What is below the CAP? Evaluating spatial patterns in agricultural subsidies

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Abstract

Common Agricultural Policy (CAP) ensures competitiveness and a common organisation of agricultural markets. Since 2003, CAP reform has been defining differentiated public incentives, including regionalised payments, based on land extension and/or farm-specific support. In this setting, farmers become increasingly dependent from public support and the role played by the CAP in determining and fostering agricultural sector needs more attention.
We find lack of evidences in the role played by public policies in contributing to added value production in agriculture sector. This paper aims to develop an empirical framework by using an augmented Cobb-Douglas Production function that directly consider the impact of the subsidies. The analysis takes into account the presence of spatial autocorrelation and heterogeneity in order to evaluate the occurrence of externalities. We investigate the existence of a relationship between neighbouring areas, which can directly, or indirectly, affects the formation of added value and, in overall, economic performances. In detail, using data on subsidies and economic results of farms from the RICA dataset, we provide empirical evidence on how the Italian Agricultural sector is still highly dependent by human and public capital, and highlight the presence of negative spillover effects of labour on economic performances.
The results of this study may contribute to the redefinition of the role of Community policies as an instrument for the efficiency and competitiveness of farms.

1 Introduction

During the last decades, public policies become a central pillar in supporting and stabilising agricultural sector. Since 1962, EU policy-makers developed the so-called Common Agricultural Policy (CAP) to ensure competitiveness and a common market organisation for agricultural

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products. CAP was conceived as a flexible political tool able to identify and correct market inefficiencies by promoting modernisation processes and the renewal of agricultural work force. However, a substantial revision of the CAP was required to deal with the scale enlargement and the land abandonment in less favoured areas caused by globalization of commodity market[1].

In 1992, "MacSharry" reform reverses the traditional perspective in CAP by shifting from product to producer support. This approach poses a strong emphasis on liberalization of global market by removing distortion caused by the support on prices and quantities[2]. This reforming process was consolidated in 2003 with the development of a single payment scheme. The major novelties introduced in 2003 includes the decoupling of the incentives from the production of any particular product and an increasing focus on a land-based approach and the sustainability of agricultural sector. Furthermore, EU Commission offers freedom of choice in how implement CAP. This has produced a series of differentiated public incentives, including regionalised payments on the basis of land extension, farm-specific support (e.g. France and Italy where payments are based on historical farm production levels) or a combination of both (e.g. Sweden and Germany).

In this context, farmers become highly dependent to public support. Notwithstanding, the role played by the CAP in determining and fostering agricultural sector is not yet fully investigated. This point has a twofold relevance. On one hand, European policy-makers are deeply committed in sustaining agricultural sector (43 % of total budget during the programming period 2007-2013), while total public support reached 32 % of agricultural income on average in the EU. Moreover, EU Commission, through the CAP, recognizes and promotes agricultural production and, in overall, rural areas as potential instruments to foster employment and competitiveness (Zhu et al., 2012; Olper et al., 2014).

On the other hand, decoupling public support to production stabilizes agricultural sector from prices volatility (Hennessy, 1998).This income-stabilizing attribute has a corresponding insurance effect, which may affect optimal decisions. In this sense, policy change was expected to induce efficient farms to exit unprofitable businesses leading to aggregate productivity gains for the sector and supporting behavioural changes related to farms specialization (Kazukauskas et al., 2010, 2014).

However, literature presents lack of evidences on the role played by public policies in fostering the production of added value. This paper aims to develop an empirical framework by using an augmented Cobb-Douglas Production function which directly consider the impact of the subsidies. Furthermore, our analysis considers the presence of spatial autocorrelation and heterogeneity to evaluate the occurrence of externalities. In other words, we test the existence of a relationship between neighbouring areas which can directly, or indirectly, affects the formation of added value and, in overall, economic performances.

[1]Literature on globalization of agricultural sector is widespread and heterogeneous. Key factors caused by globalization include: a major dependence on international trade to satisfy internal demand (Fader et al., 2013; Porkka et al., 2013) and urbanisation processes (Lucas, 2004).

[2]For a critical analysis of "MacSharry" Reform see: Daugbjerg (2003); Folmer et al. (2013).

2 Literature Review

The impact of agricultural policies is mainly investigated by analysing the effects on farm technical efficiency. Theoretical results on the link between subsidy-efficiency are ambiguous. Zhu et al. (2012), focusing on the case of Netherlands, Germany and Sweden, find a negative impact of the subsidies on farm efficiency. Moreover, the aforementioned authors argue the existence of an inverse relation between subsidies and efficiency (i.e. higher level of policies produce lower farmer efficiency).

The negative impact of the subsidies on productivity may result from allocative (and technical) efficiency losses owing to distortions in the production structure and factor use, soft budget constraints and the funding to less productive enterprises (Rizov et al., 2013). Policies may negatively affect farm productivity by distorting production structure of recipient farms, leading to allocative inefficiency. Indeed, farmers may start investing in subsidy-seeking activities that are relatively less productive (Alston and James, 2002). However, Bojnec and Latruffe (2013), analysing Slovenian farms, show an increase in allocative efficiency and profitability on small farms, while negative effects on technical and economic efficiency.

Giannakis and Bruggeman (2015) highlight how actual CAP policies increases performance differentials between Northern and Central EU countries and peripheral regions (Mediterranean, Eastern, Northern Scandinavian). In this sense, they observe how countries with an high share of utilized agricultural land in less favoured areas, such as in the Mediterranean, are 94 % less likely to attain high economic performances[3]. RodrÍguez-Pose and Fratesi (2004), looking at Obj.1 Regions, find significant effects of the CAP limited to investments in education and human capital, which represents only one-eight of the total commitments.

To summarize, Minviel and Latruffe (2017) by implementing a meta-regression analysis argue that the ambiguous results on farm technical efficiency are highly conditioned by different factors, including the empirical case, the type of policy considered and the methodology used. In this sense, they observe how empirical findings seem to be inconclusive and dependent from the case-study.

Starting from this assumption, we try to analyse the role played by the CAP by focusing on the impact on the formation of value added. This operation, has required the implementation of an augmented Cobb-Douglas Function. Since the seminal work of Griliches (1964) the estimation of the aggregated production function becomes a common pratice in agricultural economics (see Martin and Mitra (2001); Fleischer and Tchetchik (2005); Herrendorf et al. (2015) intra alia).

Rizov et al. (2013) introducing the presence of the subsidies in an APF, find evidences on the inefficiencies of public incentives in EU-15 countries between 1990 and 2008. Furthermore, after decoupling reform the effect of subsidies on productivity was more nuanced and in several countries become positive. However, our analysis is not limited to evaluate only the direct impact of the policies on added value, but we focus on the occurrence of spillover effects by including spatial

[3]Additional critiques to the CAP includes the access of new EU state members (Gorton et al., 2009; Wegener et al., 2011), the lack of institutional adaptation to CAP reform (Dwyer et al., 2007) and failures in guarantee and preserving biodiversity (Pe'er et al., 2014).

econometric techniques. To the best of our knowledge, the unique application in agricultural economics of a spatial augmented production function is in Billé et al. (2015). The aforementioned authors suggest an approach based on a two-step procedure to deal with unobserved spatial heterogeneity. In this way, they are able to demostrate whether or not the model parameters show to be spatially clustered and thus locally homogeneous.
However, their approach is far away from the objectives of this paper and, for this reason, we implement a methodologies borrowed from the literature on Knowledge Production Function (KPF). Marrocu et al. (2013) and De Dominicis et al. (2013) modify the traditional KPF to study the impact of geographical proximity in explaining spillover effects. Their approaches allow to consider spatial dependence for geo-referenced data and can be easily applied to agricultural economics (Autant-Bernard, 2012).
While the role of geographical proximity in determining knowledge spillovers is strongly supported by the literature, the major challenge of this work is to find evidences on spatial spillovers in the primary sector. More in detail, in this work we develop a multi-step analysis. In the first step, we estimate a cross-sectional APF by considering farms microdata to obtain baseline results of our model. In the second step, aggregating the units at NUTS-3 Level, we check for the presence of a temporal trend by estimating an a-spatial panel model. In the last step of this work, we combine both temporal and spatial heterogeneity by estimating a spatial panel model. In this way, we can obtain robust estimates of both direct and indirect effects by showing how spatial heterogeneity distorts a-spatial estimates.

3 Data and Exploratory Data Analysis

In 2008 and 2009 agricultural system was deeply conditioned by the global macroeconomic crisis. During this period, EU-27 deals with a contraction on agricultural production and a deflationary trend on prices. Moreover, the growth of input prices, due to the volatility on both energy and fertilizer markets, produces a reduction on added value per worker and employment. Under this perspective, Italian case is of particular interest.
Indeed, Italian agricultural performances are not only affected by the global crisis, but, especially in 2009, the presence a difficult weather trend has empowered the negative effect of the crisis. In overall, 2009 shows a reduction in agricultural production (-2.6 %), expenses on intermediate consumption (-4.7 %) and real term added value per worker (-3.1 %) (INEA, 2009). Furthermore, Italy is characterized by structural problems conditioning Agricultural performances. These issues include the presence of systematic differences between North and South (Mezzogiorno), the lack of young farmers (only 13,2 % has less than 44 years) and a land abandonment on marginal areas, especially for high altitude zones. However, the level of subsidies remains stable and contributes, in average, to the 18 % of the net added value.
The highly dependence of the added value to public intervention constitutes the central pillar of

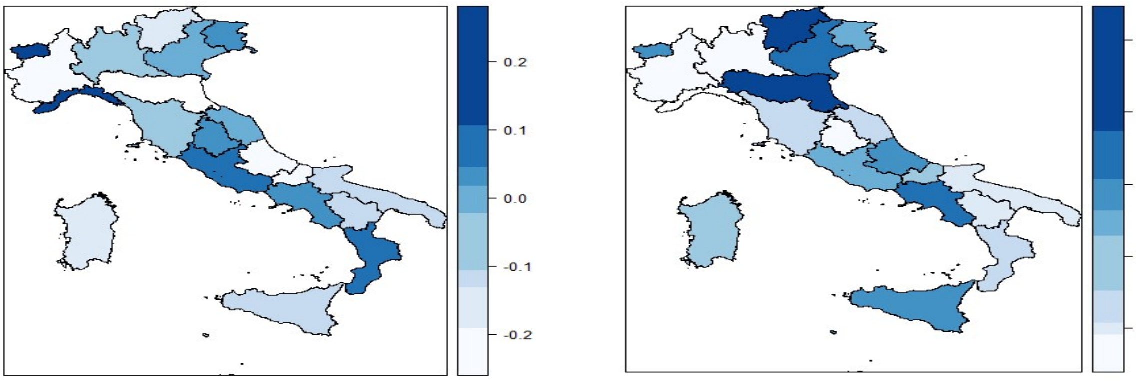
this paper. By considering information extrapolated by RICA dataset[4] for the years 2008 and 2009 we introduce in our analysis five different variables.

Table 1: List of Variables

Variable	Label	Measure unit	Description
Value-added	VA	€	Total Revenues-Current Expenses
Labour	L	Unit	Full time worker. Every 2200 working hours in the farm represent a FTW
Capital stock	K	€	Land Capital+ Agricultural Fixed Capital
Land	G	Hectares	Utilised Agricultural Area (UAA)
Subsidies	S	€	Total Amount of subsidies for farm

Table 1 considers all the major determinants on value added formation: Labour, Fixed Capital, Land and Policies. Moreover, by applying differentiated formulation of the Cobb-Douglas APF we can understand the marginal impact of all the different variables in determining and stimulating value added. Furthermore, subsidies are considered as a global indicator of public expenses to stimulate and sustain agricultural activities. In this sense, the total amount of subsidies is obtained by adding all the amount of the different public instruments allocated to every farm, independently from their source or objective (i.e. we do not distinguish between National or European fund or between policies devoted to current activities, rural development or capital subsidies).

Figure 1: NUTS-II Distribution of Value Added and Subsidies



(a) (b)

Note: Panel (a) (resp. b) shows regional growth rate between 2008 and 2009 for Added Value per Average Worker Unit (resp. Subsidies).

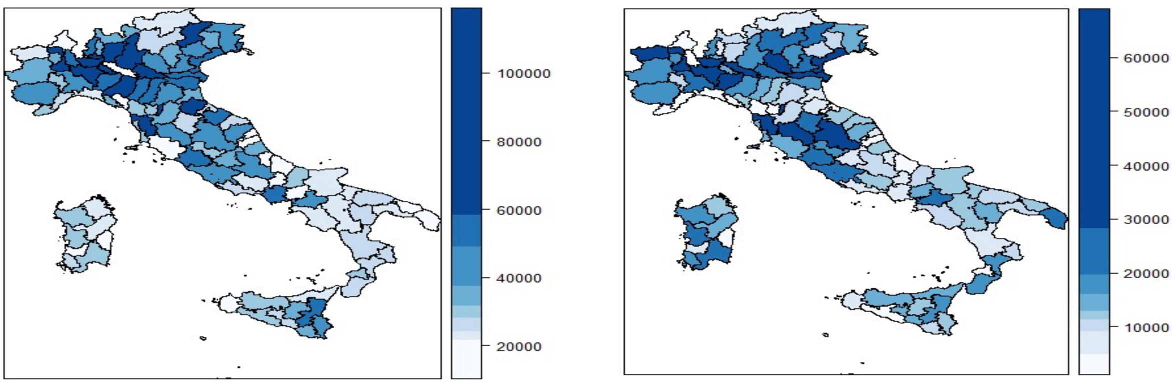
Notwithstanding this paper is focused on the impact of public policies in value added we do not consider a counterfactual approach. This choice is related to the peculiarity of the agricultural sector. Indeed, 90% of the farms in RICA dataset are subject to policies. However, most of the subsidies are decoupled by production objectives and, in many case, constitutes a sort of income

[4]Rica is part of the European Farm Accountancy data network (FADN) and it represents the only harmonized survey to collect micro-economic data on firms operating in agricultural. Italian RICA collects information on 11000 farms sampled at regional level.RICA's field of observation considers only the farm with at least 1 hectare of UAA or a production value greater than 2500 Euros.

maintenance. In this sense, we exclude from our analysis all the farms which are not subsidized and we consider the incremental impact of the policies (i.e. effect of receiving an additional euro of public funds). In this way, we build a dataset composed by 6179 farms for the year 2008 and 2009.

The first step of our exploratory spatial data analysis passes through the aggregation of the farms at NUTS-II level. Figure 1 shows NUTS-II level aggregated growth rate between 2008 and 2009. In panel (a) we observe how value-added per Average Worker Unit (AWU) is stable across the different regions. In overall, Mezzogiorno and Central regions perform better in comparison with the North of Italy. However, as we will explain later this does not allow to proceed at a convergence process. Panel (b) shows the increasing commitment of public authorities to, at least partially, counteract the negative effects of the macroeconomic crisis. Nonetheless, to understand the presence of spatial heterogeneity in value-added distribution look at regional growth rate is not sufficient. For this reason, we focus on the two variables distribution in 2009, disaggregating at NUTS-III level.

Figure 2: NUTS-III Distribution in 2009



(a) (b)

Note: Panel (a) (resp.b) shows NUTS III distribution of Added Value per AWU (resp. Subsidies) in 2009.

Figure 2 demonstrates the presence of systematic differences between North and South. Indeed, excluding the South of Sicily, Italian map shows a shape going from dark to light blue (i.e. from higher to lower value-added). Indeed, distribution of subsidies appear more heterogenous and fragmented and does not allow to individuate clearly the presence of spatial clusters.

At this end, we estimate two different measure of spatial association: global and local Moran Index[5]. The spatial weight is computed by using a queen type row standardized matrix (i.e. two areas are neighbours if they share a boundary). Furthermore, by aggregating microdata at NUTS-III level we obtain information on 100 provinces[6], which become the field of observation of this analysis.

[5]Global spatial analysis or global spatial autocorrelation analysis yields only one statistic to summarize the whole study area. In other words, global analysis assumes homogeneity. If that assumption does not hold, then having only one statistic does not make sense as the statistic should differ over space. To allow for differentiated spatial patterns for each location, Local Moran I is a better option Anselin (1995).

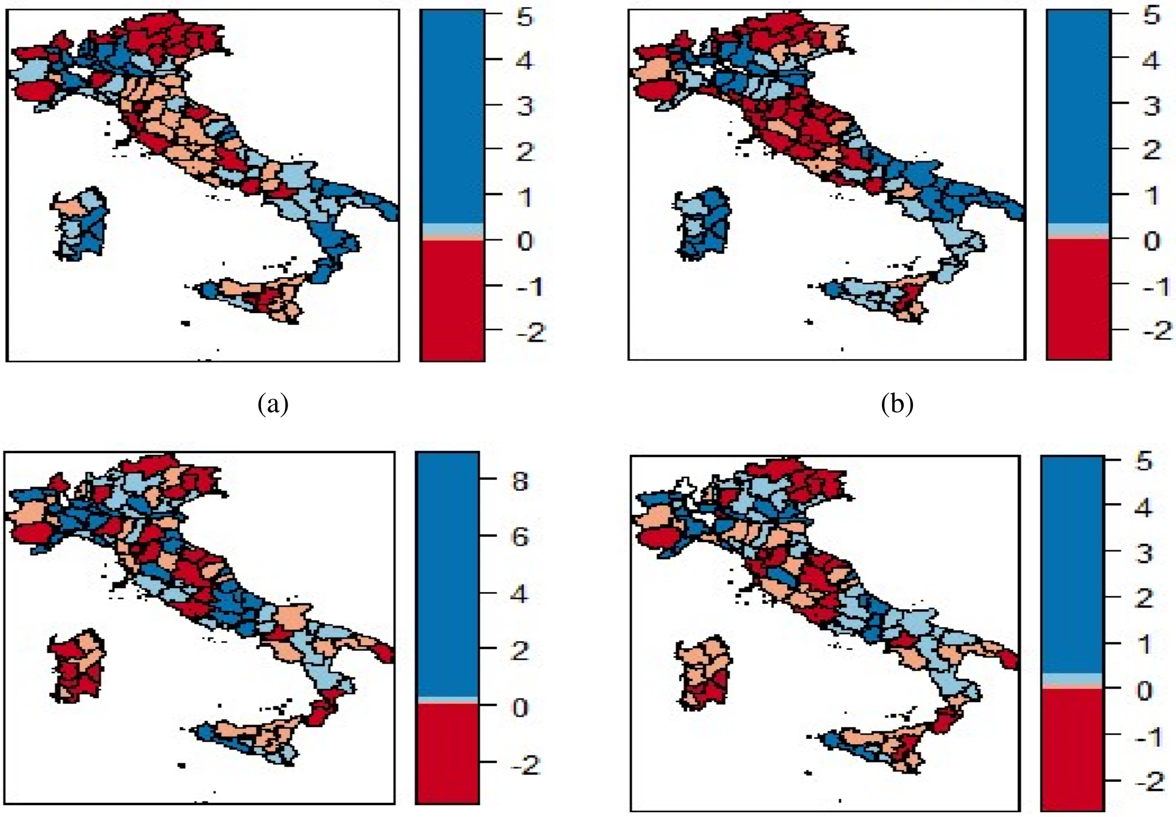
[6]In this paper we exclude the Province of Varese because of a lack of information on farms located in this area.

Table 2: Moran Index

Variable	Year	Moran I	Expectation	P-value
Subsidies	2008	0.291	-0.009	0
Subsidies	2009	0.258	-0.009	0
VA / AWU	2008	0.299	-0.009	0
VA / AWU	2009	0.38	-0.009	0

Table 2 shows the presence of a strong spatial autocorrelation of both subsidies and value-added per AWU. But, what happens if we relax the assumption of homogeneous spatial autocorrelation across the space?

Figure 3: Local Moran Indexes



(a) (b) (c) (d)

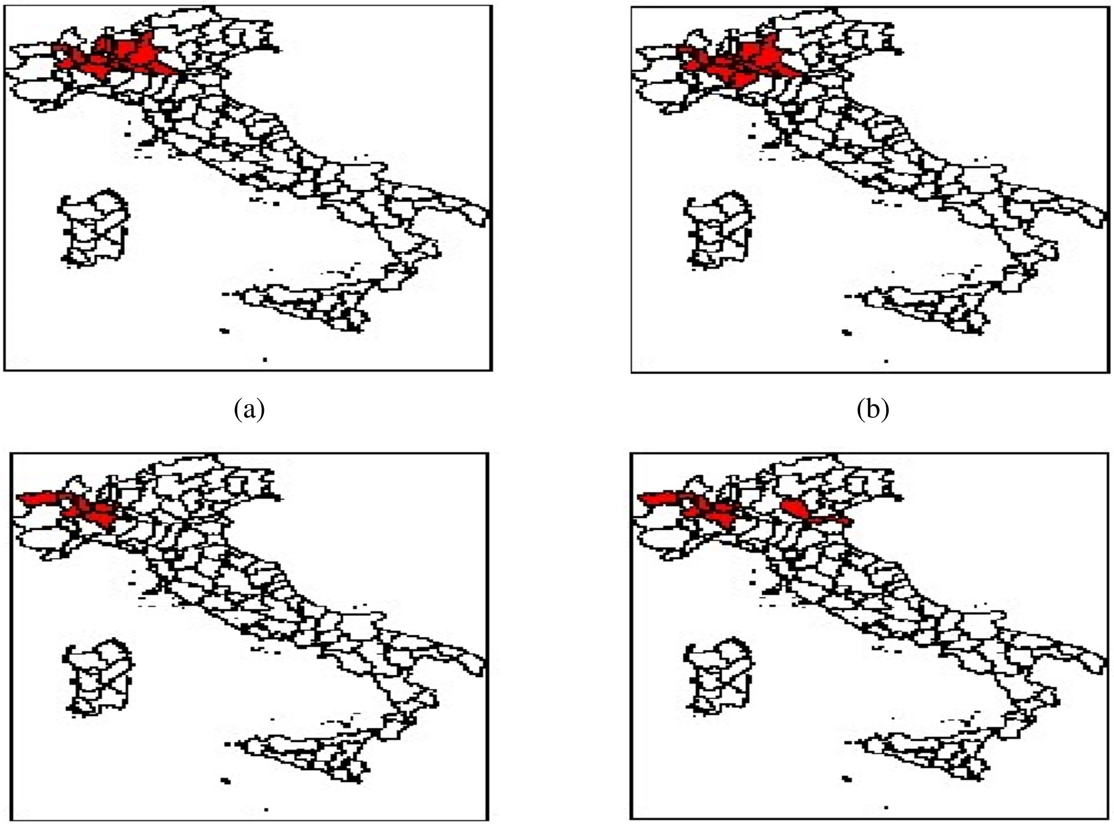
Note: Figure 3 shows Local Moran Indexes. In detail, panel (a) (resp. b) represents Added Value per AWU on 2008 (resp. 2009), while panel (c) (resp. d) for Subsidies on 2008 (resp. 2009).

Figure 3 shows the presence of spatial clusters (concentration of areas with blue or red colours), especially on the North. This intuition is confirmed by looking at the statistical significance, which highlight the presence of a limited cluster, between Lombardy and Piedmont, in which both value-

Furthermore, we do not take into account the 9 Metropolitan Cities: Turin, Genova, Milan, Venice, Bologna, Florence, Rome, Naples and Bari. This choice is due to the fact that these areas are characterized by a high degree of urbanization and, consequentially, a strong prevalence to tertiary sector, while Agriculture covers a marginal role. In this sense, we can look only at rural areas and development. Furthermore, excluding these areas does not invalidate the quality of our sample.

added and subsidies are significative.

Figure 4: Local Moran Clusters



(a) (b) (c) (d)

Note: Figure 4 indentifies evidences of clustering by Local Moran Indexes. In detail, panel (a) (resp. b) represents Added Value per AWU on 2008 (resp. 2009), while panel (c) (resp. d) for Subsidies on 2008 (resp. 2009).

To conclude, local and, in particular, global Moran indexes suggest the presence of a not random spatial distribution of the value added. In this sense, in the remainder of this paper we check for the inclusion of the spatial dimension in evaluating the impact of the different components in stimulating value added.

4 Methods and Results

The empirical analysis in this paper relies on an unrestricted Cobb-Douglas APF .The traditional approach in estimating Cobb-Douglas APF is based on the estimation of the relationship between the value of production and technological input. However, in this work we aim to find evidences on the impact of the subsidies on economic performances of the farm. In this sense, we do not look at production value by itself, but, by using value added, we consider the relative impact of the different input in fostering agricultural performances. The baseline model assumes the form in:

$$Y = AL^{\alpha}K^{\beta}G^{\gamma}S^{\delta} \tag{1}$$

Where Y is the Added Value, A the Total Factor Productivity, L the labour units, K the fixed capital, G represents the ground extension (i.e. UAA) and S the total amount of subsidies. Following the traditional approach, we implement a log transformation of the APF. The final model assumes the following formulation:

$$ln(Y) = lnA + \alpha * lnL + \beta * lnK + \gamma * lnG + \delta * lnS \quad (2)$$

Under this formulation we are able to identify and estimate all the parameters. Applying a log transformation of the APF is a completely risk-free assumption, even if it implies a different approach in discussing parameter estimates. Indeed, parameter estimate represents the elasticity (i.e. marginal impact in the output on a percentage change of the input).
The empirical strategy implemented in this paper is based on a two-stage analysis. In the first step we look at the effect at individual level. Under this perspective, we can check for the relative impact of all the different inputs and provides baseline results. In the second step, we aggregate the data at NUTS-III level by estimating traditional and spatial panel model. In the remainder of this paper we will present and discuss the result obtained.

4.1 Microfounded APF

Literature on the impact of public policies on agricultural performances is still scarce. In this sense, to fully understand the impact of the different inputs on the formation of the added value and, consequently, on performances we estimate a micro-founded model by using cross-sectional observations. Furthermore, to observe the relative impact of all the variables we estimate 12 different specification of models. The baseline approach starts from the traditional Cobb-Douglas Function and considers two only inputs: labour and fixed capital.

Table 3: Micro-Founded Cobb-Douglas Estimation

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
K	0.221*** [0.006]	0.119*** [0.006]	0.120*** [0.006]	0.102*** [0.006]	0.222*** [0.006]	0.119*** [0.006]	0.120*** [0.006]	0.102*** [0.006]	0.119*** [0.006]	0.102*** [0.006]	0.119*** [0.006]	0.102*** [0.006]
L	1.052*** [0.013]	0.899*** [0.013]	0.932*** [0.013]	0.896*** [0.013]	1.052*** [0.013]	0.898*** [0.013]	0.932*** [0.013]	0.895*** [0.013]	0.936*** [0.013]	0.900*** [0.013]	0.935*** [0.013]	0.899*** [0.013]
G	-	0.329*** [0.008]	-	0.152*** [0.011]	-	0.329*** [0.008]	-	0.152*** [0.011]	-	0.150*** [0.011]	-	0.15*** [0.011]
S	-	-	0.267*** [0.006]	0.189*** [0.008]	-	-	0.267*** [0.006]	0.189*** [0.008]	0.271*** [0.006]	0.194*** [0.008]	0.272*** [0.006]	0.195*** [0.008]
time	-	-	-	-	-0.035* [0.016]	-0.043** [0.015]	-0.043** [0.015]	-0.045** [0.015]	-	-	-0.040** [0.015]	-0.041** [0.015]
C	-	-	-	-	-	-	-	-	0.777° [0.454]	1.214** [0.452]	0.770° [0.454]	1.207** [0.452]
S*C	-	-	-	-	-	-	-	-	-0.114* [0.045]	-0.151*** [0.045]	-0.113* [0.045]	-0.149** [0.045]

Note: Table 3 presents the results of observational data for 2008 and 2009. Estimates are considered in terms of elasticities, while standard errors are in square brackets. Additional covariates are introduced to check for temporal trend (time), the impact of capital subsidies (C) and the interaction between capital and other subsidies (C*S).
Statistical significance: *** <0.001, ** 0.01, * 0.05, ° 0.1

The estimates in Table 3 show that the most effective input in improving performances is the labour. Indeed, L parameter passes from 1.052 to a minimum of 0.895 which means that a marginal increment of a percentage in labour is completely balanced in terms of marginal increment of performances. While results on fixed capital is stable around 0.1, the estimates on the subsidies underline their relative importance on fostering performances. In overall, a percentage change on level of subsidies allocated to farms contributes to 0.2, 0.3 percent increase in performances. Furthermore, the impact of increasing UAA is significant, but of lower intensity in comparison with the effect of subsidies.
Including the presence of time effect we demonstrate how 2009 was the hardest year during the crisis, showing a negative and significant coefficient. Interestingly, while capital subsidies show a higher impact on value added, the interaction between capital and other types of incentives has a negative and significant effect on performances. These results confirm the strong dependence of Italian farms on CAP, even if the results on capital subsidies can open up to an in-depth analysis of the ways in which incentives are administered.
As previously remarked, CAP are payments decoupled by production and investments and its main objective is to stabilize farmers income and improve rural areas. However, impact on capital subsidies suggests that "decoupling" is not the best solution. Indeed, capital subsidies foster directly investments and consequentially performances. This point is relevant for the policy-makers and an in-depth analysis is proposed in conclusive section. To conclude, all the specification of the APF present a sum of the exponents greater than one, which implies the occurrence increasing return to scale in economic performances for all the different models.

4.2 NUTS-III APF

After estimating the micro-founded model which provides baseline results on the impact of subsidies in affecting performances, we aggregate farm's observational data at NUTS-III level. Given the meaningful time trend between 2008 and 2009 we estimate two different types of panel model. Furthermore, to take into account the possible impact of neighbours value added on own economic performances, we apply a general model of the form:

$$Y_t = A_t (WY)_t^{\rho} L_t^{\alpha} K_t^{\beta} G_t^{\gamma} S_t^{\delta} \tag{3}$$

The presence of WY (i.e. a proxy of the value added of neighbours units) introduces a measure of spatial autocorrelation between units. As already done in the microfounded model, we apply a log transformation of the APF to obtain:

$$ln(Y_t) = lnA_t + \rho * ln(WY)_t + \alpha * lnL_t + \beta * lnK_t + \gamma * lnG_t + \delta * lnS_t \tag{4}$$

The spatial and time-period specific effects may be treated as fixed effects or as random effects. However, in this case Hausman test shows that fixed effect is preferable. In the fixed effects

model, a dummy variable is introduced for each spatial unit and for each time period (except one to avoid perfect multicollinearity) and the estimation procedure of the spatial lag model is based on Maximum Likelihood Estimator (Elhorst, 2003, 2014).
Furthermore, as we will explain later on this paragraph, a spatial lag model allows to decompose the total impact in direct and indirect (or spillover) effects. Clearly, full model presented in Equation 4 can be easily reconducted to a traditional panel model by imposing $\rho = 0$. In this case, a non-spatial fixed effect model is estimated.

Table 4: Aggregated Cobb-Douglas Estimation

	Panel				Spatial Panel			
	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]
K	0.281***	0.183*	0.099	0.118	0.264***	0.178**	0.104*	0.121*
	[0.071]	[0.081]	[0.075]	[0.077]	[0.049]	[0.057]	[0.052]	[0.054]
L	0.993***	0.995***	1.083***	1.099***	0.989***	0.989***	1.062***	1.076***
	[0.145]	[0.143]	[0.134]	[0.135]	[0.101]	[0.098]	[0.093]	[0.093]
G	-	0.159*	-	-0.087	-	0.145**	-	-0.079
		[0.069]		[0.087]		[0.049]		[0.061]
S	-	-	0.250***	0.297***	-	-	0.230***	0.273***
			[0.052]	[0.071]			[0.037]	[0.050]
Rho	-	-	-	-	-0.242***	-0.223**	-0.189**	-0.190**
					[0.071]	[0.069]	[0.067]	[0.067]
Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Table 4 presents the results of NUTS-III Level APF. Data constitutes a balanced panel of 100 observation and 2 years (2008-2009). Column named Panel are estimated by fixed effect, while Spatial Panel is computed using a ML estimator of a Spatial Autoregressive Model. Estimates are considered in terms of elasticities, while standard errors are in square brackets. Statistical significance: *** <0.001, ** 0.01, * 0.05.

Table 4 reports the estimates of both linear and spatial panel models. Results are in line with the ones provided for the micro-founded model, even if some interesting conclusion can be done. In first instance, labour is still the major components in fostering performances. However, in this case it increases its contribution when we consider the full model (4), while fixed capital is still positive but not significant. Subsidies are the second major determinant in added-value with impacts in a range between 0.23 and 0.3. Furthermore, Land becomes less effective and switch to negative in (4).
Looking at spatial model, results are similar to the estimates of the non-spatial panel both in terms of extension than statistical significance of the effects. However, this approach allows to consider spatial autocorrelation by identifying and estimate ρ parameter. The negative and meaningful ρ underlines a detrimental impact of the performances on neighbouring areas. However, this parameter does not furnish an estimate of the spillover effects. Indeed, in models containing spatial lags of the dependent variables, interpretation of the parameters becomes richer and more complicated. A number of researchers have noted that models containing spatial lags of the dependent variable require special interpretation of the parameters (Kim et al., 2003; Anselin and Le Gallo, 2006).
LeSage and Pace (2009) show how the marginal effect of every variable in a spatial lag model is not the parameter by itself but becomes a composite function. By considering, in way of example,

the derivative of y with respect to K we have :

$$\frac{dy}{dK} = (I - \rho W)^{-1} * \beta$$

Clearly, the matrix $(I - \rho W)$ can be inverted only in the case in which $|\rho| < 1$. However, by inverting the matrix we obtain a summary of the indirect effects by considering the average of the summation by row (or column) of the off-diagonal elements, while the direct effects are estimated by averaging the diagonal element of the inverse. To conclude, a summary of the total effect is estimated by averaging the summation by row (or column) of all the elements in the inverse matrix. Clearly, this approach allows to obtain an average measure of direct, indirect and total effects. The results of the spillover effects are in Table 5.

Table 5: Marginal Impacts

	[1]			[2]			[3]			[4]		
	Dir	Ind	Tot	Dir	Ind	Tot	Dir	Ind	Tot	Dir	Ind	Tot
K	0.268***	-0.055**	0.213***	0.18**	-0.035*	0.145**	0.105°	-0.018	0.087°	0.122*	-0.021	0.102*
	[5.467]	[-3.085]	[5.315]	[2.874]	[-2.152]	[2.880]	[1.816]	[-1.464]	[1.808]	[2.159]	[-1.628]	[2.172]
L	1.004***	-0.208***	0.797***	1.002***	-0.193***	0.809***	1.072***	-0.179**	0.893***	1.086***	-0.182**	0.904***
	[9.248]	[-3.437]	[8.655]	[9.203]	[-3.322]	[8.350]	[10.239]	[-2.691]	[8.954]	[11.945]	[-2.993]	[10.023]
G	-	-	-	0.146**	-0.028*	0.118**	-	-	-	-0.08	0.013	-0.066
	-	-	-	[2.964]	[-2.264]	[2.908]	-	-	-	[-1.281]	[1.108]	[-1.287]
S	-	-	-	-	-	-	0.233***	-0.039*	0.194***	0.276***	-0.046*	0.23***
	-	-	-	-	-	-	[6.519]	[-2.590]	[6.117]	5.231	[-2.559]	[5.125]

Note: Table 5 presents the results of the decomposition in direct, indirect and total effects. Estimates are considered in terms of elasticities, while z-values are in square brackets. The z-values and p-values are estimated by Montecarlo Simulation. Statistical significance: *** <0.001, ** 0.01, * 0.05, ° 0.1

Direct and indirect effects are estimated following the approach in Piras (2014). Overall, total impact is smaller than the direct effect. This is due to the presence of negative and significant spillovers, especially for labour and subsidies. But, how we can interpret indirect estimates and how a marginal change in the amount of subsidies of one area affect performances?

Looking at the full model (column 4), we can imagine, in way of example to a point percentage increase of policies in the Province of Trieste[7]. This can have a twofold impact on economic performances. On one hand, it fosters performances of Trieste by 0.276 %, while it has a detrimental impact on Gorizia by reducing its value-added of 0.046 %[8]. This consideration highlight the presence of a trade-off between enhancing local and overall competitiveness.

[7]The choice of Trieste is uniquely due to the fact that it has only one neighbour, Gorizia. Indeed, it is located in the final part of Friuli-Venezia Giulia and it is completely surrounded by Slovenia. However, this example can be easily extended to the case with more than one neighbours.

[8]For sake of clarity, spatial spillovers are multi-directional. To look at indirect effects on Trieste, we can think to an increase of public subsidies on its neighbour units (in this case Gorizia). This change in Gorizia has an average indirect effects of -0.046 on the performances of Trieste. Clearly, this impact is not limited to Trieste, but it influences value added of all the other neighbours of Gorizia.

5 Conclusions

Investigating the impact of public subsidies on farm performances is becoming a critical issues in applied policy analysis. Notwithstanding the highly dependence of the farm from public support, literature appears still scarce and fragmented and empirical findings are inconclusive. Furthermore, omitting the presence of spatial dependence in evaluating the impact of the policies can induce a twofold fallacy. On one hand, CAP is designed as a ”space-neutral” approach, albeit it exhibits a considerable spatial impact in fostering performances differential between more and less developed areas (Giannakis and Bruggeman, 2015).

On the other hand, Italy is charactized by an heterogenous agricultural sector with considerable regional variation in terms of farm structure and production. Moreover, Obj.1 Regions are highly involved in structural problems, including resource constraints (such as water scarcity), consequences of climate change and land abandonment. These issues, combined with the systematic differences between North and South, contributes to enlarge structural differences between Mezzogiorno and the rest of Italy. In this sense, it seems clear how agriculture is a clear example of ”place-based” sector and omitting spatial dependence can ensure biased estimates of the performances.

In this sense, this paper introduces the presence of spatial autocorrelation between different areas in evaluating the marginal impact of CAP on economic performances. However, this operation is not straightforward and has required two different stages. In the first stage, we analyse microdata of Italian farms from RICA dataset for the years 2008 and 2009 to understand relationships between different inputs (Land, Labour, Fixed Capital and Policies) and value added. The estimation procedure is based on an Augmented Cobb-Douglas Production Function.

The results highlight how Italian Agricultural sector is still highly dependent by human and public capital (i.e. Labour and Subsidies). This assumption is linked to the peculiarity of Italian primary sector. Indeed, Italian average farm size is well below European average. Furthermore, 70% of Italian farms are located in areas at risk of marginalization. Under this perspective, Galluzzo (2013) demonstrates how small farms are not able to use in an efficient way the land and agrarian capital due to the difficulties in accessing credit related to their dimension and geographical localization. However, these issues are, at least partially, counterbalanced by the availability of public Funds for both rural development and income stabilization.

In addition, our results demonstrate the difficulties encountered by agricultural sector in 2009 (i.e. the presence of a significant and negative time trend) and the need of a greater effort of the policymakers in reforming CAP to foster capital investments. Indeed, an increase of 1 Euro of capital subsidies (which constitutes a minimum part of the overall amount erogated by the CAP) improves agricultural performances of 1.20 Euros (Table 3). This point underlines the presence of a trade-off between local and global objectives. Actually CAP aims to avoid local land abandonment by stabilizing local farmers' income, while fostering innovation and the greening of agricultural sector can open up to a reinforcement on global intermediate and final markets.

In the second step of our analysis, we aggregate microdata at NUTS-III level to focus on the impact of the CAP on the performances of the different rural areas by estimating panel models. If we omit spatial dependence, results are similar to the one of the microfounded model. In this case, however, only the effects of labour and policies are still significant, while land parameter becomes negative.

Testing for spatial dependence, we found evidence of spatial autocorrelation for all the different specifications of the model. In this sense, we estimate a so-called Spatial AutoRegressive (SAR) panel model. The peculiarity of the SAR is that the marginal impact (i.e. the derivative with respect to a covariate) does not constitute the parameter by itself, but it is a composite parameter which considers both the direct impact of the regressor and the spatial autocorrelation. In this way, it is possible to decompose the overall impact in direct and indirect effects.

Indeed, the negative spillover passes through two different channel: human and public capital. On one hand, labour in agriculture can be considered a stable and place-based input. This assumption underlines the fact that agrarians are highly linked to the place in which they live and work, while urbanization processes do not allow to increase the amount of labour supplied. In this sense, neighbouring farms are deeply involved in a competitive labour market to obtain skilled human capital. Considering, the scarce propensity to move of agricultural workers and the limited supply of human capital can justify negative spillover effects of labour on economic performances [9].

On the other hand, one of CAP's major aims is to foster rural development. Notwithstanding CAP is strongly promoted by EU Commision, both in terms of accessibility and financial effort, farms have to compete to obtain a greater amount of public funds. Under this perspective, it becomes clear how increase the amount of subsidies in one area increases the overall performances of local farms, while neighbouring areas are penalized by the lack of additional funds. Combining the two distinct impacts is the major challenges for the policy-maker in designing effective and efficient agricultural policies.

Indeed, the negative spillover effects of the labour can promote the development of appropriate formation programmes to increase the supply and the skill of human capital to decrease the competitivity in labour market. Furthermore, policies devoted to rural development are place-specific, while the promotion of global, and not only local, competitiveness passes through policies which aims to foster areal "excellence" and restricting the phenomenon of land abandonment.

[9] For ease of interpretation we can imagine, in way of example, two distinct farms A and B which share the same neighbourhood. A increases its human capital of 1 skilled labour with a positive effect in generating additional value added. On the other hand, B facing off with an increase in the performances of A is not able to increase its own labour demand and, by consequence, reduces its capability of being profitable.

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