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Abstract

Boosting convergence and shared prosperity in the European Union achieved renewed urgency after the global financial crisis of 2008. This paper assesses the role of agriculture and the Common Agricultural Program in achieving this. The paper sheds light on the relationship between poverty and agriculture as part of the process of structural transformation. It positions each member country on the path toward a successful structural transformation. The paper

then evaluates at the regional level where the Common Agricultural Program funding tends to go, poverty-wise, within each country. This approach enables making more informed policy recommendations on the current state of the Common Agricultural Program funding, as well as evaluating the role of agriculture as a driver of shared prosperity. The analysis performed throughout the paper uses a combination of data sources at several spatial levels.

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Poverty, Inequality, and Agriculture in the EU¹

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1. Introduction²

Shared prosperity is still a challenge in the European Union

After the global financial crisis of 2008, economic growth seems to be back on track in the European Union. Nevertheless, disparities across EU member states in income, growth, and the speed of recovery, among other economic indicators, persist and remain to be solved. In this regard, it is also worth mentioning that poverty rates for some EU countries are still higher than pre-crisis levels. It is clear then, that convergence and shared prosperity in the EU have room left for improvement. Policies that promote shared prosperity, by ensuring that growth reaches everyone, should be implemented. The focus of the present paper is agriculture and its role in ensuring shared prosperity and fostering inclusive growth. We assess agriculture also from the role it plays in the structural transformation of a country. Furthermore, we explore how the CAP program, being a policy targeted to agriculture, has impacted shared prosperity and inclusive growth. In this fashion, we seek to point out possible room for improvement in the CAP program and its current implementation, as well as provide some general recommendations.

This working paper is organized around two main questions related to non-intentional impacts of the CAP in respect to poverty and inequality at the subnational level. Although the original objectives of the CAP program were not necessarily aligned towards poverty alleviation, this paper aims to first investigate whether it played a role in the registered reduction of monetary poverty during the last decade. The second guiding question for this working paper consists on documenting the relationship between agricultural activity and the CAP in respect to monetary poverty, with a particular focus on the observed heterogeneity across EU member states. The answers to these two guiding questions based on the latest and most granular analysis of the past ten years of the CAP, can inform if and where agriculture and the CAP can be one of the important drivers of social inclusion and territorial cohesion.

A main motivating question in this analysis is whether, and how, the CAP may complement other policies, or foster territorial cohesion on its own. A clear objective of the EU, as stated by the European Commission, is to “strengthen economic and social cohesion by reducing disparities between regions in the EU” (European Parliament, n.d.). In addition to economic and social cohesion, territorial cohesion was later included as a further objective. In a similar line as Crescenzi and Giua (Crescenzi & Giua, 2016), an important motivating question is whether sectorial policies like the CAP can contribute to or complement other policies’ objectives, specifically social cohesion in the EU. In the particular case of the CAP, we want to analyze if this program further complements other existing policies’ objectives by better channeling resources to socio-economically deprived areas. This could potentially aid in the Cohesion Policy of the EU, as it contributes to reducing disparities between regions, based on poverty rates, across the EU.

The data used for the purpose of the various analyses in this working paper came from several sources; including the EU-SILC survey from years 2003 to 2014 at the NUTS 1 and NUTS 2 levels, the

² This work was produced as a background paper to the *EU Regular Economic Report: Thinking CAP - Supporting Agricultural Jobs and Incomes in the EU*. (Brink, Kordik, and Azevedo, 2018).

EU-Poverty Map at the NUTS 3 level, the CAP administrative records at the NUTS 3 levels, and the Farm Structure Survey for several years including 2010 and 2011. This paper is structured as follows. In Section 2 we start by briefly motivating the need for additional policies that foster inclusive growth, as suggested by the state of inequality and poverty in the post-crisis period. Section 3 introduces the main framework, and the results from the analysis of the relationship between poverty and agriculture. Section 4 then briefly introduces the CAP and proceeds to analyze the relationship between poverty and the CAP. Section 5 wraps up the main results, by presenting an integrative analysis taking results from the previous sections, and finally Section 6 concludes.

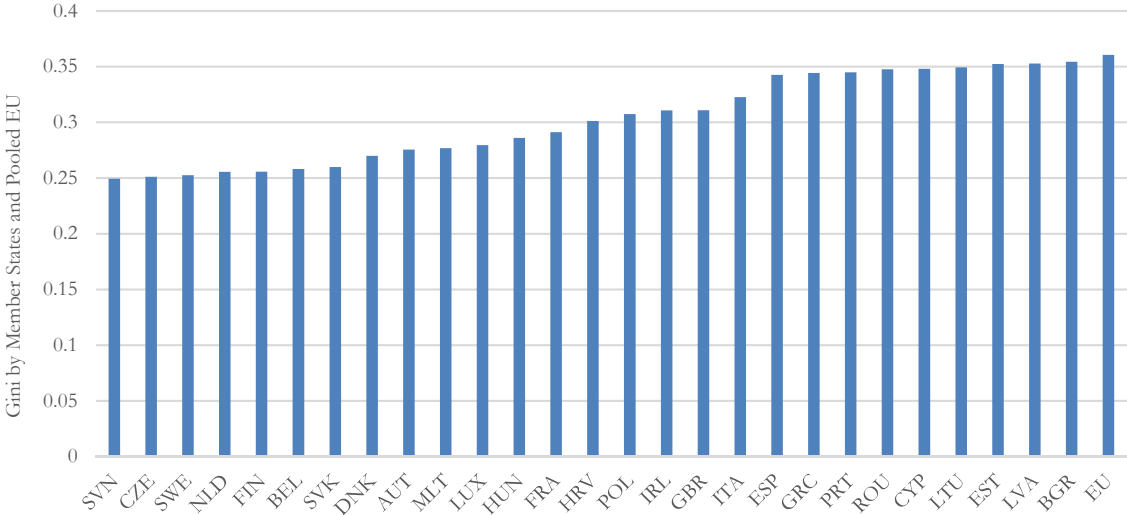
2. Motivation

The current state of inequality and poverty in the European Union

After the global financial crisis of 2008, some of the economic indicators across the European Union have been under recovery, however others still lag behind, one of these being inequality. Thus, the current state of inequality and poverty in the EU points to the need for inclusive policies that promote shared prosperity. In this section we describe the current state of these indicators in the region. Convergence in agricultural income is also introduced and briefly discussed as an important channel for overall income convergence across EU member states.

Inequality has become an important topic in the policy discussion of the EU, especially since the Great Recession. Even though inequality in the EU member states is low compared to other parts of the developed world (OECD, 2017), inequality in the region has become a topic of concern. The recent member state expansion towards countries with lower levels of average income has contributed to an increase of inequality across the EU. In order to further explore this, we perform an analysis by treating the EU as a single country, thus pooling the income of all member countries together and ranking them along the same distribution. The resulting Gini coefficient is higher than the coefficient associated to any single EU member state. This is a high inequality level by international standards.

Figure 1. Inequality Across the EU

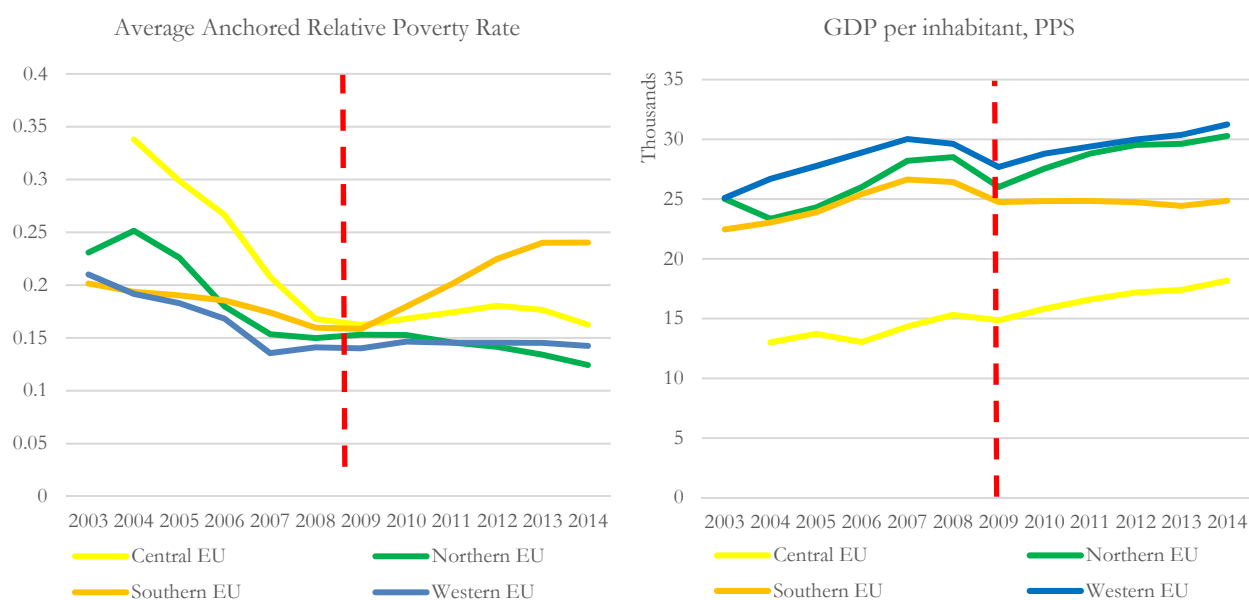


Source: EUROSTAT, WB staff calculations.

Although poverty is multidimensional, we focus on a single dimension with the purpose of maximizing comparability among the various data sources used. Thus, in the context of this work we focus exclusively on the monetary dimension of poverty, using one main measure, namely, the 2011-anchored AROP (at risk of poverty). This measure uses a relative poverty line for each member, but keeping it constant for all the years within the analysis. A country's poverty line is defined as 60% of its equivalized median income anchored on the 2011 value. Figure 2 shows the trends from 2004 to 2014 for GDP per capita and anchored monetary poverty (using an anchored relative poverty line for each member state). Since the survey coverage changes over time due to the expansion of the EU membership, we compute separate lines for each cohort of member states in terms of comparable data availability. The figure shows that although GDP per capita is already above its pre-crisis level, the relative anchored poverty level is at higher or at the same pre-crisis level, suggesting that growth during the recovery has not been inclusive. The case for the Southern EU member states is particularly alarming.

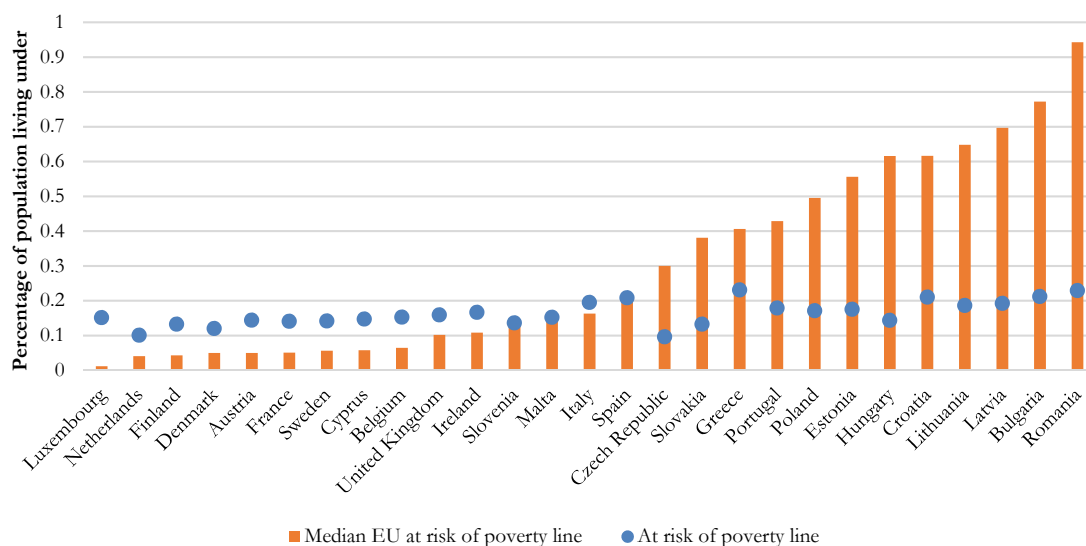
Figure 2. Although GDP per capita has recovered, anchored relative poverty rates are still higher.

Source: EUROSTAT, WB staff calculations.



Furthermore, absolute poverty levels remain high across the EU. In order to compare absolute poverty levels between countries, we define the median of the absolute national poverty lines of all EU Member States as the absolute poverty line to use across countries. This gives an absolute poverty line of US\$21.70 per day (in PPP). Using this measure, poverty remains high across the EU, and further stresses the large disparities across countries. Figure 3 below compares the poverty rates that result from using absolute measure and relative measures.

Figure 3. Poverty rates between member states are extremely different using an absolute poverty line, compared to a relative measure.



Source: EUROSTAT, WB staff calculations.

The role of agriculture in income convergence

Although the speed of convergence remains low, member states are catching up with each other in terms of income, and at a faster rate for agricultural income. In recent years there has been a reduction in the dispersion of mean incomes between EU member states, or what is referred to as beta convergence in the literature. This means that member states have experienced a convergence in their income level, especially in agricultural income. In particular, agricultural income growth is converging faster than non-agricultural income growth. This may also indicate a decrease in the agricultural income gap. However, results show that agricultural income is catching up faster with non-agricultural income in old member states (OMS), compared to the pace for new member states (NMS). This result further highlights the importance of addressing how other policies can contribute towards more inclusive growth, in particular the CAP, which targets agriculture and may help in reducing the difference in convergence rates between member states. The potential of the CAP program in aiding inclusive growth depends on the state of structural transformation where each country finds itself.

Table 1. Speed of convergence for different incomes between OMS and NMS

		OLS			LSDV		
		EU27	OMS	NMS	EU27	OMS	NMS
Mean total household income	Speed of Convergence, β	0.04%	0.00%	0.05%	0.21%	0.21%	0.24%
	Half-life of convergence	1863	175913	1340	334	338	290
Mean agricultural income	Speed of Convergence, β	0.13%	0.13%	0.08%	0.72%	0.76%	0.65%
	Half-life of convergence	550	525	903	97	91	107

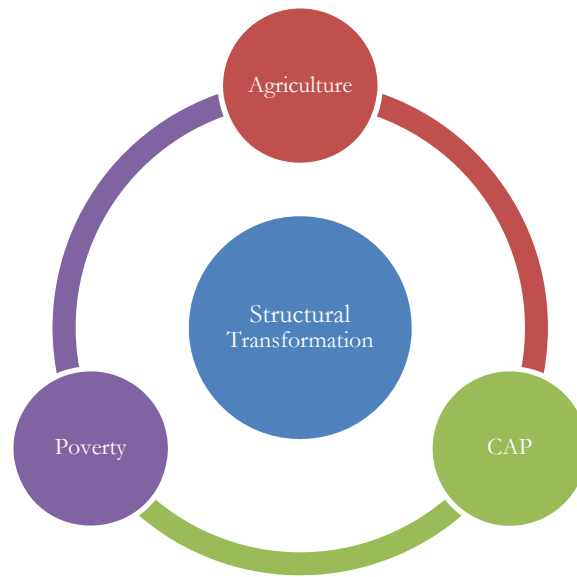
Notes: (1) Speed of Convergence is calculated using the coefficients of respective variables of interests; (2) Half-life of convergence is calculated as $0.6931/\text{speed of convergence}$; (3) OLS columns report results using OLS regressions, while LSDV columns results using fixed effect models; (4) OMS are 14 old member states, while NMS are 13 new member states that joined the EU after 2004; (5) Data Source: EU-SILC, Eurostat (2005-2014)

3. Agriculture and Poverty

A Structural Transformation Approach to agriculture and poverty

Structural transformation may be broadly defined as the transition of an economy from a strong reliance in labor intensive and low-productive sectors to more skill-intensive and high-productive sectors (UN Habitat, 2016). This transition usually occurs as labor and other economic resources move away from the traditionally labor-intensive agricultural sector to modern sectors such as manufacturing and services, which are characterized by higher skills and productivity. Concomitant to such transition is an increase in productivity and income. There are several economic characteristics of the agricultural sector within a country, which signal an ongoing structural transformation. For instance; a declining share of the sector's contribution to GDP, migration from rural to urban areas, which at the same time results in a decrease of the sector's share of overall employment, an increase in agricultural labor productivity, and eventually a decline in poverty, among others.

Figure 4. We assess the key relationship between poverty, agriculture, and the CAP, from a structural transformation approach



For this work, we operationalize the process of structural transformation as described in what follows. As the transformation takes place, the agricultural sector gains in competitiveness, and its productivity increases. Agriculture then represents a source of growth and jobs for the regions where it is a predominant economic activity. Thus, it starts by spurring growth in such regions and in this way, contributes to a decrease in the associated poverty. As agricultural labor productivity increases, agricultural income increases to a point where poverty reduction is first observed in the immediate areas where agriculture predominates. As incomes continue to increase, the effect extends to whole rural areas in such a way that rural poverty is reduced. Furthermore, past this point of the process, agriculture and poverty start to appear negatively associated. Structural transformation thus hints at the role that agriculture as a sector plays in promoting inclusive growth and shared prosperity, as it represents the first milestone of a successful transformation. It is along this line that we continue our analysis in what follows.

Identifying successful and incomplete transformers using the poverty rate and agricultural indicators

Following this approach, we perform a first analysis to explore the association between poverty and several agricultural indicators, which assess the extent of agricultural activity within a region. In this fashion we seek to identify where a country is currently located on the path towards a successful structural transformation. The stylized story behind this is that, as mentioned earlier, low productivity in agriculture translates into high poverty in the areas where agriculture prevails. As the transformation moves forward, agriculture becomes more productive and incomes expand, thus decreasing poverty in agricultural regions. It is important to identify regions in which agricultural activity remains closely associated to poverty, as this suggests that they remain in an early stage of a structural transformation and may still have untapped opportunities to accelerate their development process in the near future. For this purpose, we create six indicators that capture the intensity of agricultural activity within a region; share of agricultural area, average agricultural output per hectare, average labor unit per hectare, average labor unit per holding, average holding size, and agriculture share of employment. The first analysis performed consists of assessing, for each country, how each of these indicators is correlated with poverty. Following the stylized story on structural transformation, a negative association between an agricultural indicator and poverty signals a successful structural transformation, while a positive association signals room for improvement within the transformation path.

We consider two measures of area poverty: poverty rate and the share of a country's poor population. We start with the spatial distribution of poverty, measured by the regional poverty rate, within each member state. This indicator identifies the regions in which poverty tends to happen. The results are summarized in the following table, where the sign captures the direction of a statistically significant association found between the poverty rate and the specific indicator referred to in each column, while controlling for a number of observation factors such as population and GDP. A zero indicates that no significant association was found. Thus, a positive sign suggests that agricultural activities, as measured by the indicator in place, tend to take place in poorer regions within a country. In a similar fashion, a negative sign suggests that such activities tend to concentrate in non-poor regions.

Table 2. Association between poverty rate and different agricultural indicators

Country	Agriculture share of area	Agriculture share of employment	Average holding size (hectare)	Average labor unit per hectare (AWU)	Average labor unit per holding (AWU)	Average agricultural output per hectare (Euro)	Average output per labor unit (Euro/AWU)
Croatia	+	+	+	+	+	-	+
Spain	+	+	+	+	+	+	+
Bulgaria	+	+	+	+	+	+	+
Portugal	+	+	+	+	+	+	+
Slovenia	+	+	-	+	+	+	+
Latvia	+	-	+	+	+	+	+
Greece	+	+	-	+	+	+	-
Romania	+	-	+	+	-	+	-
Malta	+	+	0	+	+	+	+
Italy	+	+	-	+	-	+	+
Sweden	+	+	-	-	+	-	+
United Kingdom	-	+	-	-	-	+	+

Estonia	-	+	-	-	+	-	-
Germany	+	-	-	-	+	+	+
France	-	-	-	-	-	-	-
Ireland	-	+	-	+	-	-	-
Slovak Republic	-	-	-	-	-	-	-
Austria	-	-	-	-	-	-	-
Finland	-	+	-	+	+	+	-
Poland	-	-	-	-	-	-	-
Belgium	-	-	-	-	-	+	+
Hungary	-	-	-	-	-	-	-

Table 2 shows the heterogeneity across the EU regarding the stage of structural transformation where its member states find themselves, suggested by the association with different sign patterns for the various indicators. The successful transformers show a negative correlation between poverty and agricultural indicators, consistent with the fact that at this phase of the transformation agriculture is no longer linked to poverty. Such is the case for Austria, France, Hungary, Poland, and the Slovak Republic. On the other hand, incomplete transformers show a consistent positive correlation between agricultural activity and poverty, as agriculture is still predominant in poor regions. Spain, Bulgaria, and Portugal are among the countries at an early phase of the transformation.

Identifying successful and incomplete transformers using the share of the country's poor and agricultural indicators

Following the analysis, we continue by assessing the correlations between poverty and agricultural activity at the regional level, but now using as a measure of poverty the share of a country's poor in each region. The share of a country's poor population concentrated in a particular region contrasts with the poverty rate, as the former one is informative in terms of where the poor population tends to concentrate, rather than where poverty tends to happen. It is important to distinguish between the two poverty measures used, since the regions with high poverty do not necessarily contain a higher share of the country's poor population. This exercise sheds light on whether agriculture takes place in areas with a high proportion of the total poor population within each EU member state. The results are summarized in Table 3, where once again a positive sign within a specific agricultural indicator denotes that agricultural activity, as measured by such indicator, takes place in regions where poor people tend to concentrate. Analogously, a negative sign for an indicator underpins that agricultural activity takes place in regions with a low concentration of the country's poor people.

Table 3. Association between share of country's poor and different agricultural indicators

Country	Share of the country agriculture area	Share of the country agriculture employment	Average holding size (hectare)	Average labor unit per hectare (AWU)	Average labor unit per holding (AWU)	Average agricultural output per hectare (Euro)	Average output per labor unit (Euro/AWU)
Latvia	+	+	-	+	-	-	+
Estonia	+	+	+	+	-	+	+
Ireland	+	+	+	-	-	+	+
Denmark	+	+	+	+	-	+	+
Slovak Republic	+	-	+	-	-	+	+

Croatia	+	+	+	+	-	+	+
Portugal	+	-	-	+	-	+	+
Austria	-	-	-	+	-	+	+
Bulgaria	-	-	-	+	-	+	+
Hungary	-	-	-	+	-	+	+
Sweden	-	-	-	-	-	+	+
Finland	-	-	+	-	-	+	+
Romania	-	-	-	+	-	+	+
Greece	-	-	-	+	-	+	+
Belgium	-	-	-	+	-	+	+
Germany	-	-	-	+	-	+	+
Poland	-	-	-	+	-	+	+
Slovenia	-	-	+	+	-	+	+
Netherlands	-	-	-	+	-	+	+
Italy	-	-	-	+	-	+	+
France	-	-	-	+	-	+	+
Malta	-	-	-	-	+	-	-

From Table 3 it is clear that there is heterogeneity across the EU regarding the relationship between the share of poor and agricultural activities. Similarly as before, in this case successful transformers can be identified as those where agricultural activities are negatively associated with the country's share of poor. Such is the case of Malta, Sweden, and the Netherlands, among other countries. Incomplete transformers still show a positive association between the share of poor and agriculture, suggesting the prevalence of agricultural activities in the regions where the poor tend to concentrate the most. In this case we find countries like Croatia, Estonia, Ireland, and Portugal, among others.

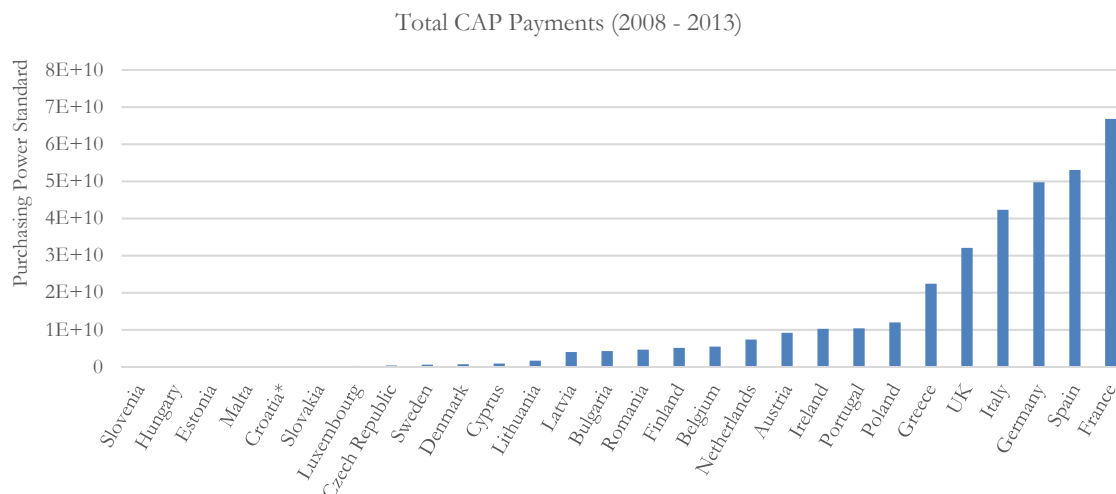
The analysis made so far will be complemented in what follows, by assessing the regions, in terms of poverty, where the CAP funds tend to go. In this fashion we seek to better evaluate potential improvement areas for the CAP funds within each member state.

4. Poverty, Inequality and the CAP

Assessing the CAP: A brief introduction

The Common Agricultural Policy was created in 1962 (European Commission, 2017) and thus stands as one of the oldest policies of the EU. According to the European Commission, the main objectives of the CAP today are “to provide a stable, sustainably produced supply of safe food at affordable prices for Europeans, while also ensuring a decent standard of living for farmers and agricultural workers” (European Commission, 2017). Broadly speaking, the Common Agricultural Policy has two main components: pillar 1 and pillar 2. Pillar 1 consists of direct payments and market measures. Under this pillar farmers can receive coupled direct payments, which are conditional to the production of a particular crop or livestock species. This pillar also entitles farmers to receive decoupled payments, which do not depend on output, but on the area of the agricultural land used. On the other hand, pillar 2 focuses on funding rural development projects. These funds support investment in development projects taken on by farmers or rural businesses.

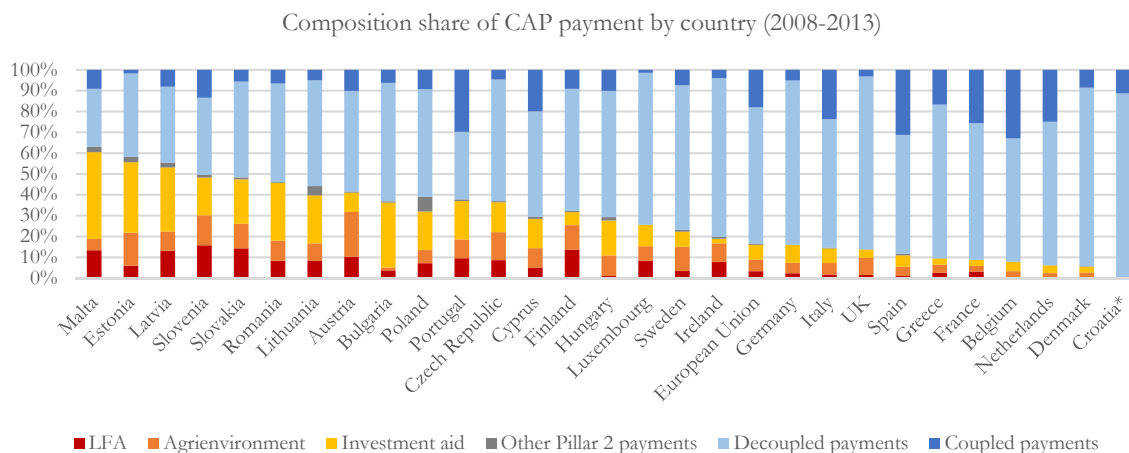
Figure 5. Levels of CAP funds received by different member states are drastically different.



Source: DG AGRI (2017) Clearance Audit Trail System (CATS) database provided by the European Commission

Figure 5 above shows how the allocation of total CAP payments differs across the EU member states. The EU determines how much CAP funds each of the member states receives. Nevertheless, member states have certain flexibility in allocating the CAP funds between the program’s pillars. This creates heterogeneity as to how the funds are spent, between both pillars, within countries, as showed in Figure 6 below.

Figure 6. There is clear heterogeneity of CAP funds allocation choices made by different countries.



Source: DG AGRI (2017) Clearance Audit Trail System (CATS) database provided by the European Commission

Allocation of CAP funds based on regional characteristics

To explore the characteristics of regions where the CAP funds tend to reach, we create four different clusters of regions at the NUTS1/NUTS2 levels based on the average holding size and the number of employees per holding. For each of these variables we create categories to group the existing regions. Table 4 below simplifies the clusters by characteristics, in which regions are grouped. Table

5 provides summary statistics for each of the four clusters. The holding size average for all regions is 36.1, while the average number of workers per holding stands at 1.4. Clusters 1 and 2 contain regions with mostly small holdings, whereas clusters 3 and 4 contain regions with a higher number of employees per holding. Most of the regions belong to clusters 1 and 2.

Table 4. Clusters of regions based on average holding size and employees per holding

		Average holding size		
		Small	Average	Large
Employees per holding	Low	Cluster 1	Cluster 2	
	High		Cluster 3	Cluster 4

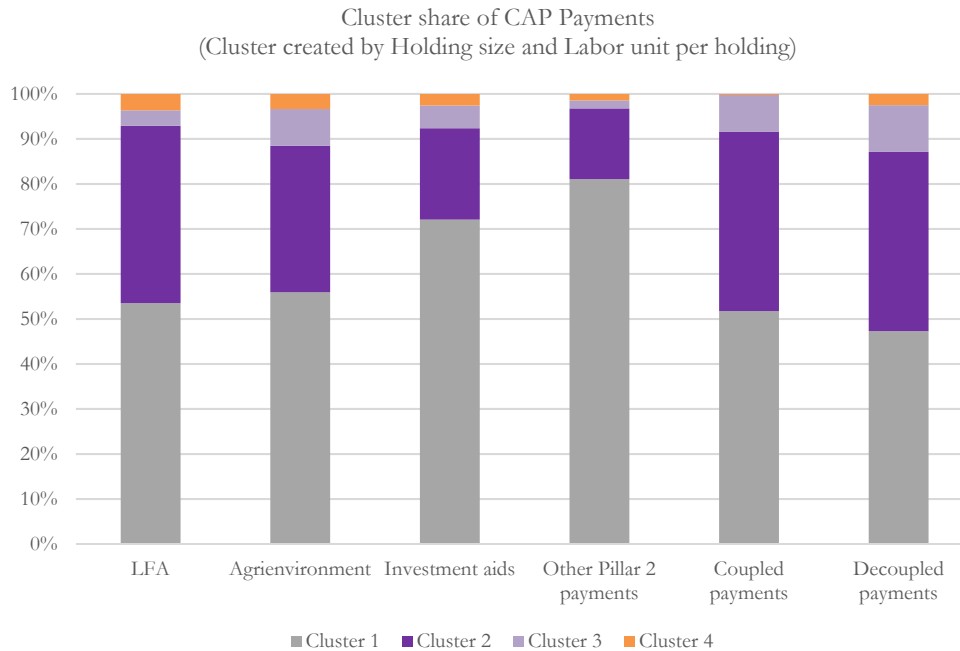
Table 5. Summary Statistics for clusters

Cluster	Qualitative Interpretation	Mean holding size	Mean employee per holding	Total number of holdings in 2013	Number of regions
Cluster 1	Small Holding, Low Employment	16.43	1.01	9697200	60
Cluster 2	Average Holding, Low Employment	55.97	1.35	638650	26
Cluster 3	Average holding; High employment	97.33	2.47	146360	14
Cluster 4	Large holding; High employment	146.49	3.65	47380	6

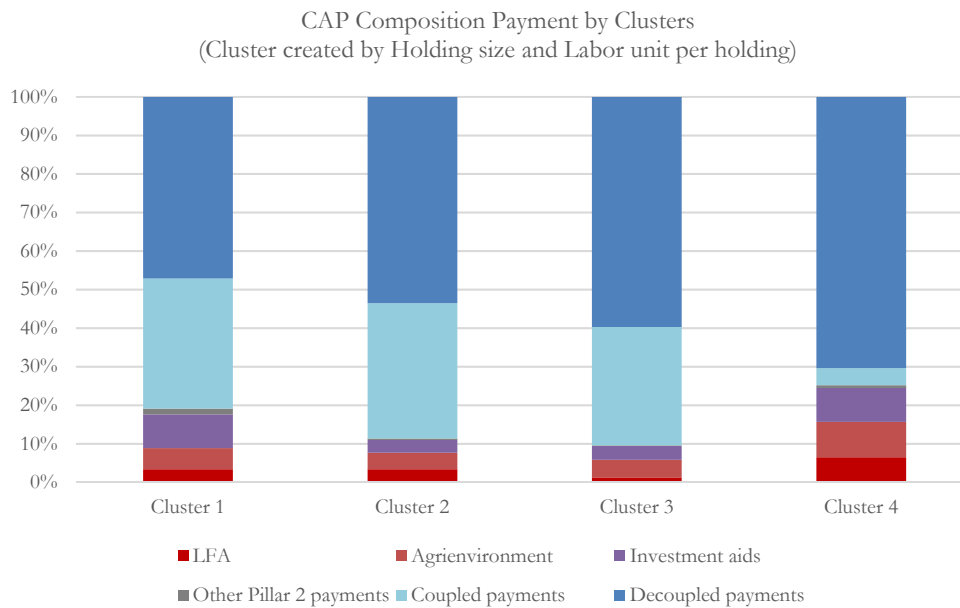
Figure 7(a) also shows that clusters 1 and 2 receive over 90% of the CAP funding, while cluster 4 is the one that receives the least. Figure 7(b) contains the CAP composition by clusters. It shows that for all clusters, most of the CAP funding is allocated to decoupled payments, followed by coupled payments for clusters 1, 2, and 3. Thus the majority of CAP funding is allocated to pillar 1.

Figure 7. Regions in different clusters are receiving drastically different levels of CAP fund and have significant different allocation choice for their CAP fund.

(a). Share of each CAP type received by each cluster



(b). CAP composition by clusters



Are the CAP funds reaching the poor regions within the EU?

Heterogeneity of the CAP funds received by each member state and on how they are allocated between the program’s pillars raises the question of whether heterogeneity persists, regarding the characteristics of the areas where the CAP funds reach within each country. In particular, following our structural transformation approach, we are interested in assessing whether there is any relationship between poverty and CAP funds. We start by investigating where the CAP funds are being allocated, by analyzing the relationship between the CAP funds and the spatial poverty rate.

Table 6. CAP payments are allocated to poorer regions

NUTS 3 CAP regressions	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
LABELS	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate
Payment (Total)	1.95e-09**													
Payment per capita (Total)		0.000472**												
Payment (pillar1)			1.95e-09**											
Payment per capita (pillar1)				0.000433*										
Payment share (pillar1)					-0.000773									
Payment (pillar2)						8.26e-09**								
Payment per capita (pillar2)							0.000325**							
Payment share (pillar2)								0.000773						
Payment (pillar1 coupled)									1.66e-09					
Payment per capita (pillar1 coupled)										0.000108				
Payment share (pillar1 coupled)											0.000739			
Payment (pillar1 decoupled)												2.56e-09**		
Payment per capita (pillar1 decoupled)													0.0000541*	
Payment share (pillar1 decoupled)														0.00195
GDP per capita (PPS)	-0.000154**	-0.000151**	-0.000155**	-0.000153**	-0.000158**	-0.000153**	-0.000150**	-0.000158**	-0.000158**	-0.000157**	-0.000158**	-0.000154**	-0.000152**	-0.000158**
Population density	0.113**	0.111**	0.112**	0.109**	0.0990**	0.106**	0.113**	0.0990**	0.102**	0.103**	0.100**	0.114**	0.110**	0.103**
Country fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Constant	17.54**	17.23**	17.79**	17.65**	18.60**	17.14**	15.68**	17.83**	18.15**	18.01**	18.19**	17.72**	17.60**	18.10**
Observations	1,181	1,181	1,184	1,184	1,181	1,181	1,181	1,181	1,181	1,181	1,181	1,184	1,184	1,181
Adj R-Squared	0.368	0.364	0.363	0.360	0.359	0.372	0.371	0.359	0.359	0.360	0.359	0.365	0.360	0.359

Note: (1) Data source: EU 2011 Poverty Map (DG-REGIO and World Bank), 2010 Farm Structure Survey (Eurostat), and EU National Statistic Institutes (Eurostat); (2) Symbols: ** p<0.01, * p<0.05, + p<0.1; (3) Missing observations in CAP data are treated as zero; (4) Luxembourg and Cyprus Republic are not being analyzed here; (5) CAP data is missing for 21 regions in Croatia and 2 regions in Spain (with 1 more region missing for Pillar 2 data); (6) Standard errors are clustered at country level

Table 6 above indicates that, overall, the CAP funds seem to be reaching poorer areas within the EU. Starting with total CAP payments, a positive and significant relationship with poverty rate is observed. Further disaggregating the total payments into the two CAP pillars supports this result, as both pillars, when individually analyzed, remain significantly associated to poverty rates. When analyzing pillar 1 by its individual components, the decoupled payments remain significantly and positively associated with poverty rate. These results remain when analyzing each of these components on a per capita level. Therefore, CAP funds do tend to reach regions where higher poverty rates prevail. Nevertheless, it is important to keep in mind that CAP payments reaching poor areas do not imply they are necessarily reaching the poorest households within those areas.

We continue our analysis by assessing the relationship between CAP payments and poverty, but now turning to the share of the countries' poor as the measure for poverty. Table 7 below presents the results obtained, which are similar to the ones previously presented using the poverty rate. Total CAP payments are significantly and positively associated with the share of the country's poor. Similarly, for the specifications including each of the CAP's pillars, we observe the same significant and positive association. In this case, both components of pillar 1, coupled and decoupled payments, seem to be reaching areas where there is a high share of the country's poor population.

Table 7. CAP payments

LABELS	(1)	(2)	(3)	(4)	(5)	(6)	(8)	(10)	(12)	(14)	(16)	(18)
	Share of country poor	Share of country poor	Share of country poor	Share of country poor	Share of country poor	Share of country poor	Share of country poor	Share of country poor	Share of country poor	Share of country poor	Share of country poor	Share of country poor
Total CAP payments	1.46e-09**	1.45e-09**										
Payments for pillar1			1.39e-09**	1.83e-09**								
Payments for pillar2					6.73e-09*	6.11e-09*						
Payments for pillar1 coupled							4.46e-09*					
Payments for pillar1 decoupled								2.04e-09**				
Payments for investment aids budgets									1.08e-08**			
Payments for LFA budgets										2.22e-08+		
Payments for Agri-environmental budgets											2.00e-08**	
Payments for pillar2 other												1.82e-08**
Population density(Inhabitants per hectare);		0.0571*		0.0511*		0.0527*	0.0427*	0.0525*	0.0534+	0.0460*	0.0483*	0.0416*
Gross Domestic Product(PPS per inhabitant)		6.98e-06		9.42e-06		7.18e-06	6.28e-06	9.64e-06	7.89e-06	6.21e-06	1.12e-05	-3.93e-06
Poverty line		0.000804**		0.000765**		0.000664**	0.000702**	0.000776**	0.000725**	0.000579**	0.000600**	0.000704**
Number of zero-beneficiary budgets		0.0246+		0.00257		0.0243*	-0.0140	-0.479	0.0345+	0.121+	0.0524	0.212+
Constant	2.476**	-11.33**	2.647**	-9.422**	2.123**	-9.474**	-8.189**	-9.595**	-10.19**	-7.082**	-8.160**	-8.186**
Country fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1,181	1,181	1,181	1,181	1,181	1,181	1,181	1,182	1,181	1,181	1,181	1,181
Adj R-squared	0.566	0.599	0.561	0.577	0.575	0.604	0.571	0.576	0.595	0.595	0.587	0.587

Note: (1) Data source: EU 2011 Poverty Map (DG-REGIO and World Bank), 2010 Farm Structure Survey (Eurostat), and EU National Statistic Institutes (Eurostat); (2) Symbols: ** p<0.01, * p<0.05, + p<0.1; (3) Missing observations in agricultural indicators are treated as zero; (4) Luxembourg and Cyprus Republic are not being analyzed here; (5) CAP payment data in Croatia, 5 regions in Estonia and 1 region in France (Seine-Saint-Denis) is missing;

Do the CAP payments reach poor regions within each country?

So far, the broad picture points to CAP payments, on average, reaching areas with higher poverty rates and with a higher share of the countries' poor population. Nevertheless, this need not be true for all countries. Therefore, we extend the analysis to assess any possible heterogeneity across member states. For this purpose, we compute the relationship between the poverty rate and 8 different indicators for the CAP payments. Such indicators include the total payments, then disaggregate the total payments by pillars, and finally individually analyze the components within each pillar. The results are presented in Table 8 below. This analysis provides spatial information as to where CAP funds reach within each particular country, in terms of poor and non-poor regions.

Table 8. Association between poverty rate and CAP payments

Country	total CAP payments	pillar1 CAP payments	pillar2 CAP payments	pillar1 coupled CAP payments	pillar1 decoupled CAP payments	LFA payments	AgrienvIRONMENTAL payments	Investment Aids payments
Croatia	+	+	0	+	+	0	0	0
Spain	+	+	+	+	+	+	+	+
Romania	+	+	+	+	+	+	+	+
Bulgaria	+	+	+	+	+	+	+	+
Portugal	+	+	+	+	+	+	+	+
Slovenia	+	+	+	+	+	+	+	+
Greece	+	+	+	+	+	+	+	+
Italy	+	+	+	+	+	+	+	+
Malta	+	0	+	0	0	+	+	+
Sweden	+	-	-	+	+	-	+	+
Belgium	-	-	-	-	-	+	+	-
Finland	-	-	-	-	-	-	-	+
United Kingdom	-	-	-	-	-	-	-	-
Latvia	-	+	-	+	+	-	-	-
Ireland	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	-	-
Netherlands	-	-	+	-	-	+	-	-
Austria	-	-	-	-	-	-	-	-
France	-	-	-	-	-	-	-	-
Poland	-	-	-	-	-	-	-	-
Denmark	-	-	-	-	-	0	-	-
Slovak Republic	-	-	-	-	-	-	-	-
Estonia	+	-	+	-	+	-	+	+

The sign indicates the direction of a significant association found between the poverty rate and the specific CAP payment indicator. A zero indicates that no significant association was found. However, for the case of Croatia, a zero indicates missing data due to its more recent entry to the EU. Thus a positive sign suggests that the particular CAP payment referred to by the indicator in place tends to be allocated to poorer regions within a country. In a similar fashion, a negative sign suggests that such payment reaches non-poor regions. The heterogeneity of the spatial correlation between CAP

funds and poor regions across EU member states can be seen, as different countries are associated with different patterns of signs for the indicators. Countries that allocate all CAP funding to high poverty regions include Spain, Romania, Bulgaria, Portugal, Slovenia, Greece, and Italy. On the other hand, countries for which CAP funds are negatively correlated with poverty rate include Hungary, the Slovak Republic, Poland, France, Austria, the United Kingdom, Germany, and Ireland.

Table 9 presents the results for the analysis of the correlations between the CAP payment indicators and the share of a country's poor. Countries for which all the CAP payments reach areas where a large share of the country's poor population concentrates include Malta, Latvia, Ireland, Denmark, and Estonia. On the other hand, countries which show a negative correlation between CAP payments and areas with a high concentration of the country's poor include Spain, Italy, the United Kingdom, Germany, France, Poland, and Hungary. The cases for countries like Spain and Ireland are interesting, since both countries completely switch their correlations depending on the poverty indicator used. In the case of Spain, the country's CAP payments reach regions with high poverty rates, but are negatively correlated with regions which show a high share of the country's poor population. Ireland shows the opposite case; its CAP payments consistently reach areas where the poor concentrate, but are negatively correlated with regions that show high poverty rates.

Table 9. Association between share of poor and CAP payments

Country	total CAP payments	pillar1 CAP payments	pillar2 CAP payments	pillar1 coupled CAP payments	pillar1 decoupled CAP payments	LFA payments	Agrienviromental payments	Investment Aids payments
Croatia	+	+	0	+	+	0	0	0
Spain	-	-	-	-	-	-	-	-
Romania	+	+	+	-	-	-	-	-
Bulgaria	+	+	+	+	+	-	+	-
Portugal	+	+	-	+	+	-	-	-
Slovenia	+	+	+	+	+	-	+	+
Greece	-	-	+	-	-	-	-	-
Italy	-	-	-	-	-	-	-	-
Malta	+	+	+	+	+	+	+	+
Sweden	+	+	+	+	+	-	-	+
Belgium	+	+	+	-	-	-	-	+
Finland	+	+	+	+	+	-	-	+
United Kingdom	-	-	-	-	-	-	-	-
Latvia	+	+	+	+	+	+	+	+
Ireland	+	+	+	+	+	+	+	+
Germany	-	-	-	-	-	-	-	-
Netherlands	+	+	+	-	-	+	-	+
Austria	+	-	+	-	-	-	-	-
France	-	-	-	-	-	-	-	-
Poland	-	-	-	-	-	-	-	-
Denmark	+	+	+	+	+	+	+	+
Slovak Republic	+	+	-	+	+	+	-	+
Estonia	+	+	+	+	+	+	+	+

After documenting that CAP funds tend to reach regions with high poverty rates and with a high share of a country's poor, the question of whether CAP has actually contributed to poverty alleviation remains pending. It is worth highlighting that by answering this question, we are in no way trying to evaluate the CAP's overall performance since, as specified earlier in this paper, the program's original objective is not related directly to reducing poverty in the areas where it is allocated. Nevertheless, this question is important for further policy recommendations, and more importantly, to assess whether CAP is an instrument that supports the successful structural transformation of a country.

Poverty and inequality dynamics and the CAP

With this in mind, we use panel data to determine the impact, if any, that the CAP has had on poverty rates. Despite heterogeneity in the allocation of the CAP across EU member states, on average a positive impact of the CAP on poverty has been observed. Table 10 documents that total per capita CAP payments are associated with a decrease in the poverty rate over time in the EU. The total per capita payments are further disaggregated into the program pillars to explore potential differences in each pillar's contribution to poverty alleviation. In the individual analysis, the per capita payments of both pillars remain significant and negative in their association with poverty growth. However, when both pillars are jointly analyzed, it seems that pillar 2 is more significant in its contribution to poverty reduction.

Table 10. Per capita CAP payments are linked to regions with higher poverty reduction.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate
Total payments (per capita)	-0.294*	-0.185+	-0.244*									
Payments to pillar1 (per capita)				-0.352*	-0.173	-0.270+				-0.251	-0.0519	-0.171
Payments to pillar2 (per capita)							-0.618*	-0.517*	-0.549*	-0.393+	-0.476*	-0.412+
Share of individuals in agricultural households		0.314+	0.235		0.300*	0.216		0.544*	0.251+		0.339*	0.246
Share of inhabitants with secondary education		0.00214	0.126		0.0166	0.137+		0.0148	0.175+		0.00786	0.135+
Share of inhabitants with tertiary education		-0.137	-0.104		-0.131	-0.0995		-0.130	-0.0838		-0.133	-0.100
Unemployment rate		0.420*			0.429*			0.470*			0.454**	
GDP per inhabitant		-2.791	-4.405		-2.760	-4.288		-3.186	-5.179		-3.090	-4.649
Dependency ratio		-0.0620	-0.152+		-0.0443	-0.136		-0.0601	-0.152*		-0.0650	-0.158+
Population density		0.00495*	0.00307		0.00617**	0.00433*		0.00445*	0.00302+		0.00428*	0.00260
R-Squared:												
Within	0.387	0.497	0.433	0.367	0.480	0.415	0.359	0.508	0.425	0.388	0.510	0.437
Between	0.0586	0.222	0.0453	0.0416	0.213	0.0435	0.0537	0.330	0.0964	0.0663	0.312	0.0588
Overall	0.00414	0.283	0.0866	0.00302	0.266	0.0789	0.0427	0.375	0.133	0.00611	0.363	0.103
Observations	959	959	959	959	959	959	959	959	959	959	959	959

Notes: (1) Panel Fixed Effects; All regressions include year fixed effects; (2) Anchored Relative Poverty line (60% of median at 2011); (3) Data Source: Farm Structure Survey, Eurostat; EU-SILC, Eurostat; (4) Symbols: ** P<0.01, * P<0.05, +P<0.1

In a similar way as with poverty, our analysis also finds a significant impact of the CAP on the dynamics of inequality within regions in the EU. For this purpose, we first draw on the Gini index to measure inequality. Starting with per capita total payments, we find a strong and significant negative effect of such payments on the increase of inequality as measured by the Gini index. When analyzing each of the pillars separately, their individual effects on the decrease in inequality remain significant, particularly for pillar 2. Further disaggregating each of the pillars by their payment components gives no additional information on the particular performance of any of them in terms of inequality. All the results described remain qualitatively similar when we use the Theil index as our measure for inequality.

Table 11. CAP payments are associated with inequality reduction

(a). Inequality measured by Gini Index

	(1)	(2)	(3)	(4)	(5)
	Gini	Gini	Gini	Gini	Gini
Total payments per capita	-0.06**				
Payments per capita for pillar1		-0.06+			
Payments per capita for pillar2			-0.16**		
Coupled payments per capita				-0.00	
Decoupled payments per capita					-0.03
GDP per inhabitant	-0.19	-0.36	-0.30	-0.67	-0.69
Share of inhabitants with secondary education	-0.09*	-0.08*	-0.08*	-0.07*	-0.07*
Share of inhabitants with tertiary education	-0.01	-0.01	-0.01	-0.00	-0.00
Unemployment rate	0.07*	0.07*	0.09**	0.09*	0.09*
Share of individuals in agricultural hholds	0.00	0.00	0.01	0.00	-0.01
Household dependency ratio	0.04	0.04	0.04	0.05	0.05
Population density	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**
R-squared					
Within	0.15	0.14	0.16	0.13	0.13
Between	0.07	0.07	0.07	0.06	0.06
Overall	0.04	0.04	0.04	0.03	0.04
Observations	959	959	959	959	959

Notes: (1) Panel Fixed Effects including fixed effects; (2) Inequality is measured by Gini index; (3) Data Source: Farm Structure Survey, Eurostat; EU-SILC, Eurostat; (4) Symbols: ** P<0.01, * P<0.05, +P<0.1; (5) Standard errors are clustered at country level

(b). Inequality measured by Theil Index

	(1)	(2)	(3)	(4)	(5)
	Theil	Theil	Theil	Theil	Theil
Total payments per capita	-0.11**				
Payments per capita for pillar1		-0.12**			
Payments per capita for pillar2			-0.24*		
Coupled payments per capita				-0.01	
Decoupled payments per capita					-0.04
GDP per inhabitant	0.02	-0.19	-0.29	-0.79	-0.87
Share of inhabitants with secondary education	-0.14*	-0.14*	-0.13*	-0.12+	-0.11*
Share of inhabitants with tertiary education	0.02	0.02	0.03	0.03	0.04
Unemployment rate	0.12*	0.12+	0.15*	0.14*	0.15*
Share of individuals in agricultural hholds	-0.08	-0.08	-0.07	-0.07	-0.10
Household dependency ratio	0.09	0.10	0.10	0.11	0.11
Population density	-0.05**	-0.05**	-0.05**	-0.05**	-0.05**
R-squared					
Within	0.23	0.23	0.23	0.22	0.22
Between	0.27	0.27	0.26	0.26	0.26
Overall	0.13	0.13	0.13	0.13	0.13
Observations	959	959	959	959	959

Notes: (1) Panel Fixed Effects including year fixed effects; (2) Inequality is measured by Theil index; (3) Data Source: Farm Structure Survey, Eurostat; EU-SILC, Eurostat; (4) Symbols: ** P<0.01, * P<0.05, +P<0.1; (5) Standard errors are clustered at country level

Agriculture and poverty dynamics: Strategies at the household level

Besides the impact of the CAP funds on poverty reduction, other analyses were performed to identify additional potential factors that are beneficial to poverty alleviation. In particular, the following analysis focuses on strategies at the household level that have been associated with a reduction in poverty. We start by identifying certain agricultural activities that tend to be associated to regions with higher poverty rates. The analysis performed shows that some agricultural activities are strongly associated to regions with higher poverty. Table 12 below records the spatial correlation between certain agricultural activities and poverty. In particular, certain crops seem to be the agricultural activity performed in poorer regions across the EU. Some of these crops include specialist horticulture, specialist vineyards, combined permanent crops, and mixed crops, all of which show a significant association to poor regions. On the other hand, livestock activities tend to develop in regions with lower poverty. Some of these include specialist dairying, specialist pigs, and combined cattle dairying, rearing and fattening, all of which show a negative association to poor regions.

Table 12. Relationship between agriculture area share by crop type and poverty

Agriculture area with agriculture type:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
LABELS	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate	Poverty rate
Specialist horticulture - indoor	0.000548*										
Specialist horticulture - outdoor		0.000202**									
Specialist vineyards			3.07e-05**								
Various permanent crops combined				0.000188+							
Specialist dairying					-2.08e-05**						
Cattle-dairying, rearing and fattening combined						-6.62e-05**					
Specialists pigs							-1.07e-05*				
Various granivores combined								0.000168**			
Mixed cropping									6.65e-05**		
Mixed livestock, mainly grazing livestock										7.41e-05*	
Various crops and livestock combined											5.02e-05*
Total utilised agricultural area	2.48e-06+	2.44e-06*	2.22e-06*	1.80e-06*	5.79e-06**	3.62e-06**	2.60e-06+	2.07e-06	1.77e-06**	2.93e-07	-7.74e-08
Population density(Inhabitants per hectare);	0.0987*	0.0959*	0.107*	0.106*	0.100*	0.108*	0.103*	0.0953*	0.0979*	0.0966*	0.0905*
Gross Domestic Product(GPS per inhabitant)	-0.000148*	-0.000143+	-0.000154*	-0.000153*	-0.000142+	-0.000152+	-0.000153*	-0.000147+	-0.000150*	-0.000149*	-0.000147*
Poverty line	-0.000356*	-0.000431*	-0.000402*	-0.000435*	-0.000385*	-0.000351*	-0.000408*	-0.000327+	-0.000401*	-0.000436+	-0.000389+
Dummy: agricultural data zero	1.674*	2.265+	0.740	0.494	0.624	-0.167	0.563	1.777**	1.331+	0.787	1.356
Dummy: data at NUTS 2 level	-0.287	0.683	-0.774+	-0.428	0.309	-0.681+	-0.490	-0.657	-0.283	-0.711	-0.893+
Constant	22.56**	22.25**	23.49**	24.23**	23.38**	23.61**	23.96**	21.69**	23.33**	24.42**	23.64**
Interaction terms with countries	N	N	N	N	N	N	N	N	N	N	N
Country fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1,205	1,205	1,205	1,205	1,205	1,205	1,205	1,205	1,205	1,205	1,205
Adj R-squared	0.376	0.376	0.369	0.376	0.391	0.377	0.368	0.376	0.372	0.372	0.373

Note: (1) Data source: EU 2011 Poverty Map (DG-REGIO and World Bank), 2010 Farm Structure Survey (Eurostat), and EU National Statistic Institutes (Eurostat); (2) Symbols: ** p<0.01, * p<0.05, + p<0.1; (3) Missing observations in agricultural indicators are treated as zero; (4) Luxembourg and Cyprus Republic are not being analyzed here

In terms of poverty dynamics, we identified several strategies that have an impact on poverty over time. Table 13 below summarizes two important results. First, that there is a positive association between the poverty rate and the share of individuals who live in an agricultural household through time. Thus, an increase in the share of individuals in agricultural households was associated with an increase in poverty through time. On the other hand, household diversification is negatively associated with the poverty rate through time. Suggesting that as diversification of the income sources at the household level increases, poverty decreases. Households that have more diverse sources of income, in terms of agricultural and non-agricultural income, are associated with a lower poverty rate. This means that households who diversify seem to do better than those who rely only on agriculture. Thus, agricultural households could benefit from diversifying their income by complementing it with non-agricultural sources. However, it is important to note that this result relies on well-functioning labor markets, especially labor in the non-agricultural sectors, that can provide real alternative sources of income to members of agricultural households.

Table 13. Regions with higher household diversification have greater poverty reduction

LABELS	(1)	(2)	(3)	(4)
	Poverty rate	Poverty rate	Poverty rate	Poverty rate
Share of individuals living in agriculture households	0.66*	0.24*	0.60*	0.42*
Household diversification index	-1.75*		-1.07+	-0.29
GDP per inhabitant		-10.57*	-10.13*	-8.46*
Share of inhabitants with secondary education		0.16+	0.15	0.04
Share of inhabitants with tertiary education		-0.06	-0.06	-0.10
Unemployment rate				0.34+
R-Squared:				
Within	0.33	0.49	0.50	0.54
Between	0.21	0.14	0.16	0.24
Overall	0.25	0.14	0.16	0.24
Observations	959	959	959	959

Notes: (1) Panel Fixed Effects; All regressions include year fixed effects; (2) Anchored Relative Poverty line (60% of median at 2011); (3) Data Source: EU-SILC, Eurostat; (4) Symbols: ** P<0.01, * P<0.05, +P<0.1

Although diversifying the sources of income, between agricultural and non-agricultural, may prove useful to alleviate poverty in households over time, further results suggest that households who receive agricultural income may be better off by specializing in a particular agricultural activity. Table 14 shows that an increase in the share of the area used in specialized crop production seems beneficial to poverty reduction, as regions with higher areas of specialization holdings show higher poverty reduction. However, an increase in the share of land used for specialized livestock shows no significant effect on poverty reduction. Hence, households who turn to agriculture as a source of income do better when they specialize, particularly in crops. Thus, for poverty alleviation, it is useful to have different sources of income. Nevertheless, households should not diversify across agricultural income sources.

Table 14. Regions with higher farm holdings specialization have higher poverty reduction

	(1)	(2)	(3)
	Poverty rate	Poverty rate	Poverty rate
Agricultural area of specialized holdings share of total	-0.02	-0.02	
Agricultural area of holdings specialized in crop share of total			-0.05+
Agricultural area of holdings specialized in livestock share of total			-0.02
Ratio of agricultural area to total		-0.03	-0.02
Agricultural employment share	0.22	0.22	0.22
GDP per inhabitant	-0.01**	-0.01**	-0.01**
Share of inhabitants with secondary education	0.28+	0.28+	0.30+
Share of inhabitants with tertiary education	0.16	0.16	0.17
Year fixed effects	Y	Y	Y
R-Squared:			
Within	0.42	0.42	0.43
Between	0.14	0.14	0.13
Overall	0.12	0.12	0.11
Observations	367	367	367

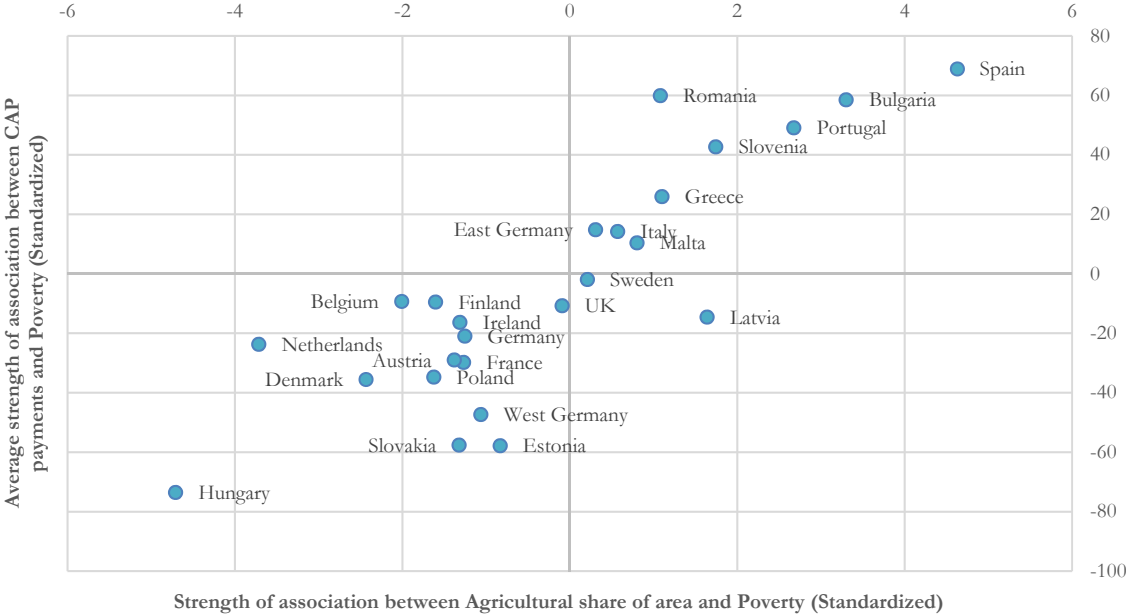
Notes: (1) Panel Fixed Effects; All regressions include year fixed effects; (2) Anchored Relative Poverty line (60% of median at 2011); (3) Data Source: Farm Structure Survey, Eurostat; EU-SILC, Eurostat ; (4) Symbols: ** P<0.01, * P<0.05, +P<0.1

5. Poverty, agriculture, and the CAP: A comprehensive analysis

So far, we have documented how CAP funds can contribute towards inclusive growth by reducing poverty and inequality. With this message in mind, the specific areas for improvement will depend on a country's level of structural transformation and on its current allocation of the CAP based on high poverty areas. The goal of this section is to integrate the parts of the past analyses; on one side we have the relationship between agriculture and poverty, which provides the state of a country

relative to a successful structural transformation, on the other hand we have the relationship between CAP and poverty, which identifies the regions which the CAP payments reach within the country. In this section we integrate both parts, in order to identify areas for improvement. With this in mind, we present the following figure, which plots the countries in terms of their association between poverty rate and agricultural indicators (X-axis), and their association between poverty rate and CAP payments (Y-axis).

Figure 8. Country plot of the association between poverty rate, agriculture, and overall CAP payment



The results are easier to describe in terms of the plot quadrants. We start by describing the lower left quadrant, which indicates a negative association both between poverty rate and agricultural indicators, and poverty rate and CAP payments. This represents the case for successful structural transformers, since it holds that agriculture is no longer associated to poverty and thus the CAP funds are not correlated to regions with high poverty. Some of the countries in this quadrant are France, the Netherlands, Germany, Belgium, and Austria. In this case, we identify no specific areas for improvement. Nevertheless, it is worth emphasizing that within this quadrant, we can find both OMS and NMS. NMS in this quadrant suggests an efficient use of the CAP funding.

We continue describing the results for the upper right quadrant, which indicates a positive association in both indicators, implying that in these countries agriculture takes place in high poverty regions and CAP funds reach the poorest regions. Despite the consistency in assigning CAP funds to high poverty areas, and agriculture taking place in poverty areas as well, this is also an indicator that this quadrant is located at the start of a structural transformation. For OMS countries located in this quadrant, such as Spain, Portugal, Greece, and Italy, this incomplete structural transformation hints at the existence of areas for improvement to achieve an efficient use of CAP funding. These countries may have been receiving the CAP for a longer time, and may thus have alternative ways to use them more efficiently in order to achieve a successful transformation.

Finally, the lower right quadrant underscores the most potential in areas for improvement. This quadrant suggests that although agriculture takes place in poor regions within the country, the CAP

funds are reaching non-poor regions instead. Countries in this group include Sweden and Latvia. In this case, countries could improve poverty reduction by better targeting the CAP funds to include poor regions where agriculture takes place.

6. Conclusion

In this paper we first document the relationship between agriculture and poverty, and use this information to place the EU member states in their path towards achieving a complete structural transformation. We then proceed to investigate the regions where the CAP funding has been going within each country, by analyzing the relationship between the program's payments and different indicators of poverty. Additionally, we find that the CAP has contributed to poverty alleviation. In this way, we conclude that the CAP is a powerful instrument towards achieving shared prosperity, and thus also complements the EU goal of social cohesion by reducing disparities in the regions where agriculture prevails.

7. References

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Appendix 1: Beta Convergence

We measure the convergence of income and inequality among the EU regions using Beta convergence. This method was developed by Sachs and Warner (Sachs and Warner 1997) following the Solow Growth Model. This tool can measure the trend of two groups of regions in terms of economic growth, presenting the dynamic picture of their discrepancies. Old member states (OMS) and new member states (NMS) were analyzed separately in order to show the income gap within the EU.

Beta convergence is the result of regressing the annual growth rate of the analyzed variable on the log of the variable from the previous year:

$$g_{it} = \alpha + b \log(y_{i,t-1}) + \varepsilon_{it}$$

$$\text{where } g_{it} = \log(y_{i,t}) - \log(y_{i,t-1})$$

We use both the OLS regression and the fixed effects model (LSDV) to estimate the beta convergence. The regressions are weighted using the average population in each region across the analyzed period (2005 – 2014).

Table 1 shows the results on several income and inequality measurements that we selected. The speed of convergence (β) is calculated as:

$$\beta = \frac{\ln(1 - \frac{-bT}{100})}{-T}$$

Where T is the elapsed time, which equates 11 in this case.

The half-life of convergence indicates how long it would take for the two groups of economies to converge. Following the interpretations in Mathur (2005), it is roughly equal to $\log(2)/\beta$.

Appendix 2: Country specific effects

A key step in analyzing the countries' stances in using the CAP fund is to calculate the country specific strength of association between poverty and CAP as well as between poverty and agriculture. We try to gain a comprehensive understanding on two issues: if the CAP funds are going to the poor areas in a country and if a country's agricultural activities take place mainly in the poor areas.

In order to draw a picture of where each country stands, we use the 2011 NUTS 3 level data for this analysis. The CAP funds distribution data are from the DG AGRI Clearance Audit Trail System database (CATS), provided by the European Commission. The 2010 agricultural indicators from the EU Farm Structure Survey are used to represent the regional agricultural situations. Since the German agricultural data are only available at the NUTS 2 level, they are used as proxies for the NUTS 3 level agricultural variables.

We use the regression model listed below to explain the regional poverty rates:

$$AROP_i = \beta_0 + \beta_1 X_i + \beta_2 country_i + \beta_3 (X_i \times country_i) + \beta_4 population\ density_i + \beta_5 GDP\ per\ capita_i + \varepsilon_i$$

X represents a series of variables including different categories of the CAP funds and normalized agricultural indicators such as agricultural share of area. Population density is a proxy for the urban rural typology.

For each variable used to explain the regional poverty, margins of responses for each country are calculated to show the country-specific strength of associations between poverty and the specific variable. Tables 2, 3, 8, and 9 show the signs of the results, whereas the zeros indicate insignificant marginal effects at 10% significance level. In Figure 8, the results were standardized by the standard errors to become better comparable between variables.

Appendix 3: Analysis methods comparisons for CAP

	Book Chapter 4	Our replication	Our analysis 1	Our analysis 2
Data				
Outcome	NUTS1/2 level apportioned to NUTS3 level: GDP per head, Unemployment rate, Population change	NUTS3 level: GDP per head, Population change, Poverty rate, Share of the country poor NUTS2 level: Unemployment rate	NUTS3 level: Poverty rate, Share of the country poor	NUTS1 and NUTS2 level: Poverty rate
CAP	NUTS1/2 level apportioned to NUTS3 level: CAP support per hectare of utilizable agricultural area, CAP support per agricultural work unit	NUTS3 level: CAP support per hectare of utilizable agricultural area, CAP support per agricultural work unit	NUTS3 level: Total CAP support	NUTS1 and NUTS2 level: CAP support per capita
CAP data source	FADN database; appointed RD budgets	Clearance Audit Trail System (CATS) database	Clearance Audit Trail System (CATS) database	Clearance Audit Trail System (CATS) database
CAP categories	Pillar1: Market price support and direct income payments	Pillar1: Market price support and direct income payments	Pillar1: coupled and decoupled payments	Pillar1: coupled and decoupled payments
Method	Pearson correlation coefficients	Pearson correlation coefficients	OLS regressions	Fixed effects regressions
Period	1999	2011	2011	2005-2013
Country coverage	EU15	EU28 except Lithuania and Czech Republic	EU28 except Lithuania and Czech Republic	EU28 except Germany

The table above shows comparisons of the different methods we adopted in order to study the correlation between poverty and the CAP support. The Book here refers to “The

CAP and the Regions: The territorial impact of the common agricultural policy” by Shucksmith, Thomson and Roberts. Following their work in the early 2000s, we attempt to re-examine social impacts of the CAP after its major reforms in 2003. More accurate CAP data become available for us in the CATS database, along with agricultural data at NUTS3 level from Eurostat’s Farm Structure Survey. In addition, more countries started receiving CAP funds. To capture this difference, we provide one set of results using all EU members and another set of results using only the EU15 in our replications of results of Shucksmith et al.

Table 1. Pearson correlation coefficients between level of total Pillar 1 support accruing to NUTS3 regions (2008-2013) and socio-economic indicators (2011)

Variables	Unemployment rate	Poverty rate	Share of the country poor	GDP per inhabitant	Population change (2008-2013)	Support per hectare UAA	Support per AWU
EU15							
Support per hectare UAA	0.1163	0.0630*	0.1420**	0.1636**	0.0853**	1	0.6479**
Number of observations	193	963	963	963	963	963	962
Support per AWU	0.0942	0.0846**	0.1540**	0.0651*	0.1954**	0.6479**	1
Number of observations	193	964	964	964	964	962	964
EU28 (except for Czech Republic and Lithuania)							
Support per hectare UAA	0.1061+	-0.0401	0.0353	0.0733+	-0.0125	1	0.5392**
Number of observations	250	1165	1165	1165	1165	1165	1164
Support per AWU	0.0814	0.002	0.1195**	0.1098**	0.0628*	0.5392**	1
Number of observations	250	1166	1166	1166	1166	1164	1166

Note: (1) Symbol + indicates correlation statistically significant at 0.1 level; * indicates correlation statistically significant at 0.05 level; ** indicates correlation statistically significant at 0.01 level; (2) CAP support are the sum of payments for the period 2008-2013; (3) Unemployment rate data is at NUTS2 level; (4) EU15 are Belgium, Denmark, Greece, Finland, France, Germany, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Spain, Sweden and the UK

Table 2. Pearson correlation coefficients between the level of market price support and direct income payments accruing to NUTS3 regions (2008 - 2013) and socio-economic indicators (2011)

Variables	Unemployment rate	Poverty rate	Share of the country poor	GDP per inhabitant	Population change (2008-2013)	Support per hectare UAA	Support per AWU
EU15							
Market Price Support							
Support per hectare UAA	0.0777	0.0252	0.0944**	0.1942**	0.0688*	1	0.6267**
Number of observations	193	963	963	963	963	963	962
Support per AWU	0.0974	0.0436	0.1061**	0.1333**	0.1825**	0.6267**	1
Number of observations	193	964	964	964	964	962	964
Direct Income Payments							
Support per hectare UAA	0.1941**	0.1443**	0.1460**	-0.0115	0.2126**	1	0.4994**
Number of observations	193	965	965	965	965	965	964
Support per AWU	0.0567	0.0907**	0.0843**	-0.1282**	0.2184**	0.4994**	1
Number of observations	193	966	966	966	966	964	966
EU28 (except for Czech Republic and Lithuania)							
Market Price Support							
Support per hectare UAA	0.0721	-0.0319	0.0469	0.1303**	-0.0022	1	0.5748**
Number of observations	250	1165	1165	1165	1165	1165	1164
Support per AWU	0.0904	0.017	0.0830**	0.1264**	0.3339**	0.5748**	1

Number of observations	250	1166	1166	1166	1166	1164	1166
Direct Income Payments							
Support per hectare UAA	0.1788**	-0.0222	0.0326	0.0338	-0.0275	1	0.3095**
Number of observations	250	1168	1168	1168	1168	1168	1167
Support per AWU	0.041	-0.0138	0.0261	-0.005	0.2042**	0.3095**	1
Number of observations	250	1169	1169	1169	1169	1167	1169

Note: (1) Symbol + indicates correlation statistically significant at 0.1 level; * indicates correlation statistically significant at 0.05 level; ** indicates correlation statistically significant at 0.01 level; (2) CAP support are the sum of payments for the period 2008-2013; (3) Unemployment rate data is at NUTS2 level; (4) EU15 are Belgium, Denmark, Greece, Finland, France, Germany, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Spain, Sweden and the UK; (5) Market price support is estimated to be all pillar 1 payments other than the direct aids payments

Table 3. Pearson correlation coefficients between socio-economic indicators and the level of market price support accruing to NUTS3 regions, selected New Member States

	No. observations	Unemployment rate (NUTS 2)	Poverty rate	Share of the country poor	GDP per inhabitant	Population change (2008-2013)	Support per hectare UAA	Support per AWU
Bulgaria								
Support per hectare UAA	28	-0.153	-0.1741	0.0779	0.9825**	0.8784**	1	0.9578**
Support per AWU	28	-0.0784	-0.1304	0.052	0.9301**	0.7944**	0.9578**	1
Estonia								
Support per hectare UAA	5	N/A	-0.579	0.1414	0.9959*	0.9374*	1	0.9890**
Support per AWU	5	N/A	-0.4609	0.0808	0.9779**	0.8830*	0.9890**	1
Hungary								
Support per hectare UAA	20	0.4716	-0.3448	0.1847	0.8639**	0.6857**	1	0.9998**
Support per AWU	20	0.6152	-0.354	0.1756	0.8692**	0.6870**	0.9998**	1
Latvia								
Support per hectare UAA	5	N/A	-0.4862	-0.3486	0.3241	0.4377	1	0.9959**
Support per AWU	5	N/A	-0.4236	-0.3479	0.2897	0.3666	0.9959**	1
Malta								
Support per hectare UAA	2	N/A	-1	1.0000**	1.0000**	1.0000**	1	
Support per AWU	2	N/A	1.0000**	-1	-1	-1	-1	1
Poland								
Support per hectare UAA	47	-0.1704	-0.3893**	-0.2216	0.5826**	-0.1098	1	0.9945**
Support per AWU	47	-0.1249	-0.3634*	-0.2116	0.5306**	-0.1008	0.9945**	1
Romania								
Support per hectare UAA	42	-0.1615	-0.4321**	-0.1485	0.7534**	-0.1508	1	0.9999**
Support per AWU	42	-0.071	-0.4318**	-0.1468	0.7556**	-0.1504	0.9999**	1
Slov Republic								
Support per hectare UAA	8	-0.9443+	-0.6345	-0.6601	0.5403	0.2210	1	0.9978**
Support per AWU	8	-0.9226+	-0.626	-0.6476	0.5315	0.2040	0.9978**	1
Slovenia								
Support per hectare UAA	12	1**	0.0704	0.2928	-0.0052	-0.1824	1	0.9929**
Support per AWU	12	1**	0.0914	0.2839	-0.0535	-0.1975	0.9929**	1

Note: (1) Symbol + indicates correlation statistically significant at 0.1 level; * indicates correlation statistically significant at 0.05 level; ** indicates correlation statistically significant at 0.01 level; (2) CAP support are the sum of payments for the period 2008-2013; (3) Unemployment rate data is at NUTS2 level; (4) EU15 are Belgium, Denmark, Greece, Finland, France, Germany, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Spain, Sweden and the UK; (5) Market price support is estimated to be all pillar 1 payments other than the direct aids payments; (6) NMS not presented here are dropped due to the lack of observations

Table 4. Pearson correlation coefficients between total Pillar 2 support (2008-2013) and socio-economic indicators (2011)

Variables	Unemployment rate	Poverty rate	Share of the country poor	GDP per inhabitant	Population change (2008-2013)	Support per hectare UAA	Support per AWU
EU15							
Support per hectare UAA	0.1307+	0.1132**	0.2213**	0.0905**	0.0831**	1	0.7018**
Number of observations	193	963	963	963	963	963	962
Support per AWU	0.1076	0.1188**	0.1780**	0.0453	0.1097**	0.7018**	1
Number of observations	193	964	964	964	964	962	964
EU28 (except for Czech Republic and Lithuania)							
Support per hectare UAA	0.1121+	-0.0478	0.0183	0.0376	-0.0205	1	0.6478**
Number of observations	250	1165	1165	1165	1165	1165	1164
Support per AWU	0.0829	-0.0186	0.1467**	0.0863**	0.0185	0.6478**	1
Number of observations	250	1166	1166	1166	1166	1164	1166

Note: (1) Symbol + indicates correlation statistically significant at 0.1 level; * indicates correlation statistically significant at 0.05 level; ** indicates correlation statistically significant at 0.01 level; (2) CAP support are the sum of payments for the period 2008-2013; (3) Unemployment rate data is at NUTS2 level; (4) EU15 are Belgium, Denmark, Greece, Finland, France, Germany, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Spain, Sweden and the UK

Table 5. Pearson correlation coefficients between level of LFA payment (2008-2013) and socio-economic indicators (2011)

Variables	Unemployment rate	Poverty rate	Share of the country poor	GDP per inhabitant	Population change (2008-2013)	Support per hectare UAA	Support per AWU
EU15							
Support per hectare UAA	0.0882	0.1219**	0.2913**	-0.1447**	-0.0404	1	0.4097**
Number of observations	193	963	963	963	963	963	962
Support per AWU	0.0093	0.0771**	0.1162**	-0.1108**	-0.0221	0.4097**	1
Number of observations	193	964	964	964	964	962	964
EU28 (except for Czech Republic and Lithuania)							
Support per hectare UAA	0.0575	-0.0324	0.0568+	0.0011	-0.0191	1	0.2781**
Number of observations	250	1165	1165	1165	1165	1165	1164
Support per AWU	-0.0071	0.0047	0.1760**	-0.0517+	-0.0060	0.2781**	1
Number of observations	250	1166	1166	1166	1166	1164	1166

Note: (1) Symbol + indicates correlation statistically significant at 0.1 level; * indicates correlation statistically significant at 0.05 level; ** indicates correlation statistically significant at 0.01 level; (2) CAP support are the sum of payments for the period 2008-2013; (3) Unemployment rate data is at NUTS2 level; (4) EU15 are Belgium, Denmark, Greece, Finland, France, Germany, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Spain, Sweden and the UK

Table 6. Pearson correlation coefficients between level of agri-environmental subsidies (2008-2013) and socio-economic indicators (2011)

Variables	Unemployment rate	Poverty rate	Share of the country poor	GDP per inhabitant	Population change (2008-2013)	Support per hectare UAA	Support per AWU
EU15							
Support per hectare UAA	0.1572*	0.1570**	0.1796**	-0.1043**	0.0201	1	0.4074**
Number of observations	193	963	963	963	963	963	962
Support per AWU	-0.0375	0.0489	0.0733*	-0.0309	0.0792*	0.4074**	1
Number of observations	193	964	964	964	964	962	964
EU28 (except for Czech Republic and Lithuania)							
Support per hectare UAA	0.0933	-0.0385	0.0632*	0.0043	-0.0194	1	0.2800**
Number of observations	250	1165	1165	1165	1165	1165	1164
Support per AWU	-0.1093+	-0.0489+	0.0903**	0.0212	0.0208	0.2800**	1

Number of observations 250 1166 1166 1166 1166 1164 1166

Note: (1) Symbol + indicates correlation statistically significant at 0.1 level; * indicates correlation statistically significant at 0.05 level; ** indicates correlation statistically significant at 0.01 level; (2) CAP support are the sum of payments for the period 2008-2013; (3) Unemployment rate data is at NUTS2 level; (4) EU15 are Belgium, Denmark, Greece, Finland, France, Germany, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Spain, Sweden and the UK

Table 7. Cross-tabulation of per hectare Pillar 1 support (2008-2013) and farm economic size (2010)

Pillar 1 support per hectare classification (1 = lowest)	Farm size classification (1 = smallest)					Total
	1	2	3	4	5	
1	0 0.00%	7 3.00%	103 44.21%	48 20.60%	75 32.19%	233 100.00%
2	36 15.45%	31 13.30%	70 30.04%	47 20.17%	49 21.03%	233 100.00%
3	50 21.46%	54 23.18%	31 13.30%	55 23.61%	43 18.45%	233 100.00%
4	56 24.03%	58 24.89%	19 8.15%	44 18.88%	56 24.03%	233 100.00%
5	72 30.90%	87 37.34%	20 8.58%	39 16.74%	15 6.44%	233 100.00%
Total	214	237	243	233	238	1165

Table 8. Cross-tabulation of per hectare Pillar 2 support (2008-2013) and farm economic size (2010)

Pillar 2 support per hectare classification (1 = lowest)	Farm size classification (1 = smallest)					Total
	1	2	3	4	5	
1	0 0.00%	3 1.29%	108 46.35%	59 25.32%	63 27.04%	233 100.00%
2	3 1.29%	13 5.58%	73 31.33%	61 26.18%	83 35.62%	233 100.00%
3	23 9.87%	61 26.18%	24 10.30%	62 26.61%	63 27.04%	233 100.00%
4	74 31.76%	78 33.48%	21 9.01%	38 16.31%	22 9.44%	233 100.00%
5	114 48.93%	82 35.19%	17 7.30%	13 5.58%	7 3.00%	233 100.00%

Total	214	237	243	233	238	1165
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Table 9. Agricultural factors influencing the level of CAP support

	Pillar 1 support per hectare		Pillar 2 support per hectare	
	β	t	β	t
Average farm size	-10.45	-1.155	-5.766	-1.264
% holdings: rice	-383.6	-1.164	-400.7	-1.145
% holdings: pasture	-135.4*	-2.216	-76.76	-1.356
% holdings: fruit	-160.0	-1.429	-125.2	-1.105
% holdings: olives	-92.13	-1.589	-79.11	-1.299
GDP per inhabitant	0.325	1.117	0.167	0.783
Number of employed persons	58.17	1.363	54.12	1.223
Population	-0.00934	-1.085	-0.00673	-1.204
Population change	-1.854	-0.908	-2.382	-1.028
Constant	552.0	0.0982	-890.6	-0.185