Do different types of Common Agricultural Policy subsidies promote farm employment?

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1. Introduction

The creation and maintenance of jobs in agriculture and in rural areas has been a traditional Common Agricultural Policy (CAP) target, as well as an objective restated and emphasized in several European Union (EU) (EC, 2013, 2019) and European Parliament (2016a, 2016b) official documents. Food security in developing and poor countries depends on farm labor and agricultural policy (Kuiper et al., 2020) but less so in developed countries. With economic growth and a higher level of economic development, agriculture's share in employment decreases and government support for agriculture increases (Anderson et al., 2013). While agricultural subsidies have been targeted at achieving different objectives over time, they have affected agri-food value chain markets and allocation in rural and agricultural factor markets – and among the latter, labor allocation in agriculture, and farm labor demand (Garrone et al., 2019). Whether CAP can promote rural jobs, and how, has already been addressed in the literature (Matthews, 2017; Garrone et al., 2019). Our specific research question is whether CAP subsidies can contribute to job creation and prevent out-migration from farms and rural areas (Serra et al., 2005; Alasia et al., 2009). This became a relevant research and policy area following two recent global crises: first, the economic slowdown that followed the global economic crisis, and second, the ongoing global pandemic-related health crisis which has caused an economic recession and reinforced the need to understand the importance of local land use and food production, which might also contribute to job creation on farms and in rural areas.

Therefore, this study contributes to the literature on agricultural employment and job creation on farms in relation to different types of subsidies or policy instruments available under the CAP. The effectiveness of different types of subsidies in maintaining the labor force in the agricultural sector and job creation on farms is unclear, with mixed findings in the literature, while the empirical evidence is still largely inconclusive. The magnitude of economic effects may also be quite moderate and heterogeneous across CAP instruments. More specifically, the contribution of the study may be found in the following four areas. First, we investigate the employment effects on farms of the entire portfolio of CAP measures. Total farm subsidies are decomposed into the individual effects of Pillar I subsidies and different Pillar II, rural development (RD) subsidies, including agri-environmental (AE)

subsidies, less favored area (LFA) subsidies, other rural development (RDo) subsidies, and investment subsidies. Second, the farm employment effect is studied in relation to control variables for regional labor market characteristics, which may be important for maintaining local rural and farm labor markets. The study combines farm level data with control regional level labor market indicators at the Nomenclature of Territorial Units for Statistics (NUTS3). Third, in terms of farm employment a distinction is made between the employment of family farm labor and the employment of paid labor. Econometric models are estimated at farm-level for total farm employment and separately for the employment of family farm labor and the employment of paid labor. Finally, a comparison is made between the countries under analysis using Hungarian and Slovenian Farm Accountancy Data Network (FADN) datasets for the period 2007-2015.

The rest of the paper is organized in the following way. In the next section, we provide a review of related literature. The following two sections present methods, data, and econometric results. The penultimate section discusses results and suggests implications. The final section concludes.

2. Review of literature and hypotheses development

A body of literature has been developed about the rural and agricultural labor market. Numerous studies have investigated the impacts of different agricultural policy measures and subsidies on various aspects of farm, agricultural, and rural labor, and farm household employment decisions (Ahearn et al., 2006; Hennessy and Rehman, 2008; Matthews, 2017). Theoretically, it is expected that some types of CAP subsidies can increase agricultural employment as they can lead to more jobs in agriculture than would be the case without (or with fewer) subsidies (Garrone et al., 2019). However, the empirical findings of studies are mixed in this regard. Some find a positive impact of subsidies on farm employment (e.g. Breustedt and Glauben, 2007; Olper et al., 2014; Unay-Gailhard and Bojnec, 2019; Garrone et al., 2019), others find no or a mixed effect depending on the type of subsidies (e.g. Glauben et al., 2006; Dries et al., 2012; Petrick and Zier, 2012; Dupraz and Latruffe, 2015), while some studies even find a negative effect for subsidies on farm employment (e.g. Dewbre and Mishra, 2007; Petrick and Zier, 2011), particularly for coupled and decoupled area payments (Dupraz and Latruffe, 2015).

Among the recent research, Petrick and Zier (2012) investigated the effects of CAP on dynamic labor use in agriculture on a panel dataset of 69 East-German regions. This study

found few desirable effects on job maintenance in agriculture from investment subsidies, while changes in direct payments had no employment effects.

Dries et al. (2012) investigated job creation and destruction in EU agriculture, revealing the importance of diversity in farm regional distribution, farm structure, and farm type. However, the effectiveness of subsidies in maintaining the labor force in the agricultural sector was found to be unclear, and the empirical evidence is still largely inconclusive.

Olper et al. (2014) also analyzed the effects of CAP payments on farm labor migration using panel data from across 150 EU regions in the period 1990–2009. This study confirmed that relative income, relative labor share, and CAP payments significantly contributed to maintaining jobs in agriculture. In addition, the results highlighted that the magnitude of the economic effect of CAP subsidies has been moderate and heterogeneous across policy instruments. Considering the relative importance of the structure of CAP subsidies during the analyzed period, the effect of Pillar I subsidies was more than two times as great as that of Pillar II payments.

Desjeux et al. (2014) evaluated the impact of rural development measures on spatial farm labor use. The impact of CAP reforms and subsidies on trends in family labor, hired labor, and contract work using the French FADN database for field crop farms during the period 1990-2007 has been investigated (Dupraz and Latruffe, 2015). The latter found that hired labor and contract labor are substitutes, while hired labor and family labor are complementary. Coupled and decoupled crop area payments and Single Farm Payments have reduced farm labor, while AE payments, LFA payments, and investment subsidies have increased it.

Few studies on agricultural and rural labor factor markets have been conducted in Scandinavian countries. For example, Nordin (2014) explored the effect of direct payments to farmers on agricultural employment in Swedish municipalities in the period 2001-2009. It found that direct payments and grassland support contributed to an increase in agricultural employment but maintaining subsidized jobs in agriculture may be slowing down farm restructuring in grassland regions. Biørn and Bjørnsen (2015) examined labor market consequences in Norwegian agriculture over two decades by applying unbalanced data logit models. The analysis found a tendency towards substantial off-farm labor participation by family partners, but less on livestock farms, larger farms, and farms on which children had more important on-farm employment. Blomquist and Nordin (2017) evaluated the effect of CAP subsidies on employment outside the agricultural sector using Swedish municipality data for the period 2001-2009. A side-effect of the decoupling reform in 2005 which involved

a substantial increase in grassland support was found to have had positive effects on job creation in regional labor markets.

Rizov et al. (2018) investigated the effects of CAP payments on indirectly generated non-farm jobs in UK-based small- and medium-sized enterprises. They found positive net spillover effects for CAP payments from non-farm employment. Pillar I payments were found to have a stronger positive employment effect relative to Pillar II payments, and vice versa per euro spent in rural areas and within the agricultural supply chain.

Unay-Gailhard and Bojnec (2019) found that increases in labor use in Slovenia could be observed for very large dairy and field crop farms which adopted green measures along with AE subsidies. Field crop farms increased hired labor, while dairy farms increased family labor. Hired and family labor acted as substitutes for very large dairy farms, and as complements for very large field crop farms.

Garrone et al. (2019) investigated the relationship between CAP subsidies and the outflow of labor from agriculture using panel data from 210 EU regions during the period 2004-2014. They found that, on average, CAP subsidies reduce the outflow of labor from agriculture, but the effect is almost entirely due to decoupled Pillar I payments. Moreover, within Pillar I payments, coupled Pillar I payments have no impact on reducing labor outflow from agriculture or on preserving jobs in agriculture. The impact of Pillar II payments was found to be mixed, depending on types of subsidies.

Pillar II payments and investment subsidies can contribute to employment opportunities on farms in agricultural and complementary non-agricultural activities such as in agritourism (Galluzzo, 2017, 2020).

Following these studies, we set the following three main hypotheses:

H1: Pilar I subsidies promote or maintain different segments of farm employment.

H2: Pillar II subsidies have heterogenous impact on different segments of farm employment.

H3: Investment subsidies promote or maintain different segments of farm employment.

The heterogenous impact of different types of Pillar II subsidies and a positive impact of investment subsidies on different segments of farm employment can be driven by complementary or substitution role of different types of Pillar II and investment subsidies on demand for different segments of farm labor and their links with other farm production factors, particularly in relation between use of labor and use of capital (Unay-Gailhard and Bojnec, 2019; Czubak et al., 2019). For example, if the overall pattern in use of farm production factors is the substitution of labor by capital, more subsidies (as well as other

external sources of incomes such as nonfarm income) may accelerate investments and the substitution process between farm production factors (Takahashi and Otsuka, 2009). A liquidity constrained farm may speed up labor-saving investments as a result to receive more subsidies and their investment promotion. These challenging research and policy issues have encouraged our research to focus on the impact of different types of CAP subsidies from Pillars I and II and investment subsidies on three segments of farm labor (total, family and hired labor), using as case study Hungary and Slovenia. These are two neighboring post-socialist transition countries that entered in the EU in 2004. While Slovenia from the very beginning introduced full CAP subsidies from EU and national funds, Hungary introduced gradually. Following the 2003 CAP reform, Slovenia introduced decoupled payments and implemented the regional Single Payment Scheme model (Henke et al., 2015). The farm size structure is also different: in Slovenia prevails relatively small-size family farms, while in Hungary is a dual structure of small-size individual farms based on family farm labor, and large-size corporate farms based on hired farm labor. While both countries are situated in Central European region, Hungary is a bigger country and situated mostly in the Pannonian valley, while Slovenia as geographically and by population smaller country shares more diverse climatic and natural agricultural factor endowments conditions from the Pannonian valley bordering Hungary, the Alpine and up to Mediterranean climate at the Adriatic coast. Studying these countries similarities and special heterogeneities helps to explain why we have selected comparisons between these two neighboring countries to come closer to a systematic understanding of the relation between different types of CAP subsidies and different segments of farm employment.

Therefore, we investigate the employment effects (employment of family labor and employment of paid labor) of the entire portfolio of CAP measures, including Pillar I and Pillar II subsides, and investment subsidies, for Hungarian and Slovenian farms separately. In addition, we highlight the potentially heterogeneous economic effects of CAP policy instruments controlled with regional labor market and regional disparities variables of the two new EU Member States (Abrham, 2011). EU policies can affect regional performance (Becker et al., 2010; Coppola and Destefanis, 2015), as well as regional, rural, and farm labor markets and employment (Shucksmith et al., 2005; Petrick and Zier, 2011; Olper et al., 2014; Blomquist and Nordin, 2017). Therefore, regional labor market characteristics are used as control variables to different types of CAP subsidies as individual policy instruments to explain different types of farm employment.

3. Methods and data

In this section we present methods, data used at farm-level, and summary statistics of variables.

3.1 Methods

Unlike previous studies which used regional-level data and focused on changes in farm labor, our focus was the level of farm-level labor. Analysis of changes in farm labor might be problematic when using unbalanced FADN panel datasets as only approximately 10 per cent of farms are listed for all the years under analysis. Thus, we cannot follow many farms for a longer period. We estimate the following model:

$$m_{i,t} = ß_0 + ß_1 s_{i,t} + ß_2 X_{ij,t} + \alpha_k + \chi_r + \gamma_t + \varepsilon_{i,t}, \quad (1)$$

where $m_{i,t}$ is the level of labor on farm i for the year under analysis t, $s_{i,t}$ is the agricultural subsidy for farm i at the year under analysis t, and the ß's are the regression parameters to be estimated. $X_{ij,t}$ is a vector for control regional labor market variables including relative income (agricultural gross-value added (GVA) per worker /Non-Agricultural GVA per worker), relative employment (agricultural employment /Non-Agricultural employment), unemployment rate, and population density. These four-control regional labor market characteristics variables are for the location j (at the NUTS3 level) where farm i exists in the year under analysis t. Finally, we add sector-level- (α_k), regional-level- (χ_r) and time- (γ_t) fixed effects to the model. $\varepsilon_{i,t}$ is the error term to control farm-level heterogeneity. Unlike to some previous studies, the fixed effects are specified at the farm-level and not at the regional-level when this is the relevant spatial variation.

The distinguish different types of subsidies or policy instruments available under the CAP in individual regressions at farm-level are specified with control variables for regional labor market characteristics at the NUTS3 level for the farm location. Their impact on farm-level employment can be ambiguous because heterogeneity in regional labor market characteristics, proximity, or remoteness of social and demographic aspects of rural communities and their impacts on different types of farm-level employment. Regional labor market characteristics might indicate the availability of regional labor on the supply side, and the potential need to maintain or create jobs on farms and rural areas (Smailes et al., 2002;

Ricker-Gilbert et al., 2014). Masters et al. (2013) argued that urbanization with population migration flows can lead to changing farm size with implications for farm-level employment and food security.

We employ static panel models. We control for potential endogeneity bias due to omitted variables and therefore include sector-level-, regional-level-, time-fixed effects, and error term (α_k, χ_r, γ_t, *and* $\varepsilon_{i,t}$, respectively). Models are estimated clustered standard errors by region.

The FADN database allows us to disaggregate total CAP payments into different components to test whether the effect on farm labor differs among types of subsidies (EC, 2018). We differentiated CAP payments into Pillar I and Pillar II subsidies. The role of rural development subsidies (RD) is important for keeping farm labor in agriculture; thus, we investigate the impacts of different Pillar II schemes on farm labor. We distinguish different categories within Pillar II subsidies: agri-environmental payments (AES), least favored areas payments (LFA), other rural development payments (RD other), and investment subsidies.

The effect of different types of CAP subsidies on different segments of farm-level labor is tested following three-steps estimation strategy: first, with total CAP payments from Pillars I and II. Second, the effects of the different CAP measures, including investment subsidies, were tested separately, meaning that in separate equations each contains a single CAP instrument. Finally, as CAP instruments are applied simultaneously, and several farms receive more than one CAP measure in any given year, all different types of CAP instruments are considered simultaneously by multiple regression.

Previous studies have focused on total agricultural employment. While labor is heterogenous within agriculture, family labor is associated with different sources of motivation and perspectives than hired labor. Thus, in contrast to previous studies, we estimate our econometric models separately for total farm-level employment, the employment of family farm-level labor, and the employment of farm-level hired labor. This is an important value added of the article related to the differentiation of the segments of farm-level labor. From both a farmer's and policy perspectives, it is useful to understand which kind of farm-level labor is most affected by CAP subsidies: family vs. hired labor or both.

3.2 Data

The farm-level employment effects of the entire portfolio of farm-level CAP measures, including Pillar I and Pillar II subsides, and investment subsidies, were investigated using the Hungarian and Slovenian FADN datasets for the period 2007-2015. The number of employees is the *FADN* variable coded SE010 'total labor input' of farm, which is expressed in Annual Working Units (AWUs), where 1 AWU is equal 1,800 hours of full-time-equivalent work annually. The *FADN* variable coded SE015 'unpaid labor input' refers to family AWU, while the *FADN* variable coded SE020 'paid labor input' in AWU when remuneration may be in cash or in kind.

The list of CAP subsidies variables includes the *FADN* variable coded SE605 'total subsidies – excluding on investments'. Total subsidies are divided between Pillar I subsidies (the *FADN* variables coded SE610 'total subsidies on crops, including compensatory/area payments'; and SE615 'total subsidies on livestock and livestock products'), and Pillar II subsidies (the *FADN* variables coded SE621 'environmental subsidies' (AES), SE622 'LFA subsidies', and SE623 'other rural development' (RD other) payments). The *FADN* variable coded SE624 'total support for rural development' (RD) includes SE621, SE622 and SE623. The investment subsidy variable is the *FADN* variable coded SE406 'subsidies on investment'.

It is worth mentioning that the 2003 CAP reform introduced decoupled payments (SE630) as sum of Single farm payment (SFP=SE631) and Single area payment scheme (SAPS=SE632), and up to 2010 additional aid (SE640) as amount resulting from the application of modulation to the first 5,000 euro or less of direct payments. The SAPS is only for new EU Member States, which was chosen by Hungary, but not by Slovenia (and Malta), which implemented the regional SAPS (Henke et al., 2015).

In addition, agricultural GVA per worker, non-agricultural GVA per worker, agricultural employment, non-agricultural employment, unemployment rate, and population density in NUTS3 regions and price deflators expressed by harmonized indices of consumer prices using a constant base year were obtained from Hungarian and Slovenian statistical offices.

The sector dummy is based on the FADN variable coded TF8 grouping, which includes the following eight types of farms: 1. Field crops, 2. Horticulture, 3. Wine, 4. Other permanent crops, 5. Milk (or dairy), 6. Other grazing livestock, 7. Granivores, and 8. Mixed (EC, 2018). While this sectoral dummy variable reflects differences or heterogeneity in farm types, the regional dummy, which is based on the NUTS3 classification for Hungary and Slovenia, reflects regional farm differences.

3.3 Summary statistics

Summary statistics for our dependent farm-level employment variables and independent or explanatory variables for CAP subsidies per farm and population density at NUTS3 regions are presented in Table 1. Total farm employment declined during the period under analysis, both for family labor and hired labor, but differently in the sample countries.

Table 1

Summary statistics for farm-level labor, subsidies per farm, and population density in NUTS3 regions in Hungary and Slovenia

Variable	Obs.	Mean	Std. Dev.	Min	Max
Hungary					
total labor	17,553	5.46	16.57	0.01	433.9
unpaid labor	17,553	0.84	0.71	0.00	5.7
paid labor	17,553	4.62	16.73	0.00	433.9
total subsidy	17,553	64,990.67	203,350.50	0.00	5,088,339.0
Pillar I payments	17,553	53,239.47	157,633.40	0.00	3,786,887.0
RD payments	17,553	11,110.36	54,722.09	0.00	1,669,693.0
AES payments	17,553	257.96	2,286.58	0.00	93,684.0
LFA payments	17,553	382.88	4,418.89	0.00	195,110.1
RD other payments	17,553	11,751.20	56,867.90	0.00	1,749,941.0
investment subsidies	17,553	4,811.01	39,354.57	0.00	1,962,017.0
population density	17,553	92.38	47.88	51.46	3,241.7
Slovenia					
total labor	8,174	1.96	1.58	0.09	46.1
unpaid labor	8,174	1.77	0.87	0.00	7.6
paid labor	8,174	0.18	1.28	0.00	44.4
total subsidy	8,174	13,214.62	15,951.05	0.00	222,712.4
Pillar I payments	8,174	8,129.65	10,725.18	0.00	181,431.7
RD payments	8,174	2,970.56	5,505.06	0.00	92,435.2
AES payments	8,174	1,597.67	2,053.85	0.00	27,166.9
LFA payments	8,174	510.12	3,336.05	0.00	42,242.6
RD other payments	8,174	5,078.35	7,280.83	0.00	92,435.2
investment subsidies	8,174	3,088.68	17,459.81	0.00	530,363.0
population density	8,174	119.16	143.85	5.07	1,050.7

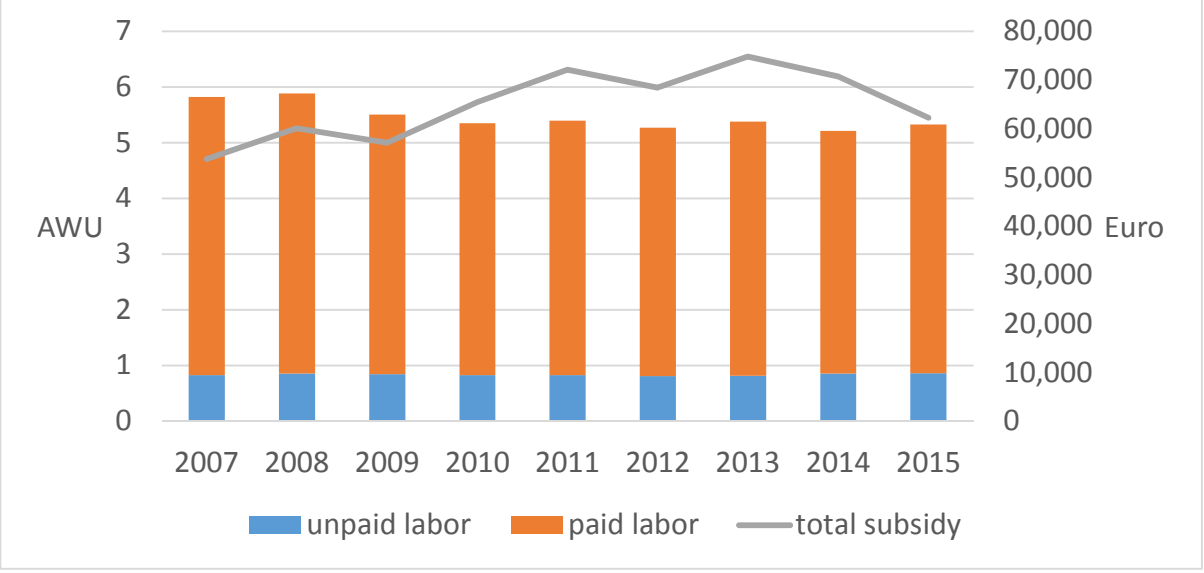
Source: Authors' calculations.

According to the number of employees in terms of AWUs per farm, the average number of full-time-equivalent employees in relation to farm size in Hungary is more than twice as many as in Slovenia. While in Hungary most employees on farms are hired paid employees, in Slovenia the great majority of employees on farms are unpaid family employees. Farms in Hungary on average received more than four times as much in subsidies than in Slovenia. Most of these subsidies were Pillar I subsidies, followed by other RD payments, and RD payments. Each of these per farm was greater in Hungary than in Slovenia. However, their relative importance in the overall structure of subsidies was similar for both Hungarian and Slovenian farms (differences can also be linked to the different size of farms). On average, Hungarian farms used more investment subsidies than Slovenian farms. In contrast, Slovenian farms on average received more AE payments and LFA payments than Hungarian farms.

Population density for NUTS3 regions in Slovenia is slightly higher than in Hungary. However, lower minimum and maximum values are found in Slovenia across NUTS3 regions than in Hungary. There is significantly greater agglomeration of population in regions surrounding the Hungarian capital Budapest than in regions surrounding the Slovenian capital, Ljubljana.

Figure 1

Paid and unpaid labor and subsidies per farm in Hungary, 2007-2015



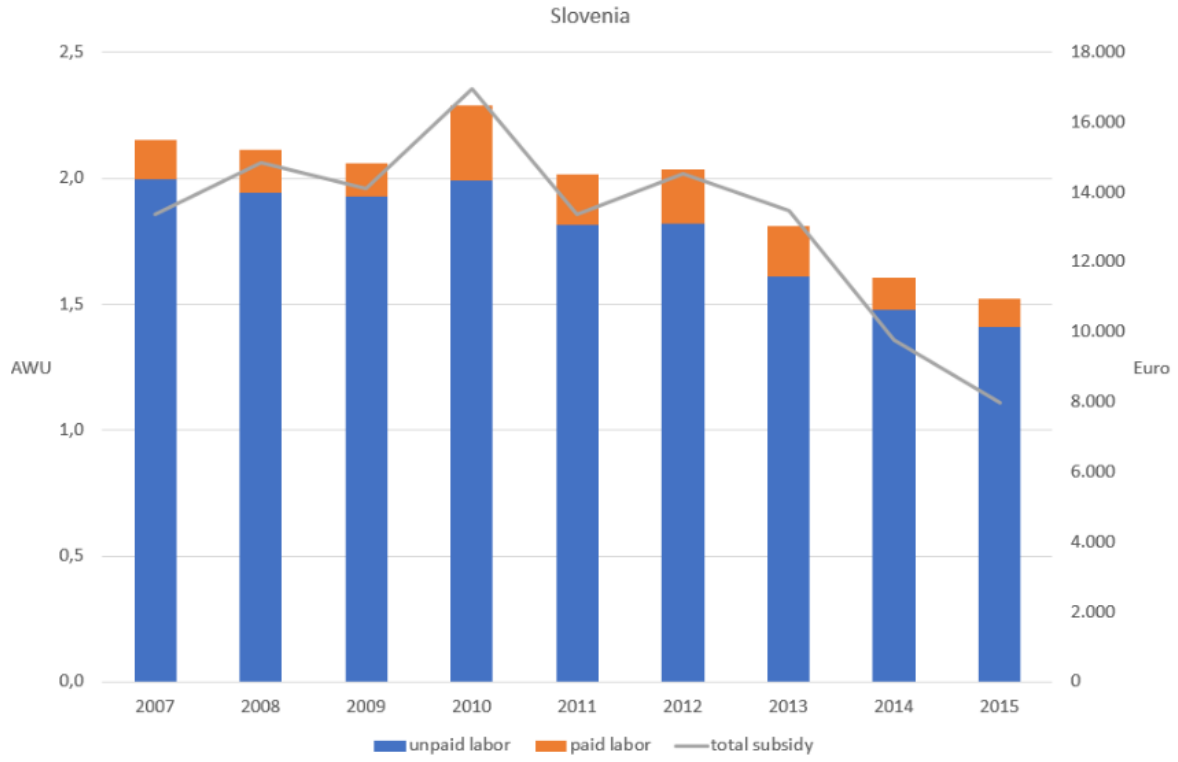
Note: AWU – Annual Work Unit, 1 AWU represents 1,800 hours per year.

Source: Authors' calculations.

Figure 1 confirms a slight decline in the average number of full-time employees (AWU per farm) in Hungary. The share of unpaid family labor is rather stable, but much smaller than that of paid labor, which is consistent with the dual farm structure in Hungarian agriculture, with large corporate farms prevailing in importance vis-à-vis a greater number of smaller family farms. Interestingly, total subsidies per farm increased until 2013, with a later decline. In 2015, they were still slightly higher than in 2007.

Figure 2

Paid and unpaid labor and subsidies per farm in Slovenia, 2007-2015



Source: Authors' calculations.

The remarkable decline in farm employment and subsidies per farm in Slovenia can be seen in Figure 2. A considerable decline in employment particularly affected unpaid family labor, a tendency which is strongly correlated to the even more rapid decline in real subsidies

at 2010-constant prices per farm since 2010.[1] Between 2010 and 2015, cumulated inflation in Slovenia was around 6%. Even at current prices (not only at constant prices), there was a substantial decline in subsidies per farm. Between 2010 and 2015, at 2010-constant prices, the decline in subsidies per farm was almost 50%, equivalent to a drop of between 16 and 8 thousand euros per farm.

The decline in subsidies per farm started in Slovenian earlier, and was much more substantial than in Hungary. Because we use unbalanced FADN panel data, the mean values of subsidies per farm over time may also be biased in line with changing farm size and type of farming structure in the FADN datasets. One such phenomenon involves the disappearance of mid-sized farms, which has been observed in Slovenia (Bojnec and Latruffe, 2013) and in some Western countries (Ge et al., 2018). However, even considering the various potential biases in FADN data samples, and thus in mean values, the mean value of subsidies per farm in Slovenia declined substantially following 2010.

4. Econometric results

Tables 2–7 display the results for Hungary (Tables 2-4) and Slovenia (Tables 5-7). The econometric results are presented in three steps: first, Column 1 presents regressions for total CAP subsidies. Second, the effects of the different CAP measures are presented separately: Column 2 for Pillar I subsidies and Columns 3-8 Pillar II and investment subsidies. We disaggregate Pillar II subsidies in its three components (columns 4-6); then separately investment subsidies (column 7) and present these four components together (column 8). Finally, the effects of all CAP instruments are presented in Column 9 simultaneously by multiple regression.

We find significantly positive coefficients for total subsidies and Pillar I subsidies in both Hungary and Slovenia. The effects of all other kinds of subsidies on farm employment differ depending on the specific samples or subsamples. All estimated regressions are controlled for time-, sector-, and regional-fixed effects.

Estimations show that other RD subsidies and, LFA subsidies have a significant positive impact on total labor in Hungary, but the coefficients of RD subsidies, AE subsidies, and investment subsidies are insignificant (Table 2). From the regional control variables, the

[1] "At 2010 constant prices" means that values of subsidy payments at current prices were deflated by the harmonized consumer price index with 2010 as the base year to eliminate inflation.

coefficients of relative income are significantly positive for all specifications, while population density has weak positive impacts on total labor for four cases of nine models. Relative employment and unemployment rate have not significant impacts on total labor.

Table 2

Regressions for employment of total farm labor in Hungary, 2007-2015

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
total subsidy	0.360***								
Pillar I payments		0.274***							0.297***
RD payments			0.014						
AES payments				0.009				0.009	0.016
LFA payments					0.034*			0.041**	0.038*
RD other payments						0.042**		0.046**	0.044**
investment subsidy							0.028	0.029	0.029
relative income	1.170***	1.166***	1.083***	1.077**	1.081***	1.097***	1.070**	1.114***	1.216***
relative employment	4.264	3.802	-0.154	-0.618	0.380	0.352	-1.252	2.304	7.507
unemployment rate	-0.037	-0.038	-0.038	-0.038	-0.038	-0.037	-0.038	-0.037	-0.037
population density	0.034	0.033	0.037*	0.038*	0.038*	0.034	0.037*	0.032	0.027
Constant	-1.133	-0.249	1.964	1.950	1.942	2.307	2.145	2.348	-0.150
N	17553	17553	17553	17553	17553	17553	17553	17553	17553
R^2	0.0942	0.0784	0.0377	0.03564	0.0349	0.0377	0.0385	0.0457	0.0989
time-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
sector-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
regional-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes

*** p < 0.01, ** p < 0.05, * p < 0.1

Total subsidies, and its component Pillar I subsidies are significantly positively associated with the employment of family labor in Hungary (Table 3). Only the RD other payments have significantly positive impact from Pillar II elements. Finally, the coefficients of relative income and relative employment are significantly positive, negative at 10% significance level for unemployment rate, and insignificant for population density.

Table 3

Regressions for employment of family labor on farms in Hungary, 2007-2015

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
total subsidy	0.012***								
Pillar I payments		0.010***							0.010***
RD payments			0.002*						
AES payments				0.001				0.001	0.001
LFA payments					0.001			0.001	0.001
RD other payments						0.004***		0.004***	0.004***
investment subsidy							0.001	0.001	0.001
relative income	0.057***	0.057***	0.055***	0.054***	0.054***	0.056***	0.054**	0.057***	0.060***
relative employment	4.864***	4.872***	4.784***	4.743***	4.722***	4.820***	4.681***	4.892***	5.059***
unemployment rate	-0.004*	-0.004*	-0.004*	-0.004*	-0.004*	-0.004*	-0.004*	-0.004*	-0.004*
population density	-0.001	-0.002	-0.001	-0.001	-0.001	-0.002	-0.001	-0.002	-0.002
Constant	0.607**	0.623**	0.705***	0.702***	0.709***	0.739***	0.715***	0.734***	0.647***
N	17553	17553	17553	17553	17553	17553	17553	17553	17553
R^2	0.0716	0.0738	0.0762	0.0763	0.0768	0.0765	0.0764	0.0759	0.0727

time-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
sector-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
regional-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes

*** p < 0.01, ** p < 0.05, * p < 0.1

In line with theoretical expectations, the higher relative income, and the higher relative employment increased employment on Hungarian family farms. Surprisingly, the higher regional unemployment rate reduces family farm employment suggesting possible regional labor market mismatches. The insignificant population density suggests that in Hungarian rural areas, and particularly in remote villages where family farm households prevail, might have relatively low population density.

Estimations for the employment of paid farm labor are more like the results for employment of total farm labor in Hungary. We find positive and significant coefficients for total subsidies, Pillar I subsidies, other RD subsidies, and, to a lesser extent, for LFA subsidies, but insignificant ones are found for RD subsidies, AE subsidies, and investment subsidies (Table 4). The coefficients of relative income are significantly positive for all models. We find weak positive impacts of populations density on paid farm labor for four of all specifications. Other control variables are insignificant.

Table 4
Regressions for the employment of paid labor on farms in Hungary, 2007-2015

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
total subsidy	0.339***								
Pillar I payments		0.258***							0.280***
RD payments			0.012						
AES payments				0.007				0.007	0.013
LFA payments					0.034*			0.040**	0.037*
RD other payments						0.038**		0.041**	0.039**
investment subsidy							0.027	0.027	0.028
relative income	1.111***	1.107***	1.028**	1.022**	1.027**	1.041**	1.017**	1.056**	1.152***
relative employment	-0.808	-1.253	-5.058	-5.470	-4.412	-4.562	-5.998	-2.717	2.184
unemployment rate	-0.033	-0.033	-0.034	-0.034	-0.034	-0.033	-0.033	-0.033	-0.032
population density	0.035	0.035	0.039*	0.039*	0.039*	0.035	0.038*	0.033	0.029
Constant	-1.624	-0.787	1.297	1.290	1.270	1.599	1.461	1.644	-0.706
N	17553	17553	17553	17553	17553	17553	17553	17553	17553
R^2	0.0898	0.0746	0.0349	0.0337	0.0328	0.0351	0.0361	0.0423	0.0920
time-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
sector-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
regional-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes

*** p < 0.01, ** p < 0.05, * p < 0.1

In Slovenia, similarly to Hungary, the significant positive association of farm employment, employment of family labor, and employment of paid labor is found with total subsidies and Pillar I subsidies. There are considerable differences between the employment of family labor and the employment of paid labor in relation to the remaining types of subsidies. Considering that the proportion of employment of family labor in Slovenian farms

is much greater than the employment of paid labor, the regression results between total farm employment for the whole sample of FADN farms, and, within this, for the employment of family labor, are more similar than the regression results for the employment of paid labor.

In addition to total subsidies and, within this, Pillar I subsidies, total farm labor employment is significantly positively associated with AE subsidies, RD subsidies, and investment subsidy, but insignificantly with LFA subsidies and other RD subsidies (Table 5). In contrast to in Hungary, in Slovenia a significant positive role for the employment of family labor is found for population density in NUTS3 regions. This crucial difference for employment on farms in general and for the employment of family labor in particular can be explained by the more decentralized or polycentric form of regional and rural development in Slovenia, with less distance between small regional towns and villages (with employment opportunities in non-farm activities in rural areas), which reduces migration out of rural areas and leads to the higher population density, including in remote and farming areas. Unemployment rate and relative income at less than 10% significance level reduce farm employment. This finding suggests possible regional labor market mismatches or structural unemployment. The impact of relative employment is insignificant.

Table 5
Regressions for employment of total farm labor in Slovenia, 2007-2015

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
total subsidy	0.250***								
Pillar I payments		0.111***							0.110***
RD payments			0.023**						
AES payments				0.013***				0.014***	0.010**
LFA payments					0.001			-0.002	-0.013
RD other payments						0.001		0.002	0.002
investment subsidy							0.005**	0.005**	0.005**
relative income	-1.263**	-1.080*	-1.049*	-1.147*	-1.003	-1.006	-1.003	-1.153*	-1.196*
relative employment	-1.244	-1.302	-0.521	-0.575	-0.584	-0.565	-0.622	-0.579	-1.358
unemployment rate	-0.020*	-0.021*	-0.021*	-0.021*	-0.021*	-0.021*	-0.021*	-0.021*	-0.021*
population density	0.556**	0.548**	0.602**	0.579**	0.570**	0.566**	0.562**	0.570**	0.512*
Constant	0.063	1.328***	1.835***	1.942***	1.989***	1.994***	1.990***	1.940***	1.359***
N	7116	7148	7148	7148	7148	7148	7148	7148	7148
R^2	0.0986	0.0650	0.0307	0.0290	0.0246	0.0243	0.0264	0.0311	0.0687
time-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
sector-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
regional-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

For employment of family labor in Slovenia, except for other RD subsidies in all model specifications, and LFA payments in multiple subsidies regression 9, all other regression coefficients pertained to subsidies are positive and statistically significant: total subsidies, Pillar I subsidies, RD subsidies, AE subsidies, investment subsidies, and LFA subsidies (Table 6). The significant positive regression coefficient of the population density confirms

the important role that higher regional population density in rural areas plays in terms of the employment of family labor and farm self-employment creation. The impact of relative income is negative at less than 10% significance level suggesting that family farms are increasing relative income efficiency with labor reduction. Relative employment and unemployment rate do not significantly affect employment of family labor.

Table 6

Regressions for employment of family labor on farms in Slovenia, 2007-2015

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
total subsidy	0.176***								
Pillar I payments		0.090***							0.085***
RD payments			0.022***						
AES payments				0.012***				0.011***	0.008***
LFA payments					0.014**			0.011**	0.004
RD other payments						0.001		0.001	0.001
investment subsidy							0.007***	0.007***	0.006***
relative income	-1.156**	-1.051*	-1.010*	-1.095*	-0.966*	-0.967*	-0.972*	-1.094*	-1.138**
relative employment	1.498	1.329	2.016	1.969	2.032	1.968	1.898	1.996	1.365
unemployment rate	-0.004	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
population density	0.321**	0.312*	0.354**	0.333**	0.368**	0.319*	0.317*	0.370**	0.335**
Constant	0.397	1.214***	1.598***	1.698***	1.658***	1.747***	1.741***	1.618***	1.170***
N	7116	7148	7148	7148	7148	7148	7148	7148	7148
R^2	0.2583	0.2204	0.1634	0.1556	0.1493	0.1426	0.1513	0.1685	0.2331
time-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
sector-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
regional-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes

*** p < 0.01, ** p < 0.05, * p < 0.1

Table 7

Regressions for employment of paid labor on farms in Slovenia, 2007-2015

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
total subsidy	0.094***								
Pillar I payments		0.032***							0.035***
RD payments			0.006						
AES payments				0.002				0.003	0.002
LFA payments					-0.010*			-0.011*	-0.015**
RD other payments						0.001		0.001	0.001
investment subsidy							-0.001	-0.001	-0.001
relative income	-0.187	-0.098	-0.092	-0.108	-0.083	-0.083	-0.081	-0.119	-0.128
relative employment	-2.893*	-2.798*	-2.583*	-2.597*	-2.657*	-2.587*	-2.592*	-2.631*	-2.879*
unemployment rate	-0.016	-0.016	-0.016	-0.016	-0.016	-0.016	-0.016	-0.016	-0.016
population density	0.244	0.242	0.255	0.249	0.210	0.247	0.247	0.210	0.190
Constant	-0.464**	0.071	0.222	0.251	0.329	0.260	0.263	0.319	0.138
R^2	0.0103	0.0055	0.0032	0.0032	0.0029	0.0029	0.0029	0.0032	0.0059
N	7116	7148	7148	7148	7148	7148	7148	7148	7148
time-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
sector-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
regional-fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes

*** p < 0.01, ** p < 0.05, * p < 0.1

The employment of paid labor in Slovenian farms is significantly positively associated with total subsidies and Pillar I subsidies, but in contrast to theoretical expectations, to a

lesser extent negatively associated with LFA subsidies at less than a 10% significance level (Table 7). The coefficients of RD subsidies, AE subsidies, other RD subsidies, investment subsidies, relative income, unemployment rate and population density are insignificant. It is negatively associated with relative employment at less than 10% significance level. The employment of paid labor on farms may be connected with regular employment on a few agricultural corporate farms/enterprises, and to seasonal work which could be related to farm hiring and outsourcing of some service activities during the harvesting period for crops or seasonal peaks in work for some specific farming activities such as growing hops, vegetables, fruit, and grape production. Seasonal outsourcing service activities largely involve local labor, including different machine-related activities for the harvesting of crops. Other seasonal work can include the temporary employment of local labor or foreign labor from countries with lower labor costs, among them particularly South-Eastern Europe and Eastern Europe.

5. Discussion and implications of results

Table 8 summarizes and compares findings between Hungary and Slovenia. There are only two similarities between the countries: total subsidies, and, within these, Pillar I subsidies, are of crucial importance for employment on farms irrespective of the studied country and type of employment, which is consistent with the set H1. This finding is also in line with findings of Garrone et al. (2019) that CAP subsidies reduce the outflow of labor from agriculture due to decoupled Pillar I payments. However, the former authors distinguished between decoupled and coupled Pillar I payments, and for the latter did not find a significant impact for reducing labor outflow from agriculture or for preserving jobs in agriculture. The impacts of Pillar II subsidies are mixed confirming the complexity of the set H2 regarding heterogenous impact of different Pillar II subsidies on different segments of farm labor. Except for total and particularly family labor, the set H3 regarding a positive impact of investment subsidies on different segments of farm labor can be rejected.

The employment of family labor on Slovenian farms is particularly significantly positively associated with Pillar II subsides according to the different types thereof, except for other RD subsidies. This finding – particularly related to AE subsidies – is consistent with the conclusions of Unay-Gailhard and Bojnec (2019) about the positive impact of green economic measures on rural employment, particularly green jobs on farms in Slovenia. AE subsidies, RD subsidies, and investment subsidies significantly positively affect only the

employment of family labor on Slovenian farms, but not the employment of paid labor, and not in Hungary either for employment of family labor, except for RD subsidies, nor for the employment of paid labor. LFA subsidies reduce paid labor employment in Slovenia, suggesting a possible substitution effect with more employment of family labor, or even employment shrinkage in locationally handicapped areas that pertains to paid labor. On the contrary, in Hungary LFA subsidies increased the employment of paid labor, but not the employment of family labor. For the employment of paid labor in Hungary, other RD subsidies are also important, but not in Slovenia where LFA areas make up a substantial part of all agricultural land.

The coefficients of regional labor market variables are mixed within and between the analyzed countries. Relative income has significantly positively affected farm employment in Hungary, but not in Slovenia where it is insignificant for paid labor and to a lesser extent significantly negative for total and family labor. Relative employment has significantly positively affected employment of family labor in Hungary. The impact of unemployment rate is insignificant, except for negative sign for family labor in Hungary and total labor in Slovenia at less than 10% significance level. Population density is positively associated with the farm employment of family labor in Slovenia, and, to a lesser extent, the employment of paid labor in Hungary. Regional population density can be positively correlated with greater number of smaller, more labor-intensive farms in more populated regions, and vice versa negatively correlated with smaller number of larger farms in less populated, remote regions or countries.

Table 8

Summary of the sign and significance of the regression coefficients of farm-level employment pertaining to subsidies and regional labor market variables

	total subsidy	Pillar I	RD	AES	LFA	RDo	Investment subsidy	Relative income	Relative employment	Unemployment rate	Population density
	Hungary										
Total labor	✓	✓	ns	ns	s5% or s10%	s5%	ns	s5% or ✓	ns	ns	ns or s10%
Family labor	✓	✓	s10%	ns	ns	✓	ns	s5% or ✓	✓	-s10%	ns
Paid labor	✓	✓	ns	ns	s5% or s10%	s5%	ns	s5% or ✓	ns	ns	ns or s10%
	Slovenia										
Total labor	✓	✓	s5%	s5% or ✓	ns	ns	s5%	ns or -s5% or -s10%	ns	-s10%	s5%
Family labor	✓	✓	✓	✓	ns or s5%	ns	✓	-s5% or -s10%	ns	ns	s5% or s10%
Paid labor	✓	✓	ns	ns	-s10%	ns	ns	ns	-s10%	ns	ns

Note: ✓ positive and significant at less than 1% significance level, *s5%* positive and significant at less than 5% significance level, *s10%* positive and significant at less than 10%

significance level, *-s5%* negative and significant at less than 5% significance level, *-s10%* negative and significant at less than 10% significance level, and *ns* non-significant.

The results of regressions confirm that CAP subsidies in general contribute to maintaining employment on Slovenian and Hungarian farms, and, depending on type of subsidies, on farm job creation. The latter has been, except for other RD subsidies, confirmed for growth in the employment of family labor in Slovenia, where farms are smaller on average and may be engaged in more labor-intensive farming. This type of farming might be less internationally competitive without subsidies, which have not been found to contribute to different components of total factor productivity (Baráth et al., 2020). Interestingly, subsidies per farm in Slovenia are much smaller than in Hungary, where farms on average are bigger. A striking finding is that the mean value of subsidies per farm in Slovenia declined earlier and more rapidly than in Hungary since 2010.

CAP subsidies can have mitigating and off-setting effects on farm survival in LFA areas and for greener agri-environmental farming practices (Unay-Gailhard and Bojnec, 2015), while farm restructuring, resilience and modernization also require investment (Bojnec and Latruffe, 2013; Unay-Gailhard and Bojnec, 2020). All these activities can be subsidized according to CAP, contributing to the inflow of stable sources of income for farms in comparison with their more unstable market-driven income (Bojnec and Fertő, 2019). Instabilities in farm market incomes are well known and may occur for different reasons, such as instabilities in farm production and the market price of farm products due to adverse market and weather conditions and changing climatic conditions. Diversification of farm incomes and farm diversification strategies in response to rural policy have historically been confirmed as a farm survival strategy (García-Arias et al., 2015; De Rosa et al., 2019), which has also gained support in EU (EC, 2016) official documents.

However, CAP subsidies can be costly for taxpayers in relation to farm job creation and maintaining farm jobs and involve a trade-off between efficiency and equity in the design of targeted agricultural subsidy systems (Cong and Brady, 2012). These findings raise questions about the cost to budgets per job saved or created in agriculture, and the trade-off with social and other government policies that address rural and agricultural employment and possible mismatches in the related labor markets (Garrone et al., 2019). Moreover, the existence and distribution of such subsidies raise questions about of the future sustainability of the farming and food system, particularly the role of the small farm in rural sustainability, in relation to different drivers of global (un)sustainability and food security. Farm and rural jobs can play

various multifunctional roles in agriculture and in depopulated rural areas with a question about farmers' strategies in a no-CAP situation (Latruffe et al., 2013) and its implication on migration within between rural and urban areas, and between the EU Member States (Simionescu, 2018).

Declining subsidies per farm, even when farm size on average has increased, suggest that the necessary changes in farming practices and farm management should include a greater role for entrepreneurial policy options and farm managerial practices if the long-term sustainability of farming and farm employment is to be assured. The impact of the 2020 global pandemic crisis strengthens the call to support local farming and farm employment. This would help local producers with short value chains provide a minimal level of food security for very short periods of instability, market imperfection, and failure in the global food value chains which have become dominant not only in developed, but also in developing countries, as well as in Central- and Eastern-European countries (Dries et al., 2004).

There may be some mismatch between the capacity of small farmers and the supply required by big retail supermarkets in agri-food value chains, with implications for farm employment and local rural labor markets. Local farm production can serve a complementary role or can even be a part of global value chains, but can also be substituted, and, through the market selection process, be eliminated from the market, leading to farm exit or subsistence farming. The role of global value chains in relation to local farm production and farm employment represents an issue for further research. Moreover, Colombo et al. (2020) argued that farmer cooperation can reduce the number of jobs required for the management of farms by increasing the competitiveness of smallholdings, albeit this involves making trade-offs between economic profitability and job creation. A special issue for the research in the future can be the intergenerational farm renewal and the role of young farmers in this process (Maya et al., 2019).

6. Conclusion

This paper investigates the effect of CAP and regional labor market characteristics on farm-level employment separately for family labor and paid labor by comparing the situation in Hungary and Slovenia.

Our calculations show that total agricultural employment declined during the period of analysis, including both family- and hired labor. A striking finding was the substantial decline in the mean value of subsidies per farm in Slovenia since 2010. This decline has also occurred in Hungary since 2013, but the average amount received per Hungarian farm was

more than three times as high as in Slovenia. It is known that the amount of subsidy per farm is strongly linked to the size of farms in terms of used farm inputs, such as utilized agricultural area and size of livestock herd.

Our analyses confirmed that, in general, total subsidies and Pillar I subsidies positively impact total farm-level employment, and separately affect the employment of family labor and the employment of paid labor both in Hungary and Slovenia. However, the effects of specific forms of Pillar II CAP support are heterogeneous in terms of their impact on the employment of total farm-level labor and have distinct effects on the employment of family labor and the employment of paid labor. Pillar II subsidies have different impacts in Hungary and Slovenia, or do not have significant effects, on employment on family farms and the employment of hired labor.

Pillar II subsidies are not important in terms of the employment of family labor on farms in Hungary, except for other rural development subsidies and to a lesser extent RD subsidy, Pillar II subsidies are not important for the employment of paid labor on farms in Slovenia. A striking finding is that LFA subsidies reduce the employment of paid labor on farms in Slovenia. However, except for other rural development subsidies, Pillar II subsidies are important for the employment of family labor on farms in Slovenia, where rural development subsidies, agri-environmental subsidies, LFA subsidies, and investment subsidies positively influence the employment of family labor. In Hungary, LFA subsidies and other rural development subsidies have a positive impact on the employment of paid labor on farms.

The impact of regional labor market characteristics on farm employment is mixed and heterogenous between different types of farm employment and between the analyzed countries. Relative income increases farm employment in Hungary both for family and paid labor. This is consistent with theoretical expectations. The impact of relative employment differs between significantly positive for family labor in Hungary and to a lesser extent significantly negative for paid labor in Slovenia. The unemployment rate only to a lesser extent negatively affect employment of family labor in Hungary and total farm-level employment in Slovenia. Regional population density is positively associated with total farm-level employment in Slovenia, particularly for the employment of family labor on farms. The findings for Hungary are mixed but indicate a positive impact on the employment of paid labor on farms.

Among the study limitations are the use of unbalanced FADN datasets. The latter provide a great number of observations but can bias empirical results. This generally known limitation of FADN datasets exists because the entries for new farms and the exits of existing

farms from FADN datasets may be related to the changing sampling structures involved in the FADN data collection processes. Among the recommendations for further research is the application of dynamic farm employment models.

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