Comparative Analysis of Factor Markets for Agriculture across the Member States

245123-FP7-KBBE-2009-3

WORKING PAPER

No. 38, March 2013

Paul Feichtinger and Klaus Salhofer

Influence of the Common Agricultural Policy and Heterogeneous Land Quality on Land Rent and Land Allocation

ABSTRACT

Against the background of the current discussion about the EU's common agricultural policy (CAP) after 2013, the question of the impact of government support on land prices is crucially important. Validation of the CAP's success also hinges on a proper assessment of a choice of policy instruments. This study therefore has the objective of investigating on a theoretical basis the effects of different government support measures on land rental prices and land allocation. The different measures under consideration are the price support, area payments and decoupled single farm payments (SFPs) of the CAP. Our approach evaluates the potential impact of each measure based on a Ricardian land rent model with heterogeneous land quality and multiple land uses. We start with a simple model of one output and two inputs, where a Cobb-Douglas production technology is assumed between the two factors of land and non-land inputs. In a second step, an outside option is introduced. This outside option, as opposed to land use of the Ricardian type, is independent of land quality. The results show that area payments and SFPs become fully capitalised into land rents, whereas in a price support scheme the capitalisation depends on per-acreage productivity. Moreover, in a price support scheme and a historical model, the capitalisation is positively influenced by land quality. Both area payments and price supports influence land allocation across different uses compared with no subsidies, where the shift tends to be larger in an area payment scheme than in a price support scheme. By contrast, SFPs do not influence land allocation.

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ISBN 978-94-6138-298-6

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Paul Feichtinger and Klaus Salhofer*

Factor Markets Working Paper No. 38/March 2013

1. Introduction

The EU, throughout its history, has devoted a considerably large share of its budget to support European agriculture. After decades of price support and direct payments (e.g. area payments) in 2003, the Fischler reform introduced profound changes in the way the EU supports farmers through the introduction of decoupled direct payments (or alternatively called single farm payments, SFPs). It is important to understand the impact of the common agricultural policy (CAP) on input and output markets, farm development and rural development as a whole in a most comprehensive manner. In this study we have the objective of investigating the impact of these main governmental support measures of the CAP on land rental prices and land allocation. The importance of this question is additionally emphasised by the fact that rental shares are at a high level in a number of EU member countries. Swinnen et al. (2009) report shares of rented farmland in the total utilised agricultural area (UAA) of between 96% and 70% in six EU member countries (Slovakia, the Czech Republic, France, Malta, Belgium and Germany, in descending order) in 2005.

However, to analyse the effects of different support measures (namely an output subsidy, land subsidy and decoupled payments with and without mandatory production) Guyomard et al. (2004) use an *n* producer/one output agricultural economy model with the purpose of classifying income support programmes according to their ability to achieve different policy goals (income support, the maintenance of a maximum number of farmers and a reduction of negative externalities arising from non-land input use). Their results show that no support measure absolutely dominates the others and that their ranking depends on the policy goal. Further work at a theoretical level has been done by Courleux et al. (2008), Ciaian et al. (2008) and Kilian et al. (2012), who all analyse the distributional effects of SFPs as well as earlier CAP instruments. While a two producer/one output agricultural economy model (where land is held by landowners and rented by farmers) is used in the first two papers, an aggregated graphical model with heterogeneous land quality is used in the third paper. All three papers have the common goal of comparing SFPs with the non-intervention situation with no consideration of other policy regimes. In addition, Latruffe and Le Mouël (2009) provide a comprehensive review of research done on the influence of governmental support on land prices earlier than the papers mentioned above.

After a review of the CAP measures, we use the model of Kilian et al. (2012), which is a graphical application of Ricardian land rent theory, as a starting point and extend it to an analytical model in a first step in order to determine the capitalisation of different governmental support measures into land rental prices. The capitalisation of governmental support into land rental prices is the extent of a change in land rental prices through a change in governmental support. In a second step we introduce an outside option, which allows us to examine the land allocation under different policy settings.

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2. Common agricultural policy

As mentioned above, governmental support for agriculture has a long history in the EU. For decades price support was predominant. This changed with the McSharry reform in 1992. The main feature of the reform was the introduction of (coupled) direct payments based on acreage or number of animals. This was continued in the AGENDA 2000 reform.

Coupled direct payments were replaced by decoupled direct payments during the Fischler reform in 2003 and the Health Check in 2008. The goal was to fully decouple governmental support from production decisions through the introduction of a single farm payment scheme. Farmers now receive payment entitlements that can be activated on eligible hectares (one entitlement per hectare). The value of the entitlements was calculated on the basis of direct payments received in the reference period 2000–02. In the implementation of the Fischler reform and specifically in the calculation of the entitlement values, member countries were allowed to choose among different models:

- In the *regional model* (e.g. Malta and Slovenia), all payments received by the farmers of a certain region in the reference period were summed up and divided by the farmed hectares. Therefore, following the reform the value of the entitlements is equal across a region but different among regions.
- In the *historical model* (e.g. Austria, France and the Netherlands), all payments received by a certain farmer in the reference period were summed up and divided by the farmed hectares. Therefore, following the reform the value of the entitlements varies for each entitlement.
- The *hybrid model* (e.g. Luxembourg and Sweden) consists of a regional part and a historical part. Some countries that opted for the hybrid model (e.g. Germany, Finland and England) use its dynamic form, i.e. a stepwise change to a regional model until 2013.

3. Ricardian land rent

Ricardo (1817) defines rent as "that portion of the produce of the earth, which is paid to the landlord for the use of the original and indestructible powers of the soil". In other words, Ricardian land rent or residual returns, as they are called by Featherstone and Baker (1988), are the returns to land after the costs of all other factors of production are subtracted.

In our framework, a farm enterprise uses land (*M*) and an aggregate of non-land inputs (*K*) to produce one homogeneous output *Q* based on a Cobb-Douglas production technology. Besides the amount of land and other inputs, land quality has an effect on output quantity. Following Lichtenberg (1989) we assume land quality *j* can be represented by a scalar, which is normalised such that the minimal land quality is zero and the maximal land quality is one ($0 \leq j \leq 1$).[1] Hence,

$$Q = jK^{\alpha}M^{\beta}. \tag{1}$$

Dividing both sides of equation (1) by M and assuming constant returns to scale ($\alpha + \beta = 1$) we derive

$$q = jk^{\alpha}, \tag{2}$$

where $q = Q/M$ is output per acreage and $k = K/M$ is non-land input per acreage. Given $\beta > 0$ and therefore $\alpha < 1$, equation (2) is no longer homogenous of degree one and exhibits decreasing returns to scale.

[1] Similar applications include those of Guyomard et al. (2006), Feng and Babcock (2010) and Martinet (2012).

(Ricardian) land rent per acreage (R) is defined as the per-acreage revenues minus the per-acreage costs.

$$R = pjk^{\alpha} - rk \,, \tag{3}$$

where *p* and *r* are exogenously determined prices of output and non-land inputs, respectively. Given that land is the only fixed factor of production in the short run, restricted profits π are given by

$$\pi = R - F \,, \tag{4}$$

where *F* are fixed costs. If a farmer has rented land, *F* are the expenditures on land (i.e. the per-acreage rental rate). If a farmer owns land, *F* are the opportunity costs (forgone receipts) of farming the land. In equilibrium, a land-renting farmer's maximum price bid *F* equals *R*. As it does not alter our results, we do not consider *F* in the following and therefore restricted profits equal land rents. Maximising profits by choosing optimal inputs, we derive the input demand function for non-land inputs

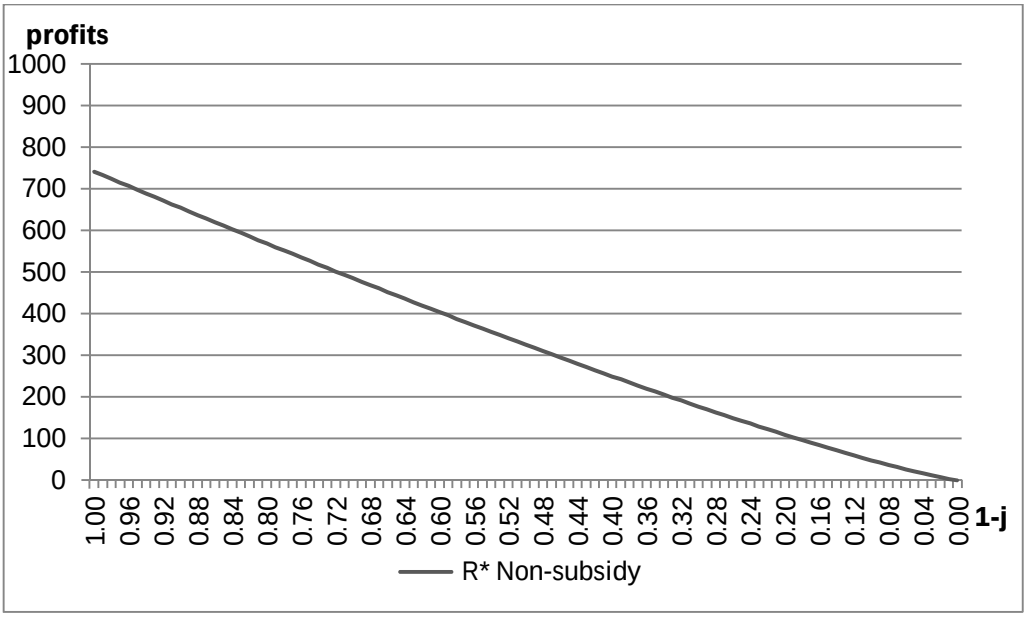
$$k^{*} = [(\alpha pj)^{-1} r]^{\frac{1}{(\alpha-1)}} \,. \tag{5}$$

Substituting k^{*} into (4) gives us the per-acreage 'indirect' land rent function (R^{*}) or equivalently the per-acreage indirect restricted profit function (π^{*})

$$\pi^{*} = R^{*} = (1-\alpha)(pjr^{-\alpha}\alpha^{\alpha})^{\frac{1}{(1-\alpha)}}. \tag{6}$$

In equation (6) land rents are determined solely by exogenous variables. Graphically, the land rent function for different land qualities can be drawn as 'R^{*} Non-subsidy' in Figure 1. For better illustration, the abscissa is labelled with $1-j$ and therefore land of maximum quality is located on the left-hand side. Land rent is strictly positive with regard to land quality, output price and α $\left(\frac{\partial R^{*}}{\partial j} > 0; \frac{\partial R^{*}}{\partial p} > 0; \frac{\partial R^{*}}{\partial \alpha} > 0\right)$, and strictly negative with regard to input price $\left(\frac{\partial R^{*}}{\partial r} < 0\right)$.

Figure 1. Land rent function for different land qualities



Source: Authors' calculations.

4. Influence of the CAP and land quality on land rents

To evaluate the impact of different agricultural support policies on land rents for different land qualities, the restricted profit function in equation (4) is extended by different potential policy instruments (s_x) as utilised by the CAP. The corresponding 'indirect' land rent function is given by

$$R^*_{sub} = (1-\alpha)((p+s_o)jr^{-\alpha}\alpha^{\alpha})^{\frac{1}{(1-\alpha)}} + s_l + js_h. \quad (7)$$

Before the 1992 McSharry reform of the CAP, price support was the most common instrument. This instrument is represented by s_o in equation (7), where s_o is the difference between the market price p and a set floor price. After the McSharry reform, per-acreage area payments became prominent, represented by s_l. The 2003 Fischler reform introduced decoupled SFPs. Ciaian et al. (2008), Courleux et al. (2008) and Kilian et al. (2012) pointed out that the effect of these payments on land rents and land prices crucially depends on the model implemented (regional, historical or hybrid) and the ratio between entitlements and eligible area. Courleux et al. (2008) and Kilian et al. (2012) find that in case of an entitlement surplus, SFPs are equal to direct payments per hectare. In this study, we only consider the case of a number of entitlements equal to or higher than the eligible area and therefore, in line with these studies, s_l also represent SFPs in the regional model.[2]

In the case of the historical model (and entitlement surplus), payments per acreage vary. For simplicity we assume that SFPs linearly depend on land quality. The rationale for this assumption is that entitlement values were derived from the payments received in the reference period 2000–02 and at that time area payments for cereals and corn along with slaughter premiums for bull fattening accounted for the largest share of CAP spending (Gay et al., 2005). Arable farming and intensive bull fattening is by tendency done on land of higher quality. Area payments were based on historical average yields, implying higher payments per acreage for higher quality land. Moreover, in course of the sugar market reform in 2006, compensation payments for price cuts were also included in SFPs and sugar beet production usually takes place on land of higher quality.[3] Hence, SFPs in the historical model are represented as js_h in equation (7).[4]

The effects of particular policy measures on land rent are summarised in Table 1.

[2] We consider the case of a number of entitlements equal to or higher than eligible area because Salhofer et al. (2009) found a small entitlement surplus for Germany in the first subsidisation year after the Fischler reform in 2005. Swinnen et al. (2009) report that total distributed entitlements exceed the eligible area in Finland and are almost equal to the eligible area in Belgium, France, Germany, Northern Ireland and Scotland in 2007. Furthermore, they report a share of unactivated entitlements of between 0.9% and 6.8% for all study countries.

[3] However, it has to be mentioned that dairy farmers (who use a considerable share of Middle Europe's grassland) received a dairy premium that was fully decoupled in 2007 and was distributed equally on farmed hectares.

[4] Accordingly, we find a medium-to-strong positive correlation of soil quality and SFPs in Bavaria for 2007.

Table 1. Comparative statics with respect to different subsidies

$\frac{\partial R^*_{sub}}{\partial s_o}$	$((p + s_o)^{\alpha} j r^{-\alpha} \alpha^{\alpha})^{\frac{1}{1-\alpha}} > 0$
$\frac{\partial R^*_{sub}}{\partial s_l}$	1
$\frac{\partial R^*_{sub}}{\partial s_h}$	j

Source: Authors' calculations.

The impact of a price support policy on land rent obviously depends on acreage productivity. In contrast, area payments and SFPs in the regional model increase the land rent by the same amount as the subsidy.

Very similar results are obtained when considering SFPs in a historical model ($\partial R^*_{sub}/\partial s_h$). Governmental support becomes fully translated into land values. Yet, the increase depends on land quality *j* since the value of the entitlement does.

Land quality does not influence the capitalisation of area payments and SFPs in a regional model. Nevertheless, as shown in Table 2, land quality will influence capitalisation of price support policies and SFPs in a historical model.

Table 2. Influence of land quality on the capitalisation of subsidies

$\frac{\partial R^*_{sub}/\partial s_o}{\partial j}$	$(1-\alpha)^{-1}((p + s_o) j r^{-1} \alpha)^{\frac{\alpha}{1-\alpha}} > 0$
$\frac{\partial R^*_{sub}/\partial s_h}{\partial j}$	1

Source: Authors' calculations.

From $\frac{\partial R^*_{sub}/\partial s_o}{\partial j} > 0$ and $\frac{\partial R^*_{sub}/\partial s_h}{\partial j} = 1$ one can see that land quality has a positive influence on the change in land rents through a price support policy and SFPs in a historical model. Hence, for these two policy instruments land rent increases more sharply (in absolute terms) for high quality land. While this increase is explained through per-acreage productivity in a price support policy, it is explained through a linearly higher *s* for better land in a historical model.

5. Influence of the CAP and land quality on land allocation

While the analysis above is concerned with the effects of policy instruments on land rents for a given land use, in most cases farmers face more than one production possibility and therefore have to decide how to allocate their land. To analyse the effect of different CAP measures for alternative land uses, we introduce an outside option with a constant per-acreage rent (profit) *d* independent of land quality. Our model may describe, for example, in a very stylised way the fact that land of good quality can be used for crop farming where rents vary considerably with land quality, and extensive grassland used as an outside option where land quality does not play a (considerable) role.

We follow Lichtenberg (1989) and assume that the amount of acreage having a particular land quality j is denoted by $g(j)$. The distribution, for analytical convenience, is assumed to be uniform and continuous.

A farmer maximises total restricted profits (Π) by allocating land between the two different utilisations in an optimal way. Let $0 \leq m \leq 1$ be the amount of land allocated to the outside option and $1 - m$ to the initial use; then the farmer's maximisation problem becomes

$$\max_j \Pi = \int_0^m d + js_h + s_r\, g(j)dj + \int_m^1 (1-\alpha)((p + s_o)jr^{-\alpha}\alpha^{\alpha})^{\frac{1}{(1-\alpha)}}$$

$$+ js_h + s_r + s_l\, g(j)dj \tag{8}$$

$$= dm + a(p + s_o)^{\frac{1}{1-\alpha}} r^{\frac{\alpha}{\alpha-1}} \left[1 - m^{\frac{2-\alpha}{1-\alpha}}\right] + s_l(1-m) + s_r + \frac{s_h}{2}$$

with $\alpha = (1-\alpha)^2(2-\alpha)^{-1}\alpha^{\frac{\alpha}{1-\alpha}} \geq 0$.

One remembers from equation (7) that we introduced the same variable (s_l) for area payments and SFPs in a regional model. In equation (8), an outside option is included that is eligible for receiving SFPs in a regional model but not for area payments, which goes along with their specification in the CAP. Only parcels devoted to the production of certain crops (e.g. cereals and corn) were eligible for area payments, whereas others were not (e.g. grassland). Thus it is necessary to differentiate in equation (8) between those subsidies and to introduce area payments (s_l) and SFPs in a regional model (s_r) separately. For modelling purposes, we assume that area payments were equal across all regions in the EU. This was not the case, as the different levels of area payments reflected differences in historical yields across regions.

The m that maximises total restricted profits (rents) in equation (8) is given by

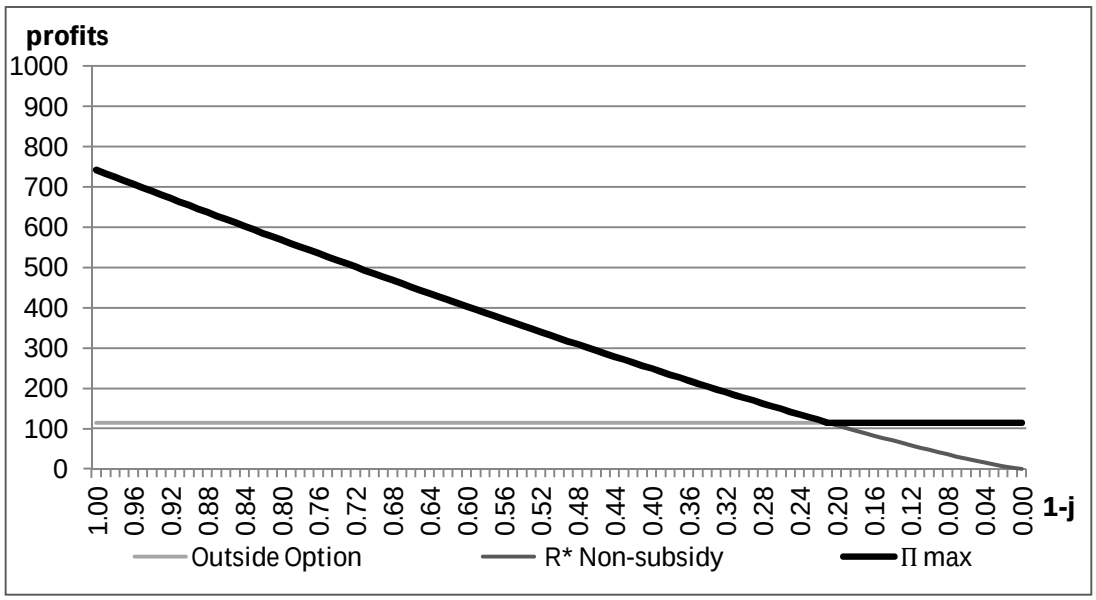
$$m^* = \left(\frac{d - s_l}{1-\alpha}\right)^{1-\alpha} ((p + s_o)r^{-\alpha}\alpha^{\alpha})^{-1}$$

$$= \overline{a}(d - s_l)^{1-\alpha}(p + s_o)^{-1} r^{\alpha} \tag{9}$$

with $\overline{a} = \alpha^{-\alpha}(1-\alpha)^{\alpha-1}$.

Figure 2 shows the land rent function of producing q_j (R^* Non-subsidy), the outside option rent function and the function where total restricted profits are maximised. The surface below this last function is equal to Π in equation (8) without subsidies ($s_x = 0$). The intersection point between the former two functions denotes m^*, the land quality for which the land use changes. An outcome of $m^* = 0.21$ as in our stylised case means that 79% of the land is devoted to produce output q_j and 21% of the land is devoted to the use through the outside option.

Figure 2. Land allocation with an outside option



Source: Authors' calculations.

We apply comparative statics to see the influence of changes in prices and subsidies on total restricted profits.

Table 3 shows a positive (negative) influence of p (r) on Π. All subsidies positively influence Π as $\frac{\partial \Pi}{\partial s_x} \geq 0$, but with different magnitudes. For example, s_o yields the same effects as p because $\frac{\partial \Pi}{\partial p} = \frac{\partial \Pi}{\partial s_o}$. The influence of SFPs spent in a regional model on Π is greater than those spent in a historical model. The same holds for area payments if $m \neq 0$.[5]

Table 3. Comparative statics with an outside option

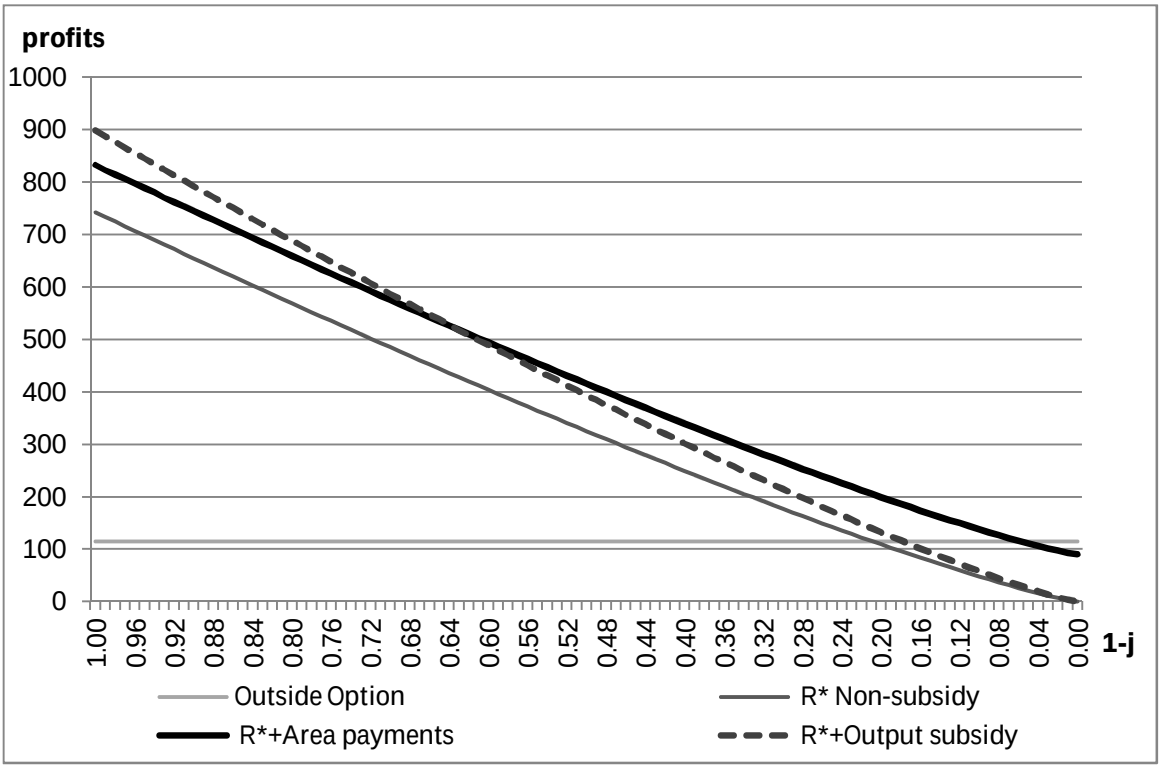
$\frac{\partial \Pi}{\partial p}$	$a(1-\alpha)^{-1}(p + s_o)^{\frac{\alpha}{1-\alpha}} r^{\frac{\alpha}{\alpha-1}} \left[1 - m^{\frac{2-\alpha}{1-\alpha}}\right] > 0$
$\frac{\partial \Pi}{\partial r}$	$-a\alpha(1-\alpha)^{-1}(p + s_o)^{\frac{1}{1-\alpha}} r^{\frac{1}{\alpha-1}} \left[1 - m^{\frac{2-\alpha}{1-\alpha}}\right] < 0$
$\frac{\partial \Pi}{\partial s_o}$	$a(1-\alpha)^{-1}(p + s_o)^{\frac{\alpha}{1-\alpha}} r^{\frac{\alpha}{\alpha-1}} \left[1 - m^{\frac{2-\alpha}{1-\alpha}}\right] > 0$
$\frac{\partial \Pi}{\partial s_l}$	$1 - m$
$\frac{\partial \Pi}{\partial s_r}$	1
$\frac{\partial \Pi}{\partial s_h}$	$\frac{1}{2}$

Source: Authors' calculations.

[5] An absolute order with current knowledge is not possible.

Allocation changes induced by price supports and area payments are graphically displayed in Figure 3. Similar to Figure 2, the intersection points denote the respective land-use shares where restricted profits are maximised (m^*). Although m^* becomes smaller through the introduction of a subsidy, in both cases the shift tends to be larger through area payments (after the McSharry reform) than through price supports (before the McSharry reform). More land would be devoted to q_j production and less land to outside option use in an area payment-based scheme than in a price support-based scheme. A steeper curve after including price supports indicates that land of higher quality is disproportionally more subsidised than land of lower quality. In contrast to area payments, an outward shift is parallel, as parcels of different land quality are subsidised equally.

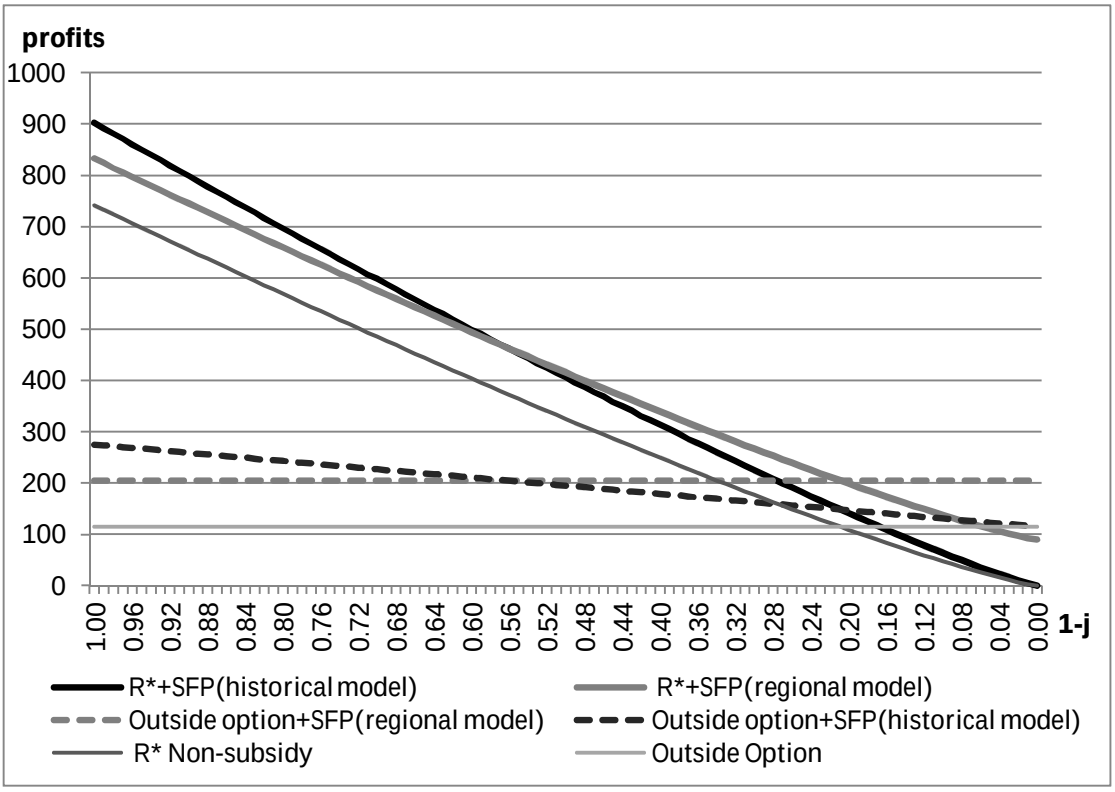
Figure 3. Influence of a price support policy and area payments on land allocation



Source: Authors' calculations.

During the implementation of SFPs as the core innovation of the Fischler reform, countries were mainly able to choose between a regional and a historical model. Figure 4 shows that with the introduction of the regional and historical models, both the restricted profit (rent) functions, of producing q_j and of an outside option use, are shifted. This shift is parallel with a regional model, but not with a historical model. As both land uses are subsidised, land allocation does not change, which holds even if subsidisation depends on land quality as in the historical model. Furthermore, in the historical model both curves are steeper; therefore, similar to price supports, land of better quality is disproportionally more subsidised than land of lower quality.

Figure 4. Influence of the CAP regional model and the CAP historical model on land allocation



Source: Authors' calculations.

6. Conclusion

Over many decades, the common agricultural policy has played a central role in governmental support for EU farmers. The objective of this working paper is to investigate on a theoretical basis the impact of different governmental support measures on land rental prices and land allocation.

For this purpose we use a Ricardian land rent model that accounts for heterogeneous land quality. The results show that area payments and SFPs (the regional and historical models) become fully capitalised into land rents. This means that every additional euro transferred as governmental support to farmers increases land rents equally. Whether and the extent to which an active farming community profits from the support measures discussed here crucially depends on the respective share of rented land. As landowners collect a considerable share of the payments, the benefits for active farmers increase with a lower share of rented land. These results are based on the assumption of a Cobb-Douglas production technology with an elasticity of substitution of unity between land and non-land inputs. The impact of subsidies on non-land input markets are not discussed here.

We introduce an outside option to examine the influence of external price changes and governmental support measures on land allocation. This model with two land uses can be extended arbitrarily. If both land uses are subsidised through a governmental support measure (as with SFPs), then land allocation does not change even if subsidies depend on land quality (as with historical SFPs). By contrast, price supports and area payments influence land allocation across different uses, with the shift tending to be larger in an area payment scheme than in a price support scheme. With area payments, land of lower quality is more heavily subsidised than with price supports. If one has the goal of having as much land as possible in production, then input subsidies for land that are independent of land quality are favourable. Even more efficient would be a targeted subsidisation of land of lower quality (e.g. less-favoured area payments).

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Comparative Analysis of Factor Markets for Agriculture across the Member States

245123-FP7-KBBE-2009-3

The Factor Markets project in a nutshell

Title	Comparative Analysis of Factor Markets for Agriculture across the Member States
Funding scheme	Collaborative Project (CP) / Small or medium scale focused research project
Coordinator	CEPS, Prof. Johan F.M. Swinnen
Duration	01/09/2010 – 31/08/2013 (36 months)
Short description	Well functioning factor markets are a crucial condition for the competitiveness and growth of agriculture and for rural development. At the same time, the functioning of the factor markets themselves are influenced by changes in agriculture and the rural economy, and in EU policies. Member state regulations and institutions affecting land, labour, and capital markets may cause important heterogeneity in the factor markets, which may have important effects on the functioning of the factor markets and on the interactions between factor markets and EU policies. The general objective of the FACTOR MARKETS project is to analyse the functioning of factor markets for agriculture in the EU-27, including the Candidate Countries. The FACTOR MARKETS project will compare the different markets, their institutional framework and their impact on agricultural development and structural change, as well as their impact on rural economies, for the Member States, Candidate Countries and the EU as a whole. The FACTOR MARKETS project will focus on capital, labour and land markets. The results of this study will contribute to a better understanding of the fundamental economic factors affecting EU agriculture, thus allowing better targeting of policies to improve the competitiveness of the sector.
Contact e-mail	info@factormarkets.eu
Website	www.factormarkets.eu
Partners	17 (13 countries)
EU funding	1,979,023 €
EC Scientific officer	Dr. Hans-Jörg Lutzeyer