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A WINDING ROAD FROM INVESTMENT SUPPORT TO THE ECONOMIC GROWTH OF FARMS: EVIDENCE FROM SPATIAL ECONOMETRIC ANALYSIS OF AGRICULTURAL HOLDINGS IN SLOVENIA

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Abstract

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This paper discusses the application of spatial econometric methods to analyse the effects of farm investment support and other relevant determinants affecting the economic performance of farms in Slovenia during the period 2007-2011. The analysis combines farm-level data from administrative sources (Common Monitoring and Evaluation Framework, Integrated Administrative and Control System) with secondary statistical data describing agricultural structures, socio-economic conditions and geographical conditions. Farm-level data are grouped, as the analysis is carried out at the municipality level (LAU2). Factors affecting change in economic performance between 2007 and 2011 were analysed (i) from farms receiving investment support (ii), from all farms that applied for Common Agricultural Policy (CAP) measures during the analysed period and (iii) in relative terms, comparing supported farms with the entire farm population in analysed areas. Results show that farm investment support failed to increase revenues on supported farms. Instead, investment support only mitigated the general drop in farm revenues. Spatial analysis reveals the presence of spatial heterogeneity of effects on supported farms, while the economic performance of the farming population is spatially correlated.

Key words: Rural Development Policy 2007-2013, farm investment support, agricultural economic growth, spatial models

Abbreviations: EU (European Union); CAP (Common Agricultural Policy); RDP (Rural Development Policy); CMEF (Common Monitoring and Evaluation Framework); SO (standard output); OLS (ordinary least squares); ESDA (exploratory spatial data analysis); LISA (local indicators of spatial association); LM (Lagrange Multiplier); UAA (utilised agricultural area); LSU (livestock unit); PP (payment rights).

Introduction

The induced-innovation theory (Ruttan, 2001) stipulates that the adoption of new technologies in agriculture emerges in response to scarce resources and to economic opportunities. The adoption of new technologies through farm modernisation entails improvements in efficiency of resource use and adaptation to new environmental, structural and market conditions. As such, it can be considered to be a principal vehicle for enhancing the competitiveness of agricultural holdings (Medonos et al., 2012). Nevertheless, technology transfer in agriculture is often aggravated by an asymmetric information flow between lenders and borrowers. This, combined with uncertain conditions in agriculture and in financial markets, has resulted in credit constraints that affect adoption behaviour (Sunding and Zilberman, 2001).

The modernisation imperative in agriculture, together with the above-mentioned imperfections in the credit market, are the main drivers of public support for farm modernisation in today's economies. In the European Union (EU), the

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modernisation of farms is the structural measure of the EU Common Agricultural Policy (CAP) with the longest history of implementation, ranging over four decades. Priorities addressed, as well as the focus of the measure, have been adapted to respond to challenges that have evolved over time. The current priorities are listed in the preamble to the main regulation, Regulation (EC, 2005) No 1698/2005, which states that "the purpose of Community farm investment aid is to modernise agricultural holdings to improve their economic performance through better use of the production factors including the introduction of new technologies and innovation, targeting quality, organic products and on/off-farm diversification, including non-food sectors and energy crops, as well as improving the environmental, occupational safety, hygiene and animal welfare status of agricultural holdings."

The EU co-finances investment projects on agricultural holdings through its Rural Development Policy (RDP). This funding by the EU is further complemented by national public expenditures to cover part of the total investment cost (ECA, 2012). Farm investment support under the measure, "modernisation of agricultural holdings" (often referred to by its measure code, 121) covers a wide variety of investments which may range from simple items to complex projects. During the programming period 2007-2013, 11.1 billion euros were budgeted for this measure. This represents around 11% of all the EU's planned spending on its rural development. All EU member states have chosen to use measure 121.

Regarding the effectiveness of public expenditures, measure 121 should follow intervention logic by demonstrating a clear connection between EU strategic guidelines, programme- and sector-specific objectives, supported activities and their impacts. Together with other measures of the common EU RDP, the Common Monitoring and Evaluation Framework (CMEF) has been established to verify whether the intervention logic is respected.

The designation of CMEF is often regarded as a major step towards a more effective planning of rural development support for the future. On the other hand, the methodological framework of evaluation, resulting from the CMEF (ENRD, 2009), is much less defined. Another set of concerns arises from the assumption by the CMEF that a simple linear relationship exists between the funds invested and the result achieved (RUDI, 2010). Due to the cause-effect relationship between the choice of measures and the way they are implemented, as well as the complexity of their effects, this linear relationship may not be sufficient.

Having said this, it becomes clear that the evaluation reports, which follow a formally defined evaluation procedure (ENRD, 2006; ENRD, 2009) are rather limited in the evaluation of the effects of the supported actions. This gap was partly closed with the analysis of measure 121, which was carried out by the European Court of Auditors. The results indicate problems related to the targeting of support, resulting in a limited value of the allocated funds (ECA, 2012). As these findings were based largely on qualitative research methods, they are lacking empirical rigour. Apart from this, none of the above approaches are able to address two additional problems of the CMEF and EU evaluation guidelines (which eventually might lead to wrong conclusions about the success of the programme): i) an inability to associate the result and impact indicators with policy intervention, since there are a number of other factors and circumstances affecting the results; and ii) an inability to carry out counterfactual analysis, as support is usually targeted to particular sectors or regions (Medonos et al., 2012).

Despite its limitations, the analytical potential of the CMEF remains largely untapped, and this represents a challenge in the applied research of rural development measures. The authors of this paper accept this challenge by applying a spatial econometric approach to analyse the effects of measure 121 (modernisation of farms) in Slovenia during the period 2007-2010. Limitations of the CMEF are surpassed by the inclusion of other relevant factors affecting the economic performance of farms, and by treating separately supported farms and the entire farm population (counterfactual). To our knowledge, the effects and spatial spillovers of investment support in agriculture have not yet been explored in a dynamic setting. The paper attempts to address this challenge, as well.

The paper is structured as follows: In the section entitled "Research area, data collection and organisation", we present a description of the study area and the organisation of data. The section "Methodology" describes the steps and procedures applied in the empirical analysis of spatially aggregated data describing farm structure and performance. The "Results" section describes the findings of the spatial econometric analysis of the factors affecting growth in agricultural output between 2007 and 2011 (measured according to the EUR value of standard output) (i) for farms receiving investment support; (ii) for all farms that applied for CAP measures in the analysed period, and (iii) in relative terms, comparing supported farms with the general performance of the farming sector in analysed areas. The paper concludes with the section "Discussion and conclusions", which outlines the key findings of the paper, emphasises their main policy implications, and suggests some improvements of the monitoring and evaluation systems, leading towards a more evidence-based agricultural and rural development policies in the future.

Research Area, Data Collection and Organisation

To investigate the spatial and non-spatial effects of farm investment support on the economic performance of the farm sector in Slovenia, municipalities (LAU2) have been chosen as the most appropriate spatial units of analysis. As stipulated in the Local Self-Government Act, municipalities are the basic self-governing local communities in Slovenia. According to their fragmented structure (210 municipalities) and small size (according to SORS, 2013 - 75% of the municipalities has fewer than 10 000 inhabitants) and are relatively homogenous in terms of geographic conditions. The choice of this territorial level of analysis is meaningful also in terms of data availability, as municipalities comprise the basic level for statistical observations.

Having said this, some data-related obstacles remain. According to CMEF (2006), the key baseline and impact indicator of measure 121 is labour productivity in agriculture. Unfortunately, one of the key obstacles in spatial analysis of measure 121 is that the CMEF labour productivity indicator is monitored only at the national level, as the programming, implementation and monitoring of farm investment support is centralised and does not allow for territorially-disaggregated analysis (Juvančič and Jaklič, 2008). Derivation of this data from administrative databases is not feasible due to a significant amount of missing accounting data (MKGP, 2010) and the incomparability of monitoring procedures between member states and/or regions (ECA, 2012). Both standard statistical surveys and administrative databases, therefore, fail to provide relevant data on socio-economic performance at an individual level, which is needed for econometric analysis.

An alternative solution to this problem was found by estimating farm revenues in accordance with the FADN[1] methodology (EC, 2008; EC, 2009), which sets standard outputs (SO[2]) to determine economic size of farms. In order to conduct this research, a panel data set with (IACS, 2007; IACS, 2011) data on individual farms that applied for CAP Pillar 1 direct payments in the years 2007 and 2011 was developed to include information about ID identification for each farm, the municipality label and all physical indicators for each type of crop, along with its corresponding cultivated hectares, and the number of heads for all types of livestock. The economic size of all agricultural holdings that applied for CAP direct payments were calculated (separately for 2007 and 2011) based on the sum of the individual SO of reported agricultural production resources present on the holding (i.e. cultivated area, livestock status). After merging the same farms for both years (with the purpose being to achieve the same farm population), the databases contain data on 57 800 farms. The final step was to aggregate all the individual SOs at the municipal level.

The next database was collected from the approved applications for measure 121 (modernisation of farms). The applications contain information on all supported agricultural households for the years 2008, 2009 and 2010. In total 2213 subsidies were awarded to 1760 different farms. The database of supported farms also contains ID identification codes, which allowed us to merge this data with the above described IACS database with calculated SOs for 2007 and 2011. By filtering out the subset of farms receiving investment support, information about their economic performance in 2007 and 2011 was revealed. The approved applications, in addition, contained a large amount of potentially relevant information, such as the volume of RDP support, the type of farm production, the farms engaged in organic production etc. In order to enable spatial analysis, individual data were aggregated at the municipality level (LAU2).

The core of the analysis deals with the spatial econometric analysis of the effects of investment support on the economic performance of the farm sector. In order to gain greater insight into the economic performance of the supported farms and to enable counterfactual analysis, a set of three mutually connected dependent variables was developed as follows:

- *y1 – Farm revenue growth of the supported farms* [*in EUR of standard output, SO*] = $(SO\ in\ EUR_{2011\ supported\ farms} / SO\ in\ EUR_{2007\ supported\ farms}) * 100$ (1)
- *y2 – Farm revenue growth of the total farm population* [*in EUR of standard output, SO*] = $(SO\ in\ EUR_{2011\ population} / SO\ in\ EUR_{2007\ population}) * 100$ (2)
- *y3 – Revenue growth index of the supported farms according to total farm population = (y1/y2) * 100* (3)

As for the independent variables, data from the two administrative databases (IACS with the standard output data for 2007 and 2011 and the CMEF with data on supported farms

[1] The Farm Accountancy Data Network (FADN) is an instrument for evaluating the income of farms and the impacts of the Common Agricultural Policy.

[2] The standard output of an agricultural product (crop or livestock) is the average monetary value of the agricultural output at farm-gate price, in EUR per hectare or per head of livestock. The SO excludes direct payments, value-added tax and taxes on products. There is a regional SO coefficient for each product, as an average value over a reference period (five years). The economic size of a holding is the value of its total SO. It is the sum of the individual SOs of all the agricultural products present on the holding, and it is expressed in EUR.

and approved applications) were augmented by two secondary statistic sources: Agricultural Census 2010[3] (SORS, 2010) and general socio-demographic data (SORS, 2011). Correlation matrices of independent variable candidates with dependent variables were prepared. Variables that do not correlate to the dependent variable were excluded. The remaining set of explanatory variables and their descriptive statistics are presented in Table 1.

Further selection of explanatory variables was based on various criteria. We checked the theoretical relevance of included variables, the significance of variables and the regression equation that explains the largest variance. It has to be pointed out that, in the revenue growth model for supported farms, revenue growth applies to supported farms only, while the explanatory variables were chosen from data collected from approved applications and from general socio-demographic data. Structure data from the Agricultural Census are not included because they carry information for the whole farm population. In the case of the revenue growth model for the total farm population, a different approach has been applied. The dependent variable applies to the whole population of farms in a municipality, while the explanatory variables have been derived from the Agricultural Census and from general socio-demographic data. The third model (the economic growth of the supported farms according to total farm population) combines all the data.

Table 1
Summary statistics for dependent and significant variables in the models

Variable	Mean	MIN	MAX	SD
y1 [a]	91.91	56.09	161.35	20.79
y2 [a]	84.89	68.22	116.06	9.74
y3 [a]	97.98	0.00	189.82	36.10
RDP expenditures – from measure 121, EUR/ha [b]	1272.18	0.00	7752.89	1388.97
Land productivity proxy, SO per hectare UAA, EUR/ha [c]	1507.12	668.33	3787.98	602.57
Average LSU, only on farms with livestock breeding, num. [c]	7.31	0.56	22.60	3.76
Share of farms engaged in plant production, % [c]	33.07	0.00	98.15	20.96
Structure of UAA, % of permanent grassland, % [c]	60.28	2.84	100.00	29.33
Structure of UAA, % of permanent crops, % [c]	5.72	0.00	86.65	11.38
Average PP (CAP pillar I), num. [b]	28.70	0.00	113.52	20.60
Average PP arable land (CAP pillar I) in log, num. [b]	2.05	-3.22	4.41	1.52
SO for grazing livestock, in 1000 EUR [a1]	127.95	0.00	958.54	175.33
Structure of SO, % of SO for field crops, % [a1]	23.70	0.00	90.79	21.72
Structure of SO, % of SO for permanent crops, % [a1]	13.45	0.00	99.85	23.15
Specialization in poultry breeding, % [b]	1.71	0.00	50.00	6.25
Specialization in pig breeding, % [b]	5.80	0.00	100.00	14.63
Specialization in horticulture, % [b]	4.01	0.00	100.00	12.20
Share of supported farms engaged in organic prod, % [b]	8.98	0.00	100.00	21.10
Share of supported farms engaged in conventional prod., % [b]	60.76	0.00	100.00	34.57
Type of investments, % of mechanization, % [b]	64.82	0.00	100.00	31.25
Average monthly net earnings, EUR/capita [d]	932.53	640.88	1300.54	108.54

MIN, minimum; MAX, maximum; SD, standard deviation; y1, the economic growth in SO of supported farms; y2, the economic growth in SO of the total farm population; y3, the economic growth index of the supported farms according to total farm population; SO, standard output in EUR; UAA, utilised agricultural area, land which agricultural enterprises and family farms use for a crop production (arable land, permanent grassland and permanent crops); LSU, livestock unit, a criterion for determining the extent of livestock breeding; PP, payments rights, which include payments rights for permanent grasslands and arable land (financial support of the Common Agricultural Policy); grazing livestock includes bovine animals, sheep and goats. It has to be pointed out that bovine animals are the most represented category; permanent crops consist of vines and fruit trees.

Source of data: [a] data on the economic size; [a1] data on the economic size, calculated only for the supported farms; [b] approved application for measure 121; [c] agricultural census data; [d] general socio-demographic data.

[3] The first Slovenian Agricultural Census was carried out in 2000, and the next one in 2010.

Methodology

A non-spatial, classical linear model with an ordinary least squares (OLS) method was first used to develop economic growth models. The next step of the analysis consisted of spatial exploration. The exploratory spatial data analysis (ESDA) approach was the main tool used to determine whether spatial patterns exist. In line with the principles of the ESDA, LISA (local indicators of spatial association) cluster map and Moran's I statistic were performed – for more details see Anselin (1995); Anselin et al. (1996); Florax et al. (2002). First, the existence of spatial autocorrelation was determined by Moran's I coefficient. The value of Moran's I ranges from -1 and +1, where 0 represents a random spatial pattern (high and low values are randomly distributed in space). The two extremes indicate two types of spatial clustering; if the value approaches +1, there is a strong positive spatial autocorrelation (clusters of similar values, high-high or low-low), but if it decreases to -1, it means that there is a strong negative spatial autocorrelation. In this way, it can be seen how the spatial patterns among municipalities interact (positive spatial correlation could be defined as high-high or low-low interactions). The ESDA reveals spatial patterns in the analysed data, which gives rise to the decision to re-estimate the non-spatial models by including a spatial weight matrix into the standard OLS model, thus estimating spatial econometrics models.

Spatial analysis of the data, including the estimation of spatial models, involves a formal definition of the spatial patterns. This pattern is usually represented by a matrix of spatial interactions-weight matrix (W). The matrix defines the relationship among different locations; in other words, it defines the spatial neighbourhood for every location-the elements take the value of 1 if two municipalities share a common boundary, otherwise 0 (Kelejian and Robinson, 1995). There are several choices of spatial matrices, depending on the neighbouring criterion (Anselin, 2002; Getis, 2010). The municipalities of Slovenia vary greatly in size from 7 km^2 to more than 500 km^2; nevertheless, all municipalities have neighbours (there are no isolated regions). For this reason, the queen contiguity was chosen as the most appropriate weight matrix for this study. The philosophy of queen matrix is simple: Two municipalities are neighbours only if they share a common border. This matrix was row-standardised, so that the sum of each row is equal to one. With 210 municipalities, the matrix used has the dimension 210 by 210 (in total 44 100 weights), with 2.49% of nonzero links. There are two least-connected municipalities (Hodoš and Središče ob Dravi), with one neighbour, and one most-connected municipality (Ljubljana), with 14 neighbours (Figure 1). The queen matrix shows that Slovenian municipalities have, on average, 5.24 neighbours.

According to Anselin (1988a), spatial econometrics deals with two spatial effects: spatial autocorrelation and spatial heterogeneity. These spatial effects were included in the empirical research of economic growth in Slovenian agriculture. In regression models that use analysis based on spatial data, the two most widely used are (Eq. 4) the mixed regressive spatial autoregressive model, often called the 'spatial lag model', and (Eq. 5) the linear regression with a spatial autoregressive error, often called the 'spatial error model' (Anselin, 1988a; Getis, 2010).

- $y = \rho W y + X\beta + \varepsilon$ (4)

- $y = X\beta + (I - \lambda W)^{-1}\mu$, (5)

where ρ is the spatial parameter that indicates the spatial extent of interactions between municipalities and λ is also the spatial parameter expressing the intensity of spatial correlation between regression residuals. If ρ and λ are zero, there are no spatial effects. When this condition is met, then the error terms ε and μ are randomly distributed in space. Stated another way, the economic growth in agriculture is randomly distributed across the space. W is n by n spatial weight matrix (usually row-standardised), the n by 1 vector Wy is the spatial lag that captures spatial effects through dependent variable and I is n by n identical matrix. In comparison to the standard regression approach, the spatial models include (among other factors) the effect of space - in this case study, the spatial spillovers of economic growth in agriculture. Spatial spill-

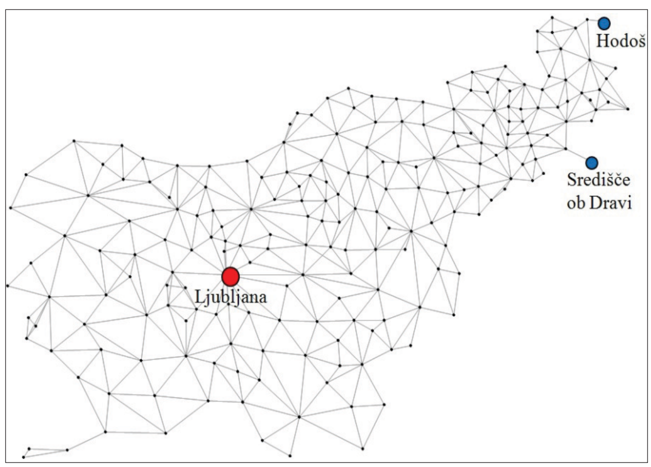

Fig. 1. The structure of queen weight matrix among municipalities in Slovenia

overs have been captured in ESDA and confirmed by spatial parameters (ρ, λ). From this starting point, it was sensible to develop the spatial models. All the spatial analyses were carried out with the statistical package R – see Bivand et al. (2008) for useful codes. The Lagrange Multiplier (LM) test – for more details see Anselin (1988b); Florax et al. (2002); Anselin, (2005) – have been applied to determine which spatial models fit data better (spatial lag or spatial error). The final step includes the interpretation of models, as well as the comparison of the spatial and non-spatial model results.

Results

The economic growth of the supported farms

The econometric results of the economic growth of the supported farms are reproduced in Table 2. As a starting point, we analysed linkages between the farm investment support and the economic performance of supported farms. The model results showed no significant evidence that the investment support from measure 121 affects the revenues on supported farms. On the other hand, results suggest that specialisation in permanent crops and poultry breeding of supported farms have a positive and significant impact on economic growth. Both specialisations (especially poultry breeding) have an expected positive impact, as they are both intensive. Conversely, a higher number of grazing animals on the supported farms indicate a more extensive production, which may reflect in a decreased economic output. Organic farming status also tends to decrease farm revenues. This may happen as a consequence of further "extensification" of production on organic farms in Slovenia, with a dominating share of extensive grazing farms (Juvančič et al., 2012). One possible explanation might be a lower market orientation of farms engaged in extensive production organic farming (Slabe et al., 2011). The payment rights (financial support of CAP pillar I) does not appear to significantly affect the growth of farm revenues in this model. The growth of farm revenues tends to be lower in municipalities with higher monthly net earnings (EUR/capita). Broadly, this can be interpreted that farmers in economically privileged areas prefer to exploit on-farm diversification or off-farm income opportunities.

The LISA cluster map of economic growth and the Moran scatter plot (Moran's is 0.1389) indicate a low level of spatial autocorrelation (Figure 2), but there are still some small clusters of high values and one large cluster of low values. The low values of economic growth were found in the country

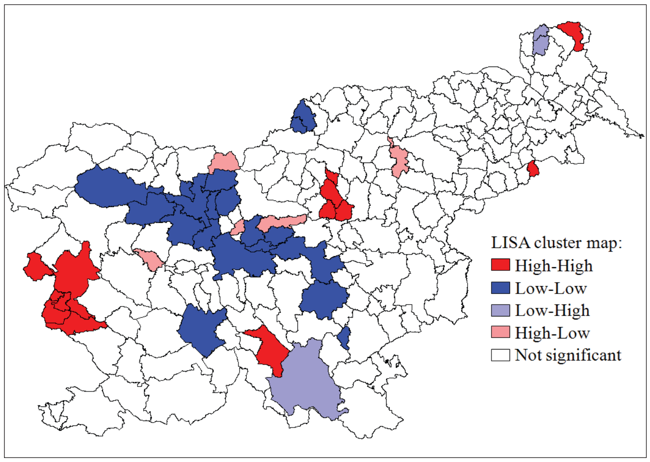

Fig. 2. LISA cluster map and Moran's I for the economic growth of the supported farms

Table 2
Model results for revenue growth on the supported farms

y1	OLS model		Spatial error model	
	coeffic.	p-value	coeffic.	p-value
RDP expenditures – from measure 121, EUR/ha	0.0001	0.9584	0.0000	0.9928
Structure of SO, % of SO for permanent crops, %	0.2462	0.0001	0.2340	0.0001
SO for grazing livestock, in 1000 EUR	-0.0198	0.0147	-0.0184	0.0189
Specialization in poultry breeding, %	0.7270	0.0010	0.8218	0.0001
Share of suppor. farms engaged in organic production, %	-0.1564	0.0124	-0.1322	0.0294
Average PP (CAP pillar I), num.	-0.0688	0.3329	-0.0985	0.1597
Average monthly net earnings, EUR/capita	-0.0301	0.0148	-0.0243	0.0457
Intercept	121.30	0.0000	116.36	0.0000
R^2, %	22.11		25.10	
Lambda, λ			0.2449	0.0102
Breusch-Pagan Test	9.8449	0.1975		

SO, standard output; PP, payment rights; CAP, Common Agricultural Policy capital (Ljubljana) and its surrounding. Those are municipalities with a decrease in economic growth of the supported farms (from 2007 to 2011). Here it could be said that the subsidies for measure 121 have not improved economic performance of the supported farms, which is contradictory to the goal of the measure. Some of the factors explaining the overall situation were identified in the model above.

The spatial dependence was further explored by an LM test, which suggests that the spatial error model better captures the spatial patterns than the spatial lag model does. From Table 2, it can be seen that the coefficient parameter (λ) of spatially correlated errors has a positive effect. In this case, the economic growth of the supported farms in one municipality is affected by an unknown spatial effect, and the neighbouring effect of the economic growth could not be confirmed. Additionally, there is a marginal improvement in R^2 (from 22.11 to 25.10%). Other results of the spatial error model are very similar to the non-spatial OLS model.

The economic growth of the total farm population

According to the same principles, the economic growth model of the total farm population was analysed (Table 3). It is important to emphasise that RDP expenditures for measure 121 are not included in this model because the unit of observation is the entire farm population in a municipality (the supported farms are analysed separately in the first model). As expected, the land productivity proxy shows a significant positive effect. The more productive farms, having a higher output per hectare, tend to have a higher growth in farm revenues. Furthermore, results suggest that the economic growth of the total farm population is higher in areas with a higher percentage of plant production. This is additionally confirmed by the negative coefficient of livestock farming. The economic growth decreases with the number of livestock units on farm. A word of caution is needed here: Slovenia has recorded a significant drop in the livestock status during the years 2010 and 2011 (AIS, 2012). The result is a reduction in economic size for 2011 and does not mean that the livestock farming is less productive. Somewhat surprisingly, the percentage of permanent crops is significantly negative related to the economic growth. One reason could be that farms with permanent crops switched from conventional to integrated and organic production. As in the first model, the level of the monthly net earnings (EUR) per capita shows a significant negative effect. This result might only reflect the fact that agriculture tends to be more strongly represented in municipalities facing general economic difficulties (e.g. lack of non-farm jobs).

The Moran I coefficient of 0.3296 indicates spatial clustering among municipalities. The LISA cluster map of the economic growth of the total farm population shows some significant clusters (Figure 3). There is one cluster of low-low values in N Slovenia and two smaller clusters of high-high values.

Diagnostic LM tests were performed on the non-spatial model to test whether there is spatial correlation in the data. The tests indicate that a lag model is the preferred option. The spatial approach seems to be the better way to estimate the model. The coefficient of spatial dependence (ρ) is positive and statistically significant (Table 3). This confirms that the economic growth of the total farm population in one municipality both affects and is affected by the economic growth in the neighbouring municipalities. In this case, results detected the existence of spatial spillovers across municipalities. A larger variance (from 38.28 to 42.20 %) was explained by the spatial dependence model. Otherwise, the results of the spatial lag model are similar to those in the OLS model.

Table 3
Model results of the revenue growth of the total farm population

y^2	OLS model		Spatial lag model	
	coeffic.	p-value	coeffic.	p-value
Land productivity proxy, SO per hectare UAA, EUR/ha	0.0113	0.0000	0.0098	0.0000
Share of farms engaged in plant production, %	0.1742	0.0004	0.1454	0.0016
Average LSU, on farms with livestock breeding, num.	-0.5621	0.0040	-0.4525	0.0149
Structure of UAA, % of permanent grassland, %	0.1396	0.0000	0.1203	0.0001
Structure of UAA, % of permanent crops, %	-0.1664	0.0271	-0.1573	0.0270
Average monthly net earnings, EUR/capita	-0.0119	0.0205	-0.0097	0.0469
Intercept	69.90	0.0000	47.46	0.0000
R^2, %	38.28		42.20	
Rho, ρ			0.2820	0.0006
Breusch-Pagan Test	28.063	0.0001		

SO, standard output; UAA, utilised agricultural area; LSU, livestock unit

The economic growth index of the supported farms according to total farm population

The third model attempts to identify factors of the supported farms that are more successful in economic growth than those in the total farm population (Table 4). In contrast to the first model, the RDP expenditures are found to be positive and statistically significant. The farms that have received investment funds from measure 121 tend to experience more favourable development of farm revenues compared to those in the total farm population. From this point of view, the farm investment support only partly achieves its objectives (e.g. contributing to higher productivity in agriculture). As was already identified, a higher productivity (EUR/ha) has the expected positive impact on economic growth. The supported farms that have managed to increase economic growth more successfully than those in the general population were those farms that have invested in farm mechanization. The results show that supported farms engaged in conventional (and therefore more intensive) production have a higher revenue growth (compared to the organic and integrated production). Also, in contrast to the first model, the payment rights for arable land (i.e. a basis for CAP pillar I direct payments) negatively affect the relative farm revenue growth on farms benefiting from investment support. It appears that additional financial incentives inhibit the need for improvement of income status on farms in Slovenia. The economic growth of the supported farms, according to total farm population, is also higher for the farms that specialise in field crop production, horticulture and pig breeding.

The regression model revealed that a 52.18% variance was explained by factors listed in the table above. The value of Moran I approximates zero (0.0021), which already indicates a weak spatial autocorrelation among the municipalities. The spatial dependence was further verified by the LM test, which suggests that there is no spatial dependence in the model (both the spatial lag model and the spatial error model are insignificant). The spatial patterns are randomly distributed across municipalities of Slovenia. As a spatial econometric approach does not add clarification to the economic growth of the supported farms according to total farm population, the analysis finishes with the standard OLS model.

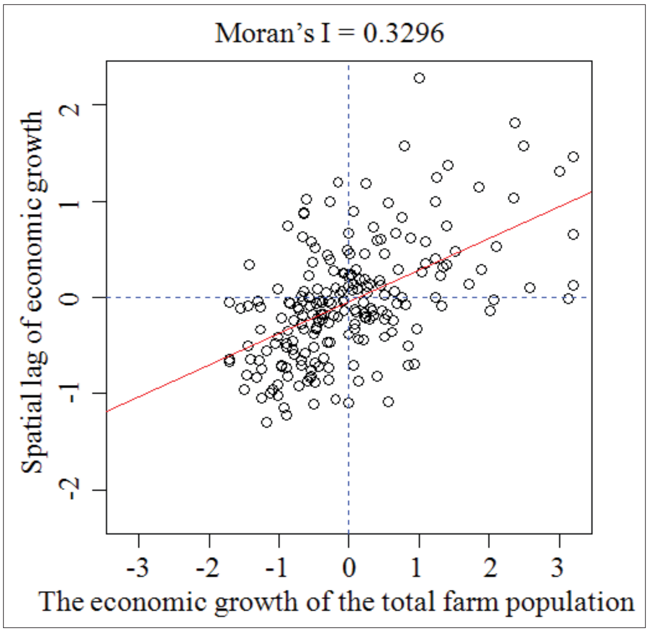

Fig. 3. LISA cluster map and Moran's I for the economic growth of the total farm population

Table 4
Model results of the relative growth of revenues on the supported farms

y3	OLS model	
	coefficient	p-value
RDP expenditures from measure 121, EUR/ha	0.0054	0.0002
Land productivity proxy, SO per hectare UAA, EUR/ha	0.0103	0.0030
Type of investments, % of mechanization, %	0.3546	0.0000
Share of supported farms engaged in conventional production, %	0.2990	0.0000
Average PP arable land (CAP pillar I) in log, num.	-5.0517	0.0037
Structure of SO, % of SO for field crops, %	0.4598	0.0000
Specialization in horticulture, %	0.5012	0.0009
Specialization in pig breeding, %	0.3564	0.0050
Intercept	29.85	0.0002
R^2, %	52.18	
Breusch-Pagan Test	8.199	0.4268

SO, standard output; UAA, Utilised agricultural area; PP, payment rights; CAP, Common Agricultural Policy

Discussion and Conclusions

The hypothesis that farm investment support contributes towards improvement of the economic performance of farms in Slovenia has been verified. Econometric analysis of the growth of farm revenues on supported farms are anything but encouraging, especially considering the fact that the farming sector in Slovenia is characterised by low productivity and a weak competitive position (Erjavec et al., 1999; Juvančič et al., 2004; Juvančič and Erjavec, 2005). The analysis showed a reduction in farm revenues, not only in general, but also in the subset of farms benefiting from investment support. On average, the total farm population experienced a reduction of 15.11% in the year 2011 (as compared to 2007), whereas the supported farms record only a slightly more favourable (8.09%) reduction for the supported farms (Table 1). From this point of view, the positive effect of RDP farm investment support on economic growth indicates that the farms benefiting from the investment support are better-off, but just in terms of a smaller decrease of farm revenues. Irrespective of this finding, the situation for the total farm population is somewhat understandable; the factors explaining this include abandonment of agricultural land, an increasing trend of switching from conventional to organic and integrated production, the ageing of the farm population etc. However, a general decrease in the economic growth of the supported farms was not at all expected. On the other hand, the real impact of investment may be noticed much later. The impact of farm investment support from 2007-2011 on economic growth would probably be more relevant to analyse a few years after investment funds were received. It should be emphasised that the majority of supported farms are still under credit commitments and also need time to adapt to new technology. Viewed from this perspective, the economic growth of the supported farms may be expected to improve over time.

The other results of the econometric models are in line with expectations. Intensive farming is found to be economically more favourable due to relatively higher yields and lower production costs. The farms engaged in more resource-intensive sectors (e.g. poultry breeding, pig breeding, field crops and horticulture) tend to face stronger farm revenue growth, and vice versa, for more extensive production (e.g. organic farming, grazing livestock breeding). It has to be noted, however, that these results should be regarded with caution as the results do not take into account the external (policy and market) environment. Even more so, conditions that will affect agricultural markets in the near future (agricultural price volatility, climate-related uncertainties and upward trends in EU farm production costs) are likely to bring substantial deterioration in the EU net trade position for agricultural products. In its Agricultural Market Outlook 2014–2022, the European Commission (2012) envisages deterioration, particularly for production systems with a high use of inputs.

The results have also confirmed the presence of spatial spillover effects; in this sense, when observing economic growth, spatial impacts should not be neglected. The CMEF indicator labour productivity for measure 121, which is the key baseline and impact indicator of the analysed measure, is monitored only at the national level, and as such does not allow for spatial analysis at the municipality level. The solution to this problem was found by estimating farm revenues of standard outputs separately for the total farm population and for farms supported by RDP investment funds. With regard to the need for a more evidence-based evaluation of RDP in the coming programming period 2014 - 2020, it would be worthwhile to consider improving the analytical potential of the monitoring data by establishing a more geographically disaggregated system of data collection. In general, better monitoring would substantially improve the empirical merit of spatial econometrics analysis of RDP measures. Spatial econometrics and its accompanying research method (e.g. ESDA) could bring potential benefits in term of more informed planning and evaluation of RD measure. Such methods could be used to simulate various alternatives of the eligibility or selection criteria. In addition, spatial econometric analysis can add value to the (ongoing, ex-post) evaluation of RD measures by substantially improving our understanding of factors affecting economic growth and the impacts of public interventions in rural development. Nevertheless, usefulness of the method is inevitably linked with the quality and scope of relevant data. Effective monitoring of RD measures is therefore a prerequisite for effective spatial analysis.

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