beneficiaries of agri-environmental-climatic payments** **- Natura 2000 areas**	**- organic farms** **- beneficiaries of agri-environmental-climatic payments**	**- organic farms** **- beneficiaries of agri-environmental-climatic payments**

Source: Own elaborations on Commission proposal (COM 2011 (625)), amendments proposed by EP (2013) and Council of the EU (2013a), CAP reform approved (Reg. (EU) No 1307/2013).

Appendix C. Greening requirements in the PMP model

Crop diversification

European Commission

$$h_{n,s} \geq 0.05 \sum_{s} h_{n,s} \Leftarrow \left\{ \sum_{s} h_{n,s} > 3 \vee org_n \neq 1 \vee ecd_n \neq 1 \right\} \quad \text{(C.1)}$$

$$h_{n,s} \leq 0.7 \sum_{s} h_{n,s} \Leftarrow \left\{ \sum_{s} h_{n,s} > 3 \vee org_n \neq 1 \vee ecd_n \neq 1 \right\} \quad \text{(C.2)}$$

European Parliament

$$h_{n,s} \leq 0.8 \sum_{s} h_{n,s} \Leftarrow \left\{ 10 < \sum_{s} h_{n,s} < 30 \vee org_n \neq 1 \vee env_n \neq 1 \vee nat_n \neq 1 \vee epd_n \neq 1 \right\} \quad \text{(C.3)}$$

$$h_{n,s} \leq 0.75 \sum_{s} h_{n,s} \Leftarrow \left\{ \sum_{s} h_{n,s} > 30 \vee org_n \neq 1 \vee env_n \neq 1 \vee nat_n \neq 1 \vee epd_n \neq 1 \right\} \quad \text{(C.4)}$$

$$h_{n,s} + h_{n,q} \leq 0.95 \sum_{s,q} h_{n,s} \Leftarrow \left\{ \sum_{s} h_{n,s} > 30 \vee org_n \neq 1 \vee env_n \neq 1 \vee nat_n \neq 1 \vee epd_n \neq 1 \right\}, \forall\, s \neq q \quad \text{(C.5)}$$

Council of the EU

$$h_{n,s} \leq 0.75 \sum_{s} h_{n,s} \Leftarrow \left\{ \sum_{s} h_{n,s} > 10 \vee org_n \neq 1 \vee env_n \neq 1 \vee cod1_n \neq 1 \vee cod2_n \neq 1 \right\} \quad \text{(C.6)}$$

$$h_{n,s} + h_{n,q} \leq 0.95 \sum_{s,q} h_{n,s} \Leftarrow \left\{ \sum_{s} h_{n,s} > 30 \vee org_n \neq 1 \vee env_n \neq 1 \vee cod1_n \neq 1 \vee cod2_n \neq 1 \right\}, \forall\, s \neq q \quad \text{(C.7)}$$

Final CAP Agreement

$$h_{n,s} \leq 0.75 \sum_{s} h_{n,s} \Leftarrow \left\{ \sum_{s} h_{n,s} > 10 \vee org_n \neq 1 \vee env_n \neq 1 \vee fid1_n \neq 1 \vee fid2_n \neq 1 \right\} \quad \text{(C.8)}$$

$$h_{n,s} + h_{n,q} \leq 0.95 \sum_{s} h_{n,s} \Leftarrow \left\{ \sum_{s} h_{n,s} > 30 \vee org_n \neq 1 \vee env_n \neq 1 \vee fid1_n \neq 1 \vee fid2_n \neq 1 \right\}, \forall\, s \neq q \quad \text{(C.9)}$$

Where:

n: farm index;

s,q: arable crop indexes, that are sub-indexes of the index j related to the whole set of activities;

$h_{n,s}$: arable crop acreage at farm level;

org_n: farm parameter, 1 for organic farms and 0 otherwise;

ecd_n: farm parameter, 1 if the arable land is entirely used for grass production, left fallow or cultivated with crops under water, and 0 otherwise;

env_n: farm parameter, 1 for beneficiary of agri-environment-climatic payments and 0 otherwise;

nat_n: farm parameter, 1 if farm situated in a Natura 2000 area and 0 otherwise;

epd_n: farm parameter, 1 where more than 75% of the eligible agricultural area is permanent grassland, permanent pasture, used for the production of grass or other forage or cultivated with crops under water, and the remaining eligible agricultural land < 50 hectares;

$cod1_n$: farm parameter, 1 if more than 75% of the eligible agricultural area is grassland or cultivated with crops under water or a combination of these;

$cod2_n$: farm parameter, 1 if more than 75% of arable land is entirely used for production of grass or other herbaceous forage, land lying fallow, entirely cultivated with leguminous crops, or a combination of these uses;

$fid1_n$: farm parameter, 1 if more than 75 % of the arable land is used for the production of grasses or other herbaceous forage, is land lying fallow, or is subject to a combination of these uses, and the remaining arable area < 30 hectares;

$fid2_n$: farm parameter, 1 if more than 75 % of the eligible agricultural area is permanent grassland, is used for the production of grasses or other herbaceous forage or for the cultivation of crops under water, and the remaining arable area < 30 hectares.

Maintenance of permanent grassland

Constraints are formulated in a different way only for the exclusion of the farms entitled *ipso facto* to the greening component of direct payments.

For example, to model the final CAP agreement, the maintenance of permanent grassland is expressed as follows:

$$h_{n,g} \geq \bar{h}_{n,g}(1-0.05) \Leftarrow \{org_n \neq 1 \vee env_n \neq 1\} \qquad \text{(C.10)}$$

Where:

g: permanent grassland index, a sub-index of the index *j* related to the whole set of activities;

$\bar{h}_{n,g}$: permanent grassland acreage at farm level in reference scenario (Baseline).

The other symbols are used as above.

Ecological Focus Area (EFA)

To model the share of total farm area allocated to EFA, the land constraint is defined as follows:

$$\sum_j h_{n,j} + green_n \leq b_n \tag{C.11}$$

The total area of the farm is equal to the sum of utilized agricultural area (UAA) in the farm production system ($\sum_j h_{n,j}$) and the EFA as required by the greening actions ($green_n$) .

The EFA requirement is represented in the model as follows:

European Commission

$$green_n \geq \left\{ \left[0.07 \left(\sum_r h_{n,r} - \sum_g h_{n,g} \right) \right] - \sum_f h_{n,f} \right\} \Leftarrow org_n \neq 1 \tag{C.12}$$

European Parliament

$$green_n \geq \left\{ \left[0.05 \left(\sum_r h_{n,r} - \sum_g h_{n,g} - \sum_p h_{n,p} \right) \right] - \sum_f h_{n,f} \right\} \Leftarrow \left\{ \sum_s h_{n,s} > 10 \vee org_n \neq 1 \vee env_n \neq 1 \vee nat_n \neq 1 \vee epd_n \neq 1 \right\} \tag{C.13}$$

Council of the EU

$$green_n \geq \left\{ \left[0.05 \left(\sum_r h_{n,r} \right) \right] - \left(\sum_p h_{n,p(20-250)} + \sum_f h_{n,f} \right) \right\}$$
$$\Leftarrow \left\{ \left(\sum_r h_{n,r} - \sum_g h_{n,g} \right) > 15 \vee org_n \neq 1 \vee env_n \neq 1 \vee cod1_n \neq 1 \vee cod2_n \neq 1 \right\} \tag{C.14}$$

Final CAP Agreement

$$green_n \geq \left[0.05 \left(\sum_s h_{n,s} \right) \right] \Leftarrow \left\{ \sum_s h_{n,s} > 15 \vee org_n \neq 1 \vee env_n \neq 1 \vee fie_n \neq 1 \vee fid2_n \neq 1 \right\} \tag{C.15}$$

Where:

fie_n : farm parameter, 1 if more than 75 % of the arable land is used for the production of grasses or other herbaceous forage, is land lying fallow, is used for cultivation of leguminous crops, and the remaining arable area < 30 hectares;

r: eligible crop index, that is a sub-index of the index *j* related to the whole set of activities;

f: land left fallow index, that is a sub-index of the index *j* related to the whole set of activities;

p: permanent crop index, that is a sub-index of the index *j* related to the whole set of activities.

The other symbols are used as above.

Appendix D. Impact of greening and redistribution of direct payments on Gross Margin per farm by Farm Type (FT) – Emilia-Romagna (plain)

Farm Type		Baseline (Euro/ha)	(Euro/ha)				Var. % compared to Baseline			
			Commission	Parliament	Council	Final	Commission	Parliament	Council	Final
Mixed crops - livestock	**Gross salable prod.**	4,480	4,291	4,401	4,402	4,401	-4.2 %	-1.8 %	-1.7 %	-1.8 %
	Variable costs	3,515	3,367	3,457	3,458	3,457	-4.2%	-1.7 %	-1.6 %	-1.7 %
	GM I level (greening)	***964***	***924***	***943***	***944***	***943***	***-4.2% (-41 €/ha)***	***-2.2% (-21 €/ha)***	***-2.1% (-20 €/ha)***	***-2.2% (-21 €/ha)***
	Payments	464	304	344	359	366	-34.6 %	-26 %	-22.7 %	-21.3 %
	GM II level (green.+ payments)	***1,429***	***1,227***	***1,287***	***1,303***	***1,309***	***-14.1% (-202 €/ha)***	***-9.9% (-142 €/ha)***	***-8.8% (-126 €/ha)***	***-8.4% (-120 €/ha)***
Specialist grazing livestock	**Gross salable prod.**	8,800	7,691	8,776	8,787	8,783	-12.6 %	-0.3 %	-0.1 %	-0.2 %
	Variable costs	8,136	7,065	8,123	8,128	8,127	-13.2 %	-0.2 %	-0.1 %	-0.1 %
	GM I level (greening)	***664***	***626***	***653***	***658***	***656***	***-5.8% (-38 €/ha)***	***-1.6% (-11 €/ha)***	***-0.8% (-6 €/ha)***	***-1.1% (-7 €/ha)***
	Payments	518	304	350	382	386	-41.4 %	-32.6 %	-26.3 %	-25.5 %
	GM II level (green.+ payments)	***1,182***	***929***	***1,002***	***1,040***	***1,042***	***-21.4% (-253 €/ha)***	***-15.2% (-180 €/ha)***	***-12% (-142 €/ha)***	***-11.8% (-140 €/ha)***
Mixed cropping	**Gross salable prod.**	4,163	4,036	4,102	4,156	4,105	-3.1 %	-1.5 %	-0.2 %	-1.4 %
	Variable costs	1,991	1,925	1,957	1,984	1,957	-3.3 %	-1.7 %	-0.4 %	-1.7 %
	GM I level (greening)	***2,172***	***2,111***	***2,145***	***2,172***	***2,148***	***-2.8% (-61 €/ha)***	***-1.2% (-27 €/ha)***	***0% (0 €/ha)***	***-1.1% (-24 €/ha)***
	Payments	332	304	284	305	297	-8.5 %	-14.4 %	-8.2 %	-10.6 %
	GM II level (green.+ payments)	***2,504***	***2,415***	***2,429***	***2,477***	***2,445***	***-3.6% (-89 €/ha)***	***-3% (-75 €/ha)***	***-1.1% (-27 €/ha)***	***-2.4% (-59 €/ha)***
Specialist permanent crops	**Gross salable prod.**	4,693	4,513	4,688	4,695	4,690	-3.9 %	-0.1 %	0 %	-0.1 %
	Variable costs	1,374	1,327	1,372	1,376	1,373	-3.5 %	-0.2 %	0.1 %	-0.1 %
	GM I level (greening)	***3,319***	***3,186***	***3,316***	***3,319***	***3,317***	***-4% (-133 €/ha)***	***-0.1% (-3 €/ha)***	***0% (0 €/ha)***	***-0.1% (-2 €/ha)***
	Payments	190	304	270	239	243	60.2 %	42.7 %	26.2 %	28.3 %
	GM II level (green.+ payments)	***3,509***	***3,489***	***3,586***	***3,558***	***3,560***	***-0.6% (-19 €/ha)***	***2.2% (78 €/ha)***	***1.4% (50 €/ha)***	***1.5% (52 €/ha)***
Specialist granivores	**Gross salable prod.**	2,886	2,800	2,837	2,849	2,837	-3 %	-1.7 %	-1.3 %	-1.7 %
	Variable costs	1,245	1,204	1,218	1,224	1,218	-3.2 %	-2.2 %	-1.6 %	-2.2 %
	GM I level (greening)	***1,642***	***1,596***	***1,619***	***1,624***	***1,619***	***-2.8% (-45 €/ha)***	***-1.3% (-22 €/ha)***	***-1% (-17 €/ha)***	***-1.3% (-22 €/ha)***
	Payments	165	304	264	232	225	83.9 %	60.1 %	40.3 %	36.4 %
	GM II level (green.+ payments)	***1,807***	***1,900***	***1,884***	***1,856***	***1,845***	***5.2% (93 €/ha)***	***4.3% (77 €/ha)***	***2.7% (49 €/ha)***	***2.1% (38 €/ha)***
Specialist field crops	**Gross salable prod.**	2,271	2,154	2,202	2,211	2,206	-5.1 %	-3 %	-2.6 %	-2.8 %
	Variable costs	1,544	1,483	1,505	1,510	1,507	-4 %	-2.5 %	-2.2 %	-2.4 %
	GM I level (greening)	***726***	***671***	***697***	***702***	***699***	***-7.6% (-55 €/ha)***	***-4.1% (-30 €/ha)***	***-3.4% (-25 €/ha)***	***-3.8% (-28 €/ha)***
	Payments	434	304	337	348	358	-30.1 %	-22.3 %	-19.8 %	-17.5 %
	GM II level (green.+ payments)	***1,161***	***975***	***1,034***	***1,050***	***1,057***	***-16% (-186 €/ha)***	***-10.9% (-127 €/ha)***	***-9.6% (-111 €/ha)***	***-8.9% (-104 €/ha)***

Source: own elaboration.

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