The Capitalization of CAP Payments into Land Rental Prices: A Grouped Fixed-Effects Estimator

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Abstract

This paper investigates the capitalisation of farm subsidies in Italy by relying on a novel approach based on the Grouped Fixed Effect (GFE) estimator. This methodology allows us to account for the regional unobserved time-varying determinants of the Italian land values. Results show that the elasticity of land price with respect to coupled and decoupled subsidies is below one. Particularly, for the latter payments, the degree of capitalization declines with decreasing competition in farmland markets.

Keywords: Common Agricultural Policy (CAP); land values; subsidy capitalisation; Grouped Fixed Effect Estimator (GFE).

JEL classifications: Q18, C33, H22, Q15.

Funding details: This study has been supported by Fondazione Cariplo, within the research project Evaluation of CAP 2015-2020 and taking action – CAPTION (Project Id: 2017-2513)

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1 Introduction

A central question in the European Union (EU) Common Agricultural Policy (CAP) is whether direct payments are capitalized into land values or not. The extent to which agricultural subsidies are translated into the value of land is crucial for the evaluation of the net amount of farmers' income support. The 2003 Fischler reform of the CAP, introduced the new so so-called Single Farm Payment (SFP) scheme, not bounded to farms production decisions, but at the same time not decoupled from land. In fact, farmland availability is required to activate entitlements. The purpose of our work is to measure the elasticity of land price with respect to farm payments for Italy, by relying on a novel approach based on the Grouped Fixed Effect (GFE) estimator proposed by Bonhomme and Manresa (2015).

The empirical literature is far from any consensus about the degree to which direct payments are capitalized into land prices (see Latruffe and Mouel (2009) and the references therein.) Some works find clear evidence of capitalization of SFP into land rental price (see O'Neill and Hanrahan (2016) and Klaiber et al. (2017). In contrast to the previous studies, Kirwan (2009) and Guastella et al. (2018) do not offer empirical results which are consistent with the view that subsidies are fully reflected in land rental prices. In this perspective, Graubner (2018) proposes a theoretical model where land subsidy is scantly capitalized into rental price, when the competitiveness of the market is low. However, the extent to which the agricultural subsidies are capitalized into land prices depends also on the type of SFP scheme has been implemented in each country. Italy applied the SFP reform through the historical model, where the initial distributed entitlements values were based on the farms' payments history. Under this model, the degree of capitalization of SFP should depend on the amount of payment entitlements with respect to the eligible agricultural area. Specifically, if the amount of eligible land exceeds the entitlements, most of the subsidy will be not translated into land prices (see Guastella et al. (2018)).

This paper contributes to the literature on the capitalization effects of EU direct payments on the land value in three main directions. Our key methodological contribution is the application of the GFE estimator, which extends linear fixed-effect models, that only controls for regional time-invariant unobserved heterogeneity. In addition, the GFE approach has the advantage to control for time-varying unobserved heterogeneity modelled with distinct grouped patterns. As a result, the GFE estimator allows to take into account the regional heterogeneity when common shocks (e.g. the recent Great Recession), or a recovery, occurs. Moreover, our work is novel in two other respects. First, we use data on land values and CAP payments, aggregated at NUTS3 territorial level, provided by the Italian agricultural research center (CREA) and the Clearance Audit Trail System (CATS), respectively. To our knowledge, this is the first analysis on land capitalization, which is based on this type of data. The CATS payments are very detailed data because they make a clear-cut distinction between different kind of payments (e.g. Pillar I vs. Pillar II, and coupled vs. decoupled) aggregated at NUTS3 regional level (see Garrone et al. (2019)).[1] This allows to understand whether these various types of payments have different effects on the Italian land values. Second, we investigate the role of subsidy capitalization on the land prices when accounting for the degree of competition in land markets. We find evidence consistent with a low degree of SFP capitalization into land value, conditional to the level of competition in land market.

The rest of the paper is set out as follows. Section 2 describes data and methodology. Sections 3 discusses the empirical results. Finally, Section 4 concludes.

2 Data and method

The dataset is a balanced panel including 102 Italian provinces, from 2006 to 2013, for a total of 816 observations. For each observation, data on 7 different variables are available. The dependent variable is represented by the average yearly deflated land values (euro/ha) taken from the CREA dataset. Data on GDP deflator for Italy is obtained from FRED database. The agricultural real subsidies (coupled, decoupled and II pillar payments) came from the European Commission and they are divided by the total Utilised Agricultural

[1] Pillar I payments are subsidies intended for all farms, in proportion to the amount of land and/or livestock. They can be linked to certain productions (coupled payments), or independent from production choices (decoupled payments, also known as single farm payment - SFP). Pillar II support are intended for a limited number of farms, which voluntarily engage in certain activities (investments, reduction of chemical inputs, organic agriculture, and diversification of farm activities).

Area (UAA). The other covariates include the agricultural gross value added per ha, the population density and the share of arable crops. Such variables are drawn from different sources, such as the Cambridge Econometrics Regional Database (CERD), Eurostat and Farm Accounting Data Network (FADN). In our analysis, all variables but the share of arable crops, are transformed into natural logarithm, so that the estimated coefficients can be directly interpreted as elasticities. Descriptive statistics of the variables are listed in the appendix.

To investigate the capitalization of direct payments into land prices we use the following model:

$$y_{it} = \alpha_{g_i t} + x'_{it}\theta + z'_{it-1}\beta + v_{it} \tag{1}$$

where y_{it} denotes the outcome variable (land values) for province i and year t, x_{it} and z_{it-1} are vectors of observed covariates in the current and lagged periods, respectively. The vectors of covariates include the CAP subsidies that are instantaneously uncorrelated with the error term v_{it} but may be correlated with the group-specific time effects $\alpha_{g_i t}$. Moreover, the set of year dummies that are individually estimated within each group membership g_i is denoted by α. Finally, we include a dummy variable in model (1) to account for two different competitive regimes in the Italian land market.[2]

The GFE estimator partitions the sample into different groups in order to control for time-varying unobserved heterogeneity that follows a group specific pattern. Thus, the estimation of parameters considered in model (1) is based on two steps. The first step finds the optimal group assignment for each unit. In practice, provinces are endogenously grouped using an iterative algorithm based on the combination between cluster and regression analysis. Thus, for given values of θ, β, the provinces are grouped together in order to minimize the following least-squares objective function:

$$\hat{g}_i(\theta, \beta, \alpha) = \underset{g \in \{1,\ldots,G_{max}\}}{\text{argmin}} \sum_{t=1}^{T} \left(y_{it} - x'_{it}\theta - z'_{it-1}\beta - \alpha_{gt} \right)^2 \tag{2}$$

[2] As proxy for the degree of competition in farmland markets we use the Gini index of operational agricultural land. A higher Gini index indicates greater inequality, with a small number of larger farms controlling much larger percentages of total farmland. The median value of the Gini index allows to construct the competitive dummy variable. The latter takes on the value 1 (high level of competition) if the NUTS3's Gini index is below the median, 0 otherwise.

where $\hat{g}_i$ represents the estimate of the group membership for each province which is fixed over time. Following Bonhomme and Manresa (2015), the accuracy of the GFE estimates depends on the choice of the optimal number of groups, chosen accordingly to the Bayesian Information Criterion (BIC). In this context, it is worth recalling that the maximum number of groups (set arbitrarily) is $G_{max} = 12$ and the BIC criterion is minimized for $G = 2$ in our sample. The second stage involves the estimation of α, θ and β by solving the following minimization problem:

$$\left(\hat{\theta}, \hat{\beta}, \hat{\alpha}\right) = \underset{(\theta,\beta,\alpha)\in\Theta}{\operatorname{argmin}} \sum_{i=1}^{N} \sum_{t=1}^{T} \left(y_{it} - x'_{it}\theta - z'_{it-1}\beta - \alpha_{\hat{g}_i(\theta,\beta,\alpha)_t}\right)^2 \qquad (3)$$

where the effects of the covariates relies on within-group variations over the entire time period.

3 Empirical results

Figure 1 shows the estimates of group membership by province on an Italian map, when G ranges from five to two (Figures from 1a to 1d, respectively). The estimated groups exhibit a strong spatial clustering that yields a clear geographic separation when G decreases.
Figure 2 reveals heterogeneous time-varying patterns and provides empirical evidence that, during the recent financial crisis, the group-specific time effects are not flat and parallel over time and hence they are not consistent with Fixed-Effect (henceforth, FE) and Pooled Ordinary Least Squares (henceforth, POLS) estimators. Thus, the characteristics of our dataset are coherent with the use of GFE estimator, rather than FE and POLS models. Our results support the view that in presence of common shocks, like economic recessions and financial crises, the regional unobserved characteristics follow a time-varying grouped structure.
Table 1 presents the estimation results from POLS, standard FE and GFE models.[3] Columns 1 and 2 report the OLS estimates with year-fixed effects capturing time-shocks that are common to all provinces. Columns 3 and 4 present the estimation results adding

[3]The other covariates, such as the arable of crops and the agricultural gross values added have the expected sign and most are statistically significant.

provincial fixed-effects. Columns 5 and 6 show the empirical results provided by the GFE estimator when G=2. Finally, columns 2, 4 and 6 consider the estimated coefficients of decoupled subsidy split for high (Comp=1) and low (Comp=0) levels of competition in land markets.

The POLS estimates show that there is a positive and significant correlation between land values and direct payments only for coupled subsidy (see column 1). The elasticity of land price with respect to payments based on output is 0.112. Including regional fixed-effects renders the magnitude of the coefficient on coupled subsidy much smaller and not statistically different from zero (see column 3). After controlling for group-time varying heterogeneity, the parameter estimate of coupled subsidy is positive and significant at 5% level. A ten percent increase in the coupled subsidy would be expected to rise the land values by 1.09% (see column 5). Turning the attention to the elasticity of land value with respect to decoupled subsidy, three interesting results emerge. First, there is a clear evidence that the degree of subsidy capitalization decreases with decreasing competition in land markets, consistent with the theoretical model of Graubner (2018). Indeed, for all estimator considered, the degree of land capitalization is higher in provinces with more competitive land markets (see columns 2, 4, and 6). However, it is significant for the OLS and FE model, in the last case with a very low elasticity of 0.004, while it is not statistically significant for the GFE estimator. This result suggests that the effect of decoupled payments on the land values, if anything, is very limited. In addition, our results indicate that coupled payments are more capitalized into land values than decoupled subsidies. Finally, the capitalization on land value of Pillar II payments is extremely sensitive to the estimator used, being positive and significant with POLS, significant negative with FE and insignificant positive with GFE.

4 Conclusions

In this paper we provide evidence of a small incidence of the elasticity estimates of land prices with respect to CAP payments in Italy. As the main goal of agricultural subsidies is farm income support, the lower is the capitalization of payments in land values, the higher is the attainment of such policy target. Our results highlight another relevant implication for policymakers in the agricultural sector: the SFP capitalization depends on the level of competition in the land market, so that more concentrated land markets prevent capitalization into land values. In addition, we highlight the importance of accounting for grouped patterns heterogeneity in the aftermath of the recent financial crisis to analyse the effect of direct payments on the land values. Using GFE estimator, our results are consistent with the view that coupled subsidies are marginally capitalized into land values, while decoupled payments are not.

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Table 1: Empirical Results

	OLS		FE		GFE	
	(1)	(2)	(3)	(4)	(5)	(6)
Decoupled subsidy $(t-1)$	0.014		0.002		0.020	
	(0.012)		*(0.002)*		*(0.017)*	
Decoupled subsidy*Comp(=1) $(t-1)$		**0.027****		**0.004***		0.028
		(0.013)		*(0.002)*		*(0.019)*
Decoupled subsidy*Comp(=0) $(t-1)$		0.007		0.000		0.016
		(0.012)		*(0.002)*		*(0.019)*
Coupled subsidy $(t-1)$	**0.112*****	**0.104****	0.009	0.007	**0.109****	**0.104***
	(0.017)	*(0.017)*	*(0.005)*	*(0.005)*	*(0.054)*	*(0.053)*
II Pillar subsidy $(t-1)$	**0.016***	**0.016***	**-0.002****	**-0.002****	0.013	0.014
	(0.016)	*(0.009)*	*(0.001)*	*(0.001)*	*(0.010)*	*(0.011)*
Share of arable crops (t)	**0.797*****	**0.739*****	**1.090***	**1.062***	**0.699*****	**0.671*****
	(0.071)	*(0.073)*	*(0.571)*	*(0.551)*	*(0.237)*	*(0.234)*
Agri. GVA $(t-1)$	**0.655*****	**0.651*****	-0.010	-0.008	**0.628****	**0.627*****
	(0.031)	*(0.031)*	*(0.030)*	*(0.031)*	*(0.127)*	*(0.129)*
Population Density (t)	-0.027	-0.026	-0.076	-0.111	-0.038	-0.037
	(0.026)	*(0.026)*	*(0.380)*	*(0.387)*	*(0.088)*	*(0.090)*
Fixed-effects						
Group NUTS3 area					yes	yes
Individual NUTS3 area			yes	yes		
Year	yes	yes	yes	yes	yes	yes
Observations	816	816	816	816	816	816

Note: Robust standard errors appear in parenthesis. The GFE standard errors are based on Pollard's (1982) fixed-T normal approximation. *** Significance at the 1% level. ** Significance at the 5% level. * Significance at the 10% level.

Table 2: Summary statistics

Variables	**Mean**	**Std. Dev.**	**Min**	**Max**
Land values (euro/ha)	21558	15423	1377	86561
Decoupled Subsidy (euro/ha)	254	153	8	819
Coupled Subsidy (euro/ha)	115	157	289e-04	1030
Agr. GVA (euro)	2.91e+08	1.97e+08	1.23e+07	9.59e+08
Population Density ($000s/Km^2$)	250	335	38	2649

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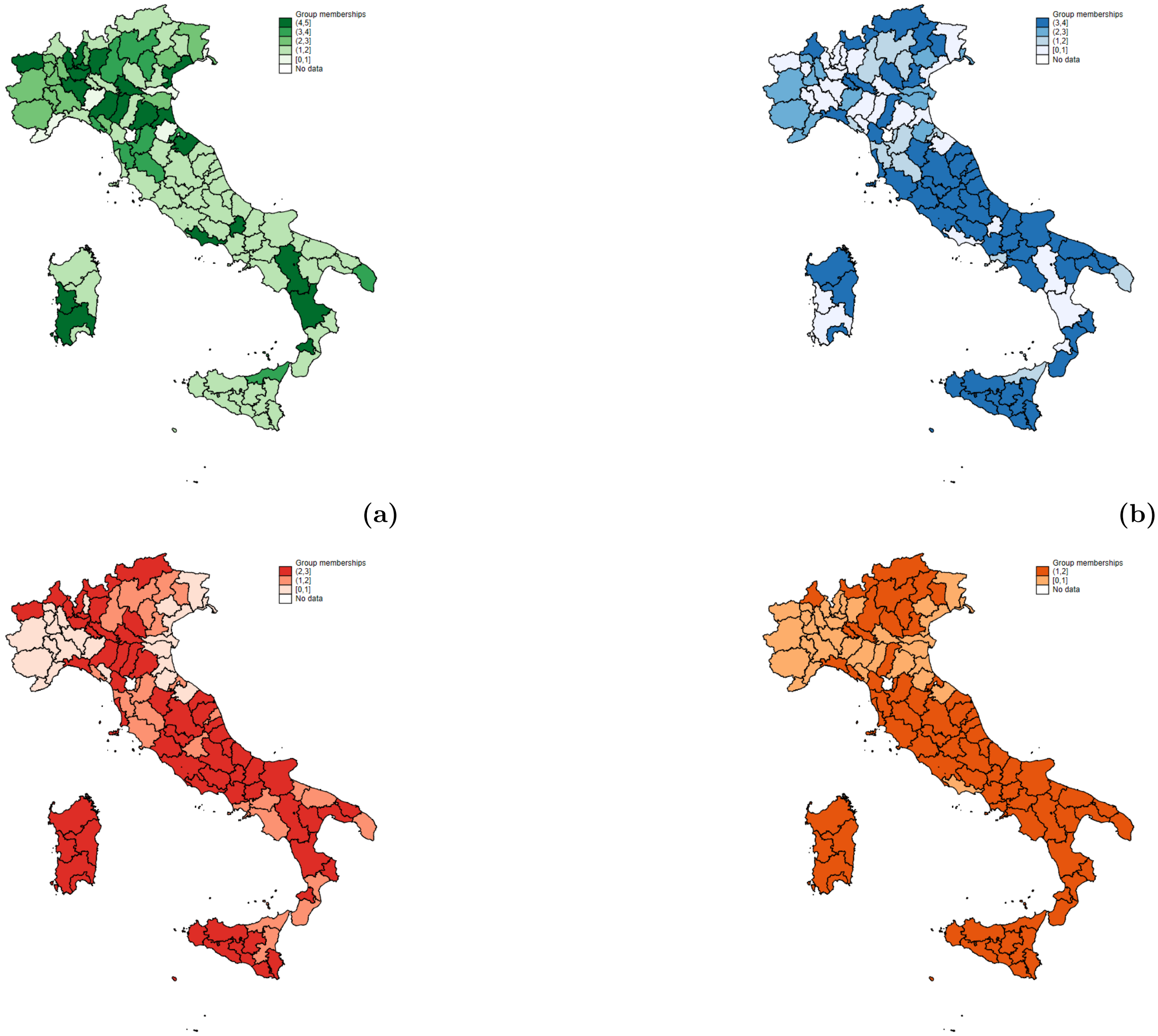
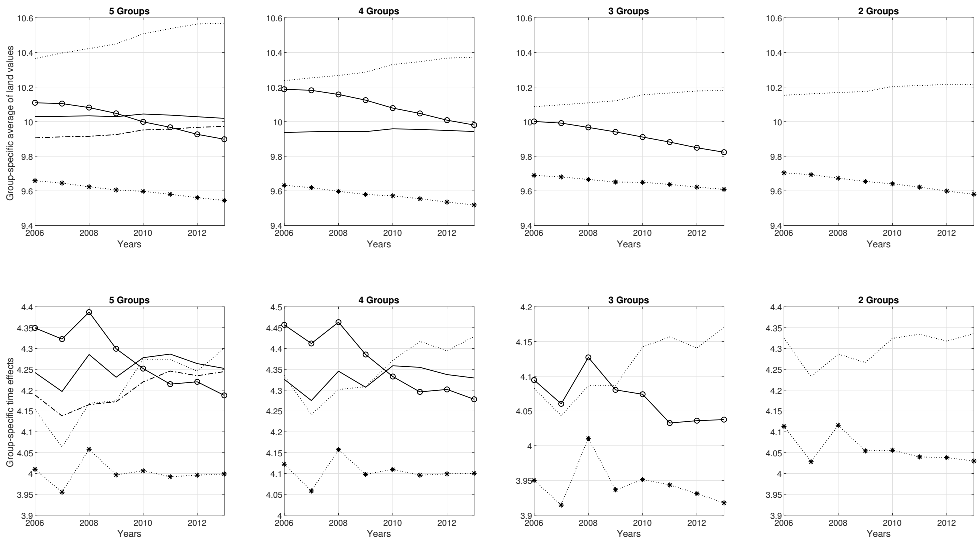
Figure 1: Group membership



(a) **(b)**

(c) **(d)**

Figure 2: Patterns of heterogeneity up to five groups



Note: Patterns of heterogeneity, $G = 2, 3, 4, 5$. The vertical lines indicate the period 2007-2009.