The role of the Common Agricultural Policy in the spatial location of agricultural activities

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Abstract— **The objective of this paper is to analyse and quantify the spatial dimension of the CAP effects in an area of Northern Italy. The analysis is based on survey information about stated intentions of farm-household in two CAP scenarios, treated through statistical analysis intended to identify the potential determinants of different farm reactions, focusing on explicit spatial variables (altitude, LFA, agrarian regions) among explanatory variables. Altogether, the study shows the relevance of explicitly addressing the spatial effects of policies and also the differentiated spatial effect of policy on different dimensions of agricultural activities. However, the work also highlights the limitation of the location-based representation of the spatial dimension compared with both non-spatial variables and more functional variables underlying the spatial dimension.**

Keywords— **Common Agricultural Policy, Spatial effects, Emilia-Romagna.**

II. INTRODUCTION

The European Union (EU) agriculture is undergoing major structural and technical changes, which are expected to continue in the foreseeable future. These changes are (potentially) non-neutral in spatial terms. In recent decades, farm exit has affected in particular peripheral areas, while new linkages are emerging between the location of farming activities and local markets.

The Common Agricultural Policy (CAP) of the EU is perceived as a major determinant of such changes. Several studies addressed the issue of structural change and farm/farm-household structural reaction to policy reforms in the European Union.

Agricultural economics research has addressed the issue of spatial effects in different ways. Model representing farming systems have increased their attention to spatial aspects ([1],[2],[3],[4],[5],[6],[7]). On the other hand, location or spatially explicit variables may be used in econometric models to explain differentiated behaviour by farmers.

However, the spatial dimension of such effects is less often taken into account in survey-based studies including stated intentions facing CAP changes.

Particularly in view of the next expected reforms (post 2013 CAP), a deeper understanding of the spatial effect of the CAP is required in order to understand its role in achieving territorial cohesion objectives and the likely changes in spatial location of agricultural activities in case of changes of CAP design.

The understanding of the territorial aspect can be relevant under different angles, first of all, cohesion objectives of EU public policy, which makes it particularly relevant for interpretation in relation to CAP effects ([8]).

The objective of this paper is to analyse and quantify the spatial dimension of the CAP effects in the province of Bologna (an area of Northern Italy). In particular, we quantify the association between different CAP scenarios and changes in agricultural activities in different sub-areas of the study area considered, differentiated by altitude, LFA status and Agrarian region (see below).

Understanding and/or building expectations about the effects of the CAP in spatial terms requires getting preliminary insights about how the CAP itself is shaped spatially. The main chapter of the CAP, the so called Pillar I, provides now payments for income support that are decoupled from production. So in principle they should not provide incentives to a particular land use and their removal should not cause land use changes. On the other hand, the payments represent a relevant income support, so their removal can be expected to affect farm exit. However, payments were previously set to reflect past yields and

have been allocated on an historical base in Italy. As a consequence, their removal should provide a change in income expectations somehow proportional to the productivity of each area.

The second component of the CAP, the so called Pillar II is rather more complex in spatial terms. First, it is composed of several tens of measures organised into three axes plus the Leader one, each measure having a specific territorial application. Secondly, some measures are especially designed to provide compensatory payments for disadvantaged areas. Their lifting would be especially sensitive in spatial terms, though the size of such payments would be likely not so important in many areas and again, only directly connectable to incentive to stay in farming rather than to more specific farm choices.

In spite of this articulation, we do not consider the separate effect of each policy component but rather stick to the overall effect.

A second specification of the model is that we use the interpretation of the term “spatial” relying only to the simplest idea of location, while we do not directly consider the spatial component in terms of distances or more sophisticated concepts.

III. METHODOLOGY

The paper is based on the analysis of survey-based data derived from responses of farmers about future farm and household changes under different scenarios. The survey data (see next section) are analysed through a statistical analysis of farm-household choices intended to identify the determinants of different farm reactions, including explicit spatial variables among explanatory variables.

The main spatial-related information concern: a) altitude; b) location in an LFA; c) location in a specific Agrarian region.

The main dimensions of change detected by the survey and used for the analysis to explore connections with location include: a) exit from agriculture; b) on-farm investment; c) farm technology change; d) input use intensity (e.g. in terms of fertilisers and pesticides).

The full list of variables used in the analysis is available in annex 1.

Answers to these behavioural variables have been collected in two different scenarios: a baseline scenario represented by the policy in place in 2009 and an alternative No-CAP scenario, assuming the complete removal of the CAP.

The statistical analysis has been performed using. a Pearson's chi-square test as a test of independence. It assesses whether paired observations on two variables expressed in a contingency table (location and change),, are independent of each other. If the test is significant it is justified to reject the null hypothesis that the row variable is unrelated to the column variable. The alternative hypothesis corresponds to the variables having an association or relationship. To understand the direction of the relationship we compared the expected frequency with the observed ones. The significant associations cannot be used to infer a causal relationship between the two variables, but should rather be interpreted in a weaker way, as indicating the potential connection of two variable modalities.

Different directions of change do not exclude each other, so association with opposite modalities of the same variable are plausible for the same location.

The empirical information about household behaviour under the two scenarios is collected by way of a survey and is hence based on stated intentions. The use of stated reactions as a good indicator of actual behaviour can be questioned. However, available literature corroborates the idea that stated intentions reveal the actual behaviour in a majority of cases (see [9] for a short review of this issue).

The questions to which the location variable are associated, so each variable listed in the annex, was formulated as a close qualitative question, with to potential formulations: a) each household was asked, under each scenario, if they expect to have decrease, increase or no change in the relevant variable; results, for these variables are expressed as association with specified direction of change: “+” means association with an increase of the variable’s value, “–“ expresses an association with a decrease of the variable’s value, while “=” mans an association with no change; b) each household was asked, in each scenario, if they would do or not such a change as described in the question; results, for these variables are expressed as association with specified answer: “Yes” means association with a

positive answer, while "No" means an association with a negative answer. In both case, no symbol in the table means no significative association.

IV. CASE STUDY AND DATA COLLECTION

The area considered in the analysis is the province of Bologna (NUTS 3), located in the centre of Emilia Romagna (NUTS 2), Northern Italy. The province is characterised by a mix of plain, hill and mountain areas, distributed respectively from the North to the South. About 42% of the province area and 12% of the province population are located in the mountain and hilly area. This already denotes a rather uneven distribution of population between the two areas, which is even growing as, in the last 30 years, population has continued to decrease in hill and mountain areas and increase in plain areas.

The mountain and hill area is characterised by high internal heterogeneity of development, mainly connected to different environmental features (soil, altitude) and with infrastructure development (roads, railways).

As for agriculture, the hill and mountain area includes about half of the farms of the province. The number of farms is declining in the whole province. Between 1982 and 2000, based on census data, the number of farms in the province has declined by 33% on average, with a minimum in the mountain area (30%) and a maximum in the plain (35%). On the contrary, cultivated land (UAA) has been declining more sharply in hill and mountain areas (about 50% between 1960 and 2000) and to a negligible extent in the plain area.

Based on the 2000 census, farm size expressed as Total Agricultural Area (TAA) is 14 ha/farm in plain, 16 ha/farm in hill area and 11 ha/farm in the mountain area. However, UAA per farm in mountain areas was much smaller, with about 5 ha/farm.

In terms of land use, the mountain area is mainly characterised by permanent grassland and pasture, in some areas connected to quality dairy production. Hilly areas are also relevant for fruit and vineyard production. The plain area is dominated by arable crops, in particular cereals, but also vegetables. Fruit production is also relevant in some areas of the plain.

The data used come from a survey of about 300 individual farm-household in the province of Bologna, carried out in 2009 in the framework of the project CAP-IRE (Assessing the multiple Impacts of the Common Agricultural Policies (CAP) on Rural Economies, 7th Framework Programme, www.cap-ire.eu). The sample includes farms in plain, hill and mountain areas, as well as at a different distance from the main urban area of the province.

Sampling was conducted based on a stratified sample from the beneficiaries of the Single Farm Payment of the province of Bologna, made available by the regional administration. The sample was stratified according to the amount of SFP (above or below the average of the province) and location (plain, hill and mountain).

The survey was conducted by telephone. The questionnaire asked farmers about their intended behaviour in the next ten years, on a number of dimensions (structural, organisational, environmental) .and under the two different scenarios discussed above.

The main location variable used in the analysis was altitude, divided in plain, hill and mountain.

Other location-related variables were also explored. Municipality was first considered. However, it revealed to have a too low number of observation per municipality to be a valid location variable.

Agrarian region were also tested. In the Italy statistics system, agrarian regions are aggregation of municipalities that have homogeneous characteristics in terms of agriculture (specialisation, structure) and are homogeneous in terms of altitude, within the same Province. The province of Bologna is divided into 8 agrarian regions.

Finally, location in a Less Favoured Area (LFA) as also considered. The location variable include also partial location in LFA, which concerns the cases in which the municipality in which the farm is located is partially included in an LFA.

Both Agrarian regions and LFA are clearly related to altitude, so some homogeneity among the three analyses was expected. However, the results revealed also relevant differences, so the three views were all retained.

V. RESULTS

The preliminary results confirm that the trends in farm structural and technological change are non-neutral with respect to spatial location (table 1).

Table 1 – Main variables showing association with location, CAP and No-CAP scenario (significativity at 10%)

	CAP			No-CAP		
variables	**plain**	**hill**	**mountain**	**plain**	**hill**	**mountain**
Household labor on farm	-	+	=			
Non household labor on farm	+	+	=	-	+	=
Other activity	+	+	=	+	+	=
Use of pesticides	-	-	=	-	-	=
Use of water				-	+	=
External machinery services	+	+	=	+/-	+/-	=
Innovation in robotisation	yes	yes	no	yes	yes	no
Innovation in irrigation system.	yes	yes	no	yes	yes	no
Innovation in ecommerce	yes	yes	no	yes	yes	no

However, only 9 out of 42 variables considered show significative associations.

The first major observation is that most of the associations showing a direction different from "no change" concern plain and hill, while mountain is generally characterised by no change in most of the variables.

In many cases, the direction of the association is also similar across the two scenarios, revealing that the prevailing trend is not modified by the hypothesis of removing the CAP. However there are relevant exceptions to this.

None of the variables concerning exit from farming activity or land ownership/renting appear as significative. This means that there is no major structural process differentiating the three altimetric areas, and, in addition, this is not differentiated across associations.

The use of labour shows different trends connected to different locations. Household labour shows an association of the decrease of labour use with plain areas and an association of increase of labour use with hill location; however this happens only in the CAP scenario, while there is no significative association in the No-CAP scenario. The outcome concerning labour is consistent with the different opportunity cost of labour in plain and hill areas, due to higher development of alternative activities at a short distance.

Non household labour used on farm tend to increase significatively in plain and hill (both positive) in the CAP scenario. In the No-CAP scenario, a significative association remains with increase in labour for the hilly areas, which the association become significative with a decrease of labour in plain. Taking this together

with household labour seems to hint at some substitution between the two, particularly in plain.

Plain and hill are associated with a development of other activities, in both scenarios. These are mainly intended as non-conventional agricultural activities, such as agri-tourism, which hints at an ongoing process of differentiation whatever the scenarios, still not relevant for mountain areas.

As resource use is concerned, negative signs prevail. Plain and hill are both associated to the decrease in the use of pesticides in both scenarios. Changes in the use of water are significative only in the no-CAP scenario: the reduction of the use of water is associated to plain areas, while the increase is associated to hill areas.

Increase in the use of external machinery services are associated with plain and hill in the CAP scenario, while only the reduction of the use of machinery services remains as significatively associate to plain in the No CAP scenario.

Finally, innovation-related variables appear mainly as increase (adoption) and associated with plain areas in both scenarios. In the No-CAP scenario this extends also to hill areas for robotization and irrigation systems.

Alternative ways of explaining spatial differences in reaction to policy are illustrated in tables 2 (Less favoured areas) and table 3 (Agrarian Regions).

Table 2 – Main variables showing association with location in a LFA, CAP and No-CAP scenario (significativity at 10%)

	CAP			**No-CAP**		
variables	**LFA**	**No LFA**	**Partially LFA**	**LFA**	**No LFA**	**Partially LFA**
Household move from the farm to live off the farm[1]				no	yes	no
Household labor on farm	-	-	=			
Use of pesticides	=	-	=	=	-	=
External machinery services	=	+	=	=	+	=
Innovation in robotisation	no	yes	no	no	yes	no
Innovation in irrigation system.	no	yes	no	no	yes	no
Innovation in energy crops or production of energy				no	yes	no

1. [1] A sign minus in this case means an association with the answer no about the intention of moving out from the farm.

Table 2 – Main variables showing association with location in a specific Agrarian region, CAP and No-CAP scenario (significativity at 10%)

					CAP			
variables	**1M**	**2M**	**3H**	**4H**	**5H**	**6P**	**7P**	**8P**
Non household labor on farm	=	=	+	=	+	=	=	+
Land rent out	=	=	=	=	=	+	+	-
Other activity	=	=	+	=	=	+	=	+
Use of pesticides	=	=	-	=	-	-	-	-
External machinery services	=	=	+	+	=	+	=	+
Innovation in robotisation	no	no	yes	no	yes	yes	yes	yes
Innovation in irrigation system.	no	no	yes	no	yes	yes	yes	yes
					No-CAP			
variables	**1M**	**2M**	**3H**	**4H**	**5H**	**6P**	**7P**	**8P**
Non household labor on farm	=	=	+	=	=	=	=	+
Land rent in[2]	=	=	=	-	=	=	+	+/-
Use of pesticides	=	=	=	=	-	-	-	-
External machinery services	=	=	+	=	=	-	-	-
Production under contract	=	=	=	=	=	=	-	-
Innovation in robotisation	no	no	yes	no	yes	yes	no	yes

2. [2] +/- means that both directions of change are significatively associated with the respective Agraria region.

The results for the LFA areas reflect to a large extent the differences between different altimetric zones, with non-LFA areas showing a behaviour similar to plain and hilly areas, while LFA show a behaviour similar to mountain areas. Partially LFA areas are similar to LFA, with the exception of the use of household labour on-farm, in which the reduction seems to be associated only to LFA areas.

The two main interesting issues compared to altimetric zones are changes in household location and innovation in energy production. Changes in household location from on-farm to off-farm shows associations in the case of CAP removal, while there is no significative association in the case of the present CAP scenario. Besides, the association is negative with total and partial LFA conditions, while it is positive with location in non-LFA areas. Altogether, it seems that the CAP encourages staying on the farm, but not in LFA. However, it should be highlighted that this outcome is generated by the answer of very few respondents.

Uptake of energy crops become significative if the CAP is lifted in non-LFA areas. This is relevant to show that energy production would be of relevance as a competing use of soil in the most fertile areas (plain and hill). In addition, it is seen rather as a substitute of current crops in the case the CAP is removed (i.e. the CAP produces disincentives towards adoption of energy crops).

The use of Agrarian regions as an indicator of location show a substantial confirmation of the outcome for the mountain/LFA areas, in which location is significatively associated only with no change answers.

Hilly areas show a substantial heterogeneity, as no variable has the same behaviour in all three Agrarian regions. Among the three Agrarian regions, the Agrarian region n. 4 (located in the western part of the province) seems to be less close to the other two, that show some similarities and are general more reactive. The heterogeneity seems to be emphasised in the No-CAP scenario.

The plain areas are again rather heterogeneous, even if, for several variables, only two out of three reflect the association identified in the case of using altitude as the location variable.

Compared to altitude and LFA as explanatory variables, this is the only case in which renting plays a role as a significative association. In particular, increase in land rent-out is significatively associated to plain Agrarian regions 6 and 7 in the CAP scenario. The same happens for rent-in for Agrarian region 7 in the case of No-CAP scenario, in which also Agrarian region 8 shows some significativity different from no-change, going, however in both directions. This may reveal an internal heterogeneity in the area and a higher association of either directions of change compared to other areas.

The shift of policy from CAP to No-CAP seems to have a relevant effect here. The main effect is to shift from an association with increase rent-out in plain (in the CAP) to increase rent-in in plain (in the No-CAP), that could be interpreted as an expectation of higher profitability from renting in the case of the CAP and expectation of lower renting prices in the case the CAP is removed. The opposite happens, even if with a less detectable effect, in the hilly area, in which the renting-in of land seems to be depressed by the removal of the CAP.

VI. DISCUSSION

The overall message arising from this paper is the difficulty in finding a clear connection between policy removal and location. This can be caused by several issues related to the study design, such as the use of very simplified variables to assess farm reaction, some difficulty in providing answers to future intentions, and potential biases in the understand of scenarios. However, it seems even more likely that the general message reveals that spatial location is in fact a poor explanation of major structural changes, at least in the area, where a number of major external drivers, such as urban development, family life cycle and economic trends, guide choice about ownership, as it often happens for land dynamics associated to land markets ([10]).

On the contrary, activity choices, technical change and production techniques are still connected to location in a higher measure. In particular, the plain area seems to be more dynamic and reactive to scenarios, probably because it is characterised by more flexible systems and because it has resisted adaptation

in the last years due to higher profitability, while the reduction of crop cultivation has already been dramatic in the last 50 years in hilly and mountain areas, leading to the very extensive systems with less room for adaptation.

The hill area appears as dynamic as the plain area, which is not surprising in the province of Bologna, as the hill area has specific strengths (connect, for example to some fruit or wine production), and is generally well connected to plain through road infrastructure. As a result, it is not just as intermediate between plain and mountain. This may be also relevant to note in order to avoid oversimplifications linked to patterns of altitude or to patterns in land productivity.

The comparison of the two scenarios shows that their effect is not straightforward, which also justifies further research in this direction. This is not surprising as, after decoupling, policy effects are less oriented in specific production directions and more determined by a mix of location, personal and path-dependent or opportunity driven variables. This is confirmed by other studies, such as [11]. The variables that are most independent from the hypothesised policy change and that have relevant differences in the association with location are the increase in other activities, the decrease of input use, and the increase in e-commerce innovation. This seems consistent with the present trends of the agriculture in the area.

In terms of policy effects, the removal of the CAP would cause contrasting effects in the direction of labour and water use, while the use of machinery services would altogether decrease. Innovation seems to become stronger in the absence of the CAP. The economic rationale behind this could be find in the fact that, removing public support would induce a higher number of farms to shift from a rent-seeking to a more entrepreneurial attitude. However, this is also in contrast with expectations from the fact that the second pillar component of the CAP (explicitly included in the CAP removal scenario) provides in fact incentives to innovation and the that the first pillar would provide liquidity for investment through unconstrained payments. This would call for further scrutiny into the interactions and potential offsets between different policy components.

VII. CONCLUSIONS

To some extent, the study shows the relevance of explicitly addressing the spatial effects of policies and also the differentiated spatial effect of policy on different dimensions of agricultural activities. However, the spatial components of future trends and the spatial effects of removing the CAP are not particularly evident and only reveals as significative in a few selected variables.

The work also highlights the limitation of the most traditional representation of the space dimensions connected to location and the need for a more functional interpretation of the spatial dimension based on a better understanding of the underlying spatially-relevant variables. This was not directly addressed in this paper and would be of interest for further work. In addition the work could be refined taking into account a more fine scale for spatial analysis (e.g. municipality).

While the spatial component, being directly relevant in policy design, certainly deserves further attention, particularly in view of its easiness of usability as a zoning instrument in policy deign, the results also confirm that the spatial dimension alone is not sufficient to explain the effects of major policy changes.

As a result, enquiring into the less deterministic causes of change, such as entrepreneurship attitude and non-local knowledge and material connections would remain a growing issue for future research. IN addition, disentangling the effects of different policy components would be a further work of some interest, though this would require a replication of the empirical part.

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Annex 1 – Full list of variables used in the anlaysis

variables	description
go_onA	Intention to continue farming activity in the cenario CAP
go_onB	Intention to continue farming activity in the scenario No-CAP
to_live_onA	Intention to move the household from present location to live on the farm in the scenario CAP
to_live_onB	Intention to move the household from present location to live on the farm in the scenario No-CAP
to_live_offA	Intention to move the household from the farm to live off the farm in the scenario CAP
to_live_offB	Intention to move the household from the farm to live off the farm in the scenario No-CAP
hh_lab_onA	household labour used on the farm in the scenario CAP
hh_lab_onB	household labour used on the farm in the scenario No-CAP
hh_lab_offA	household labour used off the farm in the scenario CAP
hh_lab_offB	household labour used off the farm in the scenario No-CAP
nhh_lab_onA	Non household labour used on the farm in the scenario CAP
nhh_lab_onB	Non household labour used on the farm in the scenario No-CAP
land_ownedA	Land owned in the scenario CAP
land_ownedB	Land owned in the scenario No-CAP
land_rentinA	Land rented in in the scenario CAP
land_rentinB	Land rented in in the scenario No-CAP
land_rentoutA	Land rent edout in the scenario CAP
land_rentoutB	Land rented out in the scenario No-CAP
oth_activityA	Other activity in the scenario CAP
oth_activityB	Other activity in the scenario No-CAP
pesticidesA	Pesticides use in the scenario CAP
pesticidesB	Pesticides use in the scenario No-CAP
waterA	Water use in the scenario CAP
waterB	Water use in the scenario No-CAP
buildingA	farm endowment of buildings in the scenario CAP
buildingB	farm endowment of buildings in the scenario No-CAP
machineryA	farm endowment of machinery in the scenario CAP
machineryB	farm endowment of machinery in the scenario No-CAP
external_machservA	farm endowment of external machinery services in the scenario CAP
external_machservB	farm endowment of external machinery services in the scenario No-CAP
contractA	amount of production under contract in the scenario CAP
contractB	amount of production under contract in the scenario No-CAP
inn_robotA	Innovation in robotisation and/or precision farming in the scenario CAP
inn_irrigationA	Innovation in new irrigation systems in the scenario CAP
inn_ecommerceA	Innovation in ecommerce in the scenario CAP
inn_energyA	Innovation in energy crops or production of energy in the scenario CAP
inn_othA	Other innovation in the scenario CAP
inn_robotB	Innovation in robotisation and/or precision farming in the scenario No-CAP
inn_irrigationB	Innovation in new irrigation systems in the scenario No-CAP
inn_ecommerceB	Innovation in ecommerce in the scenario No-CAP
inn_energyB	Innovation in energy crops or production of energy in the scenario No-CAP
inn_othB	Other innovation in the scenario No-CAP