The Rural Development Policy and the support to innovation and education. Which role for rural and remote EU regions?

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Summary

For more than 50 years, growth of agricultural production has been mostly driven by innovation. Thus, public contributions to R&D and education in agriculture are still important. Among them, Rural Development Policy plays a key role. Specific measures from Axis 1, namely measures 111, 114, 115 and 124, are targeted to support education and training in agriculture. Nevertheless, such a support is uneven in its territorial allocation throughout the EU. This paper aims to assess main differences affecting the intensity of this support at territorial level. Firstly, differences at Rural Development Programme level are taken into account. Eventually, this paper also assesses local differences, i.e. those generated by considering expenditure intensity at NUTS 3 level. A large heterogeneity occurs at local level: it mostly comes from the ongoing differences in single regions' capacity of attracting and spending EU funds. In particular, being an urban region, with a higher per capita GDP and a services-based local economy are all features that are positively related with a greater financial support in the promotion of education and training. Furthermore, even labour productivity in agriculture is positively linked with such a financial support.

Keywords: innovation, EU rural development policyProgramme, regional patterns

JEL Classification codes: O18, Q01, R58

Innovation and education within Rural Development Policy. Which Role for Rural and Peripheral EU Regions?

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1. INTRODUCTION

Innovation still represents a key driver for growth of agricultural production, in both developing and developed Countries. At global level, agricultural production has steadily increased for more than a century (Alston *et al.*, 2010) and such a growth has been almost entirely generated by major increase in agricultural factor productivity (Fuglie, 2010; Esposti, 2012). Total Factor Productivity (TFP) expresses that part of growth that can be attributed to a purely technological component: in about 50 years, it increased by about 55% worldwide, thus confirming the existence of an ongoing technological process, bringing brand new innovations into agricultural production (Esposti, 2012).

When trying explaining major progresses in agricultural innovations, relevant and appropriate R&D investment is not the only key factor. Actually, *research* couples with two other drivers: the amount of human capital embodied in agricultural labour force (*education*) and public provision of services and institutions informing farmers and facilitating the whole learning process (*extension*). Those three components represent the so-called "knowledge triangle", according to the OECD (2012) definition[1]. Nonetheless, of those three components, R&D (and public research, in particular) is usually considered as the hierarchically dominant one: actually, it is expected to generate those results that may activate the other two components, namely education and extension (Esposti, 2012).

According to this framework, the contribution of public R&D to the agricultural sector is undoubted, even though public R&D growth rates have been steadily declining throughout developed Countries since 1970s (Esposti, 2012). In spite of a lower amount of disposable funds under the latest funding schemes, European Union (EU) policies still support largely both innovation and research. This support is not only limited to agricultural sector: rather, it characterises all the sectors of the economy. Within Europe 2020 Strategy (i.e., the European Union's ten-year strategy for jobs and growth, launched in 2010 to create the conditions for smart, sustainable and inclusive growth), research and development actually represent one of the five headline targets, being agreed for the EU to achieve by 2020. Within this general framework, innovative agriculture and forestry are largely supported, as well. When specifically focusing on agriculture, the EU still represents the largest financing body throughout Europe. In particular, two major funding streams support innovation in agriculture: Horizon 2020 and the Rural Development Policy.

Horizon 2020 is a Research and Innovation Framework, through which the EU implements and finances Innovation Union, i.e. one of the Europe 2020 flagship initiatives. Referring to innovation in

[1] The EU adopts a slightly different version, the three component being research, high education and innovation (European Commission, 2011).

agriculture, the EU has allocated nearly 4 billion Euros to Horizon 2020's Societal Challenge 2 "*Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bioeconomy*".

An additional key funding stream for innovation in agricultural and forestry is the Rural Development Policy. Under its latest programming periods, innovation has always been intended to represent a flagship area of the EU support to rural areas. Actually, Rural Development Policy has comprised several measures, aimed at both supporting the creation of operational groups as well as providing innovation services. Moreover, next Rural Development Policy programming period (i.e., for years 2014-2020) will set '*Fostering knowledge transfer and innovation in agriculture, forestry and rural areas*' as its first priority, thus acknowledging a large importance to this issue[2].

Nonetheless, although the EU has repeatedly claimed the importance of both innovation and R&D, the amount of disposable funds to those interventions is still limited, compared to the whole EU budget. In addition to a limited amount of money, even its allocation throughout the EU space is far to be homogeneous. Indeed, when focusing on a very local level (namely, NUTS 3 level), some regions are targeted by an amount of funds which is even ten times larger than other regions. Those large imbalances occur even among neighbouring regions. Accordingly, support to R&D and innovation in agricultural sector represents a territorially-biased policy. Its allocation depends on both political (i.e., top-down) decisions and a sort of bottom-up capacity of single regions to attract EU funds and properly spend them (Camaioni et al., 2014a).

Following this simple idea, this paper points out the existence of some major territorial patterns in allocation of EU funds aimed at supporting education and training within the agricultural sector, throughout the EU-27. Despite the existence of several funding streams, this paper just focuses on Rural Development Policy funds, namely the European Agricultural Fund for Rural Development (EAFRD). In particular, it takes into account *ex-post* EAFRD expenditure for years 2007-2011. In order to highlight the support to innovation within the agricultural sector, this analysis focuses on some specific measures under Axis 1 of 2007-2013 Rural Development Policy: measure 111, measure 114, measure 115 and measure 124. Eventually, after having mapped the spatial allocation of expenditure under those measures, some considerations about major drivers that might affect it are also drawn. In particular, this paper takes into account both political choices, mostly taken at higher territorial levels, and structural characteristics of regions.

The rest of the paper is organised as follows. Section 2 provides some more detailed information about EAFRD expenditure data and the way expenditure has been disentangled in order to perform this analysis. Section 3 maps the territorial allocation of the expenditure, according to a top-down (i.e. political) framework: this section takes into account major differences among Rural Development Programmes throughout the EU. Conversely, section 4 focuses on a more local level of analysis and it maps expenditure at NUTS 3 level. At this territorial level, *ex-post* allocation of funds also depends on structural characteristics of regions, affecting the way they spend EU funds: here, urban-rural typologies, economic development and

[2] Furthermore, the EU has also taken several steps to bring science and practice closer together. In particular, in order to support a more demand-driven research policy and a more evidence-based agricultural policy, the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) has been launched. It is aimed at linking together the different policies and facilitating a broader uptake of research and innovative solutions on the ground.

structure of the economy, labour productivity in the agricultural sector are mostly considered. Eventually, section 5 concludes the paper, by suggesting some remarks for further researches.

2. DATA: DISENTANGLING RURAL DEVELOPMENT POLICY EXPENDITURE

The Common Agricultural Policy (CAP) is the most important EU policy, in terms of total expenditure (44% out of total EU budget, in 2011) (Henke *et al.*, 2010). Since its origin, the CAP has undergone major reforms, which have switched most of its funds from market measures to direct income support (Shucksmith *et al.*, 2005). In 1999, Agenda 2000 set up two different "pillars". According to that framework, the European Agricultural Guarantee Fund (EAGF) now finances direct payments to farmers and measures to respond to market disturbances (Pillar One). Conversely, the European Agricultural Fund for Rural Development (EAFRD) is aimed at financing the rural development programmes within either single EU Member States or regions (Pillar Two).

According to this framework, Pillar Two (namely EAFRD) represents EU Rural Development Policy. It accounts for less than 25% out of total CAP and it is aimed at complementing direct income support to farmers, by including an additional set of measures, serving broader environmental and rural development objectives. Referring to the 2007-2013 programming period, the Rural Development Regulation provided a menu of 44 measures (Regulation 1698/2006) from which either Member States or their regions may choose, when designing specific Rural Development Plans. Among them, some measures specifically aim to support education, training and (on a broader scale) innovative processes as well. As already mentioned, those measures represent one of the most important funding stream for innovation in agricultural and forestry sectors (together with Horizon 2020).

Before providing a thorough description of the adopted dataset, some additional definitions ought to clarify the focus of this study. In 2007-2013 programming period under study here, Rural Development Policy was built around three main axes: i) structural investments to improve competitiveness for farming and forestry (namely Axis 1); ii) agri-environmental protection, countryside management and territorial development (namely Axis 2); iii) improvement of the quality of life and diversification of the rural economy (namely Axis 3)[3]. Nevertheless, such a taxonomy, which is simply based on major Rural Development Policy's axes, is not useful for the purposes of this work. Indeed, when trying disentangling policies for education within the agricultural sector, it would be misleading to take into account all the measures from Axis 1. Such a problem is not new in literature. Sotte (2009) has already claimed that CAP Pillar Two should be considered not as a unique Rural Development Policy. Rather, it is a more complex 'basket of policies', each of them being different in terms of major aims, operational tools, funding schemes and beneficiaries. According to the theoretical framework suggested by Sotte (2009), Pillar Two measures may actually refer to seven different thematic areas: i) Education and training (together with technical assistance); ii) Young farmers; iii) Competitiveness and structural investments; iv) Food quality; v) Agro-environment; vi) Forest sector; vii) rural economy diversification, quality of life improving and Leader approach. These seven thematic areas do not correspond to Pillar Two Axes. Rather, it is possible to specifically disentangle those measures that are related to "Education and training", thus pointing out the role of policies for education and

[3] Rural Development Policy also comprised a fourth axis. So called "Leader Initiative" referred to local action groups. They have been established at local level and they have defined their own strategy under local development programmes based on the three axes of the RDP. According to this framework, they have mostly followed a bottom-up approach.

training (and innovation) within whole EAFRD expenditures. In particular, according to Sotte (2009), we have taken into account following four measures, under Axis 1:

- Measure 111: Vocational training and information actions, including diffusion of scientific knowledge and innovative practices, for persons engaged in the agricultural, food and forestry sectors;
- Measure 114: Use of advisory services;
- Measure 115: Setting up of management, relief and advisory services;
- Measure 124: Cooperation for development of new products, processes and technologies in the agriculture and food sector.

Firstly, the importance of these measures out of total EAFRD expenditures is assessed. Results are quite unexpected, though. Actually, although these measures are intended to represent a key area within Rural Development Policy, they just account for a tiny amount of money out of overall budget. In years 2007-2011, four selected measures accounted for about 314m €, i.e. 2.71% out of total Axis 1 expenditure and just 0.80% out of total EAFRD expenditure. Among four measures, measure 111 is the largest one (225.6m €), whereas measure 115 is the least important one (Table 1).

Table 1. Measures 111-114-115-124 expenditure (EU-27, years 2007-2011)

	Million €	Share out of Axis 1 Expenditure	Share out of total EAFRD
Measure 111	225.635	1.95%	0.58%
Measure 114	38.215	0.33%	0.10%
Measure 115	10.428	0.09%	0.03%
Measure 124	39.615	0.34%	0.10%
Total	313.893	2.71%	0.81%

Source: own elaboration

Despite their low figures at EU level, these measures might play a larger role at local level. Indeed as pointed out in previous works, the CAP as well as its second pillar (i.e., Rural Development Policy) both show uneven patterns throughout the EU, also because of historical reasons (Shucksmith et al., 2005; Copus, 2010; Crescenzi et al., 2011; Camaioni et al., 2013; 2014b). Therefore, the aim of this work is twofold. Firstly, we aim to assess the allocation of those expenditures according to each specific Rural Development Programme (RDP), i.e. at either national or regional level. Such an allocation mostly depends on some top down political decisions. Each RDP might decide to allocate available funds to alternative purposes and objectives in a very different way. Indeed, EU RDPs currently shows strikingly different patterns in terms of expenditure choices. Secondly, even the spatial allocation of funds at a more disaggregated territorial level (namely NUTS 3 level) is of particular interest, here. Such a territorial analysis is carried out by collecting detailed data about local expenditure in order to highlight major differences in terms of use of funds among regions showing different structural characteristics.

Nonetheless, both kinds of analyses are not easy tasks. Actually, general availability of detailed territorial data on EU policies is rather poor (Shucksmith *et al.*, 2005). When referring to CAP funds, no information on real expenditure at regional level is available: DG Agriculture usually provides just data at national level. Conversely, regional data (when available) just refer to either *ex-ante* allocation of funds or a reconstruction of the real expenditure based on some sample observations (e.g., FADN data)[4]. Data on real

[4] Farm Accountancy Data Network (FADN) database collects data on average CAP expenditure at both national and regional (NUTS 2) level. For example, referring to Pillar Two, data disentangled by main measures are available as well (e.g., agro-environmental payments, less favoured areas payments…). Nevertheless, data are never available for current programming period: they always refer to the previous one.

ex-post expenditure, although they are public, have not been collected in any comprehensive dataset, which cover all EU Members States. For the purposes of this analysis, the European Commission (DG Agriculture) has provided data on *ex-post* expenditure. In particular, we have retrieved data on real payments as registered *ex post* by EU bureaus, aggregating individual beneficiaries. Data refer to 2007-2013 programming period, although the final dataset gathers payments from years 2007 to 2011 only.[5] For the purpose of this work, we have not taken into account national co-funding.

From a territorial perspective, data refer to payments received by beneficiaries throughout the EU-27 (Croatia is not considered, for it was not a Member State under the programming period under study here). Payments are based on the declaration of the paying agencies. In order to keep the anonymity, average NUTS 3 level data are considered. According to NUTS2006 classification, EU-27 Member States consist of 1303 regions. Nevertheless, for the purpose of this work, 15 regions have been excluded from the analysis, for they lack any territorial contiguity to the European continent (e.g., French *Departements d'outre-Mer*, Spanish NUTS 3 regions belonging to Canary Islands, ...). Thus, the final set of observation consists of 1288 NUTS 3 regions.

Although data on real expenditure are collected at local level, they do not allow for a properly comparison across EU regions. As NUTS 3 regions largely differ in their size throughout the EU, any analysis on funds allocation has to be performed by means of some specific indexes of expenditure intensity that can eliminate (or strongly reduce) heterogeneity (as well as heteroskedasticity) due to the different regional size. Following Camaioni et al. (2014a; 2014b), we can express the intensity of the support by means of different dimensions. For the measures under study here deal with agricultural issues, we have considered the following three dimensions: agricultural area, agricultural labour force, gross value added from agricultural activities[6]. Accordingly, following expenditure intensity indexes have been taken as basic units for this analysis:

1. Expenditure per unit of utilized agricultural area (UAA in ha.). UAA comprises those areas that host farming activities (arable lands, permanent grasslands and crops). Unused agricultural land (e.g., woodland and land occupied by buildings, farmyards, ponds) are not included into UAA;
2. Expenditure per unit of agricultural labour work (expressed in annual work unit, AWU). One AWU corresponds to the total amount of work, which is performed by a single person occupied on a full-time basis on an agricultural holding;
3. Expenditures per unit of agricultural gross value added (GVA, in million €). We define agricultural sector according to NACE, Rev. 2 Classification. Sector A (Agriculture, forestry and fishing) and its gross value added have been taken to perform this analysis.

As previously pointed out, data on Rural Development Policy expenditure refer to years 2007 to 2011. Conversely, data on UAA and AWU refer to 2007, being retrieved from Eurostat - Farm Structure Survey[7]. Data on agricultural GVA (as a thousand Euros) have been retrieved from Eurostat – National and Regional

[5] Although referring to 2007-2013 programming period, expenditures from subsequent periods may overlap (Camaioni et al., 2014a). For instance, expenditure that is observed in early years (2007 and 2008) could still refer to the previous programming period while, at the same time, expenditure still referring to programming period 2007-2013 but actually made in 2014 or 2015 would remain unobserved even if 2012 and 2013 data were available. Camaioni et al. (2014a) already noticed that this issue explains why having five years of observation (2007-2011) of 1303 regional expenditure does not constitute a panel dataset.

[6] This choice partially follows the methodology suggested by Copus (2010). He analysed the intensity of rural development expenditure per hectare of agricultural land (UAA), per agricultural holding, per annual work unit (AWU) and per European size unit (ESU). Nevertheless, he just analysed patterns of intensity at national level. At NUTS 3 level, data on agricultural holdings and European size units are not so reliable: actually, they show a larger number of missing values.

[7] This is a periodical survey (2000, 2003, 2005 and 2007): when 2007 figures were not available, previous ones have been considered.

Economic Accounts. To take the economic cycle into account, we have considered 2007-2010 yearly average, here[8]. Camaioni et al. (2014b) point out further caveats in the methodology that is adopted here to compute aforementioned support intensity indexes.

Although being useful in reducing heterogeneity within the sample of observations, it can be easily noticed that indexes #1 - #3 just provide information about the intensity of the support per different kinds of agricultural unit. Nevertheless, they just represent part of the story. Indeed, as we focus on four specific measures under rural development policy, a fourth index may provide additional information on the relevance of the support to innovation out of overall expenditure. Thus, in this work, we suggest the following additional index:

4. Expenditure as a share out of total RDP expenditure (years 2007 to 2011).

Compared to previous indexes, index #4 is not affected by the whole amount of funds a given region has received in the same years. Thus, it returns a more reliable indicator of the importance of those funds specifically aimed at supporting education and training within the agricultural sector.

3. TOP-DOWN ALLOCATION OF FUNDS: INNOVATION AND RURAL DEVELOPMENT PROGRAMMES

Firstly, data on expenditure on education, training and technical assistance (i.e., the overall amount of 2007-2011 expenditures under measures 111, 114, 124 and 125) are analysed by focusing on their proper political level. As mentioned, even though data are available at NUTS 3 level, *ex ante* allocation decisions are taken at a higher territorial level, which is an institutional one, namely the Rural Development Programme (RDP) level. During 2007-2013 programming period under study here, Rural Development Policy was implemented by specific programmes at either national or regional level[9]. Vast majority of EU Member States have opted for a nation-wide implementation, whereas just three Countries have opted for regional implementation: in Spain and Italy, RDPs have been implemented by referring to NUTS 2 level (17 and 21 programmes, respectively); in Germany, RDPs have been implemented by referring to NUTS 1 level, (14 different programmes[10]). Besides these Member States, other exceptions are represented by:

- Belgium (2 RDPs: Flanders and Wallonia);
- Finland (2 RDPs: Mainland and Region of Åland);
- France (6 RDPs: 'Hexagone', Corse, Guadeloupe, Guyane, Martinique, Réunion);
- Portugal (3 RDPs: Mainland, Azores, Madeira);
- The UK (4 RDPs: England, Wales, Scotland and Northern Ireland).

Accordingly, under 2007-2013 programming period, 88 programmes were developed altogether. Nonetheless, this paper focuses on just 81 programmes: indeed, according to the abovementioned selection of NUTS 3 regions, the RDPs of Canarias (Spain), Azores, Madeira (Portugal), Guadeloupe, Guyane, Martinique and Réunion (France) have not been considered.

Ex-post allocation of expenditure under those measures aimed at supporting education and training largely differs among RDPs. On average, each RDP allocated 3.88m € to measures 111, 114, 115 and 124

[8] For Italian NUTS 3 regions, years 2007 to 2009 have been considered.
[9] Pillar Two differs from Pillar One in its implementation: actually, Pillar Two expenditure is not directly managed by the EU Commission.
[10] Actually, this number differs from the number of German Länder (i.e., German NUTS 1 regions) for some of them have implemented joint programmes: Brandenburg and Berlin; Lower Saxony and Bremen.

(data refer to the whole amount of money for years 2007-2011). Nonetheless, 10 RDPs allocated more than 10m € each to same four measures, whereas 8 regions earmarked no money to them (Table 2). Among top spenders, there are many nation-wide RDPs from Northern EU Member States. Conversely, regional RDPs used to spend the least amount of money on those measures: this is the case of many Italian Southern regions together with Spanish ones. Even Malta and Saarland (in Western Germany) did not supported at all those measures aimed at supporting innovation to agriculture. Nonetheless, Wales (UK) and Galicia (ES), although being region-wide programmes, are comprised among EU top spenders.

Furthermore, besides these striking differences, it can be easily noticed that 10 RDPs, which spend most in the measures supporting education, training and technical assistance, account for about 64% out of total EU expenditure in same measures. Thus, these results suggest the existence of a severe territorial concentration in spatial allocation of funds.

Table 2. 10 RDP which spend least and most in education, training and technical assistance (measures 111-114-115-124, years 2007-2011)

Name	Measure 111	Measure 114	Measure 115	Measure 124	Sum of the four measures
England (UK)	30,684,832.82	69,582.85	365,788.85	1,374,507.15	32,494,711.67
Sweden	28,741,557.70	0.00	0.00	297,254.59	29,038,812.29
Hungary	22,507,139.72	5,389,174.75	0.00	0.00	27,896,314.47
Austria	18,630,984.64	0.00	0.00	4,613,238.03	23,244,222.67
Denmark	17,412,923.29	0.00	0.00	4,746,638.41	22,159,561.70
Wales (UK)	8,012,944.87	189,319.70	0.00	7,156,120.14	15,358,384.71
Galicia (ES)	5,622,989.90	2,677,473.63	2,575,878.77	3,118,712.38	13,995,054.68
Finland	7,870,652.47	0.00	0.00	5,223,788.62	13,094,441.09
Czech Republic	3,381,247.17	2,958,694.62	0.00	5,483,228.52	11,823,170.31
France Hexagone	11,404,462.89	0.00	0.00	85,838.26	11,490,301.15
Sicily (IT)	0.00	1,320.00	0.00	0.00	1,320.00
Sardinia (IT)	0.00	330.00	0.00	0.00	330.00
Saarland (DE)	0.00	0.00	0.00	0.00	0.00
Asturias (ES)	0.00	0.00	0.00	0.00	0.00
Navarra (ES)	0.00	0.00	0.00	0.00	0.00
Aosta Valley (IT)	0.00	0.00	0.00	0.00	0.00
Molise (IT)	0.00	0.00	0.00	0.00	0.00
Puglia (IT)	0.00	0.00	0.00	0.00	0.00
Basilicata (IT)	0.00	0.00	0.00	0.00	0.00
Malta	0.00	0.00	0.00	0.00	0.00

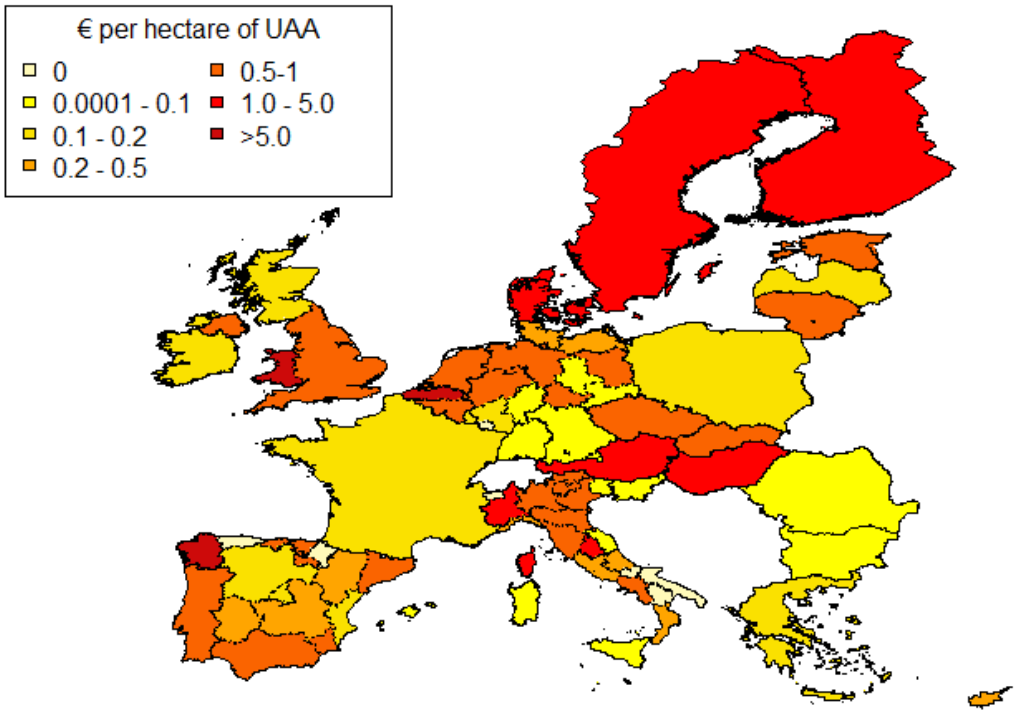
Source: own elaboration

Nevertheless, as already observed, these findings are heavily affected by some sort of statistical biases. Actually, the amount of funds each RDP allocates for education and training measures also comes from the dimension of the area covered. Large nation-wide programmes, such as 'Hexagone' (i.e., French mainland), usually cover a wider total surface than regional RDPs. Thus, even the amount of money they allocate to all measure will be larger, at least on average. Accordingly, raw data on absolute *ex-post* expenditure do not allow a proper representation of the support to education and training in agriculture. In order to get rid of these possible distortions, specific indices have been computed (see previous section). They directly express the intensity of the EU support under measures 111, 114, 115 and 124.

Figures 1-3 show the spatial allocation of the intensity of expenditure by referring to the RDP level. Compared to absolute values, intensity indices return partially different results. Once again, Northern Member States gave education and training a larger support under measures 111, 114, 115 and 124 than Southern ones. Some Central and Eastern RDPs (e.g., Austria, the Czech Republic and Hungary) also

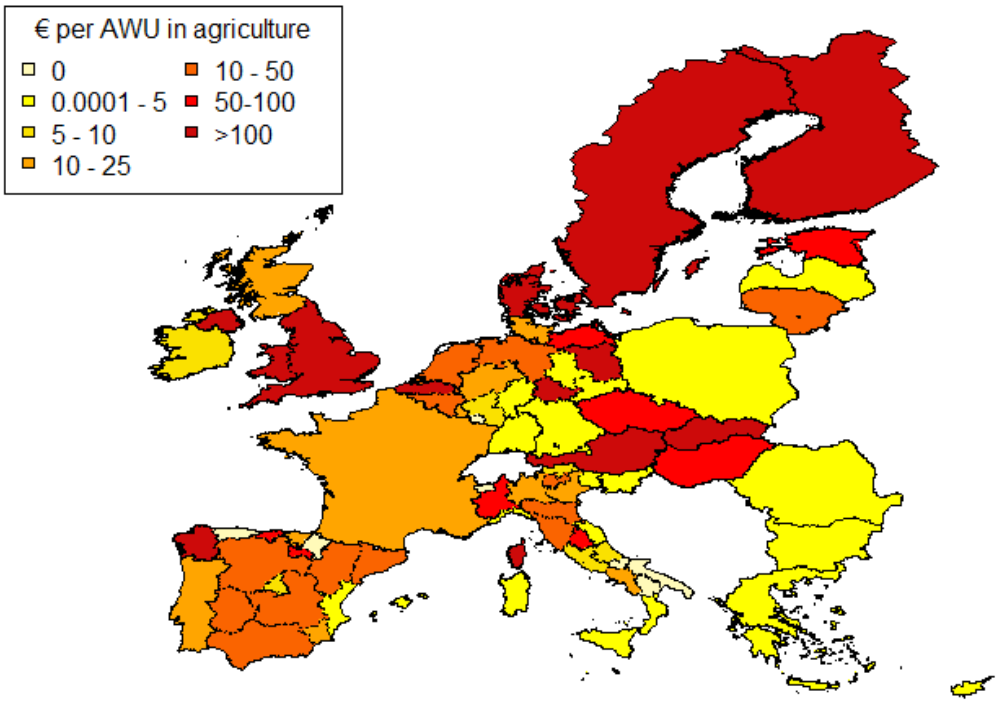
supported widely those measures. Conversely, RDPs across Southern and Eastern Europe, together with France, share the lowest support intensity when referring to education and training.

Figure 1. Expenditure intensity per hectare of UAA (sum of measures at RDP level).



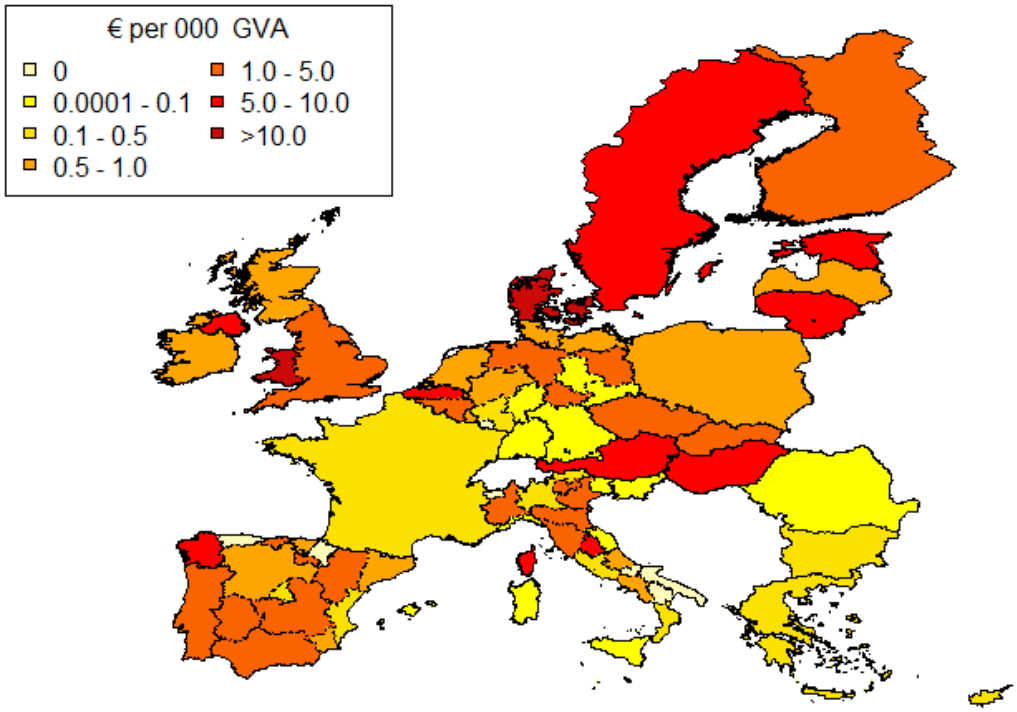
Source: own elaboration

Figure 2. Expenditure intensity per AWU in agriculture (sum of measures at RDP level).



Source: own elaboration

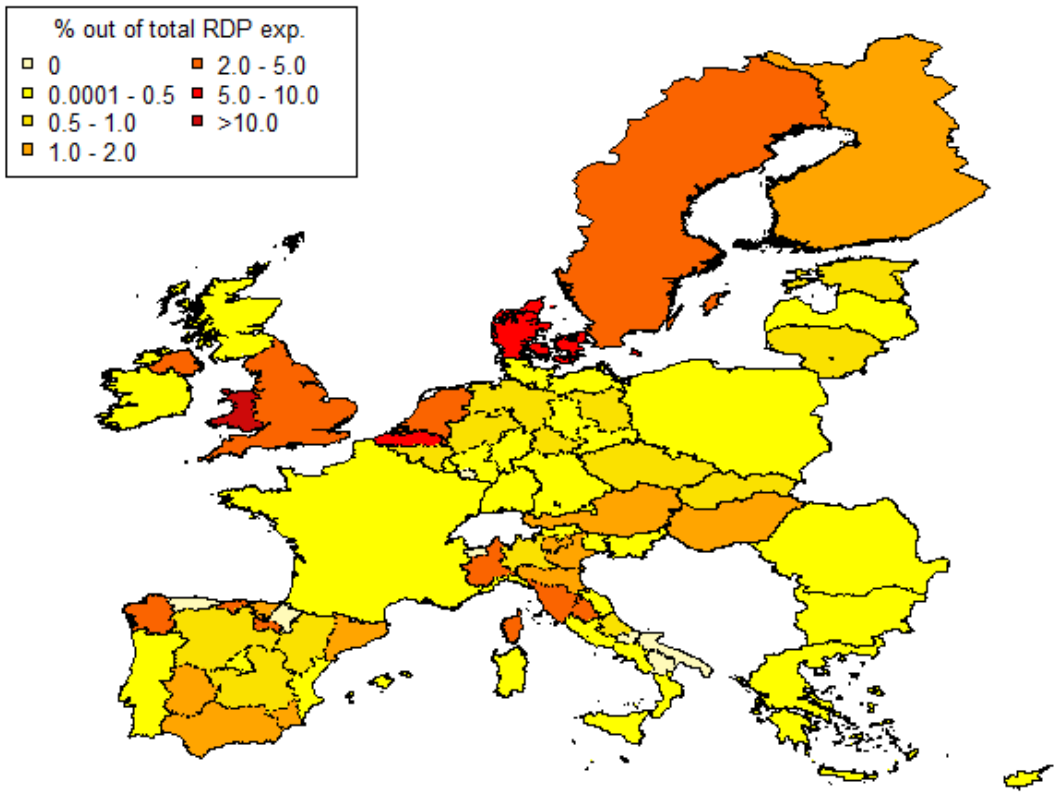
Figure 3. Expenditure intensity per a thousand € of agricultural GVA (sum of measures at RDP level).



Source: own elaboration

These results are insightful, as they provide a first picture about EU geography of spatial allocation of expenditures under Rural Development Policy measures supporting education and training. Nevertheless, a further analysis is added, here: the share of expenditure aimed at supporting education, training and technical assistance out of total EAFRD expenditures can provide important information as well. In particular, this latter indicator better describe territorial allocation of those kinds of expenditure, by controlling for the total amount of EAFRD expenditure (which largely differ among RDPs). Such a measure, being independent on the total amount of EAFRD expenditure, returns the true importance of those measures in political terms. Actually, it shows which share out of total budget has been allocated to education and training, according to political decisions. Figure 4 shows how small such a share generally is. It is below 1% in most RDPs, whereas just three RDPs (namely Wales, Flanders and Denmark) allocates more than 10% out of total EAFRD funds to education, training and technical assistance.

Figure 4. Share out of total EAFRD expenditure (sum of four measures by RDP).



Source: own elaboration

4. BOTTOM-UP CAPACITY OF ATTRACTING FUNDS

4.1. The local allocation of expenditures supporting innovation

Major differences in the real allocation of *ex-post* EAFRD expenditure, which supports innovation in the agricultural sector, do not only depend on political decisions and choices made by different RDPs (i.e., the decision of supporting more education and training than rural economy diversification). Actually, when considering a more disaggregated territorial level of analysis (such as NUTS 3 level), such *ex-post* allocation also depends on the way each given region is able to attract and spend EU funds (Camaioni et al., 2014a). In other words, with the real implementation of policies across the EU space, other specific (or structural) features of single NUTS 3 regions are likely to play a role. Thus, they largely affect the total amount of money each region really receives[11]. In particular, moving from a picture of the spatial allocation of expenditure throughout 1288 EU NUTS 3 regions, we will analyse whether such an allocation is linked to the following structural features at regional level or not. In particular, we will consider the extent of urban-rural features, the structure of the regional economy and total labour productivity in the agricultural sector.

As already pointed out (Shucksmith et al., 2005; Camaioni et al., 2014b), spatial allocation of EAFRD expenditures is not homogeneous at local level: rather, it shows a large heterogeneity even within those

[11] This also explains why working at such a level of territorial disaggregation (i.e. NUTS 3 level) in analysing EU expenditure allocation actually represents an important advancement in this field of study (Camaioni et al., 2014a).

regions that are comprised under a same RDP. Such a territorial pattern occurs even when considering expenditure under measures supporting education and training.

On average, four aforementioned measures just account for 1.82 € per hectare of UAA, 26.99 € per AWU in agriculture and 1.76 € per a thousand € of agricultural GVA (Table 2). Nevertheless, their allocation throughout Europe largely differ from average values. Figures 5-7 provide evidence about EU spatial patterns, by considering the intensity of the support per unit of UAA, per AWU employed in agriculture and per thousand Euros of agricultural GVA, respectively.

Territorial allocation mostly follows major differences already pointed out when having analysed differences among RDPs. Nevertheless, the picture is even more complex than it was in the previous analysis. Here, differences clearly refer to specific structural features of EU regions, such as land use features (e.g., the presence of woodlands and forests) or sector-based characteristics (e.g., the relevance of the agricultural sector within the local economy). Just the combination of these factors generates the complex picture mentioned. Furthermore, a large heterogeneity in the intensity of support to education and training occurs even among neighbouring regions (namely, regions which belong to a same RDP). For instance, the intensity of expenditure supporting innovation in agriculture per hectare of UAA is particularly low throughout South-Eastern Europe (i.e., Southern Italy, Romania and Bulgaria) even though some exceptions occur. For instance, the regions comprising Bucharest (Romania) and Sofia (Bulgaria) share larger intensity of the support. Intensity of support to innovation throughout French *Departements* is quite scattered as well, even though they are all comprised under the same RDPs (Hexagone). Similar patterns, when considering the intensity of the support per hectare of UAA, also occur throughout Germany and Poland. Again, some NUTS 3 regions showing very large values in the same areas can be spotted out. Conversely, more homogeneous patterns occur throughout Scandinavia, the Netherlands, the Czech Republic, Slovakia and Hungary: in all cases, the intensity of the support is very large per hectare of UAA (Figure 5).

When turning to the intensity of the support per AWU employed in agriculture, figures slightly differ. In this case, the support to education and training is less scattered, even though some neighbouring regions still show opposite behaviours (e.g., region surrounding Helsinki and other Finnish NUTS 3 regions) (Figure 6).

Eventually, when considering the intensity of the support to education and training per a thousand euro of agricultural GVA, local differences are even less sharp and more homogenous patterns occur among neighbouring NUTS 3 regions[12] (Figure 7).

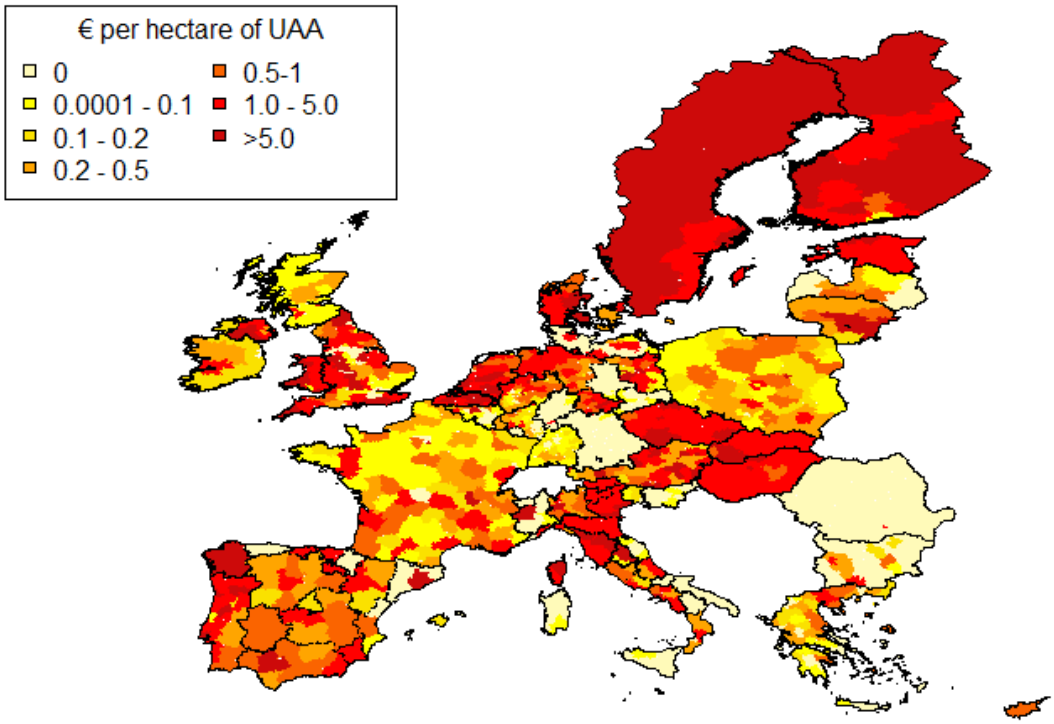
Table 2. Average expenditure intensity, per measure (1 288 observations).

	€ / UAA	€ / AWU	€ / 000 € GVA
Measure 111	1.311	19.403	1.268
Measure 114	0.222	3.286	2.148
Measure 115	0.061	0.897	0.586
Measure 124	0.230	3.407	0.223
Sum of the measures	1.824	26.992	1.764

Source: own elaboration

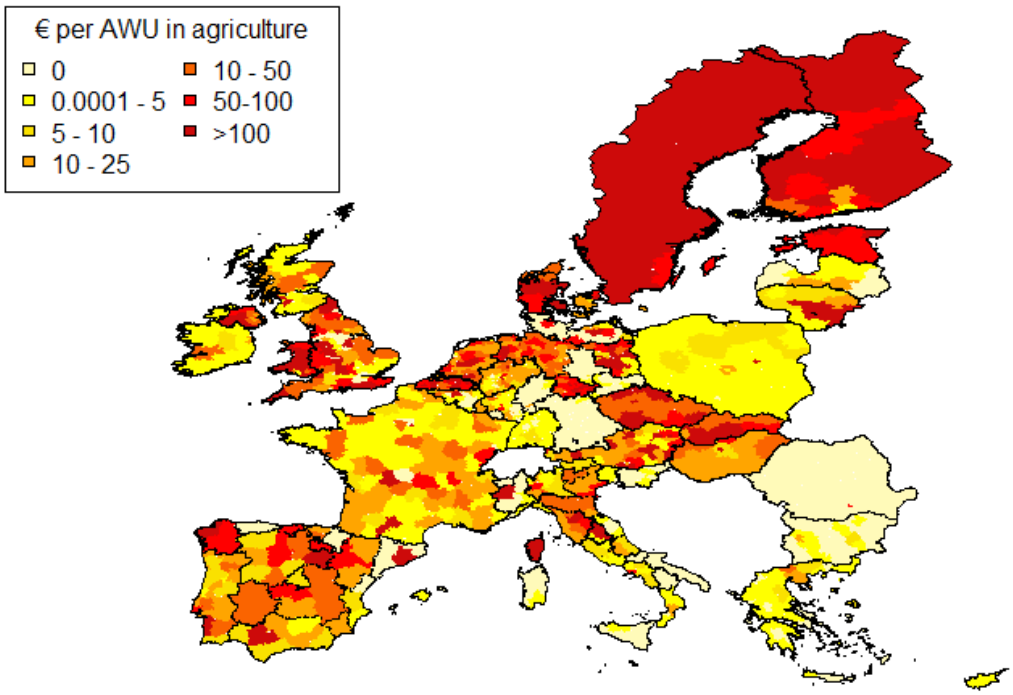
[12] In spite of these results, one could conclude, by simply comparing Figures 5 to 7, that spatial distribution of the three expenditure intensities, and of €/UAA and €/AWU in particular, are rather similar. Nevertheless, these indicators are not entirely redundant. Thus, the analysis is here always repeated for all the three indicators of expenditure intensity.

Figure 5. Expenditure intensity per hectare of UAA (sum of measures).



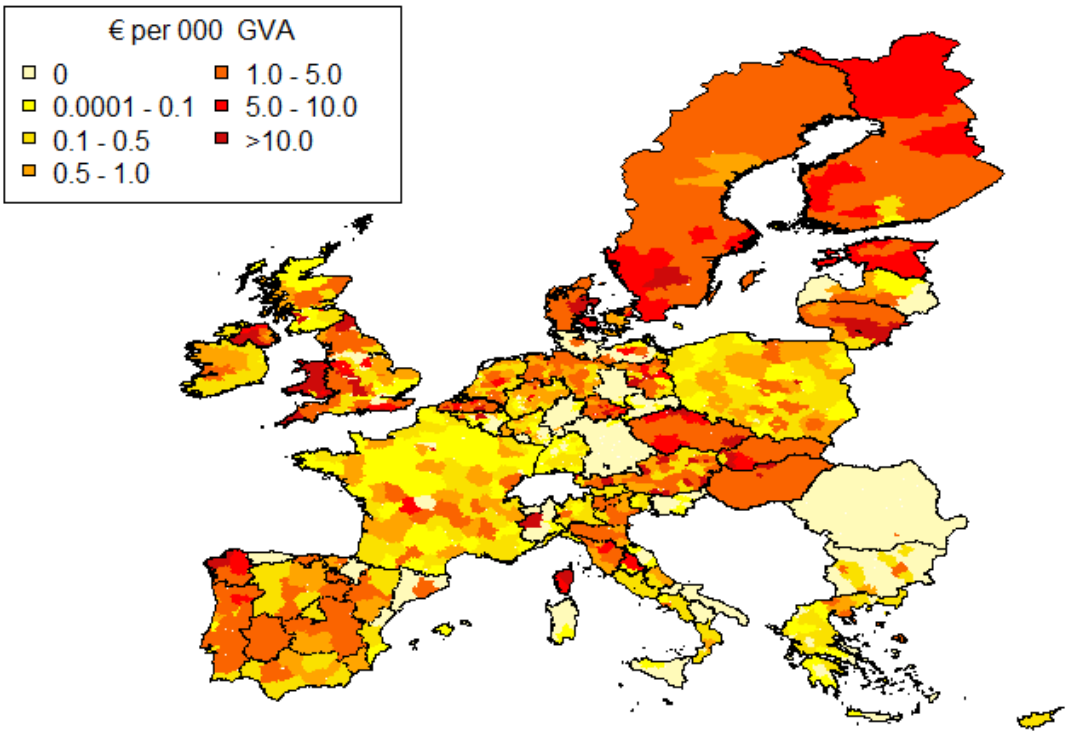
Source: own elaboration

Figure 6. Expenditure intensity per AWU in agriculture (sum of measures).



Source: own elaboration

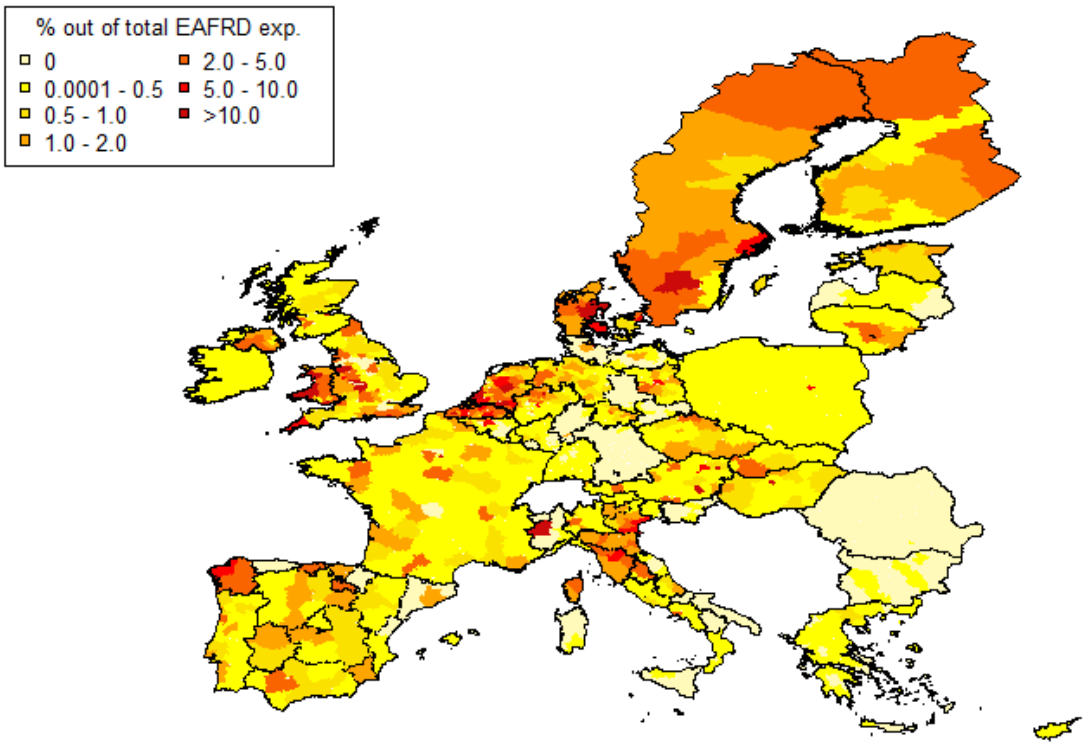
Figure 7. Expenditure intensity per a thousand € of agricultural GVA (sum of measures).



Source: own elaboration

Furthermore, it is again possible to focus on the share of expenditure aimed at supporting education, training and technical assistance out of total EAFRD expenditure. According to this indicator, some interesting findings emerge. In particular, North-Western EU regions tend to share the highest shares among EU regions. In particular, expenditures as a share of total EAFRD funds are above 5% in many NUTS 3 regions throughout Wales, Belgium, the Netherlands, Denmark and Sweden. Nevertheless, other some over-supported regions (namely above 5% out of total EAFRD) are some city-regions in Austria, Hungary and Poland together with some NUTS 3 regions across Northern Italy. Therefore, according to these results, it is easy to notice that over- and under-supported regions coexist under a same RDP: in particular, some spatially isolated NUTS 3 regions show large intensity of this support, whereas their neighbours are largely under-supported (Figure 8).

Figure 8. Share out of total RDP expenditure (sum of measures).



Source: own elaboration

4.2. Urban-rural divides in the allocation of expenditure under measures supporting education

The analysis in the section 4.1 clearly returned the existence of complex geographical patterns that affect the territorial allocation of those measures under Axis 1 that aim to support education, training and technical assistance (namely measures 111, 114, 115 and 124). The wide heterogeneity that occurs at NUTS 3 level is expected to couple with some socio-economic and structural characteristics of EU regions. In particular, these features might play a key role in defining the bottom-up capacity of single regions to attract funds for supporting their local innovation and education.

Among structural characteristics of EU regions, their degree of rurality has been proved to play a role in the allocation of overall EAFRD expenditure (Camaioni et al., 2013). In particular, it has been observed that more urban and central regions on average receive the largest intensity of the support from EAFRD. Such a relation seems to hold even for expenditure under measures supporting education, training and technical assistance.

Assessing urban-rural differences is not an easy task. The most widely cited urban-rural typologies are those from OECD (2006) and Eurostat (2010): they both refer to a demographic criterion (i.e., population density and the presence of major urban areas). Eurostat (2010) classifies EU NUTS 3 regions into three different typologies: predominantly urban (PU), intermediate (IR) and predominantly rural (PR) regions. According to this taxonomy, expenditures per hectare of UAA under measures 111, 114, 115 and 124 are larger in PU regions than in IR and PR ones. Conversely, both expenditures per AWU employed in agriculture and per agricultural GVA are largest in IR regions. Furthermore, the share of expenditure in education, training and technical assistance out of total EAFRD expenditure is the highest in PU regions (on

average, 2.7% out of the total). Nevertheless, just the latter difference among urban-rural typologies is statistically significant, according to One-Way Anova[13] (Table 3, upper part).

Although Eurostat urban-rural typologies are widely adopted at EU level, adopting continuous indicators, which are also multidimensional, represents a more refined way to assess the degree of rurality of single EU regions (Copus et al., 2008; Sotte et al., 2012; Camaioni et al., 2013). In particular, within this kind of analysis, two continuous and multidimensional indicators might really improve the assessment of the EU urban-rural divide. They are population density and PeripheRurality Indicator (PRI). In particular, the latter indicator is a comprehensive (i.e., multidimensional) measurement of rurality, encompassing both the role of agricultural activities and other geographical features (remoteness) (Camaioni et al., 2013)[14].

Table 3 (lower part) shows statistical relationships between the two aforementioned urban-rural indicators[15] and the intensity of the support under measures 111, 114, 115 and 124. Results are insightful. Whatever indicator of expenditure intensity is chosen, support to education, training and technical assistance is always positively related to population density and it is negatively correlated to the PRI. Thus, a negative relationship between the degree of rurality and the intensity of the support to innovation is largely confirmed even by this analysis. A possible explanation of this result comes from the fact that most of beneficiaries that either provides technical assistance or implements learning programmes are located in urban regions and cities. Thus, urban (and more central) areas still account for the largest share of EU funds supporting innovation, learning and education programmes. Furthermore, these findings also provide a first explanation about the large variability of the support from the selected measures that occur among NUTS 3 regions even within the area covered by a same RDP.

Table 3. Average expenditure intensity, per Eurostat urban-rural typology; Pearson correlation coefficients between expenditure intensity under measures 111, 114, 115 and 124 and indicators of rurality

	€/UAA	€/AWU	€ / 000 € GVA	% out of total EAFRD expenditure
PR	1.280	34.044	1.765	0.454
IR	11.557	3174.937	6.721	1.139
PU	72.884	764.614	5.647	2.673
Levene's Test	3.692*	0.492	0.783	16.658*
	(0.025)	(0.709)	(0.457)	(0.000)
One-Way ANOVA	2.020	0.709	0.784	13.479*
	(0.134)	(0.492)	(0.457)	(0.000)
PRI	-0.183*	-0.071*	-0.106*	-0.271*
	(0.000)	(0.011)	(0.000)	(0.000)
Density	0.257*	0.107*	0.112*	0.244*
	(0.000)	(0.000)	(0.000)	(0.000)

p-values in parentheses
*: Correlation statistically significant at 5% (2-tailed)
Source: own elaboration

[13] Urban-rural typologies from Eurostat represent a categorical variable. Nonetheless, some significance testing have been performed as well. One-Way ANOVA (Analysis of Variance) tests whether those values are statistically different or not. In particular, One-Way ANOVA is a widely used statistical technique to compare group means. It uses F statistics to test if all groups have the same mean. As a major assumption of a One-Way ANOVA is that variances of populations are equal, the Levene's Test has been preliminary computed as well. It tests the null hypothesis that groups variances are equal (i.e., homoschedasticity). If the null hypothesis of equal variances cannot be accepted, it is concluded that there is a difference between the groups variances. When variances among the groups are equal (i.e., the Levene's Test is not statistically significant), simple F test for the equality of means in a one-way analysis of variance is performed. In the opposite case, the method of Welch (1951) is used.

[14] It is a synthetic but continuous indicator, which is obtained by applying a principal component analysis (PCA) to a set of 24 variables, grouped in four different thematic areas capturing different and complementary dimensions of rurality (i.e., socio-demographic characteristics; Structure of the economy; Land use characteristics; Geographical features. By construction, the PRI is positively related with rurality (the greater the PRI, the more rural the region), whereas population density is negatively related with it (the lower the density the more rural the region) (Camaioni et al., 2013).

[15] Data on population density at NUTS 3 level refers to year 2010.

4.3. Structural features: economic development, role of agricultural sector, labour productivity in agriculture

Although being important, the EU urban-rural divide is not the only structural characteristic that might help in explaining the spatial allocation of *ex-post* EAFRD expenditure aimed at supporting education and training, throughout the EU. Single regions may differ in their capacity of attracting EU funds because of other structural features. In particular, this analysis focuses on the following structural characteristics:

- Economic development (per capita GDP and unemployment rate);
- Structure of the economy (share of employment in main economic sectors, i.e. agriculture, manufacturing activities and services);
- Labour productivity in the agricultural sector. As a proxy for this indicator, here we have just taken the ratio of GVA from agricultural activities and total amount of agricultural labour force, as expressed by the number of AWUs employed in agriculture.

Six aforementioned variables help highlighting structural features of EU regional economies, thus encompassing for a broader amount of features besides the extent of rurality. Data for each of those variables have been retrieved by Eurostat, by taking NUTS values. Table 4 shows the definitions for each variable together with reference years[16].

Table 4. Socio-economic and structural variables

Variable	Definition	Year	Source
Per capita GDP	Euros per inhabitant (PPS)	2009	Eurostat
Unemployment Rate	Unemployed population (aged 15-64) as % out of the total economically active population	2009	Eurostat
Employment Agriculture (%)	Share of employment in sector A (NACE classification rev. 2) on the total	2009	Eurostat
Employment Manufacturing (%)	Share of employment in sectors C-E (NACE classification rev. 2) on the total	2009	Eurostat
Employment Services (%)	Share of employment in sectors G-U (NACE classification rev. 2) on the total	2009	Eurostat
Labour productivity in the agricultural sector (€ / unit of AWU)	Ratio of GVA from agricultural activity and AWU in agriculture	AWU: 2007 Agric. GVA: 2007-2010 av. values	Farm Structure Survey Eurostat – National Accounts

Source: own elaboration

When focusing on the relationship between the structure of the economy and the intensity of the support to education, training and technical assistance, clear patterns tend to emerge at EU level. As expected, urban-rural divide is not the only territorial characteristic playing a role in explaining the spatial allocation of expenditure under those measures. Although it is important, it couples with other structural features that might affect the way EU regions spend EU fund at a local level (Table 5).

In particular, economic development does not play the greatest role in explaining the allocation of expenditure intensity. Unemployment rate is never correlated to the intensity of the support to education and

[16] Some variables show missing values. Missing observations have been replaced with data observed at the closest higher territorial aggregation (i.e., either NUTS 2 or NUTS 1 level).

training in the agricultural sector, whereas per capita GDP is positively related to two out of four indicators of support intensity (namely, the intensity of the support per hectare of UAA and the share of support out of total EAFRD). Neverhtless, despite inconclusive findings, richer regions are likely to support education and training in the agricultural sector more than poorer ones.

Structure of the economy has a larger role in explaining funds allocation. Firstly, share of employment in agriculture out of total employment at regional level is negatively related to the share of support under measures 111, 114, 115 and 124 out of total EAFRD expenditure. Even the share of employment in manufacturing activities out of total employment negatively correlates to the intensity of that support, when it is expressed by means of € per hectare of UAA and share out of total expenditures. Conversely, the relationship between the intensity of support under measures 111, 114, 115 and 124 and the share of employment in services out of total employment is much clearer. The latter indicator shows a positive correlation with all indicators of support but the support per AWU employed in agriculture. Thus, urban economies, whose share of employment in services is highest, seem to be able to attract the largest amount of expenditures under measures supporting education and training. Furthermore, even the share of this support out of total EAFRD expenditures is higher, the higher the share of the employment in services (sectors G-U, under NACE Rev.2 Classification). This finding mostly confirms previous results on the relationship between rural/urban features and EAFRD support to innovation.

Eventually, even the relationship between the intensity of the support and labour productivity has been investigated. This analysis shows that this indicator is positively linked to the intensity of the support for training and education. Furthermore, these results are robust among alternative indicators of expenditure intensity: actually all of them, but the share of expenditure out of total EAFRD expenditure, are statistical significant at 5% (2-tailed).

Table 5. Pearson correlation coefficients between expenditure intensity in education, training and technical assistance and socio-economic and structural indicators

	€/UAA	€/AWU	€ / 000 € GVA	% out of total EAFRD expenditure
Per capita GDP	0.174*	-0.001	0.024	0.132*
	(0.000)	(0.972)	(0.385)	(0.000)
Unemployment Rate	-0.002	-0.001	-0.004	-0.038
	(0.943)	(0.962)	(0.890)	(0.178)
Employment Agriculture (%)	-0.042	-0.025	-0.040	-0.112*
	(0.136)	(0.375)	(0.156)	(0.000)
Employment Manufacture (%)	-0.080*	-0.022	-0.044	-0.120*
	(0.004)	(0.422)	(0.119)	(0.000)
Employment Services (%)	0.095*	0.033	0.060*	0.171*
	(0.001)	(0.228)	(0.031)	(0.000)
Labour productivity in agriculture (€ / AWU)	0.139*	0.097*	0.083*	0.052
	(0.000)	(0.000)	(0.003)	(0.063)

p-values in parentheses
*: Correlation statistically significant at 5% (2-tailed)
Source: own elaboration

5. CONCLUDING REMARKS

Public contributions to education and innovation within the agricultural sector are still important, even in developed Countries and in the EU. Among EU policies aimed at supporting education and training in the

agricultural sector, a key role is played by Rural Development Policy. EAFRD actually supports and finances those interventions. In 2007-2013 programming period, four measures from Axis 1 were targeted to education, training and technical assistance: measure 111 (vocational training and information actions), measure 114 (use of advisory services), measure 115 (setting up of management, relief and advisory services), measure 124 (Cooperation for development of new products, processes and technologies in the agriculture and food sector).

This paper has focused on the territorial allocation of expenditure under these measures, thus proving that such an allocation is uneven throughout the EU. Major imbalances comes from both top-down political decisions and bottom-up capacity of single regions to attract EU funds and spend them.

The former point has been analysed by focusing on major differences in expenditure intensity among EU RDPs. In years 2007-2011, ten out of 81 EU RDPs spent more than 10m € each under measures 111, 114, 115 and 125; conversely, 8 RDPs allocated no money to the same four measures in the same years. Furthermore, when focusing just on ten top-spending EU RDPs, it has been observed that they account for about 64% out of total EU-27 expenditure under same measures, although they just account for 33% out of total UAA, 18% out of total AWUs employed in agriculture and 34% out of total agricultural GVA.

This severe concentration in allocation of funds supporting innovation mostly comes from political choices. Nevertheless, top-down decision couples with some specific differences occurring at local level: actually, structural characteristics of each EU regions are proved to play a key role as well. In particular, the more urban a given region is, the higher its per capita income, the more service-based its local economy, the larger is the intensity of the EAFRD support in promoting education and training in the agricultural sector. These results are insightful. Most of expenditures under those measures currently targets urban areas and cities. Conversely, remotest and most agricultural EU regions tend to be generally under-supported.

Besides the importance of the aforementioned structural features, labour productivity in agriculture also shows a positive relationship with the intensity of the support to education and training. Therefore, although no cause-effect considerations on this relation can be drawn, due to the nature of available data, it is possible to observe that those regions whose labour productivity in agriculture is largest currently receive the largest amount of expenditures under measures 111, 114, 115 and 124. Thus, although there is more room for future researches on these themes (tackling the sign and magnitude of this cause-effect relationship on econometric basis), some doubts still arise about the way policies and measures supporting education in agriculture are targeted at local level. Actually, if these measures were targeted to EU regions whose labour productivity in agriculture is lower, the overall impact of EAFRD funds would be probably higher.

Eventually, on a broader political perspective, this analysis has proved that rural and remote EU regions still play a marginal role, when considering the allocation of expenditure supporting education and training. To this respect, cities still play a central role, representing the major hubs of the system of knowledge. This is true, even though Rural Development Policy is aimed at supporting rural areas, at least in its political intentions. In particular, most rural areas in least accessible regions would largely benefit from a broader revision of the Rural Development Policy. Actually, its future design should be promote greener and more rural interventions. Nevertheless, such an impressive change can only be reached by a radical increase in the capacity of rural regions themselves to attract available EU funds. A bottom-up effort is thus a key driver for the overall development of these regions.

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