Assessing the ex-ante impact of the CAP post 2013 reform on land market. A case study in Tuscany region

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Abstract
Several Authors pointed-out positive effects of CAP measures on productive factors demand, driving both structural change and farm growth. Moreover, the effects of CAP on farm size and land markets are the most studied structural factors. The objective of this contribution is to conduct exante analysis of the impact of the new CAP policy instruments on the land demand and then to simulate the reform impact on land market. In particular in the paper the effect of greening payments and the introduction of regionalized payments will be investigated, through the implementation of mathematical programming model. The results of our work highlight the relevance of new CAP instrument in changing land demand. Our results can to contribute to the national debate by providing a better to understanding the potential effects of the CAP reform on the value of land and on the changes in land demand.
JEL: Q18 – Agricultural Policy; Food Policy; Q10 General

Keywords: common agricultural policy; mathematical programming model; land demand; regionalised payments; scenario analysis

1. Introduction

Agricultural economics literature widely studied how Common Agricultural Policy leads to changes in the use of productive factors at farm level. Most Authors pointed-out the positive effects of the CAP measures. Such measures had driven both structural change and farm growth (see for example Harrington et al., 1995; Happe et al., 2008; Ahearn et al., 2005). Thus, the effects of the CAP on farm size and land markets are the most studied among structural factors (Ciaian et al. 2010; Bartolini and Viaggi 2013). Agricultural economics literature is interested in land use changes and in land market, as land is among the key variables in farm household models, as well as a relevant constraint on those models. In addition, land can represent the overall output of farm household decisions (see Piorr et al., 2009).
At present, the CAP is facing a deep reform process. In October 2011, the European Commission published the official proposal for the CAP reform (COM(2011)625/3), which had been debated until June 2013, when the European Parliament and the Commission came to an agreement. The member states will not officially approve the CAP before August 2014. The proposed CAP reform reconsiders the first pillar policy, while introducing novelties within the second pillar policy. In Italy, the main innovations concern a) the introduction of "active farmers", b) the shift of single farm payments from an historical towards a regional base, and c) the disentanglement of the basic payment into several components. As a result of the introduction of the "active farmers", only those farmers who fulfil the requirements set by the Regulation (EU) No 1307/2013 (Articles 9(1) and (2)) will access the payments (COMMISSION DELEGATED REGULATION (EU) No 639/2014 of 11 March 2014). Shifting single farm payments from a historical towards a regional base means that basic payments will be proportional to the operated farmland. With the disentanglement of the basic payment, four different components would form the payment for each farm: (i) the basic payment for "active farmers", (ii) the "greening" direct payment, (iii) the pay-

ment for less disadvantaged areas, and (iv) the payment to "young farmers" and "small farms".
The objective of this contribution is to conduct ex-ante analysis of the impact of the new CAP policy instruments on land demand, as well as to simulate the impact of the reform on land market. The present paper investigates the effect of the greening payments and the introduction of the regionalized payments by means of mathematical programming modelling.
The results of our work highlight the relevance of new CAP instrument in changing land demand.

2. Methodology

Agricultural economics studies land use and its connections with policy under three different perspectives: a) changes in the preferences with regard to land tenure, b) the capitalization of payments into land prices or farmland rental prices, and c) effects of the policies on land demand, for, land markets, and land reallocations (Viaggi et al., 2013). The impacts of the policy on land market had been investigated through a number of different approaches, mainly econometric methods, statistical methods, and mathematical programming modelling (Latruffe and Le Mouël, 2009). Econometric and statistical methods are often used to investigate the determinants of certain expected changes over potential changes in land demand (See for example Douarin et al. 2008), as well as to assess the probability for farms to turn into definite possible states over time (e.g by applying the Markov chain model) (see for example Zimmermann et al. 2009). Mathematical programming is used to simulate both ex-ante impacts on land demand and changes on land prices (i.e. purchase and rent agreements). Mathematical programming also allows to test different hypothesis about relevant parameters such as changes in the level of prices, amount of payments, cost of labour, and other inputs (see for example Happe et al 2008; Galko and Jayet 2011). Following Bartolini and Viaggi (2013), the marginal changes in land demand result from the Willingness to Pay (WTP) or the Willingness to Accept (WTA) for land, given a fixed policy scenario and an initial land endowment. Where, the WTP and WTA are functions of the geographical household, the farmers and farm's characteristics. Following Deininger et al. (2008), a generic farmer can claim for additional land when the WTP for the land exceeds the sum of rental prices and transaction costs (see Eq. 1 for the formal expression). Conversely, the farmer shrinks the surface of operated land when the WTA is under the rental prices (received) minus the transaction costs (TC) for rent out land (see Eq2 for the formula). Finally, there is no change in land demand at single farmers' level when the sum of rental prices plus TCs exceeds the WTP, and, at the same time, the WTA exceeds the rental prices received minus the related TCs.
Agricultural economics literature widely studied the impacts of TCs on land demand and on land market. The total transaction costs depend on frequency and asset of transactions, farmers' characteristics, quality of social relationships, and trust among peoples, as well as on institutional factors (see Williamson 1996, Allen and Lueck 2003 and Ciaian et al., 2012), When considered together, the transaction cost and the changes in land demand provide the sum of total time spent for collecting information about the availability of rentable land rent plus the cost of contract registrations. Moreover, farmers renting out land are subject to TCs, due to time spent for searching farmers interested in the transaction. The increase TCs leads to a reduction of the number of transactions number and positively affects rental prices.

$$WTP > r + tc_{in} \quad (1)$$

$$WTA < r - tc_{out} \quad (2)$$

$$r - tc_{out} > WTP / WTA > r + tc \quad (3)$$

The proposed methodology contains three steps: a) identification of representative farm households, b) development of policy scenarios, and c) mathematical programming modelling.
The present study refers to farms located within a local administration (Province of Pisa) of the Italian Region of Tuscany. Representative farms were identified performing a cluster analysis. The implementation of simulations using built rather than real farms is common in agricultural economics literatures (see for example Bartolini and Viaggi 2012). The main advantage of cluster analysis is its ability to create groups of farms which are both homogeneous and very different from one another. In addition, median values of group characteristics allow to create farm profiles that are representative for each group of farms (see example in Galko and Jayet 2010). The cluster analysis returned 14 groups of homogeneous farms: 6 located in plain areas and 8 groups hilly areas[1]. Policy impacts were quantified via scenario analysis. We simulated the impacts of the CAP post-2013 on changes in land demand by developing two alternative policy scenarios, based on different assumptions with regard to the amount of the regionalised payment and to the introduction of the greening measure. An additional scenario encompassing the complete abolishment of the CAP was built to capture the full effect of the Single Farm Payment (SFP). Table 1 shows the main assumption we made in order to built the alternative scenarios.

Table 1 Features of scenarios.

Scenario	code	Level of SFP per rights	Rights	Greening
Baseline HC 2008	ba	Historical	Current Entitlements	No
Baseline1	ba1	Historical	Current Entitlements	30% of basic payment
Regionalized 0	rp0	206.35	Current entitlement	30% of basic payment
Regionalized 1	rp1	135.94	Payment per ha of UAA	30% of basic payment

The baseline scenario (*ba*) is developed assuming 2013 payments SFP on a historical basis and number of rights equal to those endowed by the farms in 2013. The scenario is build under Health Check 2008 reform. Baseline HC 2008 scenario (*ba1*) differentiates from *ba* for introduction of greening measure. The level of SFP and entitlement mechanism remains constant. We simulated two regionalised payment mechanisms (*rp*): (i) *rp0* is is based on the application of a uniform payment per entitlement (flat rate), and (ii) *rp1* is based on a uniform payment per hectare of UAA. Thus, the level of SFP will be higher for *rp0* (about 206.35 € per right) than for *rp1* (135.94 € per ha)[2].
The third step of the methodology relies on the simulation of farmers' behaviour in response to

1. Cluster analysis is conducted using a subset of farmers surveyed in the 2010 census in Pisa province (4868 farms). A sub-set is realized excluding farm with very low farm size. The groups are indentified using k-means non-hierarchical clustering method and the groups are identified by the one with higher Calinski/Harabasz pseudo-F value. Cluster group are conducted using farm size, amount of SFP payments received and amount of household labor allocated to on-farm activities as variables. To detect collinearity among selected variables, a pairwise correlation test is applied. The test returns low coefficients of correlation among variables: 0.4243 for pair farm size and amount of SFP payments; 0.2843 for pair farm size and household labor allocated to on-farm activities and 0.1135 for household labor allocated to on-farm activities and amount of SFP received. Otherwise, farm specialization variables are not considered due to expected correlation with payments received and farmland size.
2. The SFP is calculated as sum of all SFP received by Tuscany famers divided by the amount of eligible area. Thus for the np0 scenario eligible area is equal to the sum of all entitlements owned by Tuscany Farmers, while for all UAA in a case of rp1 scenario.

policy changes. We modelled land demand using Mathematical Programming modelling. Generally, farmers aim at maximising the Net Present Value (NPV) of profit of their farm activity; the maximization on the NPV is subjected to a set of constraints. Formally:

$$\max NPV = \sum_{n=1}^{N=2020} \pi^n (1+i)^{-.n} \tag{4}$$

$$\text{With } \pi^n = x_i(i_i - c_i) - x_i^d k_i + SFP_e * e - xl_{in} * p_{in} + xl_{out} * p_{out} - xj * p_j \tag{5}$$

s.t.

$$\sum_i x_i = xl_{ow} + xl_{in} - xl_{out} \tag{6}$$

$$\sum_i x_i * a \le A; e \le ent; xl_{in} \ge 0; xl_{out} \ge 0 \sum_i x_i > 0 \tag{7}$$

Where the profit for a generic year *n* is given by the sum of the farm income minus the variable and fixed costs of growing crops, *i*, minus the cost of renting-in land and the cost of labour paid, plus the received SFP and the costs of rented-out land (when applicable). Equation 6 is the land demand equation. Due to the short time period, we assumed that only rental market is activated, thus farmers could either increase the surface of the operated land by renting land or reduce the surface of the operated land renting-out a portion of their own land. The set of equations 7 show the technical constraints we activated: (j) a maximum number of entitlements endowed by the farmer (See Bartolini and Viaggi, 2013 and Severini and Valle 2011) and (ii) non negativity constraints of land and crops variables. The model refers to short-medium period, with a time horizon between year 2014 and 2020. The short-medium period allows only for adjustment in variable factors, while the fixed factors are considered as constants. Literature about the CAP's effects on land market largely focuses only on rental prices. Actually, rental price changes and land value either have a close relationship(see Bartolini and Viaggi 2013) or are more dependent on other factors rather than profitability of agricultural activities with respect to the demand for land (i.g. position; life cycle hypothesis, credit markets etc. see Swinnen and Knops 2013 for a review). Moreover, the selected time span (short–medium term) is not able to provide a coherent behaviour of famers' investments; hence, neither the purchase nor the rental of land can be robustly investigated (See Puddu et al., 2012 for an analysis of policy impact on land demand considering both rental and buying market).
Data used for the simulation were obtained by merging CENSUS 2010 microdata with the ARTEA (regional payment agency of Tuscany) database. The latter has recorded all payments received by farmers since 2005, which we integrated with information about the dynamics of land market and prices, directly collected through interviews with experts.

3. Results

Results are presented in the two following tables. Firstly, model results under baseline scenario (historical system without greening measure) are presented. Scenarios' effects on marginal rental value are presented under the alternative assumption of transaction costs.

Table 2. Model results under baseline scenario.

Cluster	Alt.	NPV (1000 €)	SFP (1000 € per year)	Entit.(#)	Payment (€/entit)	UAA (ha)	Land owned (ha)	Land rented-in (ha)	Land rented-out (ha)
CL1	plain	170.09	5.39	22	239.80	35.1	16.94	18.16	-
CL2	plain	1,028.52	49.13	119	412.87	183.43	96.78	86.65	-
CL3	plain	940.69	75.46	105	718.69	122.04	237.52	-	115.48
CL4	plain	971.03	30.90	109	284.66	180.14	81.72	98.42	-
CL5	plain	68.26	-	-	-	12.69	9.04	3.65	-
CL6	plain	454.76	16.71	65	258.79	99.01	33.71	65.3	-
CL7	hill	1,060.43	32.81	264	124.30	265.8	184.05	81.75	-
CL8	hill	176.55	4.75	23	206.86	34.2	20.21	13.99	-
CL9	hill	638.45	22.11	94	234.03	141.21	60.08	81.13	-
CL10	hill	454.52	14.47	62	232.13	91.65	50.88	40.77	-
CL11	hill	790.34	23.72	159	149.20	161.97	90.38	71.59	-
CL12	hill	95.90	-	-	-	16.14	9.3	6.84	-
CL13	hill	99.81	2.00	11	183.46	17.34	11.17	6.17	-
CL14	hill	295.51	9.15	29	315.48	60.27	27.99	32.28	-

According to our analysis, most clusters present a similar behavior with respect to land demand under baseline condition. Almost all clusters use rented-in land to increase the surface of the land operated, while only cluster CL3 rents-out a portion of land. This cluster rents-out more than 50% owned land. The amount of SFP received by the farms are highly heterogeneous. All clusters get the SFP, but CL5 and CL12.SFP received by farms is under 10,000 € for CL1, CL8, CL13, and CL 14 and above for all other clusters. The amount of SFP is higher than the expected, because of the exclusion of all farms operating less than 1 hectare. Those farms were excluded due to negligible impact of SFP changes on small farms. (Viaggi et al., 2013). SFP provided to single farms is heterogeneous because of their amount of collected rights and their level of unitary payment. Three clusters (CL2, CL3, and CL14) show very high unitary payments, i.e. about two or three times bigger than all other clusters. The value of the unitary payment is above the average for CL9 and CL 10 and under for CL7 and CL11 However, the endowments which CL7 and CL 11 are entitled for are nearly twice other clusters' endowments.
Table 3 contains the changes in the surface of the operated land and in the marginal value of land, compared with baseline results.

Table 3. Policy impact on land demand (% of change in UAA and in WTP[3]).

Cluster	ba1		rp0		rp1	
	UAA	WTP	UAA	WTP	UAA	WTP
1	-	-	-	-	-	-
2	-	-	-0.07	-	- 4 .02	-
3	-	-	- 77.31	-	- 78.64	-
4	-	-	-	-	-	-
5	-	-	-	-	1.13	-
6	-	-	-	-	-	-
7	2.43	-	-	-	-	-
8	-	-	-	-	-	-
9	-	- 0.11	-	- 12.20	-	- 20.00
10	-	-	-	- 19.51	-	- 19.66
11	2.03	-	2.03	-	-	-
12	-	-	-	-	-	-
13	-	-	-	-	2.41	-
14	-	-	-	- 19.30	-	-14.20

Changes in the marginal value measure the increase of the objective value of having an additional hectare of land. Agricultural economists refer to the marginal value and to the changes in farmers' WTP as benchmarks to quantify changes in rental prices (Galko and Jayet, 2010). In fact, the model returns changes in the objective function (NPV) by adding one additional unit of land; then, the marginal value can capture changes in the willingness to pay for an additional land or in the willingness to accept for additional land.

According to our model, few farmers are affected by changes in land demand, due to the inclusion of the greening measure.. Only three farmers show reactions to the introduction of greening (*ba1*). Two clusters CL7 and CL11 show a relatively low increase(about 2%) in the surface of operated land, due to the needs to enlarge farm size to fulfill the greening requirements. It was not surprising noting that the clusters have entitlement endowment above the average of clusters, as well as the highest share of eligible hectares per UAA. Hence, farm types willing to maintain the whole SFP find profitable to rent-in more land to maintain the constraint of the maximum 75% land cultivated with the main crop. Conversely, CL9 only shows a reduction of WTP for additional land, due to the introduction of new crops within the crop mix, as it required by the diversification commitments.

The model shows that on third of clusters (CL2; CL3; CL5; CL9; CL 10; CL11; CL14; CL15:) seems be affected by a reduction in land demand following the introduction of the regionalized payments. expectation It was surprising noting that those clusters are the ones getting the highest payments per entitlements, rather than the ones with the highest support from SFP.. Those results seem to confirm previous literature findings on the impact of regionalized payments (Puddu et al., 2014). The introduction of both the uniformed payments per entitlements and the greening (*rp0*) resulted in a reduction in operated land in two farms and in an increase in cluster CL11 only, as it was observed for previous scenarios. The clusters with the higher unitary value of SFP are those which reduced the operated. The introduction of uniform payment per entitlements reduces by one third the unitary value of payments (CL2 and CL3). Cluster 2 shows a relative small

3. Willingness to pay refers is quite huge concepts and includes market value, not market value and option value. In this paper WTP can be approximated to shadow prices for increase of one unit the amount of operated land, due the private agents and the limitation at the rental market.

change in the operated land, while cluster 3 showed a rough 70% reduction, mainly due to a higher share of rented-out land. For other clusters, the model highlighted a reduction in WTP for an additional amount of land, while maintaining the same operated land (CL 9, CL10 and CL 19.30). The introduction of regionalized payments per hectares of UAA (rp1) produced patterns of changes very similar to previous scenarios, but for the higher magnitude. The introduction of uniform payment per hectare of UAA determined an increase in the operated land for the two clusters that do not receive payments under baseline. Contrary to all expectation, the increase is relatively small, thus highlighting other limiting factors to farm expansion. Overall, our results confirm previous literature findings about the positive effects of SFP in maintaining operated farm land (Bartolini and Viaggi 2013 and Puddu et al., 2014).

4. Conclusions

In this paper we simulated the policy impacts on the land demand. Changes in the land operated and in the marginal value of land were used as proxies for WTP or WTA. Several authors simulated ex-ante impact of new CAP policy instruments. The aim of this paper is to provide empirical evidence about the impact of the new CAP instruments. Our results highlight that regionalized payments would affect the change land demand more than other tested policy instruments. Our results point out the prominent role of the new SFP payments in affecting changes in land demand and confirm previous literature findings (Puddu et al., 2014). In particular, our results highlight the heterogeneity of the impacts of the new policy mechanism. A shared outcome of the new CAP, for some clusters, is the quite high reduction of the overall land demand. Such reduction might determine detrimental effects on rental value that can be attenuated by the implementation of the coupled payments for specific sectors (which were not included in the model for the uncertainty in the extent of the payments due to earlier stage of the reform process). In particular, it seems that livestock, cereal and olive famers will benefit quite relevant coupled payments. As a result, those sectors are expected to be less affected by changes in land demand or in rental market.

Altogether, the results of our study confirm an overall reduction of land demand and land market activity, due to the introduction of rationalised payments, and show different impacts on different representative farms. The main drivers of the impact are the endowment of entitlement, the unitary payments level, and the share of eligible land over the total UAA. According to our results, the shift to the flat rate for SFP (the so-called "Irish model" that has been selected for Italy) should have a smaller impact on the change in land demand, as the convergence mechanism will allow for gradual adjustments. The Irish model scenario is a quite comparable with *rp0* scenario.

The paper is affected by several limitations, due to the attempt to simulate policy changes without having clear norms to refer about both the amount of regionalisation payments and the level of coupled payments (i.e. Art. 68). Moreover, the proposed model does not deal with uncertainty and risk in farming activities which literature point out as being able to affect changes in farmers' behaviour. Finally, the paper does not simulate land market, but use the marginal value to as a proxy for land demand changes.

Further work would include further components of risk and investment in farmers' behaviour, as well as the simulation of the interactions among different clusters.

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