An assessment of rurality in Italian farms using a quantitative approach

Nicola Galluzzo

Association of Geographical and Economic Studies of Rural Areas (ASGEAR), 02100 Rieti, Italy
E-mail: asgear@libero.it

Abstract

Galluzzo, N. (2019) An assessment of rurality in Italian farms using a quantitative approach. *Bulg. J. Agric. Sci.,* *25*(3), 433–438

The Farm Accountancy Data Network (FADN) is a dataset able to investigated in depth the income of farmers, the items of cost and also the impact of the Common Agricultural Policy subsidies in a sample of farms. The core purpose of this research was to assess by a quantitative approach the rurality index in Italian farms part of FADN dataset investigating also if the financial subsidies and land capital endowment have impacted on the rurality. In fact, this quantitative approach has evaluated the cause-effect relationships among different items and endogenous variables correlated to the rurality. The methodology has used a non-parametric approach such as the Partial Least Square Structural Equation Model (PLS-SEM) due to a small numerousness of farms in the sample; furthermore, because of not being a general codified and well consolidated methodology aimed at investigating the rurality the non-parametric approach seems to be quite adequate to the main goal of this study. Findings have pointed out as the endogenous variables cost, financial subsidies allocated by the Common Agricultural Policy and the different endowment in crops or livestock have influenced on the rurality. Drawing the conclusions, the land endowment, payments to farmers and indirect subsidies disbursed by the European Union have acted directly on the level of rurality in all investigated Italian farms.

Keywords: PLS-SEM; rural areas; Common Agricultural Policy; rural development

Introduction

Comparing the statistical data published by the Italian National Institute of Statistics (ISTAT) in its Census of Agriculture and also by the Eurostat, Italian farms have increased their land capital endowment in terms of usable agricultural areas which is close to 8 hectares. This is anyway strongly above the average European amount of land capital which equates to 14 hectares as reported by Eurostat. The reasons of this increase have been correlated to a significant decline in farmers who are emigrated from the countryside or are retired from their own activity with the consequence to emphasize the socio-economic marginalization in rural areas arising the dichotomy between rural and urban territories (Galluzzo, 2018a).

Italian rural territories have been characterized by ageing people, a low level of investments in new technologies labour saving. Addressing the attention to inner mountainous areas farms need special financial supports aimed at reducing the emigration allocated by the Common Agricultural Policy (CAP) in the framework of less favoured areas payments which have been able to partially mitigate the permanent out-emigration, increasing the generational turn-over in the countryside, and stimulating the diversification in the path of the multifunctionality considering the second pillar of the CAP is a milestone in the process of transition from a productivist model to a post-productivist paradigm (Van der Ploeg et al., 2002; Ilbery, 1998; Galluzzo 2015a,b, 2016a; 2016b; 2018d).

In literature some studies have argued the pivotal role in using a quantitative approach as proposed by Kendall in 1975 with the purpose to assess the index of rurality; by contrast, other authors have estimated in a quantita-

tive approach an index of rurality throughout a correlation analysis setting up a Local Indicator of Spatial Association (LISA) which have investigated in depth in the frame of a spatial association the rurality index over the time of investigation in different areas of study (Galluzzo 2018a; 2018b; 2018c; Li et al., 2015; Cloke, 1977; Kendall, 1975; Lehtonen and Tykkyläinen, 2010; Griffith, 2003).

In general, many authors have investigated the role of farm typology and specialization in increasing the level of economic and technical efficiency (Galluzzo 2015a; 2015b; 2016a; 2016b; 2016c; Bojnec and Latruffe, 2008; Latruffe et al., 2017) and not so common in literature are studies aimed at investigating in depth if financial supports and aids towards farmers have acted towards the rurality by the definition of an index of rurality using a quantitative approach (Cloke, 1977; Cloke and Edwards, 1986; Galluzzo, 2016a; 2016b; 2016c; Finco et al., 2005; Galluzzo, 2018a; 2018b; 2018c). In 1977 Cloke proposed a first definition of rural index which has been a new and innovative quantitative method in investigating rural areas and in defining also a theoretical concept of rural addressing the attention of researchers and policy makers to strategies of development in a holistic and cohesive rural development perspective (Cloke, 1977; Banister, 1980; Harrington and O'Donoghue, 1998).

The main purpose of an index of rurality is to define a model able to asses which socio-economic variables have had effects on the development patterns in rural areas and also influencing a decision process in the optimal allocation of financial resources and other socio-economic variables in order to reduce the socio-economic marginalization in some rural areas where are sparsely scattered different rural villages (Galluzzo, 2018a; 2018b; 2018c; 2018d).

A comparison among different studies carried out in several European countries has underlined the strategic role of quantitative methodologies in investigating the index of rurality corroborating the role of a quantitative approach in estimating the rurality index even if more quantitative studies have been predominately based on the Principal Component Analysis and multiple correlation which are two methods able to investigate in depth the main aspects and changes in rural areas, their socio-economic variables linkages with the core purpose to obtain an unique index including all investigated variables correlated to the rurality and tightly correlated to the rural territories. (Prieto-Lara and Ocaña-Riola, 2010; Cloke, 1977; Ocaña-Riola and Sánchez-Cantalejo, 2005; Cloke and Edwards, 1986; Galluzzo, 2016a; 2016b; 2016c; Finco et al., 2005).

Aim of the Research

The core purpose of this research was to assess by a quantitative approach an estimation of rurality in Italian farms part of Farm Accountancy Data Network (FADN) dataset since 2004 to 2016 investigating also which items in all analysed endogenous and exogenous variables have impacted on the rurality in all Italian regions. In fact, this quantitative approach has estimated the cause-effect relationships among different items and endogenous variables correlated to the index of rurality.

Methodology

The source of data has been made by the findings published in the annual survey Farm Accountancy Data Network (FADN) which is a sample analysis carried out by the European Union in order to assess the impact of the Common Agricultural Policy towards some European farms (Galluzzo, 2018c).The principal aim of this study has been addressed to assess by a quantitative approach some cause-effect relationships in a small sample of Italian farms part of the Farm Accountancy Data Network (FADN) since 2004 to 2016 by the non-parametric approach called Partial Least Square Structural Equation Modeling (PLS-SEM).

The analysis has been carried out using the software Smart PLS 3 in order to estimate the cause effect relationships among variables in the Partial Least Square Structural Equation Modelling (PLS-SEM) (Ringle et al., 2015), XL-STAT pivotal in analyzing the main correlations among variables and GeoDa 1.12 able to assess in a cluster analysis the impact of CAP financial subsidies, usable agricultural areas and direct payments allocated by the second pillar in the Rural Development Programme.

The PLS-SEM is adequate for research's targets because it fits well to the specific features of the analysis and the sample of observation such as: a scarcity of theoretical models in literature able to be copied in other areas of investigation and also a modest dimension of the sample investigated which is made by less than 3 000 units of investigation (Hair et al., 2017; 2016; Tenenhaus et al., 2004; Galluzzo, 2018a; 2018b; 2018c). In fact, the non-parametric model PLS-SEM needs of non-restrictive underlying assumptions compared to the Covariance Based Structural Equation Modeling (CB-SEM) which by contrast has in literature a well define field of application, and *a priori* assumptions, a theoretical framework, some constraints in the model and other basic theoretical assumptions (Hair et al., 2016) as define in other subjects as psychology and sociology which have a well parametric defined and specific frame (Galluzzo, 2018c; 2018d).

Furthermore, the Partial Last Square Structural Equation Modelling is also adequate to estimate a modest sample size of investigation units because of there are not well-defined model specifications in the model aimed at maximizing the difference to the variance (Hair et al., 2017; 2016; Tenenhaus et al., 2004; Wong, 2013; Galluzzo, 2018a; 2018b; 2018c).

The Structural Equation Modelling describes the causality among latent variables by an iterative methodology aims at estimating the internal and external correlations and values in all investigated latent variables (Hair et al., 2017; 2016; Tenenhaus et al., 2004, Wong, 2013; Vinzi et al., 2010; Galluzzo, 2018a; 2018b; 2018c; 2018d).

Roughly speaking the PLS-SEM model can be written considering the differences between exogenous and endogenous variables as proposed by Monecke and Leisch in 2012:

$$Y = YB + Z,$$

where Y is the exogenous and endogenous latent variable matrix and Z is the error which is assumed to be $E[Z] = 0$; further, the main elements in the matrix of coefficients are assumed to be equal to zero when the elements of the adjacency matrix are zero as well (Monecke and Leisch, 2012); hence, each latent variable is tightly correlated in a direct expression of the previous latent variable in a system on interrelated equations (Hair et al., 2017; 2016; Monecke and Leisch, 2012) (Figure 1).

Results and Discussion

The Farm Accountancy Data Network dataset in all investigated Italian regions has pointed out in 2 137 farms an average dimension in terms of usable agricultural areas equal to 15 hectares which has been very close to the average value of agricultural endowment assessed by the Eurostat and anyway it has been higher than the average amount detected in the recent Agricultural Census carried out in 2010 by Istat (Table 1). The average value of the farm net income has been equal to 33 000 euros with a significant fluctuation in function of the typology of farming and the level of specialization. In fact, farms specialized in horticulture, fruit and vegetable have had a modest farms size with the higher level of produced income. The average amount of financial subsidies allocated by the Common Agricultural Policy both in the first and also in the second pillar has been equal to 5 700 euros with a maximum value assessed close to 52 000 euros; very poor have been the financial subsidies allocated towards disadvantaged rural areas and by measures correlated to the rural development, in the frame of the second pillar or rather Rural Development Programme, with a percentage of incidence on the total amount of the total CAP equal to 20%.

The cluster analysis comparing the years 2004 to the year 2016 and considering the variables total financial subsidies allocated by the Common Agricultural Policy, the direct payments towards the disadvantaged rural areas (LFA subsidises) and the financial subsidies allocated in the second pillar in the framework of the National Rural Development Programme has pointed out in 2004 a significant dichotomy between southern and northern regions (Fig. 1) with the northern regions able to get more intense amount of financial supports in the second pillar of the CAP but with a less efficient use of them. In 2016 the cluster analysis has pointed out an absence of territorial dichotomy between northern and southern Italian regions due to a different reallocation of funds even if findings have underlined a growth of clusters among southern regions due to a different allocation of financial resources which has mitigated partially the socio-economic differences among microregions increasing the territorial unbalances.

Table 2 shows the main correlation in some investigated variables pointing out the highest direct values between total subsidies allocated by the Common Agricultural Policy and the farm dimension in terms of land capital endowment.
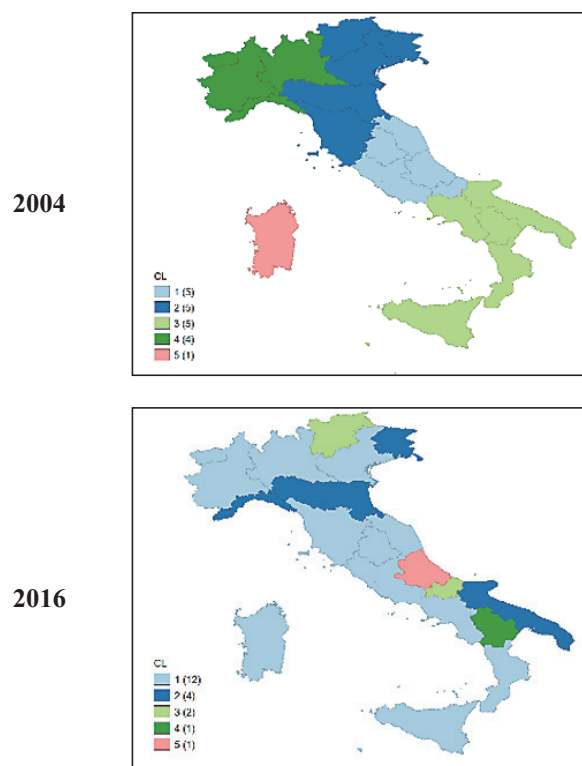
2004

2016

**Fig. 1. Cluster analysis in two years' time
in all Italian regions**
Source: Author's elaboration on data
http://ec.europa.eu/agriculture/rica/database/database_en.cfm

Table 1. Descriptive statistics in all investigated variables in Italian farms part of the FADN dataset

Variables	Unit	Obs.	Max.	Average	Std. deviation
Farm net income	€	2137	557787,000	33040,975	50140,116
Labour input	€	2137	18006,350	2856,915	2064,249
Usable Agricultural Areas	ha	2137	94,290	15,743	15,924
Seed sand plants costs	€	2137	254375,000	2741,303	9262,308
Fertilizers costs	€	2137	23380,000	1726,991	2155,428
Crop protection costs	€	2137	24251,000	1345,570	1792,550
Feed animals costs	€	2137	194915,000	8943,207	21229,582
Machinery costs	€	2137	26635,000	1444,686	1906,599
Energy costs	€	2137	56003,000	4285,454	5886,357
Wages paid	€	2137	138335,000	5585,231	10342,784
Total assets	€	2137	7548288,000	389735,875	469972,414
Net investment	€	2137	2467138,000	7508,569	54901,402
CAP total payments	€	2137	52066,000	5756,815	6676,819
Subsidies crops	€	2137	24540,000	381,907	1285,884
Subsidies livestock	€	2137	16564,000	343,873	1294,765
Environmental subsidies	€	2137	11161,000	554,682	1023,610
Less Favored Areas subsidies	€	2137	11727,000	422,368	1172,927
Rural Development Payments	€	2137	22662,000	1090,686	2066,852
Decoupled payments	€	2137	39333,000	3777,709	5100,532

Source: Author's elaboration on data, http://ec.europa.eu/agriculture/rica/database/database_en.cfm

Table 2. Main correlations in investigated variables

Variables	Usable Agricultural Areas	CAP total subsidies	Subsidies on crops	Subsidies on livestock	Environmental subsidies	LFA payments	Rural Development Plan financial aids	Decoupled payments	Farm Net Income
Usable Agricultural Areas	1								
CAP total subsidies	0.804*	1							
Subsidies on crops	0.162*	0.196*	1						
Subsidies on livestock	0.385*	0.510*	0.166*	1					
Environmental subsidies	**0.506***	**0.547***	0.008	**0.380***	1				
LFA payments	0.435*	0.487*	-0.062*	0.450*	0.710*	1			
Rural Development Plan financial aids	**0.543***	**0.593***	-0.030	**0.451***	**0.914***	**0.921***	**1**		
Decoupled payments	**0.685***	**0.875***	-0.024	**0.180***	**0.240***	**0.157***	**0.256***	**1**	
Farm Net Income	0.385*	0.459*	0.075*	0.151*	0.104*	0.044*	0.104*	0.494*	1

Numbers with the asterisks imply significance at 5%
Source: Author's elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm

A significant high correlation has been assessed between the variables Rural Development Programme subsidies, environmental payments and LFA direct payments. Furthermore, Less Favoured Areas payments and farm net income have had the poorest level of correlation; summing up, findings have corroborated the hypothesis according to which the size of farms, in terms of usable agricultural area, have acted directly on the level of financial subsidies allocated by the European Union in supporting the primary sector and to the level of farm net income in Italian farms part of FADN dataset.
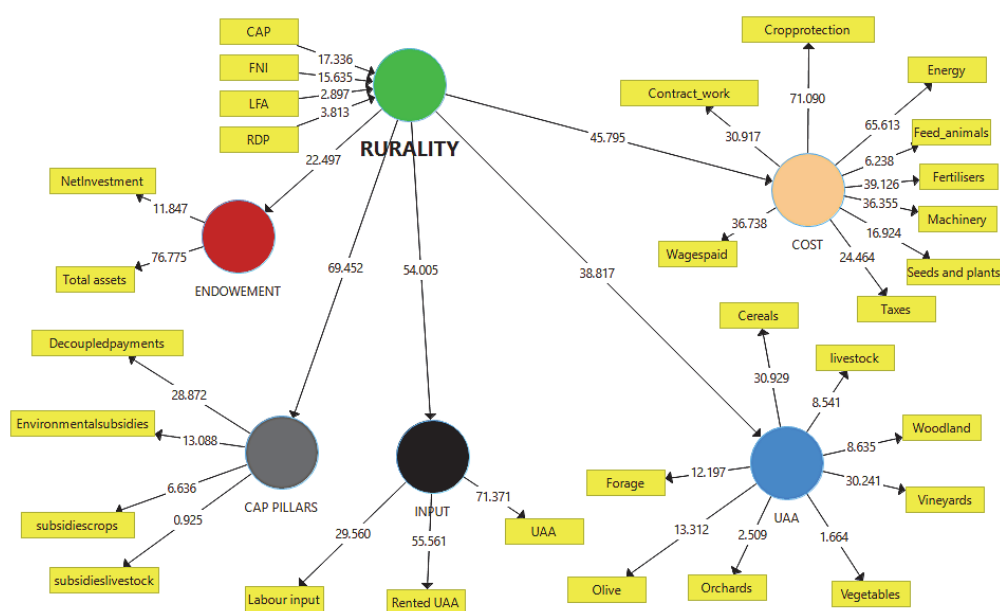
Fig. 2. Main finding in the rurality index assessed in all investigated Italian regions over the time 2004-2016
Source: Author's elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm

Over the time of study 2004-2016 findings in the index of rurality assessed by the PLS-SEM have pointed out as the exogenous rurality is directly influenced by the items farm net income and total financial subsidies allocated by the Common Agricultural Policy and by contrast an indirect link has been found between the item RDP subsidies and the exogenous variable index of rurality (Fig. 2).

The endogenous variables cost, level of investments, Common Agricultural Policy financial subsidies, input and land capital endowment have had a direct and high significant effect on the rurality index. In general, an increase of land capital and labor input and also the level of specialization of farms have been items with a significant and positive impact on the endogenous variables and consequently on the index of rurality.

Furthermore, very positive and sensitive has been the items usable agricultural areas and rented usable agricultural areas on the endogenous variable INPUT. This finding has corroborated the role of input endowment in increasing the level of rurality in all Italian regions over the time.

Conclusion

Findings have pointed out as the Partial Least Square Structural Equation Modeling is a good toolkit in assessing the cause-effect relationships among different economic variables investigated by the FADN dataset and it has been a primordial approach in evaluating an index of rurality in Italian country-side. In general, the size of farms, in terms of land endowment, farm net income and the total amount of financial subsidies allocated by the European Union have had a positive and significative impact on the rurality.

The role and effect of financial subsidies towards the Italian farms has been predominately linked to the typology of aids and payments function of its allocation by the first or second pillar of the Common Agricultural Policy; very modest has been the impact of typology of farms in terms of specialization to the rurality. A low dimension of farms in terms of Usable Agricultural Areas, in vegetable farms cluster, has been pivotal in horticulture farms and in other high specialized and high intense capital which has implied a high level of farm net income.

Drawing the conclusions, it is important in small farms located in stayed behind rural areas to subsidize by indirect payments allocated by the Rural Development Programme in the framework of development of rural areas at risk of socio-economic marginalization bearing in mind as in some not high specialized farms the less favoured payments have had a direct impact towards the index of rurality in Italian farms part of the Farm Accountancy Data Network.

Furthermore, in the next seven year time 2021-2027 of the Common Agricultural Policy planning it seems pivotal to subsidize farms in the framework of the rural development plan aimed at mitigating the out permanent emigration from the countryside even if it seems more possible as a consequence of the Brexit a decline in financial subsidies which should in-

volve mainly the first pillar and then the second one avoiding to draining resources from the decoupled payments. In fact, this is a mining field because of an extreme and intense linkage between first and second pillar of the Common Agricultural Policy narrowly connected among them hence, it is pivotal reducing the risk of amplifying the socio-economic divide between large size farms and small size farms by a careful and sound management in the allocation of financial resources taking in due consideration the particularities of different European regional agricultures.

References

Banister, D. (1980). Transport mobility in interurban areas: A case study approach in South Oxfordshire. *Regional Studies*, *14*(4), 285-296.

Bojnec, Š., & Latruffe, L. (2008). Measures of farm business efficiency. *Industrial Management & Data Systems*, *108*(2), 258-270.

Cloke, P.J. (1977). An index of rurality for England and Wales. *Regional Studies*, *11*(1): 31-46.

Cloke P.J., & Edwards G. (1986). Rurality in England and Wales 1981: a replication of the 1971 index. *Regional Studies*, *20*(4), 289-306.

Finco, A., Pronio, G.D., & Pollonara M. (2005). Multifunzionalità e sviluppo rurale delle zone montane. *Rivista di Economia Agraria*, *60*(2), 449-468.

Galluzzo, N. (2015a). Role and effect of agroforesty subsides allocated by the Common Agricultural Policy in Italian farms. *International Journal of Food and Agricultural Economics*, *3*(1), 19-31.

Galluzzo, N. (2015b). Technical and economic efficiency analysis on Italian smallholder family farms using Farm Accountancy Data Network dataset. *Studies in Agricultural Economics*, *117*(1), 35-42.

Galluzzo, N. (2016a). Role of financial subsidies allocated by the Common Agricultural Policy in reducing out emigration in Italian countryside. *Romanian Journal of Regional Science*, *10*(2), 50-63.

Galluzzo, N. (2016b). Analysis of financial subsidies allocated by the common agricultural policy to European farms in reducing economic-territorial inequalities by indexes of concentration. *Studia Universitatis Babes-Bolyai, Geographia*, *61*(1), 27-38.

Galluzzo, N. (2016c). An analysis of the efficiency in a sample of small Italian farms part of the FADN dataset. *Agricultural Economics/Zemedelska Ekonomika*, *62*(2), 62-70.

Galluzzo, N. (2018a). An analysis of rurality index in Romanian countryside by a quantitative approach. *Trakia Journal of Sciences*, *16*(2), 134-139.

Galluzzo, N. (2018b). A preliminary quantitative analysis of rurality in Romania and the impact of Common Agricultural Policy subsidies. *Review of Agricultural and Applied Economics, 22(2),* 128-135.

Galluzzo, N., (2018c). A preliminary quantitative analysis of rural development in Romania using the PLS-SEM. *Albanian Journal Agricultural Science*, *17*(3), 125-133.

Galluzzo, N. (2018d). Impact of the Common Agricultural Policy payments towards Romanian farms. *Bulgarian Journal Agricultural Science*, *24*(2): 199-205.

Griffith, D.A. (2003). Spatial auto correlation and spatial filtering. Gaining understanding through theory and scientific visualization. *Springer*, Berlin, 209 pp.

Hair, J., Hollingsworth, C.L., Randolph, A.B. & Chong, A.Y.L. (2017). An updated and expanded assessment of PLS-SEM in information systems research. *Industrial Management & Data Systems*, *117*(3), 442-458.

Hair, Jr, J.F., Hult, G.T.M., Ringle, C. & Sarstedt, M. (2016). A primer on partial least squares structural equation modeling (PLS-SEM). *Sage Publications*, Thousand Oaks, 363 pp.

Harrington, V., & O'Donoghue, D. (1998). Rurality in England and Wales 1991: a replication and extension of the 1981 rurality index. *Sociologia Ruralis*, *38*(2), 178-203.

Ilbery, B. (1998). Geography of rural change. *Routledge*, Abingdon on Thames, 280 pp.

Kendall, M. (1975). Multivariate analysis. *Charles Griffin & Company Limited*, London, 210 pp.

Latruffe, L., Bravo-Ureta, B.E., Carpentier, A., Desjeux, Y., & Moreira, V.H. (2017). Subsidies and technical efficiency in agriculture: Evidence from European dairy farms. *American Journal of Agricultural Economics*, *99*(3), 783-799.

Lehtonen, O., & Tykkyläinen M. (2010). Self-reinforcing spatial clusters of migration and socio-economic conditions in Finland in 1998–2006. *Journal of Rural Studies*, *26*(4): 361-373.

Li, Y., Long, H., & Liu, Y. (2015). Spatio-temporal pattern of China's rural development: A rurality index perspective. *Journal of Rural Studies*, *38*:12-26.

Monecke, A., & Leisch, F. (2012). SEM-PLS: structural equation modeling using partial least squares. *Journal of Statistical Software*, *48*(3): 1-32.

Ocaña-Riola, R., & Sánchez-Cantalejo, C. (2005). Rurality index for small areas in Spain. *Social Indicators Research*, *73*(2), 247-266.

Prieto-Lara, E., & Ocaña-Riola, R. (2010). Updating rurality index for small areas in Spain. *Social Indicators Research*, *95*(2), 267-280.

Ringle, M.C., Wende, S., & Becker, J.M. (2015). *SmartPLS 3. Boenningstedt: SmartPLS GmbH*, on the website http://www.smartpls.com.

Tenenhaus, M., Amato, S., & Esposito Vinzi, V. (2004). A global goodness-of-fit index for PLS structural equation modelling. *Proceedings of the XLII SIS Scientific Meeting*, *1*, 739-742.

Van der Ploeg, J.D., Long, A., & Banks, J. (2002). Living Countrysides: Rural Development Processes in Europe: the State of the Art. *Elsevier EBI*, Amsterdam, 231 pp.

Vinzi, V.E., Trinchera, L., & Amato, S. (2010). PLS path modeling: from foundations to recent developments and open issues for model assessment and improvement. In: Esposito Vinzi, V., Wynne, W.C., Henseler, J., & Huiwen W. (Eds.), Handbook of Partial Least Squares, *Springer*, Berlin, pp. 47-82 (De).

Wong, K.K.K. (2013). Partial least squares structural equation modeling (PLS-SEM) techniques using SmartPLS. *Marketing Bulletin, 24*(1):1-32.