Agri-environmental measures and on-farm labour employment

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Abstract

This study aims to contribute to the better understanding of how voluntary-based policy intervention has affected the farm structure, especially the evolution of on-farm labour. The analysis on the relationship between farms that participated in agri-environmental measures (AEMs) and evolution of their on-farm labour is investigated during the period 2004–2014 with using Slovenian Farm Accountancy Data Network (FADN). More specially, the relationship between AEMs and hired labour use is explained by farm size and farm type divisions. The results of statistical analysis give evidence that hired labour use is positively correlated by AEMs in all farm size classes. Regardless of farm size, increase in the demand for hired labour use in AEM adopted farms could be explained by the requirements of environmental farming practices that are often more labour intensive than the traditional farming practices. Farm type division analysis reveals that the correlation between AEMs and hired labour use is significantly positive, depending on the farm type. For field crop farms, we observe a weak correlation between AEM payments and total labour use. This could explain with the application of AEM practices do not necessary perceived the hired labour use as a complementary to family labour by filed crop farm managers.

Keywords: agri-environmental subsidies, family labour, hired labour, Farm Accountancy Data Network, Slovenia

1. Introduction

The impact of agricultural policies on the evolution of farm structure is a key policy issue in the ongoing debate on Common Agricultural Policy (CAP) reforms. The expansion of voluntary-based structured public intervention in agricultural policies raises the question of whether these policy reforms will influence the structural change[1] on farms in European agriculture.

Based on that policy question, our study aims to contribute to the better understanding of how voluntary-based public policy intervention has affected the farm structure, especially the evaluation of on-farm labour. For that purpose on-farm labour on the farms that participated in agri-environmental measures (AEMs) is investigated. The empirical analysis focuses on farm-level evidence, and investigates use of labour in Slovenian farms during the period 2004–2010 from Farm Accountancy Data Network (FADN).

The nature of AEMs is voluntary and relies entirely on the willingness of farmers to participate. AEMs compensate farmers for voluntarily entering a 5 year commitment to carry out measures considered to be of benefit to the environment. Farmers receive payments that provide compensation for additional costs and income foregone as a result of applying measures in line with the stipulations of AE contracts. Different measures carry different levels of support. However, across all measures the payment is calculated on an area basis.

A set of AEMs were proposed by CAP and designed at a national, regional or local level by adapting to the particular farming systems and environmental conditions. The majority of AEMs in the European Union (EU) target management of grass and semi-natural forage, input management, management of business plans and record keeping, soil cover, soil management, buffer strips, crop management and landscape feature management (Keenleyside et al., 2011). Beside environmental impact, concerning socio-economic impacts of AEMs, EC evaluation report (EEC no. 2078/92) recorded a substantial increase in hired labour in organic farms. In addition a significant employment effect is

[1] In the rural economy, "agricultural structure and structural change" include farms' embeddedness within and interactions with agricultural value chains, (rural) society, the (rural) economy and landscape, as well as institutions and policies (Balmann et al., 2006). In this study "structural change" viewed as an evolving system that is an integrated and inter-related part of the economy (OECD 1994). The "structure" of a farm includes many dimensions such as farm size, farm type, workforce and financing patterns (Boehlje, 1992).

noted concerning the labour intensive activities (e.g., where labour intensive environmental management replaces a low-labour intensive activity).

The voluntary-based structured AEMs play an essential role in the Rural Development (RD) programme for Slovenia. As in Austria and Luxembourg, Slovenian RD subsidies (Pillar 1) are greater than direct payments (Pillar 2). Furthermore, Slovenia has the highest level of RD subsidies among new member states (NMS-10) that joined the EU in 2004. Despite the fact that AEMs have primary objectives of preservation of the environment and maintaining the countryside, the high level of AEM subsidy structured Slovenian Agri-Environmental Programme (SAEP) seems to address indirectly at preserving agricultural employment, which can be consistent with maintaining rural settlement. Therefore, the aim of this paper is to investigate the consequences of the AEMs on the evaluation of on-farm labour, which is important in order to understand whether or not these subsidies contribute to maintain of agricultural employment.

Previous findings show that AEM subsidies positively affect labour use in German farms (Pufahl and Weiss, 2009; Petrick and Zier, 2011). Dupraz and Latruffe (2015) in rural policy study for France found that RD subsidies such as AEMs, less favoured area (LFA) payments and investment subsidies have increased the use of on-farm labour. Following these studies, we aim to contribute to given literature by exploring the relationship between AEM subsidies and on-farm labour (total labour and hired labour use) by considering explicitly the farm size as small, medium and large farms, and three farm types of field crop farms, dairy farms, and other grazing livestock farms in Slovenia.

This study is structured as follows. Back-ground section provides facts on AEMs in Slovenia, and labour use evolution by years. Data section describes the data source utilised and provides descriptive evidence for the main features of AEM participation in Slovenia. Statistical analysis gives results divided in two sub-sections: (i) statistical analyses by farm sizes, and (ii) statistical analyses by farm types. Final section concludes with a summary of the statistical analysis results that are important for exploring the relationship between AEM subsidies and total and hired labour use by considering explicitly the farm size and farm type.

2. Background

2.1. Slovenia: case study country

Slovenia is a largely mountainous country with rolling hills in which the majority of agricultural land (72.5%) is situated in LFAs. One third of Slovenia's total land area (20,273 km2) is agricultural land (32%) and more than half of the total land area is covered by forest (59.8%).

Rural landscapes have the greater part of Slovenia since infertile and built-up regions cover less than one tenth of total land. Agriculture has given the basic appearance to the landscapes because at the beginning of the 20th century, farmers made up three quarters of the population (Kovačič, 1999). Today, 6% of the population is working in the farming sector, and the non-farming population owns a large proportion of the land (Perko and Urbanc, 2004).

The average farm size, measured by the utilized agricultural areas (UAA), was 6.4 ha in 2010 (SORS, 2013a, b), which shows that Slovenian farms are small by European standards. Table 1 shows distribution of Slovenian farms by UAA sizes.

Table 1: Distribution of Slovenian farms by UAA sizes

	Number	%	Hectare	%
Total	72.370	100.00	485.760	100.00
< 5.00 ha	43.270	59.79	101.920	20.98
5.01 - 10.00 ha	17.260	23.85	120.630	24.83
10.01 - 20.00 ha	8.190	11.32	111.340	22.92
> 20 ha	3.650	5.04	151.870	31.26

Source: *Eurostat, Farm Structure Survey, (2013)*

In Slovenia, farms less than 5.00 ha comprise around 60% of the total farm number. Farms between 5.01 and 10.00 ha are the next most important group accounting for almost the same share of agricultural land. Furthermore, farms less than 5.00 ha and farms between 5.01 and 10.00 ha representing the core of the farm structure in Slovenia; comprising over 80% of the total number of farms, and operating on almost half of agricultural land. In this distribution, based on the importance of percentage of number of farms and farm size in hectares, our study uses three farm size classes: units less than 5.00 ha, units between 5.01 and 10.00 ha, and units over 10.1 ha.

2.2. Labour characteristics and behaviour towards ecological development in Slovenian farms

The structural change in farming sector in Slovenia is oriented towards sustainable multifunctional farming by implementation of the "Resolution on the Developmental Orientation of Slovenian Agriculture" (RSRSKŽ) in 2011. However, compare to other EU member states, small scaled, fragmented, dispersed with high percentage of situation in less favorite areas, and low economic productivity of agricultural holdings creates an unfavorable farm structure for Slovenia.

This unfavorable farm structure also involves low education level of employed in agriculture, and high percentage of older age group of workforce in farm sector (more than half of the agricultural holding operators are over 55 years old) (Bojnec, 2004; Bojnec and Dries, 2005). Demographic factor is expected to have impacts on farm exits and changes in farm structures.

Furthermore, farmer's income is two to three times lower than the income of persons employed in other occupational sectors (Kovačič, 2001). This difference in on-farm and off-farm income in rural regions obligates additional family farm budget by the supply off-farm labour. As stated by Udovč et al. (2006), diversification of income sources on the farm is one of the multifunctional farming strategies that remains the leading Slovenian farm development strategy. This labour force behaviour of farm managers have been typical profile of Slovenian family farm history: a part-time-farmer and a half-worker.[2] However, this is changing most recently. In addition to elder age farm managers, young entrepreneurs' strategies are increases farm size, production unit and diversification of farm income with activities such as tourism on farm, wood processing and other non-farming gainful activities.

As previous studies emphasize, the relationship between family labour and ecological development in farms could summarize as: family labour represents traditional agricultural production, and show distance from innovative ideas. However, in some

[2] For more information on specific historical circumstances on farms in Slovenia, see Čepič (1996) and Knežević Hočevar (2012).

family farm cases where farm families are with flexible roles, negotiation among family members frequently helps tackles with ecological development in farm (Rossier 2005).

In Slovenia, in the large parts of family farms there is an engagement of each family member even disabled and aged members (Knežević Hočevar, 2012)[3]. This old aged engagement increases information sharing such as advices between old and young generation, but in some families, this could increase the difficulty to convinced aged family labour for innovative ideas that could raise competitiveness of agriculture in economic and ecologic perspective (Knežević Hočevar, 2012).

2.3. Structure and measures of the Slovenian agri-environmental programme (SAEP)

The Slovenian AEM programme, commonly referred to as the SAEP, was first implemented in 2001 with 10 policy measures that were financed by the national budget[4]. In 2004, the consent of the EU and a new legal framework, together with the experiences and insights gained from previous implementations of the SAEP from 2001-2003, led to a newly designed programme that included 21 measures that were implemented under the 2004-2006 RDP (EC Regulation 1257/1999 and 817004). For the 2007-2013 RDP, which included 26 measures, Slovenia complied with EC Regulation 1698/2005, which outlined support for Slovenian RDP and was financed by the European Agricultural Fund for Rural Development (EAFRD). Although the seven-year period ended in 2013, the EC agreed to extend the programme through 2014 to ensure that there was no gap prior the start of the 2015-2020 RDP. The 2015 SAEP has been approved by the EC (February 2015), and procedures for its implementation have begun at the local level.

The SAEP measures are divided into three groups:

Group 1: Reduction of negative impacts of agriculture on the environment, with sub-measures for the preservation of crop rotation, greening of arable land, integrated production (crop, fruit, viticulture and horticulture) and organic farming[5].

[3] The share of family labour is around 95% for small, medium and large scale farms (Unay-Gailhard and Bojnec, 2015a).

[4] The first measures supporting environmentally friendly farming methods were implemented in 1999. However, implementation on a large scale began after the adoption of the SAEP in 2001.

[5] In the 2015-2020 SAEP, organic farming differs from previous years. Unlike the previous programmes, it is no longer implemented as in the payment context of AEM.

Group 2: Conservation of natural conditions, biodiversity, soil fertility and traditional cultural landscapes, with sub-measures for mountain pastures, mowing steep slopes, humpy meadow mowing, meadow orchards, steep vineyards, production of autochthonous and traditional agricultural plant varieties, sustainable rearing of domestic animals, extensive grassland maintenance, and preservation of extensive karst pastures. Group 3: Conservation of biodiversity and specific countryside values, with sub-measures for animal husbandry in hotspots associated with large carnivores, preservation of special grassland habitats, preservation of grassland habitats of butterflies, preservation of litter meadows, conservation of bird habitats in humid extensive meadows in Natura 2000 sites, and permanent green cover in water protection areas. A detail description of each measure is given in Appendix A. Some Selected examples of AEM in Slovenia 2007-2013 RD program period is given in Table 1.

Table 2: Selected AEM payments per hectare during the 2007-2013 RD program period

Selected examples of AEM in Slovenia (2007-2013)	**Euros/ha**
Group 1: reduction of negative impacts of agriculture on the environment	
Preservation of crop rotation	91.84
Greening of arable land	172.2
Integrated crop production	197.21
Group 2: preservation of biodiversity, traditional cultural landscape	
Mountain pasture	61.09 to 72.57
Steep vineyards	326.77 to 900
Rearing of traditional domestic breeds	89.38
Group 3: maintenance of protected areas	
Preservation of special grassland habitats	121.36
Preservation of grassland habitats of butterflies	121.36
Permanent green cover in water protection areas	31.57 to 184.50

Source: *MAFF, (2007).*

AEMs of relevance to field crop farms mainly cover measures such as reduced fertilization, adjustment of nitrogenous fertilizers for field crops, enhanced vegetal cover on arable land during winter, greening of arable land, integrated and organic production, extensive grassland production and the application of manure during the growing season.

AEMs that are relevant for dairy farms and other grazing livestock farms are mainly related to use of grassland and rough land (e.g., stocking limits and grazing management specifications), sustainable rearing of domestic animals, and mountain pastures[6].

3. Data: Slovenian Farm Accountancy Data Network (FADN)

This paper employs the Slovenian FADN survey sample for the years 2004–2010. The FADN is a European system of sample survey of farms that is used as an instrument for evaluating the income of agricultural holdings and the impacts of the CAP measures in the EU countries (Eurostat, 2012a; 2012b). In our study, secondary farm level data of the Slovenian FADN sample of farms are investigated on the relationship between AEM payments and on-farm labour use by farm size and farm type divisions.

Farm size is measured by UAA of holding in ha. At a country level this can allow to get more precise information about influence of different farm sizes on evolution of farmers' use of labour. Analysis is based on farm size divisions, which can highlight the different patterns in farmers' labour use behaviour as a function of the economic dimension of farm management. In terms of FADN evidence, among such explanatory variables can be farm revenues, farm payments, and by farm received RD subsidies, which can be positively associated with farm size. In our study we focus on the received AEM subsidies as a proxy of the effects of received RD subsidies on on-farm labour use.

Farm type is a significant factor that influences both AEM adoption and labour demand. Previous analysis confirmed that there are differences in the share of AEM participants (%) and average AEM subsidies received by farm type (Unay-Gailhard and Bojnec, 2015b). Type of farming in FADN is classified in the following eight farming branches: (i) field crops, (ii) horticulture, (iii) wine (viticulture), (iv) other permanent crops, (v) milk (dairy), (vi) other grazing livestock, (vii) granivores (livestock using cereals – pigs and poultry), and (viii) mixed farming. Due to importance of the field crop, dairy and livestock farming in Slovenia, our analysis focuses on these three farm type divisions. Table 3 gives the description of the used Slovenian FADN dataset (2004-2010).

[6] For detailed AEMs of relevance to dairy production in EU member states, see EC (2000) on the environmental impact of dairy production.

Table 3: Description of the used Slovenian FADN dataset (2004-2010)

Variables	Description	Unit
Rural Development (RD) payments		
I. Agri-environmental subsidies	Subsidies to farm that are adopted agri-environmental measures	Euros
II. Less Favoured Area (LFA) subsidies	Subsidies to farms that are located in Less Favoured Areas	Euros
III. Other Rural Development (ORD) payments	Support to help farmers to adapt standards, to use farm advisory services, to improve the quality of agricultural products, training, afforestation and ecological stability of forests.	Euros
On-farm labour use		
Total labour input	Total labour input of holding expressed in annual work units (AWU)[7]	AWU
Paid labour input	Hired labour expressed in annual work units (AWU)	AWU
Farm size divisions		
Small farms	Farm total UAA in hectares (ha) is less than 5 ha.	1
Medium farms	Farm total UAA in hectares (ha) are 5-10 ha.	2
Large farms	Farm total UAA in hectares (ha) are more than 10 ha.	3
Farm type divisions		
Field crop farms	Specialist cereals, rice, oilseeds, protein crops, root crops, field vegetables, tobacco, cotton.	1
Dairy farms	Specialist dairying, and cattle	2
Other grazing livestock farms	Specialist sheep, goats and other grazing livestock	3

Source: *Slovenian FADN dataset*

[7] Annual work unit (AWU), 1 AWU=1,800 hours of labour use per year (Eurostat 2010, p. 432).

3.2. Rural development (RD) payments and on-farm labour use

The Slovenian FADN dataset considers three categories of RD subsidies: (i) AEM, (ii) LFA, and (iii) other RD (ORD) payments. As describe in the previous section, AEM payments cover subsidies for environmental restrictions in farming practices.

AEM payments are linked to specific agricultural outputs which (can) increase the need for more on-farm labour use in farming practices (e.g., crop rotation, surface leaching of nutrients by covering the soil with winter crops during the autumn and winter seasons, and orchard areas need to be covered with permanent grassland that requires maintenance by mowing or pasturing). Some of AEM practices such as integrated production (crop, fruit, wine, horticulture), and organic farming are often more labour intensive than the traditional farm activities (e.g., due to the need to respect special technological guidelines to have an integrated production certificate, control the production of high quality foodstuffs and reduce the impact on the environment to have an organic farming certificate), so they can also expect to increase the on-farm labour demand (Pufahl and Weiss, 2009; Petrick and Zier, 2012; EEC no. 2078/92).

LFA payments given to farms that are situated in areas (by application such as AEMs) designated as "less-favoured" by considering that agricultural activity is more difficult because of natural handicaps. In Slovenian agriculture, “less-favoured” areas are mostly considered as steep slopes located farms in mountain areas, or low soil productivity farms. Due to these natural handicaps for agricultural production there is a significant potential risk of agricultural land abandonment, and loss of highly valuable rural landscape. In these farms, the LFA payments aim to mitigate agricultural land abandonment, desertification and forest fire risks. Previous studies remark controversial results on the effect of LFA payments on labour demand. Because LFA payments are linked to land and not on agricultural production or activities like AEMs, for example Olper et al. (2014) explain these controversial results with the relationship with income effect and substitution effects between production factors. Increase in income will affect farmer behaviour positively towards on-farm labour demand if this is necessary to increase production without capital investment that is substitute of use of hired labour.

ORD payments aim to help farmers to adapt standards, use farm advisory services, improve the quality of agricultural products, conduct training, create new areas of forest, and increase the ecological stability of forests.

4. Descriptive Statistics of Slovenian FADN data-set

4.1. Agri-environmental measures (AEMs) and farm size in Slovenia

Tables 4a and 4b present descriptive statistics of the data used in the farm size division analysis. The FADN farm size sample division is biased towards small and medium size farms compared to Eurostat, Farm Structure Survey (Table 1). In Slovenia, units less than 5 ha comprise around 60% of the total farm number, and units between 5.01 and 10.00 ha are the next most important group accounting for almost the same share of agricultural land (Eurostat, Farm Structure Survey, 2013). In the Slovenian FADN dataset in the 2004-2010 period, units less than 5 ha comprise 390 farms (7.4% of whole sample), and units between 5.01 and 10.00 ha are represented by 1260 farms (23.9% of whole sample). Regarding to subsidies (%) received by farm size in the 2004-2010 period, the calculations gives that medium farms received higher percentage of AE subsidies (around 76 % of medium farms received AE subsidies), while small farms received the lowest (around 57 of small farms received AE subsidies).

Table 4b shows that in addition to farm size division, participation in AEMs explores different trend by years, by keeping higher AEM participation rate for the medium size farms (72% in 2004, 81% 2007, and 75% in 2010).

Table 4a: Rural Development (RD) subsidies (%) received by farms in Slovenia (by farm size, average of the years 2004-2010)

Rural Development (RD) subsidies	**Small farms: (<5 ha)**	**Medium farms: (5-10 ha)**	**Large farms: (>10 ha)**
	n=390 (7.4%)	n=1260 (23.9%)	n= 3605 (68.6%)
I. Agri-environmental subsidies	57.44	76.51	73.29
II. Subsidies for Less Favoured Areas (LFA)	69.49	82.46	77.25
III. Other Rural Development (ORD) Subsidies	4.62	14.44	10.37

Source: *Slovenia FADN data-set, (2004-2010).*
Note: *Given numbers represent the percentage of Rural Development (RD) subsidies received by farms by size of farms as an average of years 2004-2010.*

Table 4b: Participation in agri-environmental measures (AEMs) in Slovenia, by farm size divisions

	%	**Mean** (Euro/AWU)	**Std.**	**Min.** (Euro/AWU)	**Max.** (Euro/AWU)
Small farms (<5 ha)					
2004	63.33	900.86	422.11	252.47	1593.08
2007	55.00	605.12	390.79	129.69	1471.80
2010	57.77	638.34	295.25	121.10	1310.55
Medium farms (5-10 ha)					
2004	72.27	1271.28	897.30	176.47	4131.18
2007	81.91	1247.63	788.02	111.84	3654.13
2010	75.00	1222.42	716.08	211.07	4333.04
Large farms (>10 ha)					
2004	68.87	4579.02	7202.74	122.67	89,692.48
2007	77.95	4616.95	5684.33	67.66	38,070.49
2010	71.83	5216.3	6033.92	60.55	39,281.14

Source: *Slovenian FADN dataset, (2004-2010).*
Note: *The numbers in percentage (%) represents the share of AEM participants in total number of farms, and mean numbers present the average AEM subsidies (Euro/AWU) that are received by farms.*

4.2. Agri-environmental measures (AEMs) and farm types in Slovenia

Table 5 gives descriptive statistics of the FADN data used in the farm size division analysis. The Slovenian FADN sample highlights that farm type is an important factor in participation in AEMs. There are differences in the share of AEM adopters (%) and average AEM subsidies received by farm types. During the 2004-2010 period, there is a decrease in the share of AEM adopters for horticulture and other permanent crop farms and an increase for field crops. These differences indicate that AEM practices are expanding towards field crops. Overall, in the 2004-2010 period, average AE subsidies received by dairy farms increased by around 67% (2.704 Euros in 2004 and 4.025 Euros in 2010). However, a slight decrease in % of AE subsidy receivers is observed from 59.4% in 2004 % to 54.4% in 2010. Based on these results, the features of relationship between AEMs and on-farm labour are assumed to be specific to the type of farming that is performed and should reflect different outcomes. Therefore, we aim to explore the evolution of on-farm labour with special focus given to field crop, dairy and other grazing livestock farms.

Table 5: Agri-environmental subsidies received by farms in Slovenia (by farm types and years)

Farm Types	2004	2005	2006	2007	2008	2009	2010
I. Field crop farms							
Mean (€)	5285	6895	569	5703	4884	6482	8420
% of receivers	83.33	87.3	60.29	74.32	83.54	85.29	91.84
II. Horticulture							
Mean (€)	1951	3043	98	1796	1444	8092	1067
% of receivers	83.33	77.78	71.43	81.82	66.67	72.73	60.00
III. Wine							
Mean (€)	2306	2186	298	2125	2115	2085	2755
% of receivers	66.67	77.27	69.57	81.82	84.62	85.71	91.89
IV. Other permanent crops							
Mean (€)	1803	3575	291	1681	1431	1334	2124
% of receivers	100	88.24	89.47	91.89	89.8	82.05	86.49
V. Dairy farms							
Mean (€)	2704	3044	798	2820	2569	3565	4025
% of receivers	59.45	65.79	48.66	66.94	69.17	58.93	54.88
VI. Other grazing livestock farms							
Mean (€)	4077	4382	806	3175	3289	2521	3304
% of receivers	77.32	81.34	66.67	86.18	89.27	82.48	77.55
VII. Granivores							
Mean (€)	3205	6693	NA	NA	NA	11303	13539
% of receivers	50.00	16.67	-	-	-	74.07	53.33
VIII. Mixed							
Mean (€)	4886	6519	517	5029	5018	4527	4895
% of receivers	73.03	76.61	64.44	78.46	85.62	81.41	79.17

Source: *Slovenia FADN data-set, (2004-2010).*

Note: *Given numbers represent the average agri-environmental subsidies received by farms by types of farms and years. NA: Non-available data.*

5. Results of Statistical Analyses

5.1. Pearson's correlation: the relationship between AEM payments and on-farm labour

In a first step of statistical analysis, with Pearson's correlation coefficient is provided information on whether two examined variables (AEM payment level and labour use in farm) are linearly related. Pearson's correlation coefficient is a measure of the strength and direction of association that exists between two continuous variables. It is denoted as "*r*" that indicates how far away all data points are in line of best fit. Its value can range from -1 for a perfect negative linear relationship to +1 for a perfect positive linear relationship. A value of 0 (zero) indicates no relationship between two variables.

In our study Pearson's correlation coefficients give insights on whether there is an association between RD payments (in Euros) and labour use (in AWU). Our interpretations will focus on AEM payments. Research expects positive correlation: more AEM payments were correlated with higher labour use in farms, because AEMs are causing more intensive farm practices relative to traditional ones.

The previous literature demonstrates that several structural factors influence the decision-making behaviour towards AEMs (Wynn et al., 2001; Kristensen et al., 2001; Unay-Gailhard and Bojnec 2015a, 2015b). Among the farm structure variables, farm size, and farm type characteristics are important determinants of applying AEMs, thus influence the use of labour use during implementation of contracted measures. Based on the previous evidence, as a methodological approach, AEM payments' associated with labour use in farms are measured especially in relation with farm size (small, medium and large farms), and farm type divisions (field crops, dairy farms and other grazing livestock). Table 6 and 7 show the results of Pearson's correlation coefficients by farm sizes and farm types, respectively.

Table 6: Pearson's correlation coefficients on the relationship between two continues variables of labour use (total and hired labour in AWU) and RD payments (payments for AEMs, LFA and ORD in Euros) by three farm size divisions

	AEM payments		**LFA payments**		**ORD payments**	
	Total Labour	Hired Labour	Total Labour	Hired Labour	Total Labour	Hired Labour
Small Farms (N=390)	0.154* (0.002)	0.163* (0.001)	0.099 (0.051)	-0.040 (0.428)	0.051 (0.312)	0.018 (0.720)
Medium Farm (N=1260)	0.100* (0.000)	0.247* (0.000)	-0.004 (0.900)	-0.169* (0.000)	-0.044 (0.123)	0.009 (0.753)
Large Farm (N=3605)	0.093* (0.000)	0.085* (0.000)	0.031 (0.063)	0.015 (0.377)	-0.038* (0.022)	-0.017 (0.311)

Source: *Slovenian FADN dataset, results represent an average of years 2004-2010.*
Note: *Given number are the Pearson correlation coefficient, r, which shows the strength and direction of the association between two tested variables. Correlation coefficient, r, given with * that indicate the significance of p-value. Numbers provided in parentheses show the level of statistical significance (p-value) of the Pearson correlation coefficient.*

In Table 6, second and third columns give the Pearson correlation coefficients between AEM payments (in Euros) and labour use (total and hired labour use in AWU) for three farm size divisions. The Pearson correlation coefficient for total labour use, *r*, is 0.154 for small, 0.100 for medium, and 0.093 for large farms. As the sign of the Pearson correlation coefficient is positive for all farm sizes, we can conclude that there is a positive correlation between AEM payments and total and hired labour use for all farm sizes. This confirms that increases in AEM payments in farm income increases use of total and hired labour on farms. This finding is consistent with the expectations that AEM payments display a positive correlation on labour use. If we interpret this correlation result as a positive effect of AEMs, as highlighted by Petrick and Zier (2012), AEMs are often more labour intensive (e.g., protection of a certain landscape, reduction of soil

erosion, organic farming) than the traditional farming practices. Therefore, one can expect an increase in the demand of labour use in AEM adopted farms.

The magnitude of the Pearson's correlation coefficient determines the strength of the correlation. However, in the literature there are no common rules for assigning strength of association to particular values. Based on Cohen's (1988) general guidelines[8], Pearson's correlation coefficient in our case suggests more strength correlation values for medium farms in hired labour use (r = 0.247) than for small (r = 0.163) and large farms (r = 0.085). While the positive correlation between AEM payments and hired labour use for all farm sizes make sense with respect to the common intuition, the same cannot be said on the strength correlation values between AEM payments and hired labour use only for medium farms. In theory, AEMs should induce higher quantity of labour demand in large farms relative to small and medium size farms.

The comparison of Pearson's correlation coefficient signs between three different RD payments reveals heterogeneous results. While there is a positive and significant correlation between AEM payments and labour use in farms, this correlation is negative and significant for LFA payments (r = -0.169 for hired labour in medium farms), and ORD payments (r = -0.038 for total labour in large farms). These different effects of RD payments on labour use are in line with the study of Olper et al. (2014), who investigated the influence of CAP Pillar I and II effects on out-farm migration in 150 EU regions over the 1990–2009 period. Because LFA payments are not attached to agricultural production, but are linked to the location of the farm land, one can expect an ambiguous income effect, thus this could give different effect on farmers' behaviour towards labour demand (Barath et al., 2016). Regarding to ORD, the negative and significant correlation between ORD payments and labour use could be explained by the logic of substitution between labour and capital. Because ORD covers mostly capital investment payments, farm managers could perceive production factors as comparable, so that employing more of capital makes them desire to employ less of labour.

[8] The coefficient value and the strength of association is provided by Cohen (1988) as: $0.1 < |r| < .3$ as small correlation, $0.3 < |r| < .5$ as medium/moderate correlation, and $|r| > .5$ as large/strong correlation.

Table 7: Pearson's correlation coefficients on the relationship between two continues variables of labour use (total and hired labour in AWU) and RD payments (payments for AEMs, LFA and ORD in Euros) by three farm types

	AEM payments		**LFA payments**		**ORD payments**	
	Total Labour	Hired Labour	Total Labour	Hired Labour	Total Labour	Hired Labour
Field Crop Farms (N=415)	0.159* (0.001)	0.096 (0.052)	0.095 (0.054)	0.000 (0.997)	-0.029 (0.555)	-0.023 (0.643)
Dairy Farms (N=1816)	0.245* (0.000)	0.330* (0.000)	0.273* (0.000)	0.377* (0.000)	0.000 (0.987)	-0.004 (0.850)
Other Grazing Livestock (N=1484)	0.149* (0.000)	0.198* (0.000)	0.114* (0.000	0.112* (0.000)	-0.056* (0.030)	-0.001 (0.971)

Source: *Slovenian FADN dataset, results represent an average of years 2004-2010.*
Note: *Given number are the Pearson correlation coefficient, r, which shows the strength and direction of the association between two tested variables. Correlation coefficient, r, given with * that indicate the significance of p-value. Numbers provided in parentheses show the level of statistical significance (p-value) of the Pearson correlation coefficient.*

In Table 7, for the relationship between AEM payments and total labour (hired labour) use, the Pearson's correlation coefficient, *r*, is 0.159 (0.096) for field crop farms, 0.245 (0.330) for dairy farms, and 0.149 (0.198) for other grazing livestock farms. Similar to the three farm size division results (Table 6), the sign of the Pearson's correlation coefficient is positive for all farm types. This positive correlation between AEM payments and total and hired labour use could be interpreted as there was an increase in total and hired labour use, which was driven by increase in AEM payments. This result is significant for all three farm types, except for field crop farms. The Pearson's correlation coefficient, *r*, that shows the relationship between AEM payments and hired labour use is found insignificant for field crop farms. In line with this finding, Olper et al. (2014) model shows that there is a weak effect of AEM payments on-farm labour use.

Furthermore, for the AEM payment results, the Pearson's correlation coefficient, *r*, values suggest that there is a higher strength correlation for dairy farms both for total and

hired labour use (r = 0.245 for total labour use, and r = 0.330 for hired labour use) relative to other farm type categories.

The comparison of Pearson's correlation coefficient signs between three different RD payments (Table 7) reveals less heterogeneous results than the results of Pearson's correlation coefficients by farm sizes (Table 6). As can be seen from Table 7, there is a positive and significant correlation between LFA payments and labour use (both total and hired) in dairy and other grazing livestock farms. For dairy farms r = 0.273 for total labour use, and r = 0.377 for hired labour use. Pearson's correlation coefficient suggests the more strength correlation values for dairy farms relative to other farm types. This suggests that even LFA payments were being linked to land, they could have an income effect that change behaviours towards additional labour use. Considering ORD payments, not surprisingly the Pearson's correlation coefficient is negative and significant for other gazing livestock farms, however the correlation is relatively weak (r = -0.056).

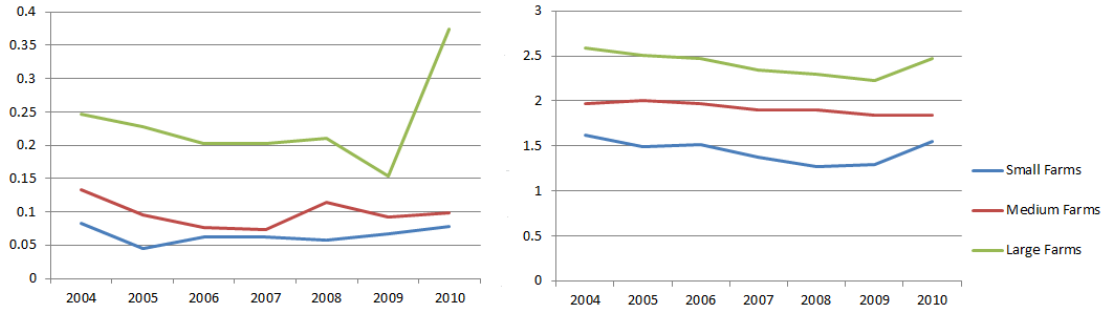
5.2. Evolution of on-farm labour use in Slovenia

In the second step of statistical analysis, we focus on the evolution of the total and hired labour use (in AWU) in Slovenia by years. This labour use trend analysis gives an approximation of the number of hours (and thus, in our case number of AWU) of total and hired labour use by farms. Beside the observation of labour use trend by years, study measures this evolution explicitly by farm sizes and farm types that reveals (i) the changes in hired labour use between small, medium and large farms, and (ii) the comparison of hired labour use between crop farms, dairy farms, and other grazing livestock farms.

As regard to the RD policy periods and AEM subsidies in Slovenia, year 2004 (entrance in EU) represents the beginning of new legal program framework, together with the experiences and insights gained from previous implementations of the SAEP from 2001 to 2003. In our analysis, evolution of the total and hired labour use given under the 2004-2010 period covers two RDPs; (i) the 2003-2006 RDP period, and (ii) the 2007-2014 RDP period.

Figures 1 and 2 provide evolution of the total and hired labour use (AWU) by three farm size categories, and by three farm type categories, respectively.

Figure 1: Evolution of the total and hired labour use (AWU) by three farm size categories



(a) Evolution of the hired labour use

(b) Evolution of the total labour use

Source: *Slovenian FADN dataset.*

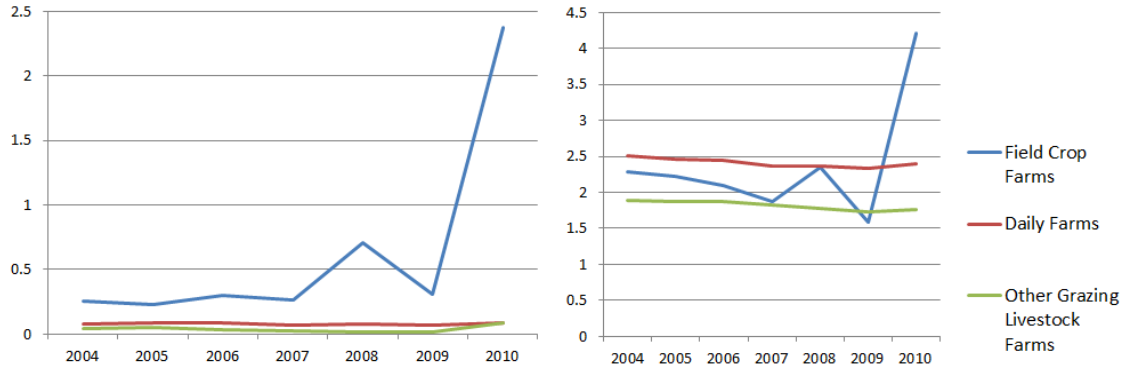
Figure 1 (a) gives the evolution of the hired labour force during the study period for small, medium, and large farms. While hired labour use has slightly changed for small and medium farms, for large farms, use of hired labour shows continues decreasing trend during the years 2004-2009, but there is a rapid increase in 2010. This two opposite trends are confirmed by Figure 2 (b), depicting the evolution of total labour use, which has a decreasing trend until 2009, and a sudden increase in 2010 for large farms.

Overall, the comparison of Figures 2 (a) and (b) by the study period reveals an increase of hired labour use for large farms (0.25 AWU in 2004 to 0.37 AWU in 2010) but not a change of total labour use (2.6 AWU to 2.5). The evolution of the use of total labour for medium farms can be characterized by stagnation; the average use of total labour use over the whole period did not experience a big change by years, however it has entered in a very slightly decreasing trend since the year 2006. This slightly decreasing use of total labour since the year 2006 is also a common trend for small and large farms. The difference is, however, while small and large farms have increased use of total labour use since the year 2009, for medium size farms total labour use has stayed at the same unit as it was in 2009.

Additionally, the comparison of Figures 2 (a) and (b) reveals that there is a slight change in the share of hired labour in total farm labour. The percentage of hired labour use stays

stable by study years and farm size categories. The share of hired labour use is around 9% for small, 6% for medium, and 9% for large farms. The previous literature on developed countries shows that the share of hired labour in total farm labour has increased over the last decades (Blanc et al., 2008). This increasing trend could be explained by several factors, such as increase in farm labour productivity, use of mechanization, improvements in farm/farmer characteristics, and tax policies (Baum et al., 2006; Benjamin and Kimhi, 2006). In our Slovenian case, increasing trend in the share of hired labour is only true for large farms. The share of hired labour use increased from 9.5% in 2004 to 15.1% in 2010. This could be explained by the differences in farm types (e.g., lager field crop farms), technologies used and farm management practices by farm sizes. These results confirmed that while hired labour and family labour perform as substitutes for small and medium sized farms, they perform as complements for large farms; hired labour and family have similar adjustment patterns towards technical and management tasks.

Figure 2: Evolution of the total and hired labour use (AWU) by three farm type categories



(a) Evolution of the hired labour use

(b) Evolution of the total labour use

Source: *Slovenian FADN dataset.*

Figure 2 gives evolution of two types of labour force in Slovenia: (a) hired labour use, and (b) total labour use. In general, on-farm labour use during the 2004-2010 period reveals a significant increase of hired and total labour used in field crop farms relative to other farm types. The total labour use for field crop farms increased from 2.29 AWU in

2004 to 4.21 AWU in 2010. Figure 2 (a) confirms that observed increase in total labour use is largely due to increase in use of hired labour, which has more than doubled. The use of hired labour per field crop farm was 0.26 AWU in 2004 and 2.38 AWU in 2010.

This finding suggests that the field crop farms in Slovenian FADN sample in use of labour behave differently than other farm types. This result is partly consistent with the study by Dupraz and Latruffe (2015) in France in the 1990-2007 period. They indicate that field crop farms have experienced faster structural changes with a higher increase in hired labour than other farm types in French agriculture. This change brings the possibility that complementarities between technical (the only operations performed by hired labour) and management tasks (which are specifically for the farm head and family labour) might has started to dominate by the combination of family and hired labour in field crop farms.

In our Slovenian case, the fluctuated curve for the use of hired labour for field crop farms could be explained by farm managers' demand for hired workers that has been higher since the year 2007 than for the earlier study years. However, this increase in the hired labour demand is less likely to be strongly correlated with the evolution of permanent hired employment, which is far away from its stabilization pattern in development. Therefore, based on the 2007-2010 years fluctuated results, it cannot be concluded that hired labour use has increased the complementarities between technical and management tasks that are dominated by the combination of family and hired labour.

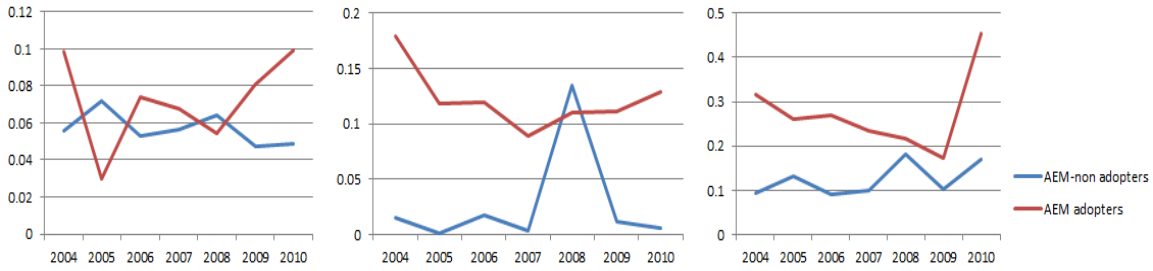
The comparison of Figures 2 (a) and (b), for dairy and other grazing livestock farms reveals a very slight change both in hired and total labour use by years; the share of hired labour in total farm labour stays stable by study years. However, there is a visible increasing trend in the share of hired labour use to the total labour use for field crop farms (11.2% in 2004, 19.2% in 2009, and 56.4% in 2010). These different results in the share of hired labour use between three farm types could partly be explained by machinery needs and outsourcing services for arable land farming. If hired workers supply their own machinery, in particular for arable farming, field crop farmers may prefer to use hired labour (who also supply their own machinery), and avoid purchasing a machinery. Another explanation could be that hired labour compensates the lack of family labour, which is much more easy/ necessary for field crop farms than for dairy and

other grazing farms. However, for Slovenian case, more evidence is needed to explain this difference in hired labour trends between farm types with machinery needs of arable lands.

5.3. Two-sample t-test: hired labour use by AEM adopters and non-adopters

In the last step of statistical analysis, study aims to understand the role of RD payments as a factor in the previously presented evolution of hired labour use (Figures 2 and 3). More specifically, study has an objective to determine whether AEMs play a role in the farmer decision towards use of hired labour, if yes how this trend keeps continuity by years. This gives an opportunity to compare whether AEM adopters sample differs from non-AEM adopters sample in terms of hired labour use by years. A *t* test compares the mean values of two groups. In our case, the *t* test used to compare the mean values of hired labour use in the current year between two populations: AEM adopters and AEM-non adopters in the current year. In order to visualize the mean value differences between study populations, Figures 3 and 4 provide evolution of mean values by farm size and farm type divisions.

Figure 3: Mean values of hired labour use by AEM adopters and AEM-non adopters: for the samples of small (N = 166), medium (N = 296) and large sized farms (N = 963)



(a) Small Farms **(b)** Medium Farms **(c)** Large Farms

Source: *Slovenian FADN dataset.*
Note: *The results of two-sample t-test values: for medium farms, the mean values between AEM adopters' and AEM-non adopters' population were significantly different from each other for the use of hired labour at the level greater than 5% significance level for the years 2004,2005,2006,2007, and 2010; for large farm sample, this holds only for the year 2010.*

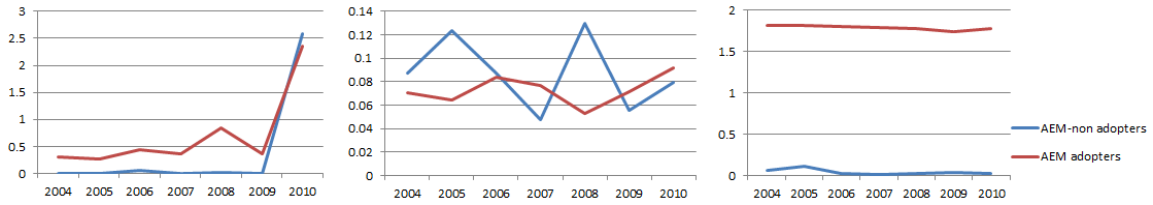
Figure 3 presents the mean values for hired labour use by two populations: AEM adopters and non-adopters by three samples (a) small farms, (b) medium farms, and (c) large scale farms. The results indicate that for medium and large farms, in the majority of the study years, mean value of hired labour use is higher (expect for the year 2008 in medium farms) in AEM adopters than in AEM-non adopters. This sheds a light on the mechanism of AEM payments affect in the behaviour of farm households towards hired labour use, which is stronger for large and medium farms. However, the fluctuation of mean values for hired labour (even for large farms), gives an evidence that farms have a challenge to adjust more precise quantity of hired labour use during the study period. Even AEM adopters' population did not show a stable share of hired labour to total labour use by years.

The higher mean values for farms employing hired labour suggests that farm size structure has a role in hired labour use for AEM adopters. In particular, the mean values of hired labour use in the years 2004-2007 were more than doubled for AEM adopters compare to AEM-non adopters for medium and large farms. Considering participation behaviour in AEMs in Slovenia by farm size divisions, this high quantity of hired labour

use can be explained by higher and increasing percentage of AEM participation rates for medium and large farms in the years 2004 and 2007, relative to the year 2010. In addition, this result could also be interpreted with the family labour adjustment limits towards AEM practices by farm size. For Slovenian small farms, their adjustment capacity of family labour to the AEM adopted farm area tasks might be more constrained relative to medium and large farms.

Overall, our results partly support the findings of previous studies that focus on the relationship between farms size and labour demand. For example, Benjamin et al. (1996) and Dupraz and Latruffe (2014) suggest that farm size has a positive effect on the use of external labour. Larger farms require more labour force, which can be filled by hired and contracted labour forces.

Figure 4: Mean values of hired labour use by AEM adopters and AEM-non adopters: for the samples of field crop farms, dairy farms, and other grazing livestock farms



(a) Field Crop Farms **(b)** Dairy Farms **(c)** Other Grazing Livestock

Source: *Slovenian FADN dataset.*
Note: *The results of two-sample t-test values: for field crop farms, the mean values between AEM adopters' and AEM-non adopters' population were significantly different from each other for the use of hired labour at the level greater than 5% significance level for the years 2006 and 2008; for dairy farm sample for the years 2005 and 2008; and for other grazing livestock farms for the years 2004, 2005, 2007, and 2009.*

Figure 4 presents the mean values for hired labour use by the AEM adopters and non-adopters populations. Results are presented by three farm type samples (a) field crop farms, (b) dairy farms, and (c) other grazing livestock farms. As regard to given mean values of hired labour and *t* test results, for dairy and other grazing livestock farms in the majority of study years, mean values between two studied populations (AEM adopters

and non-adopters) were significantly different from each other (at the level greater than 5% significance level). While for dairy farms, mean values that measure central tendency are not stable between AEM adopters and non-adopters. This stability is more clearly visible for other grazing livestock farms. The significantly higher and stable mean values of hired labour use for AEM adopters in other grazing livestock farms may be due to the specificity of adopted AEMs for these farms. On the one hand, this could be indicator of hired labour productivity, whereas on the other hand, this result can reflect a certain need for farmers to hand over some AEM related operational or practical tasks to hired labour, especially in other grazing livestock farms.

Similar to Figures 3 (a) and (b), in Figures 4 (a) and (b) are observed a significant increases of hired labour used. Due to this increases in hired labour use, which are observed both in AEM adopters and non-adopters, higher quantity of demand for hired labour use in the year 2010 relative to the year 2009 (Figures 2a and 3a) could not be explained by AEM payments' effect. This can be an issue for further research.

6. Conclusion

The implementation of voluntary-based structured public intervention in CAP, Pillar II measures raises the question of whether these policy reforms will influence the structural change in European farms. The farmers' decisions in rural labour market towards use of hired labour as a complementary to family labour use is one of the important results for structural change in farms. Looking from CAP perspective, agricultural policies do not include instruments that directly aim to preserve and increase agricultural labour use. However, CAP, Pillar II measures address this matter via subsidies on voluntary-based participation of farmers. Therefore, studies evaluating the effect of the Pillar II measures on on-farm labour use are important to understand if it is an effective policy intervention approach (relative to command and control approach), and whether it is an effective policy strategy.

This paper contributes to the literature on the relationship between Pillar II, AEMs and the on-farm labour use in Slovenia over the 2004-2010 period. AEMs play an essential role in the RD programme for Slovenia, which has the highest amount of subsidies

among NMS-10. To our knowledge there are no studies focusing on the effect of AEMs on decisions towards use of hired labour in Slovenia, but for some other EU countries such as Germany (Petrick and Zier, 2011), France (Dupraz and Latruffe, 2015), and other EU region comparisons (Olper et al., 2014).

If implementing AEMs are an effective policy tool in transferring income to on-farm labour, this effect should also be observed on the rise of total labour use on farms. Our study results partly support this hypothesis, and highlight that the relationship between AEMs and total labour use depends on the farm structural factors related to farm size and type of production. More specially, the relationship between AE subsidies and hired labour use is explained by farm size divisions of small, medium and large farms, and farm type divisions of field crops, dairy farms and other grazing livestock farms.

The results of statistical analysis gives evidence that hired labour use is positively correlated by AE subsidies in all farm size classes in Slovenia. Regardless of farm size, increase in the demand for hired labour use in AEM adopted farms could be explained by the requirements of environmental farming practices that are often more labour intensive than the traditional farming practices. In our case, even the correlation is not very strong, this is especially true for the small size farms. These findings are consistent with those of Petrick and Zier (2012) and Pufahl and Weiss (2009). Such common effect of the AE subsidies on farm size classes show that there is not such a need for a specific instrument targeting agricultural labour use by farm size division. Based on farm type analysis results, we could conclude that this may need to be adjusted for the farm production characteristics.

Farm type division analysis reveals that the correlation between AE subsidies and hired labour use is significantly positive, depending on the farm type. For field crop farms, we observe a weak correlation between AEM payments and total farm labour use. This finding is in line with Olper et al. (2014) and Dupraz and Latruffe (2015), these model shows that there is a weak/ robust effect of AEM payments on-farm labour use. For example, this weak effect in Germany and Sweden was explained by negative correlation between AEM payments and land prices (Nilsson and Johansson, 2013; Kilian et al., 2012). In Slovenian case, insignificant coefficient value might stem partly from the evidence that the AEMs do not appear to attract adoption of more lands for agricultural

production (Unay-Gailhard and Bojnec 2015a; 2015b). Even for the AEM adopted field crop farms, measures such as to reduce fertilization, adjustment of nitrogenous fertilizers for field crops, enhanced vegetal cover on arable land during winter could be realized easily with additional family labour use. Application of these AEMs in farms do not necessary perceived the hired labour use as a complementary to family labour by farm manager.

Finally, study results gives average of hired labour use as significantly higher (in most of the study years) for AEM adopted medium farms, and other grazing livestock farms relative to those that are AEM-non adopters. For these farms, AEM payments could be seen as an instrument in increasing use of hired labour, with direct or indirect effects. However, these results raise the question about the possibility to econometrically identify the direct hired labour use effect of AEMs. The analytical framework that base on dynamics of the change in hired labour use by focusing on flow analysis rather than static analysis, and applying methodologies to explain factors that influence these flow patterns are needed. Therefore, the next step should be to complete our analysis by econometric model that take into account hired labour use decision flows on each farm, with the changes over time of AEM adoption years.

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Appendix A. Supplementary data

Table A1.
Description of Slovenian agri-environmental programme (SAEP) policy measures, 2007-2014

SAEP sub-measures 2007-2014	**Description of the sub-measures**
Group 1: Reduction of negative impacts of agriculture on the environment	
Preservation of crop rotation	To improve soil properties and land fertility, the entire arable land must be included in crop rotation for five years. This includes growing at least three different crops in agricultural land. The share of cereals may not exceed 60% and legumes need to grow at least once a year.
Greening of arable land	The aim of this measure is to reduce erosion and surface leaching of nutrients by covering the soil with winter crops during the autumn and winter sessions. Winter crop sowing occurs from 1 July to 25 October of the current year and leads to the spread of green cover over the fields from 15 November to 15 February of the next year. Tillage of green arable land may start afterwards.
Integrated production (crop, fruit, wine, horticulture)	This farming method is conducted in accordance with special technological guidelines. The application of fertilisers and plant protection is controlled and a five-year crop rotation is mandatory for arable areas. Acquisition of an integrated production certificate is required.
Organic farming	To control the production of high-quality foodstuffs and reduce the impact on the environment, only the application of organically produced seeds and vegetative propagating material is allowed. The use of genetically modified organisms (GMOs) and products obtained from GMOs is forbidden. Acquisition of an organic farming certificate is required.
Group 2: Conservation of natural conditions, biodiversity, soil fertility and traditional cultural landscape	
Mountain pastures	To preserve traditional farming methods in mountain areas, stocking density during pasture is limited to 0.5-1.9 livestock units (LU)/ha. A pasture order is required in the case of common use of an Alpine or mountain pasture. Presence of a herdsman during mountain pasturing is obligatory and seasonal manual removal of bushes and weeds is mandatory after pasturing.

Steep slopes mowing	To preserve traditional farming methods, typical landscapes, natural features and habitats, at least one mowing and gathering annually is mandatory. Two measures are implemented for steep slopes, one between 35-50% inclination and one for inclinations over 50%.
Humpy meadows mowing	The aim of this measure is to conserve the cultural landscape and habitat in farms that are situated in humpy meadow areas. One mowing and gathering annually is mandatory.
Meadow orchards	To preserve extensive perennial orchards, traditional cultural landscape and biodiversity orchard areas need to be covered with permanent grassland that requires maintenance by mowing or pasturing. Growing weak rootstocks is not allowed. Number of trees per hectare is limited to a minimum 50 and maximum 200.
Steep vineyards	To preserve landscape features and conserve biodiversity, vineyards must be covered with permanent grassland. At least one mowing is required annually, and the plant protection limitation must be respected. Two measures are implemented for steep slopes, one between 35-50% inclination and one for inclinations over 50%.
Rearing of autochthonous and traditional domestic breeds	The aim of this measure is to conserve autochthonous and traditional domestic breeds and their genetic diversity by limiting feed stuffs, cereals, oil cakes and other feedings. This measure can be applied to breeds that are specified on an official list.
Production of autochthonous and traditional agricultural plant varieties	The main objective of this measure is to conserve autochthonous and traditional agricultural plant varieties and their genetic diversity and potential. Payments are granted for plants that are specified on an official list. Plantation must include a five-year crop rotation that includes at least 3 different autochthonous or traditional crop varieties.
Sustainable rearing of domestic animals	To achieve a complete nutrient cycle (e.g., nitrogen, nutrients and organic matter) and reduce loads on the environment, the stocking density on a farm is limited to 0.5–1.9 LU/ha of utilised agricultural area (UAA). It is mandatory to pasture or mow a minimum of once a year and gather annually. Use of feed stuffs, such as cereals and oil cakes are limited.
Extensive grassland maintenance	To preserve biodiversity through extensive use of grassland, the stocking density is limited to 0-0.5 LU/ha of UAA. It is mandatory to pasture or mow a minimum of once a year and gather annually. Mowing should be conducted after the full flowering of the main grass varieties.
Preservation of extensive karst pastures	Extensive grazing aims to preserve the environmental, biotic and cultural diversity of extensive karst pastures. The beneficiary must plan to set up grazing and keep records of all tasks performed. The stocking density is limited to 0.2 LU/ha–1.9 LU/ha of UAA. The grazing area must be bound by a

	fence and divided into enclosures. The grazing period may not exceed 90 normal grazing days of 1 LU/day.
Group 3: Conservation of biodiversity and specific countryside values	
Animal husbandry in hotspots for large carnivores	To preserve the large carnivore population (brown bear), grassland areas situated in areas where large carnivores are known to frequent must register officially to be grazed. During pasture, sheep and goats should be guarded with mobile fences and nets. The stocking density is limited to 0.5–1.9 LU/ha of UAA.
Preservation of special grassland habitats	This measure aims to increase the reproduction of endangered plant varieties and animal and bird species in ecologically important areas by officially registering sites and then applying greening. Flowering of grasses and rising of the offspring of endangered bird species is not allowed before 15 July. The stocking density is limited to 0.2–1.9 LU/ha of UAA.
Preservation of grassland habitats of butterflies	Increased grassland allows reproduction of endangered grassland butterfly species in inner zones of ecologically important areas. Beneficiaries are required to have an official registration and must thin existing border tree strips and hedgerows every second year. Additionally, during butterfly development (between 1 July and 20 August) mowing and pasturing are not allowed.
Preservation of litter meadows	Increased grassland allows nesting of ecologically endangered bird and butterfly species in ecologically important areas. Beneficiaries are required to have an official registration and must thin existing border tree strips and hedgerows every second year.
Conservation of bird habitats in humid extensive meadows in Natura 2000 sites	To provide a favourable population of endangered birds species and habitats in humid extensive meadows, the humid meadow area must be situated in the Natura 2000 sites where birds appear. In these areas, beneficiaries should apply a minimum of one mowing (after 1 August) and gather annually. Pasturing is not allowed.
Permanent green cover in water protection areas	To maintain utilised landscape with special status and to improve groundwater quality, only organic wastes and fertilisers are allowed. The area must be situated in close proximity to water protection areas. Applied five-year crop rotation should include at least 3 different crops, and the area must have year-round green cover.

Source: *author's compilation; data provided by MAFF, 2015.*