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Contents

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Foreword

This issue of *Studies in Agricultural Economics* is the second (after volume 116 number 1) to be produced by AKI in cooperation with the European Rural Development Network (ERDN, www.erdn.eu). ERDN was set up in 2002 to integrate the work and competencies of various research institutions in central and eastern Europe, and AKI has been an active participant in the network almost from its inception.

Much has been written in the scientific literature about the challenges faced by the countries that have joined the European Union (EU) from 2004 onwards (especially the post-socialist countries) when trying to adopt and comply with regulations and procedures that were primarily designed for western Europe. This cannot be more relevant than for farming, the agri-food value chain and rural development. Privatisation and restitution of property, technological change, the globalisation of agricultural and food markets, and institutional weaknesses with regard to implementing programmes and absorbing funds are just some of the issues affecting agriculture and rural areas in the region.

ERDN brings together agricultural economists, rural geographers, rural sociologists and others to address such challenges through collaborative research designed to identify new approaches to agricultural and rural development that can be applied in the eastern EU. The papers published in this issue of *Studies in Agricultural Economics* are contributions to this collective effort.

Research by Vőneki, Mándi-Nagy and Stark shows that, in contrast to some other projections, the Hungarian dairy herd and milk production may increase slightly in the years following the abolition of the EU milk quota system. This reflects the concentration, modernisation and selection processes that have taken place in the sector in recent years, and increasing global demand.

The decline in agricultural employment is a widely recognised trend in Europe. Čapkovičová and Hlavsa map (LAU1) regional employment by sector in Czechia (Czech Republic). In 'predominantly rural' regions the rate of change in service employment is more favourable than in 'intermediate' and 'predominantly urban' regions and the sector now accounts for over 50 per cent of jobs there.

Building an entrepreneurial environment can help rural areas to benefit from these changes. The results of Bótáné Horváth, Katonáné Kovács and Szőke show that, to achieve this, more emphasis should be placed on 'pull' type of learning designed to draw out people and resources, and that government, science/university, business/industry and civil society actors should all play a role in this process.

The path dependency of Romanian small-scale agriculture, its efficiency and contribution to socio-economic security are demonstrated by Tudor. For these reasons, the disappearance of Romanian small farms is neither likely nor desirable. Instead, they should be helped to become more resilient through investment in equipment and human capital, with emphasis on their cultural, landscape, touristic attributes and capability to provide traditional food.

The point about the efficiency of small farms is reinforced by Galluzzo, using the example of Italy where more than 90 per cent of farms have less than 9 ha usable agricultural area. In the period 2000-2011 small and cooperative farms had higher levels of scale efficiency than limited company farms and small farms had the highest levels of technical efficiency.

Efficiency can be improved via investment but Wieliczko shows that in Poland, although investment in farm machinery, equipment and means of transport is increasing, it is still insufficient given the average level of usage of fixed assets. Only about 12 per cent of farms make use of public support in their investment projects, most of which are financed from own resources.

Farm innovation in general is strongly influenced by the quality of the relationship between farmers and farm advisors. Takahashi, Todo and Degefa found that a participatory research and extension approach can greatly enhance the adoption of new varieties by farmers, and that both the trust network with extension agents and the reputations of farmers play important roles in farmers' adoption behaviour.

Finally, Athiyaman reports that consumers perceive biomass residential heaters as natural and visually appealing but dirty and difficult to use. An analysis of the industry's marketing communications suggests that although it is focusing on brand attributes such as 'green' and 'clean', it is not addressing this latter 'ease of use' issue.

I hope that the contents of this issue of *Studies in Agricultural Economics* are of interest to researchers and practitioners in the eastern EU and beyond.

Andrew Fieldsend
Budapest, March 2015

VŐNEKI Éva*, MÁNDI-NAGY Dániel* and STARK András*

Prospects for the European Union and Hungarian dairy sectors after the abolition of the milk quota system

Our study determines the competitive positions of the dairy sectors of Hungary and the other European Union (EU) Member States in the light of the abolition of the milk quota. We analyse the recent market positions of the EU Member States, the changes in the relationships between global, EU and Hungarian milk procurement prices, and the medium-term forecasts for the international markets for milk and milk products, including the results of our own model. In most Member States, milk production is below the quota level, although the most competitive countries are paying substantial penalties for excess production. The medium-term projections and the price relationships underline the fact that, due to the liberalisation of the milk market and the rapid rise in global demand, the impacts of global market developments in the EU will be further enhanced. Owing to sustained international demand, the EU's export opportunities will improve, reducing the pressure on the internal market, and this will have a spill over effect on Hungarian milk prices. Although in terms of trade balance and quota utilisation Hungary is one of the least competitive Member States, the concentration, modernisation and selection processes that have taken place in the country's dairy sector in recent years could, taking into account the favourable medium-term market forecasts, result in a slight increase in milk production levels. Thus, in contrast to the European Commission's projection, according to our profitability based model projection the Hungarian dairy herd and milk production are expected to increase slightly during the period 2016-2020.

Keywords: quota abolition, international markets, liberalisation, price transmission, medium-term projections, competitiveness

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Introduction

The milk quota system that regulates cow milk production volumes in European Union (EU) Member States was introduced in 1984. The underlying reason for this measure was the financial problems caused by the increasing butter and milk powder reserves. The previous system provided a price guarantee and intervention for producers regardless of the quantity produced. Until the introduction of the direct milk supports in 2004, the milk quota system was the only measure that had a direct impact on EU milk production. The quotas that were defined both for the Member States and the producers also affected the processors, as the rules related to their raw material base and limited the processing quantity. The system has been, since its creation, constantly adjusted due the changes occurring in the market. In line with a decision of the European Commission (EC) in 2003, the quota system will remain in place until 31 March 2015, but the quotas have been raised by 1 per cent annually from 1 April 2009, with the last increase occurring on 1 April 2013 (EC, 2012).

Despite the growth in production of recent years, according to annual data sets submitted to the EU by individual Member States as specified by EC (2004), the quantity of milk bought and directly sold has continued to remain below the quota. The so-called 'lagging behind' started to become noticeable from 2009. The quantity of milk supplied grew by 2.9 per cent to 144 million tonnes (corrected by fat content) in the 2013/14 quota year but the quota itself increased by 1.4 per cent to 150 million tonnes, leading to the utilisation of the quota growing from 94.0 to 95.4 per cent in comparison with the previous quota year. The increase in the quantity of milk bought and in the quotas was partly explained by Croatia's accession to the EU. The quota use in the EU-15 stood at 96.8, and in the Eastern EU Member States, Malta and Cyprus at 88.7 per cent in the 2013/14 quota year. In most EU regions it was not the quantitative restrictions that hampered the increase in milk production during the phasing-out of the milk quota, but other factors such as the area of available agricultural land, the costs of financing, the environmental restrictions and the retail price war (EC, 2012).

A quota system was introduced in Hungary long before the country's accession to the EU. However, it initially differed from the EU system and approximated to it only gradually. The Hungarian quota system did not restrict production at national level, neither before nor after joining the EU, and the sector has used around 75-80 per cent of its limit in recent years. After a long spell of depressed prices and extreme weather, the period leading up to the abolition of the quota system was favourable for the sector, resulting in it becoming profitable. The buying price of raw milk has increased since the middle of 2009. The intense global demand has had a 'pull effect' on domestic prices. As a result of the high buying prices, the amount of raw material exported is significant, and Hungarian dairy product exports have also been increasing since 2011. The position of the domestic dairy products in Hungary, in terms of both the volume sold and the selling price, has improved over the past two years. EU reserves have sunk to very low levels and the expansion of exports as well as the decrease in the amount of imported products have eased the pressure on the internal market. In addition, the weak national currency (HUF) has contributed to the fall in the volume of imports (Szajner and Vőneki, 2013).

Scenarios on the evolution of the EU milk sector after quota abolition are based on the findings of earlier studies in terms of the expected evolution of various aspects of production, processing and distribution of dairy products. Most of the studies we surveyed provide results of changes in the quantities and prices of dairy products based on the use of economic models (Chevalier *et al*., 2013). Academic contributions on the impact of removing quotas in 2015 provide scenarios of responses in the price of dairy products and quantities supplied and demanded. The results are often presented according to EU Member States and sometimes also at the regional level (e.g. Fellman, 2009). Some studies

also report the fluctuations in herd sizes and yields, and in some cases these are also accompanied by scenarios on the environmental impact (Kempen *et al*. 2011). All the studies considered present scenarios following the removal of milk quotas and their produced effects after 2015: Binfield (2009) takes 2017 as the last year of the time horizon; Fellman (2009) has a longer horizon (to 2020), while Réquillart *et al*. (2008) view 2016 as the last year of the time horizon. The results of these works tend to be in line with each other. In addition to academic contributions, there are also market studies providing projections on the dairy sector. For instance, Lafougère (2012), which is based mainly on market expertise and provides projections on production of dairy products such as butter, cheese, skimmed milk powder and whole milk powder; EC (2013), which includes medium-term projections for major EU agricultural commodity markets and agricultural income until 2023; and the projections contained in OECD-FAO (2013). Also of note is the study by Chevalier *et al*. (2013), which proposes a prospective vision of the future of the European milk market after quota abolition.

Our study determines the competitive positions of the dairy sectors of Hungary and the other European Union (EU) Member States in the light of the abolition of the milk quota. We analyse the recent market positions of the EU Member States, the changes in the relationships between global, EU and Hungarian milk procurement prices, and the medium-term forecasts for the international markets for milk and milk products, including the results from our own profitability-centred model.

Methodology

The comparison of the overall market positions of the EU Member States was based on EC data for imports and exports expressed in milk equivalent, and the milk quota utilisation. Market positions comparisons between Member States for liquid milk, cheese and butter used EC and International Dairy Federation data.

To determine the relationship between raw milk market prices in Hungary, and those in the EU, Germany and globally for the two EU programming periods 2000-2006 and 2007-2013, regression analysis was carried out using monthly data and the methodology of Thiele *et al*. (2013). Most data sets were supplied in EUR per kilogramme, and the Hungarian data were converted from HUF to EUR using monthly exchange rate data supplied by the Hungarian Central Bank.

The medium term EU and global outlooks according to OECD and EC projections are described. EC (2013) analyses the effects of quota abolition on the purchase of milk using the European Simulation Model (ESIM). The model attempts to determine the competitiveness of the Member States, taking into account the profit from milk production and the reactions to the changes in the buying prices in the period 2007-2012 (which includes part of the phasing out period characterised by increasing quotas). ESIM is a comparative static partial equilibrium multi-country model of agricultural production, consumption of agricultural products and some first-stage processing activities. Projections are made for a period of 11 years after the base period.

The medium-term milk production of Hungary was projected by a new simulation model developed by the Research Institute of Agricultural Economics (AKI). This model aims to forecast the average livestock numbers in the different sectors, taking into consideration the Common Agricultural Policy (CAP) support system between 2012 and 2020. The calculations focusing on the examination of the sectors are based on the AKI database of direct payments in 2013 and the moving average prices stemming from the Farm Accountancy Data Network (FADN). The model itself belongs to that group of linear optimisation methods that requires no derivation (Powell, 2007). This method is often used when there is not enough information regarding the gradient vector when searching for the optimum. The actors of the model are heterogeneous, their decisions are modelled at micro level, and then macro level changes are derived. This way the results of a linear programming model can be interpreted as equilibria of a well-defined economy/farm. The inputs of the model are divided into three groups: inputs related to FADN (FADN DATABASE), to the support system (SUPPORT) and to independent external sources (Hungarian Central Statistical Office data from 2014, OECD data from 2013 and EC data from 2013). Forecasts of the model embrace 15 sectors: wheat, barley, maize, sunflower, rapeseed, dairy cow, beef cattle (female), beef cattle for fattening (male), ewe, swine for fattening, sow, broiler, duck, turkey and goose. The change in the livestock numbers was modelled using a representative sample of 1900 farms from the Hungarian FADN database, supplemented with external sources. The five steps of the schematic model are as follows:

- DATA PROCESS: enter the necessary data such as the average livestock number per farm, the estimated variable and total costs, revenues of the sectors, the value of the inputs defined by the new support system of the CAP. An allocation table is then initialised to the farms;
- OPTIM: each farm decides how to allocate the animals and crops between the sectors. Decision are always made based on own preferences, taking into account the costs, revenues, the structure of the support system and other natural limitations for all 15 sectors. Then an objective function is set that represents the profit function. The optimum with respect to the allocation vector is found when maximising this function. The basis of the maximising process is an optimisation process, namely the COBYLA algorithm (Powell, 2007);
- AGGREGATION: the optimum values of the farms are rescaled and aggregated in order to obtain the change for a certain period at national levels. As the sample used is a representative sample, it is suitable for examining projections globally;
- ITERATION: the projections of the coming periods are forecast and recalculated through the change of costs, revenues and the supports system. The results are then adjusted by the independent outlooks of the OECD and the EU;
- OUTPUT: involves the saving of the optimised allocation vectors and the related tables, as well as compiling of the relevant statistics and figures. Cod-

ing and the base of the program was done using the programming language Python 3.4.1 (Python Software Foundation, Delaware, USA), supplementing calculations and costs fitting were done using the statistical programming language R 3.1.1 (Rogue Wave Software, Boulder CO, USA).

Results

The market positions of the EU Member States

Based on the EU's trade balance of milk and dairy products expressed in milk equivalent and the use of the quotas the Member States can be divided into four groups (Table 1):

- **Group 1** is composed of the most competitive Member States that are characterised by positive trade balance and fully or nearly fully used quotas. Within this group Germany and the Netherlands have very high export volumes, while with respect to self-sufficiency Luxemburg, Denmark, Ireland and the Netherlands are the leaders. Between the 2010/11 and 2012/13 quota years the quota use of two Eastern EU Member States, namely Poland and Latvia, significantly increased. After the end of the quota system the increase in the exports of these countries are expected to exceed that of the production, easing the pressure on the internal market of the EU;
- **Group 2** includes Member States with positive trade balance, quota use well below their potential and high self-sufficiency. From this group France, whose trade balance is the third largest in the EU after Germany and the Netherlands, clearly stands out. Notable growth in the production and the export are not foreseen for these countries;
- **Group 3** consists of Member States with negative trade balance, high level of quota use and low self-sufficiency. These countries are expected to raise their

Table 1: Grouping of the EU Member States according to their trade balance in 2010 and 2012 and the quota utilisation in the 2010/11 and 2012/13 quota years.

Member State	Imports	Exports	Balance	Imports	Exports	Balance	Quota utilisation*, %		Degree of self-sufficiency, %
	thousand tonnes, milk equivalent						quota year		2012
	2010			2012			2010/11	2012/13	
EU-27	69,216	86,616	17,400	71,591	91,929	20,339	-6.2	-6.7	115.4
EU-15	63,088	78,128	15,040	64,942	81,965	17,022	-3.9	-4.9	115.9
Group 1. Positive trade balance and (near) utilised quota									
Germany	12,126	20,704	8,578	12,558	21,969	9,410	-0.8	0.0	144.3
Netherlands	6,659	14,272	7,613	7,575	14,953	7,378	1.2	-0.4	263.9
Denmark	1,443	5,110	3,668	1,209	4,681	3,473	0.7	0.4	326.4
Ireland	974	4,320	3,345	1,269	4,652	3,383	-0.4	-3.0	267.8
Poland	1,118	3,296	2,177	1,258	3,695	2,437	-5.8	-0.6	123.8
Austria	1,402	2,157	755	1,503	2,398	895	-0.1	2.7	136.0
Latvia	255	406	151	301	564	264	-11.9	-3.8	143.5
Luxembourg	625	839	215	663	887	224	1.3	-2.4	442.2
Belgium	6,543	7,084	541	7,169	7,215	47	-0.3	-3.6	101.5
Group 2. Positive trade balance and underutilised quota									
France	6,466	12,582	6,116	6,654	13,656	7,002	-5.2	-7.5	139.6
Lithuania	439	1,176	737	617	1,447	831	-23.9	-22.2	188.0
Czech Republic	1,179	1,347	167	1,253	1,631	378	-14.4	-12.1	115.5
Estonia	94	401	307	93	433	340	-11.7	-6.7	189.5
Finland	577	1,068	491	768	939	171	-11.1	-14.4	108.0
Slovenia	300	338	38	297	340	44	-11.0	-11.0	107.5
Group 3. Negative trade balance and (near) utilised quota									
Italy	9,360	3,572	-5,787	9,013	3,671	-5,342	-2.7	-0.5	68.1
Spain	4,188	1,499	-2,689	4,235	1,682	-2,553	-4.5	-3.0	71.8
Cyprus	168	81	-87	145	101	-44	1.2	0.7	77.7
Group 4. Negative trade balance and underutilised quota									
United Kingdom	6,985	2,915	-4,070	7,210	3,101	-4,109	-9.9	-13.9	77.1
Greece	3,131	480	-2,651	2,578	562	-2,016	-20.3	-26.5	27.5
Sweden	1,565	806	-760	1,507	871	-636	-19.8	-21.7	81.8
Romania	576	194	-381	706	246	-461	-43.3	-48.0	89.4
Portugal	1,043	720	-323	1,031	727	-304	-10.2	-11.9	86.4
Bulgaria	493	268	-225	575	293	-281	-52.5	-56.2	79.5
Croatia	288	83	-205	310	87	-223	-	-34.6**	74.7
Malta	84	0	-84	106	1	-105	-17.6	-17.5	27.6
Hungary	828	528	-299	671	606	-66	-29.5	-26.9	96.5
Slovakia	594	452	-142	627	606	-21	-23.6	-20.7	97.9

* Quotas for deliveries and direct sales
** Estimated data
Source: own calculation based on European Commission data

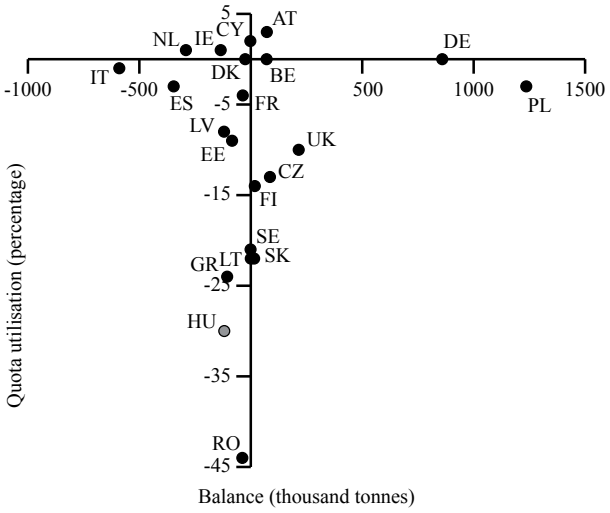

Figure 1: The trade balance of liquid milk in 2011 and the quota utilisation in the 2012/13 quota year by EU Member State.

Source: own calculation based on data from IDF (2013) and the European Commission

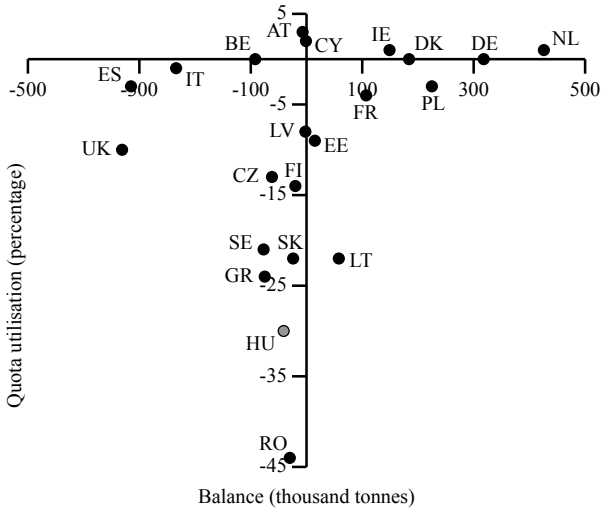

Figure 2: The trade balance of cheese in 2011 and the quota utilisation in the 2012/13 quota year by EU Member State.

Source: own calculation based on data from IDF (2013) and the European Commission

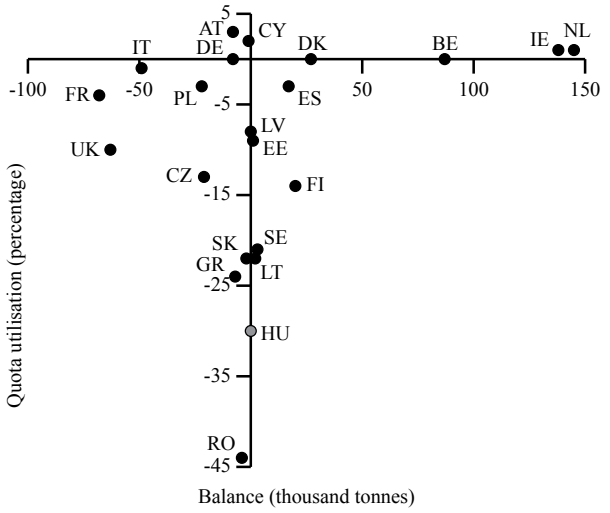

Figure 3: The trade balance of butter in 2011 and the quota utilisation in the 2012/13 quota year by EU Member State.

Source: own calculation based on data from IDF (2013) and the European Commission

production after the phasing out of the quota system, with the highest increases occurring in Spanish and Italian production;

- **Group 4** comprises the least competitive Member States that have negative trade balances, no self-sufficiency and low quota use. The quota use of many of these countries deteriorated between the 2010/11 and 2012/13 quota years, with the exception of Hungary and Slovakia. These countries are deemed to be the market of the Member States in Group 1. Although Hungary belongs to this group, its trade balance improved substantially between 2010 and 2012, and the country has become nearly self-sufficient in terms of milk and dairy products. Group 4 countries can be considered as the potential trade partners of Hungary.

For the EU Member States, in terms of the trade balance of specific dairy products with respect to the quota use, the result are different. In the period around 2012 the most competitive exporters of liquid milk were Germany and Poland (Figure 1), of cheese the Netherlands, Germany, Poland, Denmark and France (Figure 2), and of butter the Netherlands, Ireland, Belgium and Denmark (Figure 3).

Immediately before the abolition of the system, in the 2013/14 quota year, milk production showed an increasing trend in most EU Member States. In that year the quota was exceeded in eight countries, altogether by 1.47 million tonnes with the largest transgressions being in Germany, the Netherlands and Poland. The most competitive countries often had to pay significant fines for exceeding their quotas in the last years of the quota system and in 2013/14 the penalty levied amounted to EUR 409 million. The other 20 Member States produced 8.4 million tonnes less than their quota and in 14 of them the quantity of the milk supplied did not reach even 90 per cent of the quota. Regarding the major producers, France did not use 6.9 per cent of its quota, while for the UK the shortfall was 10.6 per cent.

In Hungary, in the 2013/14 quota year the supply quota increased by 0.5 per cent, the direct sales quota grew by 6.8 per cent in comparison with the previous year. The buying of raw milk in the EU decreased by 4.8 per cent, the direct sales rose by 1.1 per cent resulting in the quota use dropping from 76.3 to 69.1 per cent. High buying prices drove production on the one hand, but did not benefit the processors on the other.

Price relationships of raw milk

For the period 2000-2013 (including the milk crisis in 2008/09) there was a positive trend in terms of global milk prices: prices grew on average by EUR 0.0012 each month, i.e. EUR 0.014 each year (Thiele *et al*. 2013). This positive price trend is mainly attributed to the growing global integration. The relationship between the global and the internal EU prices of raw milk has strengthened since 2006, as a result of the reduction of the intervention prices and the rise in the global demand. At the same time the volatility of both the global and internal prices has increased. Thiele *et al*. (2013) calculated that the variances of the global prices accounted for 60 per cent of the variances of the internal prices between 2000 and 2013 (adjusted R^2), indicating a significant relation-

ship. An increase of EUR 1 in the global price raised the buying price in the EU by EUR 0.54 on average. Between 2006 and 2013 the relationship was even more significant: the variances of the global prices accounted for 77 per cent of the variances in the EU prices. The direct effect of the change in the price was stronger, a EUR 1 rise in the global price induced an increase of EUR 0.78 in the EU prices. These more intense effects of the events in the global market mean that the rising prices have benefited the milk producers in the EU.

For the same time period, we compared Hungarian raw milk prices with global prices and those of the EU and the EU's largest producer, Germany (Figure 4). Our regression analyses also indicate a strengthening relationship between the Hungarian and global as well as between the Hungarian and the EU buying prices. The variance of the global prices accounted for 49 per cent of the variance of the Hungarian prices between 2007 and 2013, while no significant relationship could be observed in the preceding period when prices were artificially regulated (Table 2). Between 2007 and 2013 a EUR 1 rise in the global price induced a price increase of EUR 0.48 in the Hungarian price. There was a statistically significant relationship between the Hungarian and the EU prices during both EU programming periods. However, while the variance of the EU prices accounted for only 16 per cent of the variance of the Hungarian prices between 2000 and 2006, the value of the same indicator was as high as 84 per cent between 2007 and 2013, suggesting a very strong integration. During the latter period a EUR 1 rise in the EU price caused the Hungarian price to increase by EUR 0.99. A strong correlation was also observed in the case of Germany, Hungary's main supplier. In the period 2007-2013 the variance of the German prices accounted for 75 per cent of the variance of the Hungarian prices and a EUR 1 increase in the former induced a change of EUR 0.74 in the latter.

Medium-term forecasts

The medium term outlooks are favourable both globally and EU wide. The increase in the real demand for milk and milk products and the trade exceed that of production, suggesting that global reserves will dwindle or could run out completely in some regions. The OECD therefore forecasts that although the production of the EU-28 will grow by 3.1 per cent (Figure 5), the export of milk and milk products from the EU will increase by 14.3 per cent between 2013 and 2022. The milk producer price is expected to rise from 2016 onwards. A new phenomenon is the growth in the Asian, mainly the Chinese, demand. Despite being the largest milk producer globally, the EU exports only a small part of its milk production, with that going to adjacent markets. Its share in the dynamically growing Chinese and in other Asian markets, compared to the main exporter New Zealand and the fast-expanding USA, is of no weight, though it is growing.

According to the medium-term outlook of the EC covering the period to 2023 (EC, 2013), purchases of milk in the EU are forecast to continue to grow after 2015, though more slowly than in the previous two years. They are expected to reach 150 million tonnes in 2023, i.e. 9.6 million tonnes more

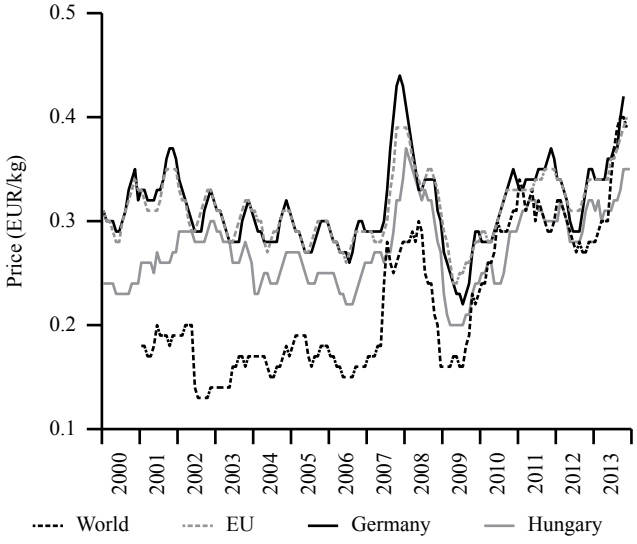

Figure 4: Monthly global, European Union, German and Hungarian raw milk prices, 2000-2013.

Data sources: LTO Nederland (global); BLE-BMELV (Germany); European Commission (EU) and AKI (Hungary)

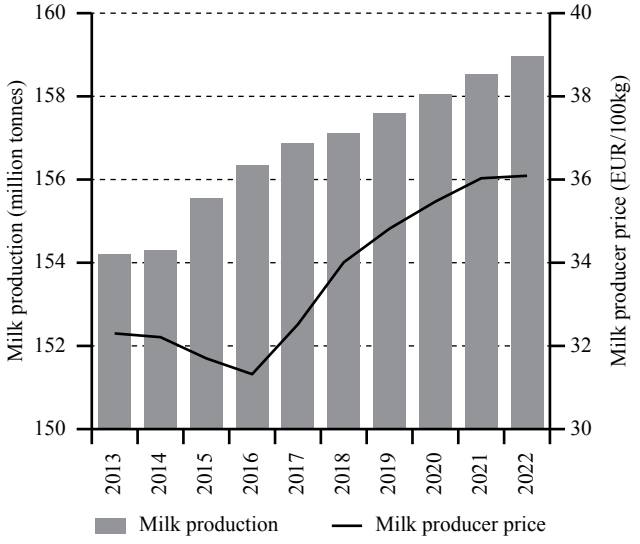

Figure 5: Projected milk production and average milk producer price of the EU-28 between 2013 and 2022.

Source: own composition using OECD data

Table 2: Interdependences between the buying prices of raw milk on the Hungarian market and those on the global (GL), European Union (EU) and German (GER) markets.

	2000-2013			2000-2006			2007-2013		
	GL	EU	DE	GL	EU	DE	GL	EU	DE
adjusted R^2	0.431	0.684	0.612	-0.012	0.157	0.109	0.491	0.838	0.752
No. observations	155	167	166	72	84	84	83	83	82
Regression coefficient	0.338	0.909	0.699	-0.044	0.388	0.287	0.477	0.992	0.740
t-value	10.85	19.00	16.16	-0.358	4.05	3.34	8.951	20.59	15.71

Source: own calculation

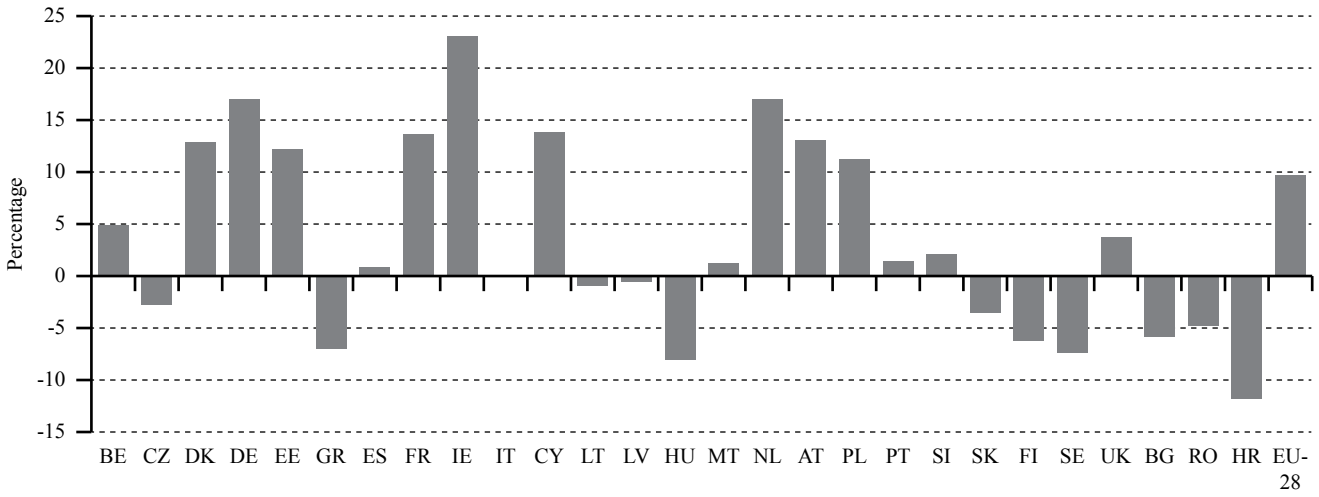

Figure 6: Projected changes in procurement of raw milk by processors from domestic producers in each EU Member State between 2012 and 2023.
Source: EC (2013)

than in 2012. The largest share of the increase is likely to be generated in the EU-15, with the combined purchases of the Eastern EU Member States (excluding Croatia), Malta and Cyprus growing by only 1.2 million tonnes. The quantity of the milk used in the economy might drop to a larger extent than in the preceding decade; direct sales and use for feeding calves are expected to moderate as well. As a result, the average share of raw milk production in the EU purchased by processors might reach 93 per cent. The growth in the yield will also be more dynamic, 2.7 per cent annually. The decrease in the numbers of dairy cows might even reach 1.9 per cent.

The results of the ESIM suggest that the higher buying price of milk has contributed considerably to the maintaining of the production level, and the elimination of the quota system would not in itself have led to an increase in the volume of production. Eleven member states (including nine of the EU-15) had so-called 'competitiveness reserves', with three of them (Ireland, the Netherlands and Germany) being the most competitive. The study took into account other factors as well, such as the investments and the technological developments made (significant especially in Denmark, Ireland and the United Kingdom) or the meeting of environmental requirements (mainly the Netherlands and Ireland). Besides, trends independent of the price and the net profit were observed, which are ascribed to the structural changes occurring in the sector. With respect to the purchase of milk, negative trends have occurred in Bulgaria, Romania, Croatia, Hungary, Greece, Slovakia, Sweden, Finland, the Czech Republic, Lithuania and Malta, while positive trends were seen in Poland and Estonia. Based on the results, in the medium term, purchases of milk are expected to grow especially in Ireland, Germany and the Netherlands (Figure 6), while the most significant drops are foreseen for Hungary (8 per cent) and Croatia (12 per cent).

The main findings of the ESIM modelling are that the purchase of milk after the abolition of the quota system will be highly dependent on factors such as the competitiveness of the milk production, the trends depicting the production and the demand of the processors, the volume of the investments, the environmental restrictions and the buying prices. The growing output of the more competitive EU Member States puts pressure on the buying prices that might make the less competitive countries moderate their domestic purchases of dairy products in favour of imports. In Member States where the independent structural trends and the other production restrictions are less significant, the price will be decisive. The decrease in the buying prices in the EU will spill over, through trade, to many of the Member States. This, however, might be mitigated by global trends, through the expanding international trade.

The AKI model is generally based on the profitability of milk production. According to the model results, with annual increases of around 1.5 per cent, the number of dairy cows in Hungary could increase by 8 per cent in the period 2016-2020 (Figure 7). Owing to the increasing productivity per cow, milk production will increase by about 2.5 per cent annually and by 13 per cent over the five year period.

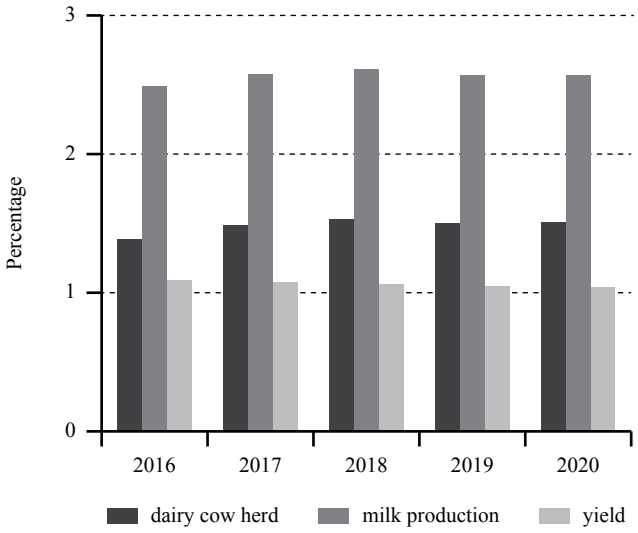

Figure 7: Projected annual percentage changes in dairy cow number, total milk production (tonnes) and milk yield per cow in Hungary in the period 2016-2020.
Source: own composition

Discussion

After the abolition of the quota system the European Union is expected to produce more milk, though this increase will not be substantial at international level. Most experts agree that the majority of the growth will occur in the 1-2 years following the abolition of the system. Production is likely to be higher in those Member States where it already approximates to or exceeds the limit. According to many forecasts, production will increase the most in Ireland, Germany, the Netherlands, Denmark, Austria and Poland. Total growth in the production of the EU-28 will reach 5-7 per cent between 2015 and 2020. However, there are some regions where a drop in production is foreseen. The international competitiveness of pasture based milk production in the European regions strengthens in line with the increase in cereal and oilseed prices, consequently the elimination of the production limits favours the north-western Member States. Milk production, in the long term, is expected to shift to countries with high precipitation and high grass yield (where fodder production is inexpensive), boosting the flow of milk and dairy products from North to South and from West to East. In the medium term – five to ten years – the more intense competition and the territorial realignment might redraw the structure of the EU milk market with raw material production taking place in cost efficient regions, and processing being carried out in regions with well-structured markets.

EU milk and dairy product exports became profitable as early as the 1990s and the export to production ratio is constantly growing. Owing to the measures liberalising the milk market and the dynamic growth in global demand, the effects of events in the global market were magnified in the EU. This is indicated by the fact that the impact of global milk prices on EU prices has grown notably in recent years. As a side effect, price volatility and the risk of the emergence of crisis situations have also increased. The consequences of the abolition of the milk quota are likely to be less severe than those of global events, therefore how the EU will be able to react to the changes occurring in the global market is crucial. Medium-term outlooks are favourable both globally and EU-wide. Global demand is expected to grow dynamically, especially in the developing countries. Thiele *et al*. (2013) estimates that the increases in the milk and dairy product exports of the EU will surpass that of the production between 2011 and 2022, rising from 19.1 to 22.6 million tonnes. This means that the share of exports will grow from 13.7 per cent in 2011 to 15.4 per cent in 2022, with global trends prevailing in the internal market.

In contrast to the ESIM projection which foresees a drop in Hungarian milk purchases, our profitability based model projects that the Hungarian dairy herd and milk production will increase slightly during the period 2016-2020. Possible reasons for this include:

- The ESIM model is a global, multi-country model which operates in an open economy and determines the expected evolution of the production on the basis of efficiency at macro level, while the AKI model simulates basically a semi-closed economy (it is adapted to the expected future price movements by international and Central European projections but it is actually a single-country model) and the projections are made on the basis of profitability;
- The AKI model does not explicitly calculate the projection from the total available national data, it is based on a statistically representative FADN sample and the results are scaled to the national level;
- The local nature of the AKI model means that it is not possible to make a meaningful projection for more than five years without knowing the detailed behaviour of the neighbouring countries. However this is also an advantage of our model because the short-term local behaviour can be modelled much better than by ESIM, since our model takes into account much more local data, such as actual land area, animal stock, profitability, support structure in the future and price changes in Central Europe. By contrast, the ESIM model does not consider the changes to the Hungarian support system which influence basically the future development of the animal stock and the milk production in Hungary;
- The AKI model does not take into account the relative impact of exports and imports.

Hungarian milk production and dairy cow numbers have both increased in the past two years due to the favourable events in the market and the high subsidies. At the same time the concentration of domestic milk production has accelerated: the number of private milk producers dropped by a quarter in 2013, while the average number of cows per farm grew by 35 per cent. Despite the rising fodder prices the profitability of the Hungarian milk producers has improved significantly, which is mainly ascribed to the increase in the buying prices and the direct supports that in 2013 made up approximately 15-20 per cent of the buying price. Direct supports of milk production in Hungary have grown continuously since 2004, and now are among the highest in the EU. However, the production cost of raw milk in Hungary is 25-30 per cent higher than in the more competitive Member States, due mainly to the high fodder costs but also to the macroeconomic conditions such as interest rates, rents, taxes and fees. Domestic milk production in Hungary has, over past decades, become highly maize-based, increasing its vulnerability to periodic prices rises, volatile markets and plant health problems (Szajner and Vőneki, 2013). However, it is an advantage of Hungary that, compared to Europe as a whole, the environmental state of the farms is favourable.

Direct supports for milk production in Hungary are expected to be provided until 2020. As a result of the reform of the CAP, the level of the subsidies granted to ruminants will remain constant or might even rise. A significant change in the new system is that milk producers are no longer entitled to a subsidy based on the milk produced, but rather on the number of animals in their possession. The total support for milk producers amounts to HUF 49.4 billion in 2015, which is 58 per cent more than in 2014. In the future, the total amount of subsidy is likely to decrease. The new system, in which the subsidy is granted per head, might have a negative effect on the volume of milk production, but a positive one on the fat and protein content of the milk. The per-litre subsidy of the farms with higher yields is expected

to be HUF 4-5 lower than that of those with lower yields. However it is important to note that the drastic change that is foreseen in the direct payments after 2020 might have an adverse impact on the funding and the competitiveness of the whole sector.

The position of the Hungarian milk sector can be assessed in comparison with that of neighbouring EU Member States. With respect to the genetic base of the livestock and the parameters of production, Hungary is considered to be a leader in the region. The country has a developed production structure as well: milk production is highly intensive, taking place in concentrated farms employing highly qualified staff, which provides a solid base for high quality production. The technology applied, the buildings and the machinery used have all been improved over the past 5-6 years (Borbély *et al*., 2013). Consequently, the sector is expected to experience no difficulties following the elimination of the system, which is crucial, as market positions are expected to be determined in the first 2-3 years of the new system.

Based on the natural capital, the number of dairy cows, the standard and the efficiency of the production technology, the level of the processing industry and the trade indicators of the milk and dairy products, Poland and the Czech Republic are Hungary's main competitors, followed by Slovakia. The country's main export markets regarding raw milk include Romania, Slovenia and Croatia. Although due to hectic market developments following Hungary's accession to the EU, a great wave of selection has taken place in the Hungarian milk production sector, concentration is expected to continue. The withdrawal of the large multinational companies from the domestic market increases the risk that the traditional Hungarian dairy brands will be produced even more from foreign raw milk, will be manufactured abroad, or even completely disappear in the domestic market.

Owing to the close ties with the rest of the EU, both the raw material and the finished product prices in Hungary adjust to those of the EU, thus the changes in global prices are expected to continue to influence domestic prices in the future. Taking into account the favourable conditions for milk production in Hungary, maintaining current export levels in the medium term is feasible. Despite the rise in raw milk prices in recent years, Hungarian prices are still competitive compared to the EU as a whole. However, it cannot be a long term strategy for Hungary only to supply raw milk to those EU Member States which are struggling with temporary shortages and quality issues (such as Romania). Hungarian milk and dairy product exports have been increasing since 2011. The competition in the EU is very intense in the cheese and cottage cheese market and especially in the market of acidified dairy products, with Germany being the toughest competitor. However, the outlook for the cheese market seems promising and the expected increase in EU exports might make way for Hungarian products, mainly in the domestic market. For the Hungarian cheese products the Middle East is foreseen to be a significant market.

Of significance in this respect is that the possible extent of the increase in production in the Member States after the abolition of the quota system is believed to vary according to the structure of the producers and the activities of the processors and retailers. Nearly 60 per cent of the Western European milk sector operates as part of co-operatives that have significant influence on prices and are the most adaptable to changes in both consumer demand and market conditions. The weakest point in the Hungarian supply chain, with no doubt, is the processing industry. While there have been remarkable investments made in the past five years in production, the processing industry – except for a few examples – has lagged behind. The most serious disadvantage though, in comparison with the more developed Western EU Member States, is the weak solvency of the consumers and the drawback stemming from the economy of scale. In order to increase the share of the high gross value added products at the processing stage, investment is essential. The competitiveness of the processors could also be boosted through cost reductions that could be achieved by the use of environmentally sound technologies which use less energy, improve the energy balance and utilise alternative energy sources as well.

In conclusion, after the abolition of the EU milk quota system intensification of market competition can be expected. However, the growth in EU exports as a result of the medium-term increase in the global demand is expected to ease the pressure on the internal market. Hence, market opportunities will expand of which the Member States with cost-effective production structures, competitive dairy sectors and effective, organised product chains will be able to take advantage. This could be an opportunity for Hungary to seize. The changes that have occurred over the past 2-3 years point to the fact that the concentration, modernisation and selection processes that are taking place in Hungary might allow it to maintain or even slightly increase its raw milk production in the future.

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Andrea ČAPKOVIČOVÁ* and Tomáš HLAVSA**

Approaching the service-based economy: regionally differentiated employment growth in Czechia

The study assesses the employment dynamics of LAU1 regions in Czechia (Czech Republic) in the period 2001-2011 using the territorial approach. It is operationalised on the basis of typological regions. Regions are differentiated firstly by their rurality according to the OECD methodology and the development of non-agricultural employment is used as the second differentiating characteristic. This reflects the regional differentiation based on the character of regional employment development potential. The specifics of rural regions are highlighted. Employment dynamics are assessed in the light of the process of employment restructuring both in its territorial and sectoral characteristics. The results illustrate employment in the service sector to be a viable driver of employment development regardless the degree of rurality but in absolute effects conditioned by its value. Furthermore, employment development is conditioned by the sectoral structure of regional employment. Components of employment development are identified by application of shift-share analysis. The strength of the competitive effect describing the existence of locational advantages for specific sectors is further relativised to calculate its relevance for employment change. In conclusion, the existence of locational advantages has only a minor impact in terms of its relative size on employment change that would normally be expected. Therefore, either more precise regional differentiation is needed or more disaggregated groups of sectors should be used.

Keywords: employment dynamics, rural regions, shift-share analysis

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Introduction

Rural employment in Czechia (Czech Republic) is losing its traditional backbone in agriculture. The current process of rural restructuring has its origins in the economic transformation that took place after the collapse of communism in the late 1990s (Bičík and Jančák, 2005), a process that was characterised by privatisation and restitution of property. More recently, the globalisation of agricultural and food markets, and technological change have also had significant impacts on employment (Porter et al., 2004; Woods, 2005; OECD, 2006).

This paper describes the characteristics of further differentiation of employment development among categories of LAU1 regions differentiated according to their degree of rurality. The study uses a territorial approach to cover issues of employment restructuring. Territoriality is captured not in space but via the categories of regions (rural, intermediate, suburban and urban). Firstly, we shed some light on the employment dynamics by superimposing differentiating characteristics on the regional degree of rurality, and further differentiate rural regions according to the level of development of non-agricultural employment while referring to their development performance. As the period of interest we choose the last two censuses (2001 and 2011). Secondly, we look at the components that affected the identified shifts in the employment structure. For this step we utilise the shift-share model in its classical form. By doing so, we are able to decompose the employment shift into three components: the national growth effect, the industry mix effect and the competitive effect.

The idea to map regional employment development originates from emerging processes that affect (hamper or improve) this development, either in social and/or economic terms. The drivers of change result in qualitatively and quantitatively different outcomes, mainly due to the regionally differentiated resource base, social and human capital endowments and economic evolutionary paths. Furthermore, differentiated dynamics among regions may also be related to the degree of flows of capital and transfers of knowledge and technologies. It is also important to consider regionally-based socio-economic and demographic structures (Abrhám, 2011).

Rural restructuring process or the story of the changing rural economy base

The weakened position of the agricultural sector as an economic driver and provider of employment has been the subject of much debate. Marsden (1995) specifically stresses the redefined role of agriculture both in social and economic life in rural areas as originated in the 1980s. The transition from productivism into post-productivism (Wilson, 2001) is considered to be one of the key factors of this. The transition resulted in a weakening of the ties between farmers and other rural dwellers, accompanied by globalisation and technological change that led to a decline in the demand for agricultural labour (Sotte, 2005; OECD, 2006). Moreover, a more consumption-based economy has evolved (Woods, 2005). Additionally, the rural space is being commercialised (Post and Terluin, 1997) as a result of (re)invention of new functions of rural space. In Czechia the concept of second homes (Fialová and Vágner, 2014) and farmers' markets (Spilková and Perlín, 2013; Spilková *et al*., 2013) are examples of how the 'brand' of rural can be commercialised.

The rural economy of the last few decades needs to be connected with the decline in agricultural employment and the increase in non-agricultural activities. Breitenfellner and Hildenbrandt (2006) used the term *tertiarisation* to refer to the rise of the tertiary sector. They point out that the countries that joined the European Union (EU) in 2004 are characterised by a process of catching-up of tertiarisation that is influenced by specific time-lag conditions for the development of service employment, mainly related to the legacy

of the centrally planned economy where manufacturing was strongly supported.

While the local economic conditions are the outcome of both local and non-local processes (Ward, 2006), we may anticipate a differentiation of this tertiarisation process not only from a macro perspective by comparing western and eastern Europe, but even more in regional terms at national level. The development may be differentiated in relation to proximity to economic centres as well as the performance of adjacent areas. We should also be aware of the fact that the economic composition of countries and regions results from an evolutionary process (Porter *et al*., 2004), when its path, speed and magnitude within boundaries of individual geographical units will depend both on inherited conditions that are local (location, resource base) and external (Porter *et al*., 2004). Lowering the macro into categorised micro perspective allows us to observe global processes with better understanding.

Regionally differentiated employment growth conditionalities

Regional disparities in economic (and related employment) growth generate both great interest as well as controversy among policy makers and planners. As Mitchell *et al*. (2005) rightly paraphrased the Keynesian macroeconomists, most differences in the sensitivity of regions to the business cycles (and therefore the existence of regional disparities in economic growth) are attributable to variations in the industry mix within each region. The understanding of the existing disparities, originated from the variations in the mix of industries, may be improved by the knowledge of the regional sectoral structures. It is related to the character of interrelations among sectors (e.g. the concept of clusters developed by Porter, 1998), the presence of diversified or specialised economic structure (e.g. Trendle, 1999, 2006; Mason, 2009; Mason and Howard, 2010; Nissan and Carter, 2010) or the existence of locational advantages (enhanced via agglomeration effects and externalities described by Marshall and Jacobs) (cited by Blažek and Uhlíř, 2011).

We proceed by identifying the main trends in employment growth in categories of regions of different degrees of rurality, using the aggregated groups of sectors (agriculture, industry and services) at the level of Czechia. The reasons for the use of aggregated groups are (a) that we can easily derive information on recent processes of interest – deagriculturalisation, deindustrialisation and tertiarisation; and (b) the focus is on the regional differentiation of above-mentioned processes, not to analyse detailed sectoral restructuring. Consequently, we look at differentiated categories of rural regions on the basis of non-agricultural employment development as it describes how well the regions cope with conditions for market-based sectors that are not dependent on natural resources. In order to be able to divide the growth into particular components, we adopt the shift-share analysis in its classical form in the further step.

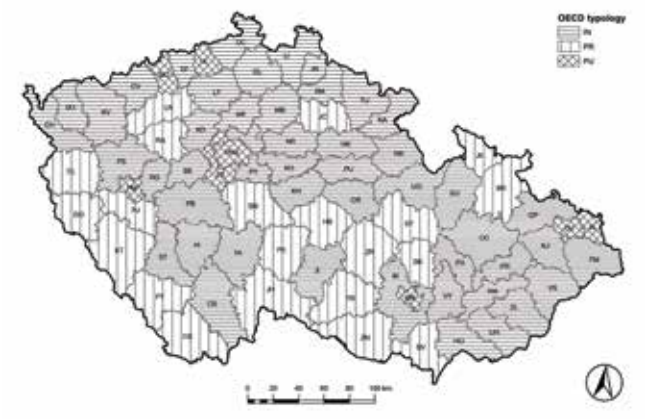

Figure 1: LAU1 regions of Czechia in 2011 according to the OECD typology of rurality (IN: intermediate; PR: predominantly rural; PU: predominantly urban).
Data source: CzSO (2012)

Methodology

Regional differentiation of rurality and non-agricultural employment

Analyses are made at the level of LAU1 regions (*okresy* in Czech) because of (a) their representative size with respect to the areas of regional labour markets (OECD, 1996) and (b) the data availability over the indicated time period (2001-2011). The regions were categorised according to the OECD typology (OECD, 2010) of predominantly rural (PR), intermediate (IN) and predominantly urban (PU) (Figure 1). Adoption of a lower population density threshold (e.g. 100 inh/km^2) would be counterproductive: according to his findings based on smaller settlement units (*obce s rozšířenou působností* or 'municipality with extended powers'), Perlín (2010) observes (p.193) that "under the conditions of the Czech settlement system, this value [150 inh/km^2] will enable a much more varied assessment of rural areas".

By applying the methodology proposed by Esposti *et al*. (2000), the LAU1 regions are further categorised into 'leading', 'average' and 'lagging' according to their non-agricultural employment development within the chosen time period. Leading regions record rates of non-agricultural employment development that are above the national growth rate by at least some percentage points (subject to choice). Similarly, lagging regions have rates of non-agricultural employment development that are lower than the national growth rate by at least some percentage points. Those regions with non-agricultural employment development between these two points are considered to have an average growth rate. In the example of Czech LAU1 regions, the categories are constructed by considering the decile distribution of non-agricultural employment development. By studying the development of non-agricultural employment, we are better able to understand the employment change in respective regions because, in the longer term, these sectors are expected to be the biggest providers of employment, especially in the rural regions most affected by agricultural labour decline.

As the reference time period we choose the years of last two censuses (2001 and 2011). This period includes the lead-up to Czechia's accession to the European Union (EU) and

more than half a decade of EU membership (2004-2011). The main data sources used for the analyses are provided by the Czech Statistical Office (CzSO). The division of LAU1 regions according to OECD categories are made on the basis of CzSO (2012) which provides the latest available data (from 2011). The regional data on employment are derived from the databases of the two censuses and the sectors of employment are gathered into three aggregated groups according to NACE Rev. 2 – agriculture (A), industry (B-F) and services (G-U).

Shift-share analysis

Shift-share analysis is a popular tool for describing regional and industrial growth over a particular time period (Herath *et al*., 2011). In the field of regional studies, employment data are most commonly used for the calculation of the components of the shift-share analysis (e.g. Ray and Harvey, 1995; Mayor and López Menéndez, 2005; Bielik and Rajčániová, 2008; Klein *et al*., 2009; Herath *et al*., 2011; Kowalewski, 2011).

The *shift* component refers to whether the local economy moved into faster (dynamic) or slower growth sectors. The *share* component then measures whether the larger or smaller share of growth occurs in a given sector in a given region (Kiser, 1992). As we refer to sectors in both definitions, the essence of the shift-share methods is in the breakdown of employment changes into instructive components describing the conditions under which growth is occurring (Ray and Harvey, 1995). The results of the shift-share analysis need to be interpreted and understood as signals only; they do not give any information on the ability of the region to maintain the dynamic (growing) sectors (Potomová and Letková, 2011). Also, the results cannot identify any locational advantages even if they signal some (Klein *et al*., 2009). The real *forte* of shift-share analysis is the discovery of employment change patterns across geographical areas (Ray and Harvey, 1995).

Based on the classical version of the model presented by Esteban-Marquillas (1972), the technique of shift-share analysis allows that "for a given period of time the regional growth of each sector can be divided into three components: national growth (g_{ij})[1], industry mix (k_{ij})[2] and competitive effect (c_{ij})[3]" (p.249). Therefore, the model will be constructed as follows:

$$d_{ij} = g_{ij} + k_{ij} + c_{ij} \quad (1)$$

where

$$g_{ij} = b_{ij} r_{CZ} \quad (2)$$

$$k_{ij} = b_{ij} r_{iCZ} - b_{ij} r_{CZ} = b_{ij}(r_{iCZ} - r_{CZ}) \quad (3)$$

$$c_{ij} = b_{ij} r_{ij} - b_{ij} r_{iCZ} = b_{ij}(r_{ij} - r_{iCZ}) \quad (4)$$

where b_{ij} = employment in sector i of region j, r_{cz} = national average rate of growth (in our case we use *CZ* as the abbreviation for Czechia), r_{iCZ} = national average rate of growth of sector i, and r_{ij} = growth rate of sector i of region j.

Therefore, by incorporating equations (2) - (4) into equation (1) we get:

$$d_{ij} = b_{ij} r_{CZ} + b_{ij}(r_{iCZ} - r_{CZ}) + b_{ij}(r_{ij} - r_{iCZ}) \quad (5)$$

The first two components are determined exogeneously while the third is the only endogeneous component in the model (Herath *et al*., 2011). Therefore the interpretations of national growth effect and industry mix effect are related to the rate of growth of the national economy and respective sectors irrespective of any regional changes. On the contrary, the competitive effect is endogeneously driven by considering the regional growth performance.

The value of the competitive effect component carries some other valuable information. For example, its positive value implies that the regional economy has been successful at attracting investment to a particular sector (Herath *et al*., 2011) that resulted in the better conditions for growth of a specific sector in a region. In other words it can also be interpreted as the comparative advantage for a region in a particular sector in relation to other regions. Moreover, combined with the positive industrial mix effect it shows the potential for a competitive advantage in that sector (Herath *et al*., 2011), derived on the local endowments as well as other factors of competitiveness localised in the region – e.g. strategy and structure of regional businesses and the intensity of local competitiveness, factors on the supply side (market size, market characteristics) and the existence of production clusters of relatively closed production chains (existence of follow-up and intertied industries) (Blažek and Uhlíř, 2011).

The classical shift-share analysis has been subject to many modifications. Esteban-Marquillas (1972) reacted to Rosenfeld´s critique on the classical shift-share model as follows: "Rosenfeld argues that the values that c_{ij} can take (4) are not only due to the special dynamism of the sector ($r_{ij} - r_{iCZ}$), but also to the specialisation of the regional employment in this activity, b_{ij}" (p.250). Therefore, he introduced the new element b'_{ij}, called *homothetic employment*, defined as the employment that sector i in region j would have if the structure of employment in that region was equal to the national structure. We incorporate homothetic employment as a way of deepening our present study.

[1] *National growth effect* (g_{ij}) describes the employment change that would have occurred if the region had grown at the same rate as the reference area. Moreover, as the region is a part of the reference area, it is assumed that any positive/negative employment change at the reference area will be mirrored by rising/declining change in regional employment (Klein *et al*., 2009).

[2] *Industry mix effect* (k_{ij}) measures the employment change that would have been experienced by the region if each of its industrial sectors had grown at the national rates for these sectors less the national growth effect (Herath *et al*., 2011). Moreover, it helps to identify fast/slow growing sectors or industries. In other words, it highlights those sectors that "have been playing a major role in employment growth" (Herath *et al*., 2011, p.162), both in positive and negative terms. A positive industry mix effect implies the existence of favourable distribution of fast growing industries in the region (Ray and Harvey, 1995).

[3] *Competitive effect* (c_{ij}) measures the regional employment change in an industry conditioned by regional factors (Klein *et al*., 2009). It is calculated as the difference between the actual change in employment of sector i in region j and the employment change that would have occurred if each industrial sector i in region j had grown at the national level (Herath *et al*., 2011). It collects the special dynamism of a sector i in region j by contrasting it with the dynamism of the same sector at the national level (Mayor and López Menéndez, 2005).

Results

Regional differentiation of employment development

The lagging regions are located by national and inner regional borders (Figure 2). The concentration of leading regions is most evident adjacent to Praha (PHA), particularly on the development axis from Plzeň (PM) to Mladá Boleslav (MB). Other leading regions are located around Brno (BM), the centre of Moravia. The category of average regions is more numerous by the southern national border and adjacent to the previously mentioned development axis.

Table 1 gives more details about the LAU1 regions according to their degree of rurality and non-agricultural employment development performance. It highlights their distribution among all regions as well as the respective population and area share. The most positive developments were recorded in two regions around Praha (PZ and PY). The data reveal their dominance in this development pattern within the group of leading regions (PU and IN). Therefore, they represent an additional category to the three OECD categories as they are subtracted from these and designated as suburban (SUB) regions.

The development of non-agricultural employment in Czechia from 2001 to 2011 was negative (-2.3 per cent). This number is connected with overall decline of employment (-3.9 per cent) (Table 2). Moreover, within the time period 2001-2011 there was the period of economic crisis (starting from 2008) that inevitably affected both the business climate as well as the investment environment. However, the employment dynamics among the categories of regions seem to be rather differentiated. The decline in overall employment was highest in the PR regions, in contrast to a substantial increase in SUB regions. Agricultural employment declined and service employment increased in all categories of regions but to differing extents.

The most positive changes in employment were observed in leading IN, followed by leading PU and leading PR LAU1 regions (Figure 3). The means for all three categories the percentage increase in employment exceeded the national

Table 1: Number of Czech LAU1 regions and their area and population share according to OECD typology and level of non-agricultural employment development, 2011.

Category	Number	Area share %	Population share %
Predominantly rural	21	34.8	16.8
leading	4	6.3	3.2
average	6	9.3	6.0
lagging	11	19.3	7.6
Intermediate	47	60.2	55.5
leading	15	19.4	19.1
average	8	10.8	9.5
lagging	24	30.0	27.0
*Predominantly urban**	7	3.2	25.1
leading	2	0.9	15.4
average	1	0.3	1.8
lagging	4	2.0	7.9
Suburban	2	1.7	2.6

*including Praha
Data source: CzSO (2012)

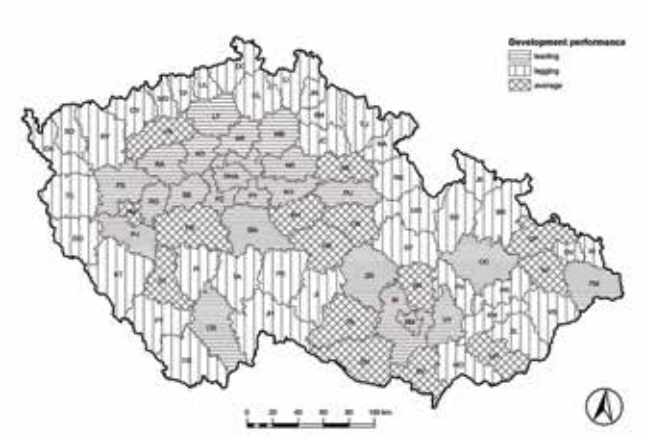

Figure 2: LAU1 regions of Czechia according to their level of non-agricultural employment development during the period 2001-2011.
Data sources: Czech Statistical Office (CzSO) censuses of 2001 and 2011

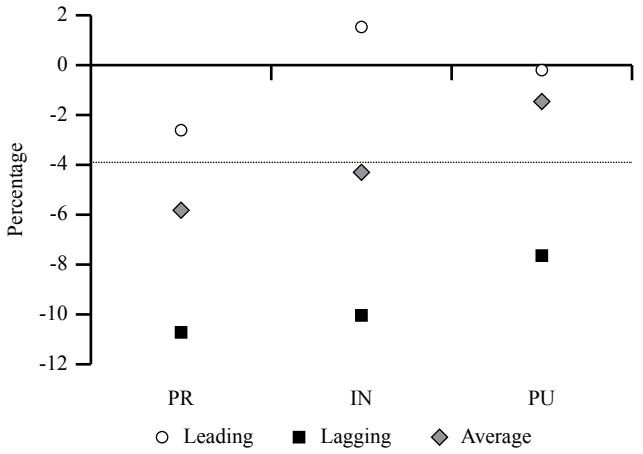

Figure 3: Employment growth in Czech LAU1 regions according to their level of non-agricultural employment development.
The dotted line indicates the change in total employment across Czechia
Data sources: CzSO censuses of 2001 and 2011

Table 2: Employment profile and change (per cent) in employment between 2001 and 2011 by aggregated groups of sectors in Czech LAU1 regions according to OECD typology.

OECD category	Agriculture			Industry			Services			Total change
	2001	2011	change	2001	2011	change	2001	2011	change	
PR	9.4	6.3	-38.4	43.9	41.3	-13.1	46.7	52.5	4.0	-7.5
IN	5.0	3.3	-37.6	44.3	40.9	-12.5	50.6	55.8	4.4	-5.2
PU	0.9	0.6	-28.0	29.7	25.5	-16.5	69.4	73.9	3.9	-2.5
SUB*	3.6	1.8	-28.1	33.8	25.7	9.6	62.5	72.5	67.5	44.5
All regions	4.7	3.0	-37.3	40.3	36.5	-13.0	55.0	60.4	5.6	-3.9

*SUB is subtracted from respective IN and PU category
Data sources: CzSO censuses of 2001 and 2011

average. By contrast, the lagging PR regions performed the most poorly. In this case, the low population density only supports the negative cumulative effect – the higher the degree of rurality, the more lagging performance in terms of employment development.

In all categories of LAU1 regions any positive changes in employment are related to the service sector (Figure 4). A slight decline occurred in employment in industry and overall performance was hindered by the decline of employment in agriculture. This supports the evidence presented by Breitenfellner and Hildebrandt (2006) on the catching-up of tertiarisation. Interestingly, the three categories of PR regions achieved the highest increases in service employment in comparison with the other OECD categories in the respective sub-groups. However, this created potential was more than offset by the declines in employment in agriculture and industry.

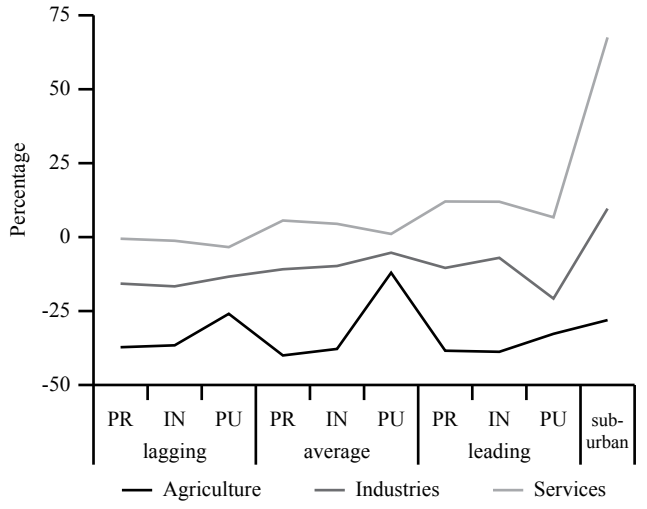

Figure 4: Rate of change in employment by aggregated groups of sectors in Czech LAU1 regions between 2001 and 2011 according to OECD typology and their level of non-agricultural employment development.

Data sources: CzSO censuses of 2001 and 2011

Regionally based employment growth components

The components of regional employment changes by sector according to OECD categories of LAU1 regions are presented in Table 3. By decomposing these changes into particular components while adopting the shift-share model in its classical form, the national growth component is seen to be negative in all cases (both total values and values for the aggregated groups of sectors). This indicates that this much employment would have been lost if the regional employment (overall and in aggregated groups of sectors) had followed the overall/national trend, i.e. a decline of 3.9 per cent. The values differ with respect to the size of the regions, and therefore the size of the regional labour market. Where it is relevant, the national growth effect is related to actual growth by stressing its role in employment decline.

Several points may be stressed. The negative value of the *national growth component* in agriculture is smaller than for the other two groups of sectors, indicating their minor role in the employment change. The pressure of the national growth effect on the employment performance in regions and aggregated groups of sectors was scaled by the size of the regional labour markets. The effect of agriculture on employment change is small in absolute terms, and this is mainly due to its regional size scaling as well as the reorientation of the economy from traditional industries towards service employment.

The *industry mix component* is used to indicate the presence of fast/slow growing industries in regions relative to the national average. The results of this component in terms of the OECD categories of regions highlight two findings. Firstly, in all categories the aggregated group of services has the highest absolute numbers. Secondly, for PR regions and IN regions, the total employment change attributed to the component of industry mix is negative. This is due to their unfavourable structure of sectors (Table 2). The performance of fast-growing service groups was negatively outperformed by those of the agriculture and industry sectors that are of

Table 3: Components of employment shift in aggregated groups of sectors in the period 2001-2011 in Czech LAU1 regions according to OECD typology (persons employed).

OECD category	Aggregated sectoral groups	National growth effect	(%)*	Industry mix effect	Competitive effect	Actual growth
PR	Agriculture	-2949	10.1	-25247	-881	-29077
	Industry	-13756	29.8	-32016	-349	-46121
	Services	-14634		35572	-6081	14858
	Total	-31339	51.9	-21691	-7310	-60340
IN	Agriculture	-5167	10.4	-44237	-418	-49822
	Industry	-45684	31.2	-106325	5770	-146239
	Services	-52162		126797	-16086	58549
	Total	-103013	74.9	-23765	-10733	-137512
PU	Agriculture	-415	13.9	-3555	983	-2987
	Industry	-14181	23.7	-33005	-12695	-59882
	Services	-33093		80444	-14694	32657
	Total	-47690	157.9	43884	-26407	-30212
SUB	Agriculture	-134	13.9	-1145	316	-963
	Industry	-1254		-2920	7274	3100
	Services	-2319		5636	36861	40178
	Total	-3707		1571	44451	42315

* Percentages only shown where actual growth was negative

Data sources: CzSO censuses of 2001 and 2011

higher absolute size in the regional employment structure. In contrast, PU and SUB regions benefit from higher shares of service employment.

The remaining component of the shift-share decomposition – *the competitive effect* – is used to measure the regional employment change in an industry conditioned by regional factors, and so to indicate the existence of locational advantages for the specific sectors in the region. The most remarkable results related to this component are the following. Firstly, PR regions were not able to offer any locational advantages in any of the three aggregated groups of sectors that would nurture the environment for further employment development. Secondly, IN regions created the conditions for the development of employment in industry that might have been attributed to the increase of 5,770. Thirdly, surprisingly, the category of PU regions recorded positive values for competitive effect in agriculture that would indicate existing locational advantages. This is in conflict with the overall decline in agricultural employment (Table 2). What the competitive effect identified is the rate of growth of employment in agriculture that is regionally higher than in Czechia as a whole. In a very cautious manner we may interpret this finding by stressing the sensitivity of the sector to the global and structural changes. What affects the rate of employment change in agriculture (Table 2) in PR and PU regions is not just the absolute numbers of persons employed in agriculture that are used for the calculation, but more importantly the description of those that are employed in agriculture and report their place of residence either in PR and PU regions. In PR regions, these are traditionally farmers and agricultural workers. On the other hand, those residents from PU regions reported as employed in agriculture are rather business managers and land owners. The fluctuation of employment within these two categories is then self-evident. Finally, only SUB regions gained with respect to regional conditions and the positive employment development in all three aggregated groups of sectors.

Shift-share analysis at the level of LAU1 rural regions and aggregated groups of sectors

Here we look at the components of employment change for individual rural LAU1 regions. Firstly, in agriculture the national growth component is negative in all cases (Figure 5) but we again should refer to the absolute size of the effect conditioned by the size of the regions. The industry growth component in relation to agriculture is also negative. This result is evident also from Table 2, where the decline in agriculture is the highest. The share of the sector in the employment structure only enhanced the magnitude of the negative consequences for regional employment. The competitive effect differs between regions, with just five positive values, and even these are not big enough to contribute positively to the employment growth in the aggregated group of agriculture. In summary, the employment growth effect in agriculture is of minor importance for the overall employment shift – the size of the effects is both conditioned on the regional size as well as on the share of the agriculture in regional employment. Therefore, although negative numbers recorded in this category do play a role in employment

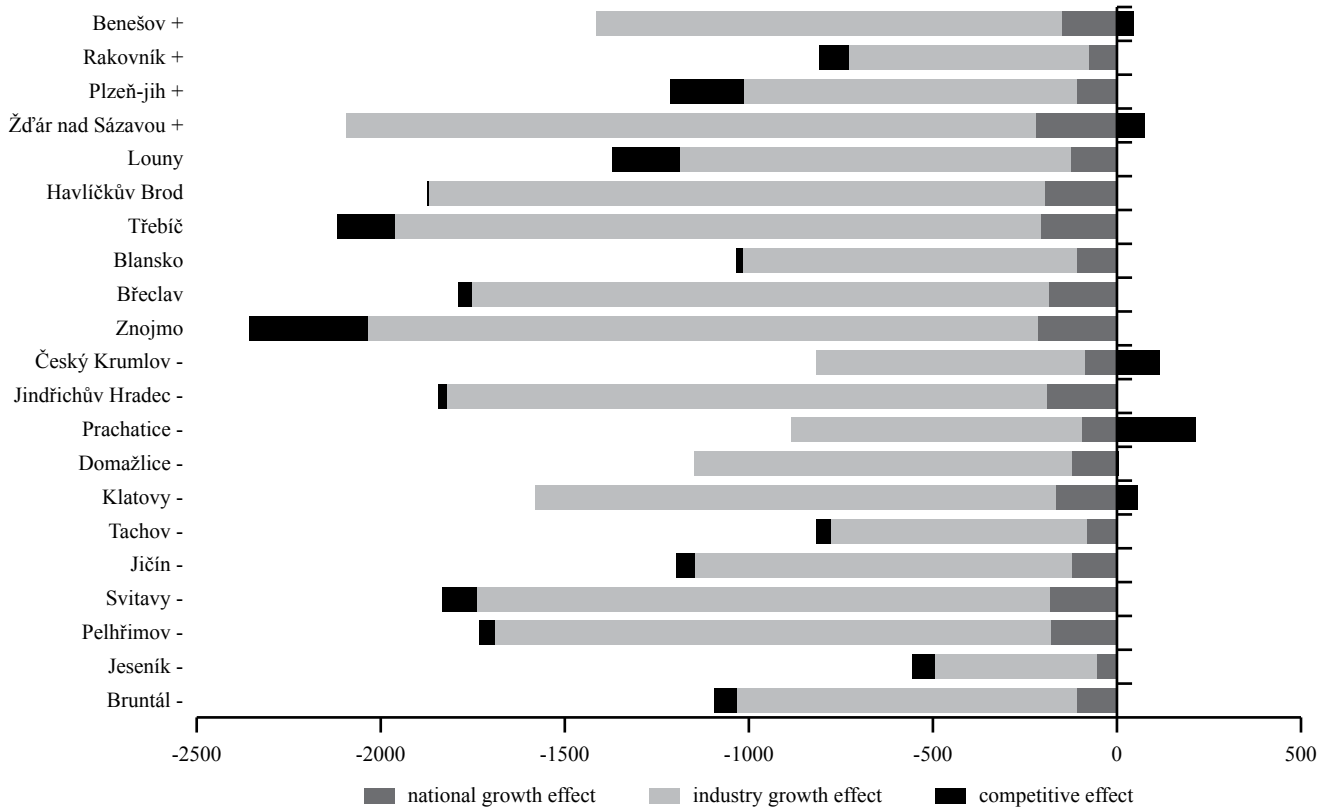

Figure 5: Employment shift in the aggregated group of agriculture in PR Czech LAU1 regions, components of shift-share analysis of 2001-2011.

Note: - refers to lagging region, + refers to leading region, the others are average regions
Data sources: CzSO censuses of 2001 and 2011

decline, it is of lesser importance than in the remaining two aggregated groups.

Secondly, we look at the components of employment change in the aggregated group of industry (Figure 6). This group has a higher share of regional employment, therefore, also the size of three components of employment change will be higher than for agriculture. The national growth component is again negative in all cases. Combined with the negative values of industry mix effect, these two factors are playing the major role in the employment decline as regards the aggregated group of industry. Although the competitive effect is strong in some examples (e.g. Plzeň-jih, Louny, Žďár nad Sázavou and Břeclav), it is outperformed by the negative change of those two components. Moreover, the differentiation of the competitive growth effect in the aggregated group of industry at LAU1 region level divides the respective rural regions into those that were successful in attracting industrial investment (positive competitive effect) and those that were not (negative competitive effect).

Thirdly, attention is paid to the aggregated group of services (Figure 7). This group is the most influential in relation to the number of jobs that are affected by the changes that have occurred. The national growth effect is negative in this aggregated group. This result is not surprising, because the component reflects the changes that would have been occurred with respect to the employment in a respective group if it had followed the overall (national) employment development, and in the period 2001-2011 this was negative. However, the industry mix effect is of higher (in the meaning of being positive) importance than it was in the case of the aggregated groups of agriculture and industry. Therefore, the aggregated group of services can be considered to be truly the driver of positive employment change – the most vital employment provider and creator. The term 'positive' refers rather to its possibility to generate employment than any effect that would be able to sustain overall positive employment development because it is also influenced by effects of employment shift in other aggregated groups as their share in regional employment structure is significant.

According to Herath *et al*. (2011), the combination of positive industrial mix effect and the positive competitive effect implies the prerequisite for the competitive advantage in the respective sector. We may find examples of this in the rural LAU1 regions of Žďár nad Sázavou, Plzeň-jih, Rakovník, Benešov, Znojmo and Blansko. With the exceptions of Znojmo and Blansko, the named regions belong to the classified leading category. Therefore, the overall performance in these regions is unarguably influenced by the presence of positive industrial mix as well as the locational advantages they can offer to service sectors. On the other hand, the other regions lack the dynamism of the employment growth in this aggregated group. The possible reasons may be the incorrect or inadequate utilisation of the development factors (e.g. infrastructure) or an even more recently pronounced development pre-requisite – the institutional environment and its capacity. In both cases (industry and services), the presence of positive competitive effects in some regions deserves further investigation that is beyond the scope of this paper.

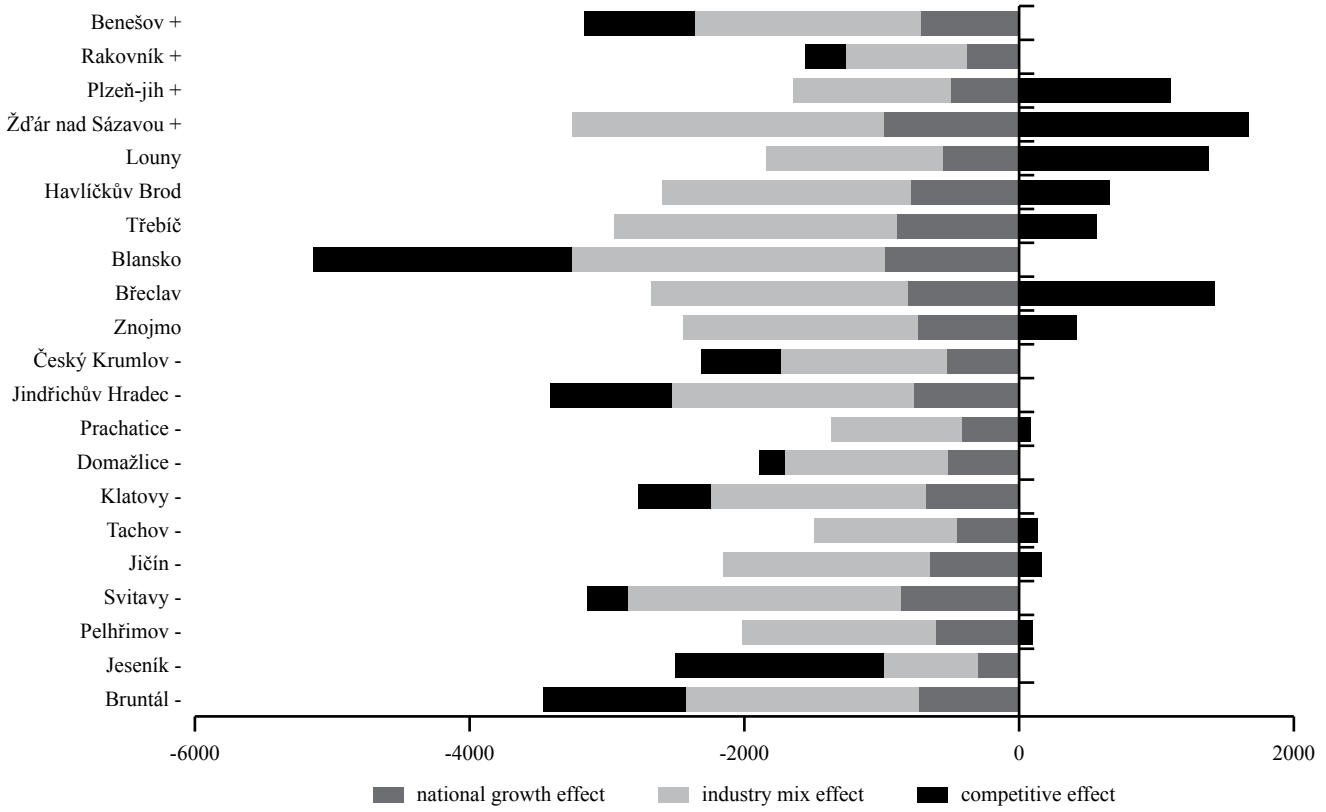

Figure 6: Employment shift in the aggregated group of industry in PR Czech LAU1 regions, components of shift-share analysis of 2001-2011.

Note: - refers to lagging region, + refers to leading region, the others are average regions
Data sources: CzSO censuses of 2001 and 2011

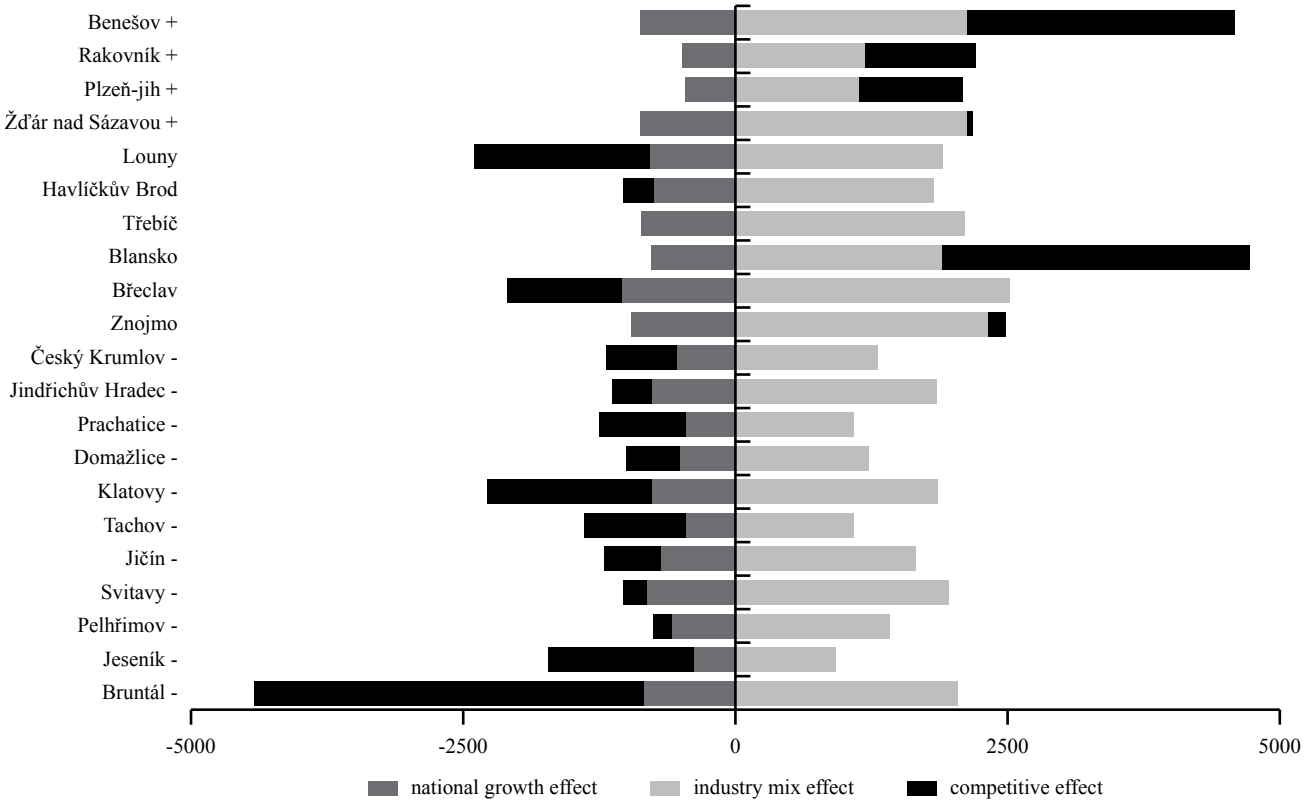

Figure 7: Employment shift in the aggregated group of services in PR Czech LAU1 regions, components of shift-share analysis of 2001-2011.

Note: - refers to lagging region, + refers to leading region, the others are average regions
Data sources: CzSO censuses of 2001 and 2011

Influence of competitive effect shift on total shift

So far we have described the components of employment growth in absolute terms. As previously mentioned, the size of these effects is conditioned on the absolute size of the regional labour market. Therefore, for analytical reasons we calculate the relative competitive effect[4]. Its value may be interpreted as the potential for regional employment shifts to influence the total shift in respective aggregated groups of sectors and irrespective the size of the region.

Quite favourable conditions present locally are in leading and average rural regions when these generate employment thanks to the locational advantages in two aggregated groups – industry and services. On the contrary, the lagging rural regions seemed to be the ones suffering from the lack of locational advantages for more progressive sectors besides the traditional – agricultural – one. Even if the presence of locational advantages is quite clear in the examples presented in Table 4, this fact does not directly imply that it would be the fruitful generator of employment. Therefore, not only is their presence crucial but more importantly the contribution they make to the employment shift. The relative values of the competitive effect are rather small: they vary from 0.02 per cent (aggregated groups of services in average rural regions) to 3.01 per cent (aggregated groups of services in leading rural regions).

[4] Calculated as the absolute size of the competitive effect compared to absolute employment at the beginning of the period. The percentage deviation of the competitive effect results (Klein *et al*., 2009).

Table 4: Competitive effect share of employment shift in the aggregated groups of sectors in Czech LAU1 rural regions, 2001-2011 (absolute and relative shift).

	Category:	Leading	Average	Lagging
Agriculture	Absolute	-163.28	-726.05	8.54
	Relative (%)	-0.11	-0.26	0.00
Industry	Absolute	1675.10	2549.69	-4573.81
	Relative (%)	1.12	0.91	-1.22
Services	Absolute	4491.13	43.62	-10615.36
	Relative (%)	3.01	0.02	-2.84

Data sources: CzSO censuses of 2001 and 2011

Discussion

In Czechia, at national level there has been an increase in service employment that corresponds with global changes. At the same time, mechanisation and improved production operations have led to declines in both agricultural and industrial employment. While referring to the aggregate group of industry, we may also point out that not only technological improvements but more importantly the global production markets (and related global production networks) have conditioned the changes in employment.

Furthermore, the magnitude of these changes is further conditioned by the regional degree of rurality. Because we operate at the level of aggregated group of services, we cannot fully assess the quality of this change in terms of the level of knowledge utilisation. With regard to the PR regions, their performance of service employment exceeded their IN and PU counterparts in all non-agricul-

tural employment development groups. This highlights the evidence on (re)invention of rural functions other than production that demand labour (e.g. recreation and tourism). Furthermore, the differentiation of PR regions in terms of non-agricultural employment development shows the heterogeneity that exists among them as was noted in the employment growth components of the respective sectors. It is attributable to their location – mainly in those areas adjacent to the capital that offer many development opportunities as characterised by the presence of infrastructure, business networks etc.

The decomposition of employment growth using shift-share analysis further supports the role of the service sector as the viable employment provider when the major increase is recorded due to their positive industry mix effect. In PR regions the positive value of the competitive effect in service employment is outperformed by the two other aggregated groups. The inner differentiation of components between lagging and leading categories reveals the presence of positive cumulating effects in the leading category in contrast to the lagging one. Furthermore, the non-agricultural employment development used as the differentiation characteristic is considered to differentiate the overall development in more complex way. What needs to be taken into account is the location itself, the existence of economic spillovers, as well as the path dependency. Referring to the latter, the utilisation of locational advantages needs to be considered from the external perspective but, most importantly, the inner conditionalities are those that operate as the base allowing/hindering the development strategies. These can be described as the quality of institutional environment, industrial tradition, image of the local economy, quality of human capital etc.

The SUB regions recorded the highest increases of service employment in the period of observation and we expect this trend to continue. Therefore, rural regions in general (and not only these) will be further threatened by the existence and the power of these strong development centres and their spread effects in adjacent areas. However, following the trend of rural commodification and the related change in lifestyles, rural areas will even more be considered to be the source of goods and services demanded by (mostly urban) customers (e.g. in the form of second homes or farmers' markets). Therefore, the potential of rural employment development is inevitably in the service provision of recreation, tourism, adventure and other place-specific activities, as well as partially in non-mass agricultural production. What remains as a threat in future is their dependency on externally defined needs related to the traditional attributes of rural areas. The extent to which rural employment would copy and adjust to urban-based tastes limits the potential for growth and challenges the qualitative change of rural labour markets (education, skills).

Surprisingly, the relativised strength of the competitive effect on overall employment change is rather small. Therefore, for further research it is advisable to reconsider the research design. The focus should be on the construction of precise regional categories as well as the possibility to incorporate further disaggregated groups of sectors.

Acknowledgement

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BÓTÁNÉ HORVÁTH Noémi*, KATONÁNÉ KOVÁCS Judit* and SZŐKE Szilvia

Building an entrepreneurial environment in rural regions: a possible way to develop human and social capital

The main hypothesis behind the paper is that creating an entrepreneurial team learning environment is a way to increase human and social capital in rural regions. Our work, based on literature review and primary research, tries to show that this process could support a shift in people's attitudes from being reactive to creative and also interdependent. The results of a Delphi survey show that all four 'spheres' of the Quadruple Helix model in rural development (government, science/university, business/industry and civil society) should play a role in the development of a learning environment, but that more importance should be attached to 'pull' type of learning designed to draw out people and resources as needed to address opportunities and challenges. In a second survey, among farmers in the Hungarian settlement of Mezőcsát, we found significant differences in the use of information channels by different age groups. Personal meetings are preferred by older farmers and the Internet by younger farmers. With regard to the Quadruple Helix model spheres, from the government sphere farmers' advisors play the most important role while from the business/industry sphere the most important relationship for farmers is with their peers. We conclude that the four spheres must create an 'outside-in' and 'inside-out' partnership. As creating entrepreneurial culture is a slow process, existing elements, such as the LEADER programme, building on those farmers who are ready to take part in rural development and the preferred usage of the Internet by the younger generation, have to be used.

Keywords: personal mastery, entrepreneurial team learning environment, rural development

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Introduction

Although there are many factors that can affect the development of rural regions (for example natural resources and geographical characteristics), earlier participatory action research by the authors has shown that, among these factors, human and social resources are the most important (Katona Kovács and Bótané Horváth, 2012; Katona Kovács *et al*., 2012; Bótané Horváth, 2013). The focus on human and social capitals can be explained in terms of the dimensions of sustainability (nature, society and economy) as follows: *nature* (planet) creates the frame, the limits of growth, while *society* (and people as part of society) has to learn and understand this system and to become conscious consumers. On the other hand people have to become conscious *creators* of physical and financial capital and now, because of the growth in the world's technological capacity to store information (Hilbert and López, 2011), so-called 'big data' capital, and these three capitals make up the third, *economic* dimension of sustainability.

Senge *et al*. (1994) drew attention to people's different views of their relationship with the world: *reacting* orientation ("the world is happening to me"), *creative* orientation ("I create my future") and *interdependent* orientation, which is when, although recognising their integrity as separate person, they also feel 'a part of' the system. With regard to how we create our own reality and how we can change it, Senge (1990) lists five disciplines which will not be successful without each other: *system thinking*, *personal mastery*, *mental models*, *team learning* and *shared vision*. In the case of personal mastery (which starts with clarifying the things that really matter to us, of living our lives in the service of our highest aspirations), Senge stresses that there are only few people who are ready to develop themselves to be able to lead their own lives. "No one can increase someone else's personal mastery. We can only set up conditions which encourage and support people who want to increase their own" (Senge *et al*., 1994, p.193). We do not live in any of these frames of mind all of the time: we might have an *interdependent* attitude toward civic life, a *creative* attitude toward work and a *reactive* relationship with people with whom we regularly interact (Senge *et al*., 1994).

Creating an entrepreneurial environment in rural regions could support a shift from being *reactive* to *creative* and also *interdependent*. Our hypothesis is that, similarly to organisations – "An organisation develops along with its people" (Senge *et al*., 1994, p.193) – increasing the number of those who are ready to develop their personal mastery could promote the development of rural regions.

Building this entrepreneurial, encouraging and supportive environment could follow the 'Big Shift' approach developed by Hagel *et al*. (2010). This involves a change from a 'push' paradigm that still pretty much dominates how we act, to a 'pull' paradigm that sets out new ways to operate and engage. 'Push' approaches begin by forecasting needs and then designing the most efficient systems to ensure that the right people and resources are available at the right time and the right place, using standardised processes. For example, we are *pushed* into educational systems designed to anticipate our needs over twelve or more years of schooling and our key needs for skills over the rest of our lives; or we consume media that have been packaged, programmed and *pushed* to us based on our anticipated needs. 'Push' approaches treat people as passive consumers whose needs can be anticipated and shaped by centralised decision makers. 'Pull' is a very different approach, defined by Hagel *et al*. (2010) as the ability to draw out people and resources as needed to address opportunities and challenges. Using 'pull', we can create the conditions by which individuals, teams and even institutions can achieve their potential in less time and with more impact than before. 'Pull' is about expanding our awareness of what is possible and evolving new dispositions, mastering new practices and taking new actions to realise those possibilities.

Addressing the question of how rural development should proceed in an age of austerity, Shucksmith (2013) suggests action at two levels: supporting networked actions at the local level while also rural proofing national, devolved and local policies. In our understanding, in order to create networked actions the above-mentioned *personal mastery* of local actors has to be strengthened. Becoming an active member of a network demands answers to questions at the level of the individual such as: what is my personal vision, what kind of networks I would like to belong to, and what role could I play there which could help the network's development and also my own.

We agree with Shucksmith that networked actions are needed. Hausmann *et al*. (2011) argue that the secret of modern societies is not that each person holds much more productive knowledge than those in a more traditional society. The secret to modernity is that we collectively use large volumes of knowledge, while each one of us holds only a few 'bits' of it. Society functions because its members form webs that allow them to specialise and share their knowledge with others. The more knowledge ('bits') one holds and the more colourful/diversified the 'bits' owned by local people the more they can share and use to build their region. As with biodiversity, higher 'knowledge diversity' of a region could increase the resilience of it. Also, the content and actors of knowledge transfer have changed radically over time, and along with this change, information has become a resource which can be easily shared. Marti *et al*. (2013) show how the very emergence of an entrepreneurial community is influenced by the contact with 'external insiders' or 'known strangers' who develop intellectual, social and affective ties with community members and help them to organise themselves and mobilise for action. They suggest that this contact is all the more effective when the community is progressively segmenting into different sub-groups of actors who are encouraged to take on particular actions, these actions contributing in turn to strengthen the entrepreneurial collective culture of the community.

Finally, the so-called Quadruple Helix model (government – science/university – business/industry – civil society) is applied. This is a development of the Triple Helix concept that interprets the shift from a dominating industry-government *dyad* in the Industrial Society to a growing *triadic* relationship between university-industry-government in the Knowledge Society (Stanford University, undated). The relationship between civil society and the Triple Helix has been conceptualised variously. In this paper civil society is understood as an 'institutional sphere' that is similar in nature to the three Triple Helix functional spheres. Carayannis and Campbell (2014) ascribe the following attributes and components to the fourth helix: 'media-based and culture-based public', 'civil society', and 'arts, artistic research, and arts-based innovation'. In this way the fourth helix represents the perspective of the 'dimension of democracy' or the 'context of democracy' for knowledge, knowledge production and innovation. Bock (2012) points out that social innovation requires new methods of innovation, characterised by processes of co-design or co-construction and collaboration with society.

By bringing together the elements introduced above, namely the human and social resources of rural regions; personal mastery and the shift from 'push' or reactive to 'pull' or creative orientation; networked actions, also with 'external insiders'; economic complexity; and the 'institutional spheres' in the Quadruple Helix model, this paper tries to answer the question how to build a more entrepreneurial, team learning environment in rural areas. We ask five questions: (a) what opportunities do residents have for their personal and professional development, (b) how important are the 'push' and the 'pull' types of learning, (c) who are the most important actors from the Quadruple Helix model to help rural citizens when 'push' and 'pull' types of learning are in focus, (d) how do farmers process information in a small Hungarian rural settlement in the 21st century, and (e) how do these farmers participate in the development of their rural settlement.

Methodology

A two-round Delphi survey was carried out to answer the first three research questions listed above. The survey was carried out in June and July 2014. The first round had 16 participants (three men and 13 women), while the second had 15. Participants with an interest in rural development from each sphere of the Quadruple Helix model took part, selected as follows. A representative from each sphere was recruited from each of two rural settlements in the NUTS 2 region of Northern Hungary, namely Mezőcsát (population 6,500), where the authors have been involved in participatory action research since 2009, and Noszvaj (population 2,000), where one of us has worked as an innovation broker since early 2014. Five interviewees came from Mezőcsát (a teacher, a mixed crop-livestock farmer, a transport and logistics entrepreneur, a representative of the association of the Mezőcsát Small Region Community and a rural development rapporteur from the small region office). Four came from Noszvaj (the leader of the local Integrated Community Service Centre, an entrepreneur in real estate, a local government representative and a person working with local groups through tenders in the field of local development). The remaining participants were drawn mainly from the neighbouring North Great Plain NUTS 2 region and two of them from Budapest (two entrepreneurs in the field of commerce and from a family business, a professor in education and an assistant professor in rural development from the University of Debrecen, a cultural coordinator at the National Institute for Culture, a senior planner from the VÁTI Hungarian Nonprofit Company for Regional Development and Urban Planning, and one of the founders of the Community Developers Association).

Prior to the Delphi survey, participants were briefed about the relevant concepts, such as the Helix Model and 'push' and 'pull' types of learning. In the first round of the survey respondents were firstly asked to evaluate on a scale from 1 to 10 (where, for example, 1 stood for *not important* and 10 stood for *essential*) the importance of personal and professional development of local actors, and were also asked to list the possibilities they see for personal and professional development of local actors. Secondly, the respondents were

asked to assess the importance of 'push' and 'pull' types of learning, and the roles of the Helix Model spheres in learning. In the second round respondents were asked to discuss the results of the first round, and had the opportunity to make comments.

To answer the fourth and fifth research questions, a survey was carried out in Mezőcsát in the spring of 2014. The survey covered farmers who applied for the single area payment scheme (SAPS) of the Common Agricultural Policy in 2012. They were selected from the database of the Hungarian Agricultural and Rural Development Agency. According to the dataset of 2012, 108 farmers registered for the SAPS in Mezőcsát, of whom 103 were contacted. Seventy-two questionnaires were returned from which 60 were suitable for evaluation. Of the 60 respondents, 19 were women and 41 were men. The statistical significance of the differences in responses between farmers of different age groups was tested. Although analysis of variance (ANOVA) is commonly used, in our case the assumptions of ANOVA were not met, so we applied non parametric tests. The non parametric equivalent of the one-way analysis of variance is the Kruskal-Wallis test (Vince and Verbanova, 1993). The sample size of the groups should be at least five, which was fulfilled. The Kruskal-Wallis test can show whether the scores of the different age groups are significantly different. For the pairwise comparisons we applied the Mann-Whitney U test (Malhotra, 2005).

Results

Delphi survey

The Delphi survey participants assessed the importance of personal and professional development for building a more entrepreneurial, team learning environment in rural areas (and, by implication, for rural development) to be extremely high but the motivation for such development to be quite low (Table 1). In the second round of the survey there was not only agreement between the respondents that personal and professional development are essential factors in rural development, but it was also mentioned that both types of development are needed not independently but side by side. There was also agreement between the respondents that strengthening motivation for personal and professional development is needed.

In the first round of the Delphi survey respondents were asked to list opportunities they see for *personal development*, while in the second round they were asked to rank them. Twenty-one opportunities were identified and for each respondent the highest ranked opportunity was scored 1, the second was scored 2, and so on. The mean results were as follows: family was ranked first (1.4), followed by human relations and conversations (2.2), while school (2.6), communities (3.0) and kindergarten (3.3) were also listed as important opportunities.

The same questions were asked in the case of *professional development*, with the following results. Education based on local demand was ranked first out of 23 opportunities (1.7). The respondents believe that education must be flexible, practice oriented, high quality, local, correctly timed and properly funded. Learning through practice (2.2), communication between local experts and exchanging experience (2.2) were joint second. Volunteer work and internship (2.3) empowerment and support (2.3) communication and dialogue (2.5), development of new perspectives (2.8), lectures, vocational days and programmes (2.9) learning from each other (2.9), networking (2.9), integrated, holistic perspective training (3.0), study trips (3.1), communication with actors outside the region (3.4), foreign language (3.5), common actions (3.5), Internet (3.7) and books and newspapers (3.9) were ranked highly by the respondents.

For rural development the respondents considered 'pull' type of learning to be more important than 'push' type of learning, but in their experience the presence of 'pull' type of learning is very low (Table 2). In the second round of the survey the respondents emphasised that both approaches are needed, and it depends on the situation which one is more important.

To the question "which are the most important spheres of the Quadruple Helix model for rural development – in the present and in the future – when development of a learning environment is in focus, and how important is their role in creating 'pull' and 'push' types of learning environments", the respondents' opinion was that today the government sphere plays the most important role when 'push' type of learning is examined (Table 3). The roles of the other segments in 'push' type of learning have to be strengthened in the future. At present, each sphere except government is

Table 1: The importance and motivation of personal and professional development in rural areas of Hungary.

Importance of personal development	8.6
Importance of professional development	9.5
Motivation for personal development	3.8
Motivation for professional development	4.8

1: not important/very low level; 10: essential/very high level
Source: own data

Table 2: The importance and presence of 'push' and 'pull' types of learning in rural areas of Hungary.

Importance of 'push'	6.9
Importance of 'pull'	8.4
Presence of 'push'	6.1
Presence of 'pull'	3.3

1: not important/very low; 10: essential/very high
Source: own data

Table 3: The importance of the four Quadruple Helix model spheres in creating learning environments in rural areas of Hungary.

Helix model sphere	Role from the perspective of:					
	'push' learning			'pull' learning		
	Present	Future	Change	Present	Future	Change
Government	9.1	7.7	- 1.4	5.9	8.1	+ 2.2
Science/ university	6.2	8.7	+ 2.5	6.9	8.4	+ 1.5
Business/ industry	4.1	6.6	+ 2.5	4.9	6.4	+ 1.5
Civil society	3.2	7.6	+ 4.4	5.6	7.9	+ 2.3

1: not important; 10: essential
Source: own data

Table 4: The importance of the science/university and business/industry spheres of the Quadruple Helix model in creating learning environments in Mezőcsát and Noszvaj, Northern Hungary.

Helix model sphere	Mezőcsát		Noszvaj	
	Role from the perspective of:			
	'Push'	'Pull'	'Push'	'Pull'
Science/university	8.8	8.4	2.5	7.5
Business/industry	1.8	2.2	5.5	7.5

1: not important; 10: essential
Source: own data

considered to have a higher role in the case of 'pull' type of learning, but all four spheres must have increased roles in the future. In the second round of the survey, with the exception of two respondents there was agreement that all four spheres have similar responsibly in creating both 'push' and 'pull' types of learning environments.

Some differences were identified between settlements. In Mezőcsát the role of the science/university sphere in creating a learning environment was evaluated very highly while in Noszvaj the business segment is stronger, at least for 'push' type of learning (Table 4).

Questionnaire

Although with the development of information technology the number of information channels is increasing, for farmers in Mezőcsát personal meeting is still the most important channel both in the case of getting (consuming) and giving (providing) information (Table 5). The second most important channel (forums and programmes) is also linked to direct contact between people, without the use of IT. In the case of consuming information, after personal contacts television, radio and Internet scored more than 3.0, while in the case of providing information, after forms of personal contact (personal meetings, forum) the Internet is the only channel with a score 3.0. Clearly for farmers in Mezőcsát the Internet already plays an important role in information flow.

The process of generation change observed in agriculture produces interesting results in the use of information channels. In our analysis we created three age groups: young (24-41 years), middle-aged (42-59 years) and old (60-77 years) people. These age ranges are of equal size (17 years) and similar numbers of respondents belong to each group (19, 21 and 20 farmers respectively). We compared the scores given by the respondents in each age group. The young age group use modern technical tools, such as the Internet, blogs and Facebook® as their primary information channel, while radio is preferred by older people. Taking part in forums or programmes is not a preferred way of communication for the younger farmers of Mezőcsát. While we found significant differences between the information channels used by the different age groups (Table 6), there were no differences between women and men (data not shown).

The farmers were asked who, through personal meetings, they considered to be their most important contacts among the four Quadruple Helix model spheres for information sharing. From the government sphere, farmers' advisors play the most important role (Table 7). This is a personal relationship between the farmer and the advisor. The Agricultural and Rural Development Agency is in second place, while

Table 5: Importance of different information channels for farmers in Mezőcsát, Northern Hungary, 2014.

Information channel	Importance in case of	
	consuming information	providing information
Personal meetings	4.9	4.5
Forums, programmes	4.2	3.5
Newspaper	4.2	1.5
Television	3.7	1.5
Radio	3.5	1.6
Internet	3.3	3.0
Book	2.6	1.2
Video, film, YouTube®	1.6	1.4
Blog	1.5	1.4
Facebook®	1.5	1.3
Mobile application	1.4	1.2

1:"I do not use it"; 5: "The most important information channel for me"
Source: own data

Table 6: Instances where significant differences occurred between farmers of different age groups in Mezőcsát, Northern Hungary, in the use of information channels in 2014.

		P value (Mann-Whitney U test)		
	Age group:	24-41	42-59	60-77
Consuming information	Radio		p=0.050	p=0.000
	Television		p=0.014	p=0.002
	News	p=0.010	p=0.027	
	Internet	p=0.002		p=0.000
	Blog			p=0.001
	Facebook®			p=0.001
Providing information	Forums, programmes		p=0.050	p=0.000
	Internet			p=0.004

Source: own data

Table 7: The relationship for sharing information between farmers in Mezőcsát, Northern Hungary and different actors of the four Quadruple Helix model spheres in 2014.

Sphere	Actor	Mean score
Government	Farmers' advisor (falugazdász)	4.6
	Agricultural and Rural Development Agency	3.3
	Hungarian Chamber of Agriculture	3.1
	Municipalities	2.1
	Hungarian National Rural Network	1.4
	National Agricultural Consulting, Educational and Rural Development Institute	1.4
	LEADER group	1.3
Science/university	Vocational school	2.0
	University	1.5
	Research institute	1.5
Business/industry	Farmer	3.9
	Vet and pest controller	3.4
	Seed sales person	2.6
	Pesticide sales person	2.5
	Consultant	2.3
	Accountant	2.4
	Lawyer	2.2
	Integrator	2.1
Civil society	Consumers	2.8
	Producer organisations (TÉSZ, BÉSZ)	2.3
	Unions	2.2
	Associations	2.0

1: no contact; 5: best relationship
Source: own data

the Hungarian Chamber of Agriculture, with its compulsory membership system, is the third most important actor in this sphere. Farmers had the opportunity to name other actors not listed in the questionnaire, but did not do so. The farmers have only weak links to the science/university sphere. Here, vocational school scored highest with 1.95, the reason for this being that a vocational school is located in Mezőcsát. From the business/industry sphere the most important relationship for farmers is with their peers. From civil society, consumers scored the highest with 2.8 but this was still more than 1 point lower than the score for farmers' advisors or peers.

In the context of the large amount of available knowledge and consumers outside Hungary (in many cases through direct Internet access) we also examined the use of foreign language. To the question "Do you or any members of your household speak a foreign language?" only 25 per cent of the surveyed farmers answered yes. To the question "Do you think knowing a foreign language is important for personal development and running the farm better?" 51.2 per cent answered that they do not need this skill.

Finally, the relationship of the farmers with the strategy of their settlement was examined (Table 8). While only 15 per cent of the farmers know the strategy of their settlement and just 23 per cent would like to take part in its formulation, 65 per cent answered they are open to taking part in its realisation. The result from Table 7 also underlines the low information sharing (2.13) between farmers and municipalities.

Table 8: Farmers' relationship with the strategy of their settlement (Mezőcsát, Northern Hungary), 2014.

	Know the strategy	Would like to take part in its	
		formulation	realisation
Percentage of farmers answering 'yes'	15	23	65

Source: own data

Discussion

Johnson (2013) believes that we are at an interesting point in history. Science and technology have progressed to the point where what we build is only constrained by the limits of our own imagination. The question we have to ask is not *can we do it* but *what do we want to do*. The deficit we have is not science, not technology, but ourselves and our own imagination. This change of the 21st century demands a shift in the learning environment – to what we (the authors) call the entrepreneurial team learning environment – to help the development of human and social capital, including in rural regions.

Looking at rural regions as learning organisations, creating a shared vision *sensu* Senge (1990) is an important element. Although legal frameworks such as the European Union's LEADER programme are provided for co-creation, the experience of the last ten years illustrates that because of lack of communication and high administration burden it is not yet operating properly. In particular, analysis of its implementation through the concept of 'mainstreaming' revealed that many regions fall short of the potential for innovative local action through this programme (Dax *et al*., 2013). The results of our survey demonstrate that most farmers in Mezőcsát do not really know the strategy of their settlement. They do not want to take part in its formulation but they are willing to take part in the realisation. This suggests that at present farmers in Mezőcsát are rather *reactive* oriented. One of the reasons for this could be similar to the case mentioned by Forsyth (2014) who drew attention to the communication gap between universities and farmers. She emphasised the 'soft' targets of the work of universities including giving confidence to farmers, which helps them to be ready to innovate and take risks. The importance of gaining confidence in the case of rural people was identified in an earlier action learning process of ours (Katona Kovács and Bótané Horváth, 2014). Giving confidence, encouraging and supporting people who want to increase their personal mastery (Senge *et al*., 1994) is part of the conditions needed for the entrepreneurial environment.

The results of our Delphi survey show that all four spheres of the Quadruple Helix model should play an important role in the development of a learning environment but that higher importance has to be given to 'pull' type of learning. Wellbrock and Roep (2015) demonstrate that the operation differs between rural areas. In rural areas with economic prosperity, close-knit networks and shared identity, public administration is more likely to delegate decision making powers and responsibilities to non-governmental actors. Our Delphi survey also showed differences in the relative importance of the Helix model spheres in creating learning environments. In Noszvaj, where entrepreneurship is stronger (due to the high number of incoming young families), the role of the business/industry sphere was evaluated more highly than in Mezőcsát. By contrast, in Mezőcsát, where in recent years more participatory action research has been carried out, science seen as having a greater role in creating a new team learning environment.

The Delphi survey respondents' opinions on the most important opportunities for personal development were in line with three of the five so-called environmental 'suns' of the Piirto Pyramid Model (Piirto, 2011), namely 'the sun' of home, 'the sun' of community and culture, and 'the sun' of school. In the case of professional development, education based on local demand was listed first by the respondents, followed by communication between local experts and exchanging experience.

Our data on which actors the farmers of Mezőcsát consider to be the most important contacts among the four Quadruple Helix model spheres for information sharing (Table 7) are in line with the results of Kühne *et al*. (2013) who state that farmers are influenced by fellow farmers in their decision making processes. Communication between farmers is an important element of the development of an entrepreneurial learning environment in rural areas. The result (Table 7) that information sharing between farmers and consumers is low, and lower than information sharing with other farmers, underlines the challenge also mentioned by Katona Kovács *et al*. (2006) and Jokinen *et al*. (2010) that farmer's strategies are focused more on production methods and not on the competitive strategies needed to compete in today's market. According to Wirwich (2013), lack of entrepreneur-

ship could also cause the differences between rural areas on public reliance. His findings show that the oldest members of the workforce in post-socialist eastern Germany are less likely to be entrepreneurs than their peers in the western part of the country, even 15 years after the fall of the Berlin Wall. The entrepreneurial gap can be partially explained by East-West differences in values and attitudes. Eastern Germans rely more on the state and perceive lower control over life events, both of which are presumably shaped by their previous exposure to socialism. The persistence of such informal institutions poses a challenge to entrepreneurship since it is low state reliance and a high internal locus of control that make an entrepreneur (Wirwich, 2013).

Our finding of significant differences between the information channels used by farmers of different age groups draws attention to the development of information flows between age groups as well. As personal meetings are the most preferred communication channels for providing information for older farmers and Internet for young farmers, creating an entrepreneurial learning environment and generating dialogue about their common needs could help local actors to find answers to their challenges.

Sharing knowledge between different spheres is underlined by Dockès *et al*. (2013), who emphasise the importance of Learning and Innovation Networks for Sustainable Agriculture (LINSA). LINSAs are defined as networks of producers, consumers, experts, NGOs, SMEs, local administrations and components of the formal Agriculture Knowledge and Information System (AKIS) that are mutually engaged with common goals for sustainable agriculture and rural development – cooperating, sharing resources and co-producing new knowledge by creating conditions for communication. These networks operate on the principle of sharing knowledge and learning. They benefit from the 'mode-2' learning process, which implies exchange and feedback loops between research, extension and practices, rather than the linear 'transfer of knowledge', as in the case of the conventional view of the AKIS. The need to find the way for better communication also underpins the idea of European Innovation Partnerships (EC, 2014), which are intended to be challenge-driven, focusing on societal benefits and a rapid modernisation of the associated sectors and markets.

While increased communication and dialogue is one of the most important actions needed in the case of the civil society and business/industry spheres of the Quadruple Helix model, the findings of Estrin *et al*. (2013) have important implications for policy makers, in our case the government sphere. Institutions are multi-faceted, and higher level institutions are slower to change than lower level ones. Their results suggest that policy makers concerned with increasing growth and employment creation through entrepreneurship should firstly try to understand more carefully which aspects of the institutional environment are deficient, and then systematically work to improve them, focusing consistently on the long term as well as short term changes. The higher order institutions remain important for growth aspiration entrepreneurship, even when we account for the moderating impact of local social structures: growth aspirations are significantly reduced where corruption is high, property rights protection is inadequate, or government size is large. These three indicate the directions for any policy reform aiming to enhance growth aspirations of owners/managers of young businesses.

According to Annibal (2015) it is also worth reflecting that while hard pressed local authorities continue to do their best, major market forces have far more impact on local rural communities than they do. He suggests that social enterprise, defined as taking a thoroughly business-like approach to addressing a social challenge, can lead the way. Social enterprise does not have to concentrate on tackling one rural challenge; the model has the scope to act as a 'junction box' to combine the wiring underpinning all the challenges facing a rural community. They have the potential to overcome the impact of multiple market failures by making profits in one area of community need and reinvesting them in another.

The above mentioned roles of the Helix model spheres in creating a shift in the learning environment have to be played not from top-down or bottom-up in hierarchy, but 'outside-in' and 'inside-out', in partnership between the spheres. Following the lessons Dinwoodie *et al*. (2014) learned from nature: 'outside-in' activities represent the tasks of preparing and introducing systemic disturbances and creating the systems, structures and processes to guide change effort, and 'inside-out' capabilities are reflected in the change leader's ability to create a web of interdependent change agents and shape an environment that elicits the behaviours across the system necessary for transformational change to take root and flourish.

This study underlines our earlier results that development of human and social capitals is one of the most important steps for rural development. Creating an entrepreneurial team learning environment, helping rural regions as learning organisations with a shared vision, where each sphere understands its responsibility in the process, sharing knowledge, creating transparency, and improving communication and dialogue, could help to develop these capitals.

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Monica Mihaela TUDOR*

Small scale agriculture as a resilient system in rural Romania

A brief overview of rural Romanian phenomena and processes in modern history reveals that rural areas and small rural households were highly stable systems, providing social and economic security. In all history, except during the communist period, small-scale agriculture was and continues to be the main provider of jobs in the rural labour market in the absence of other non-agricultural employment opportunities. In all times, consumption of self-produced food, supported by small farms, has had a leverage effect against poverty. More than that, the statistical information shows that small farms achieve higher levels of economic performance compared to large farms by diversifying their production structure and, through that, they make an important contribution to national food security. In the post-communist period (i.e. after 1989) in Romania, these functions and roles of the small farms have been restored and are widely recognised. If the meaning of 'socio-economic resilience' is the ability of an individual, of a household, community, region or country to resist, to adapt and to recover quickly after a crisis, shock or change, the economic and social functions and roles assumed in the transition period by small Romanian rural farms give them the attributes of a resilient answer of the entire Romania to the post-communist changes and shocks.

Keywords: rural areas, socio-economic changes, small farms, resilience

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Introduction

In Romania, the transition to a market economy meant a change in the relationship between the users of land resources (who became land owners) and the resource (the agricultural land, the operation of which was divided among the new owners). In the last quarter of a century, the rural areas and the small peasant household farm have represented an economic and social 'safety net' against the changes and shocks generated through the process of restructuring the socialist economy (Gavrilescu and Florian, 2007; Alexandri and Luca, 2008; Pouliquen, 2011). The small household farms in the rural areas became one of the main modalities to meet the subsistence needs of rural household members whose consumption of self-produced food helps them to survive and combat poverty (Davidova *et al*., 2009; Salasan *et al*., 2009; Mihalache, 2010).

The fact that 93 per cent of the agricultural holdings in Romania use more than 50 per cent of their production for own consumption illustrates the extent of the rural population's economic dependence on agriculture. The specialist literature on economic resilience draws attention to one aspect that decisively conditions the capacity of economic systems to face changes, namely the dependence on resources. According to Bailey and Pomeroy (1996), the communities in which agriculture, mining and fishing prevail are typical examples of communities depending on resources. Adger (2000) argues that a change in the nature of the relationship between the users and the resource can affect the population's living standard as well as the resilience of economic and social systems. If resilience[1] focuses on how to achieve and maintain stability, manage resources effectively, control change, pursue economic growth and increased human well-being, and to how to deal with changes, disturbances and uncertainties (Berkes, 2007; Ahern, 2011), it follows that the farms could be analysed in terms of their capacity to be socio-economic resilient systems.

Understanding the nature and extent of people's dependence on resources can provide a perspective on the resource users' capacity to face and adapt to changes in the user-resource relationship (Canan and Hennessey, 1983), to be resilient to changes in the utilisation of resources they are dependent on. Knowing the level and significance of dependence on agriculture and its implications for rural economic and social resilience can help the design and implementation of policies that lead to the development of economic and social systems that depend on them (Marshall *et al*., 2007) for general use.

Research questions and analytical approach

Starting from the above short theoretical and empirical excursus with regard to the dependence on resources, the shocks of changes during the Romanian transition and the resilience of the rural systems to these shocks, a series of research questions is formulated to which answers are sought. These questions are the following: Has the small farm been able to adapt to the changes of the last quarter of a century? Are the rural population's survival strategies transmitted between generations or were the strategies for surmounting the economic and social crises induced by the changes in the transition period after the collapse of communism? Is the small farm a means to ensure social security or an obstacle to the improvement of rural population's living standards? Is consumption of self-produced food on the subsistence and semi-subsistence farms a resilient answer of the rural world to the negative socio-economic effects of transition?

The analytical approach used to seek answers, be they only partial answers, without attempting to address all the problems of small farms in Romania, follows a logical path, starting from the identification of the main causes that led to the present situation of small farms in Romania, next capturing the implications of these evolutions on the rural (and not only) population's living standards and concluding with the analysis of certain aspects targeting the economic and

[1] Resilience has become an important term of many disciplines ranging from psychology to ecology, from economy to sociology. There is no commonly accepted definition of resilience that is used across all disciplines.

social resilience of small farms. The methodological basis of the cognitive approach comprises a review of the specialist literature accompanied by the empirical substantiation of conclusions through the analysis of secondary statistical information from national and international sources.

Results

The small farms between transition and historical determinism

A brief review of the phenomena and processes that influenced the Romanian rural areas in the last 25 years shows that the current stage of rural development is largely the result of transition from socialism to capitalism. The three most important changes that influenced the rural areas in the transition period are: restitution of private agricultural land ownership rights, the restructuring of the other sectors of the socialist national economy and the lack of non-agricultural occupational opportunities.

Restitution of private agricultural land ownership rights means that the land owners regained their right to work (and own) the small land properties on an individual basis. The land reform carried out after the collapse of the communist regime led to the restoration of the post Second World War land situation, in which the structure of agricultural holdings was dominated by small farms. Thus, in Romania in 2003, when the restitution of private land ownership rights was almost complete, there were about 4.5 million agricultural holdings with an average size of 3.1 ha of agricultural area per farm. By 2013 the situation has not changed significantly; there being 3.6 million agricultural holdings with an average size of 3.6 ha.

The restructuring of the other sectors of the socialist national economy generally involved closing down obsolete and economically inefficient socialist enterprises (steel, metallurgy, chemicals, mining etc.). This had two consequences: (a) a significant growth in the size of the inactive population resulting from the application of certain large-scale early retirement measures (Figure 1); and (b) a significant loss of jobs (in the ten years from 1990 the number of employees in Romania fell by half and then stabilised at this level) in the absence of consistent initiatives for the development of new private businesses, on the market economy basis, which could make up for the jobs deficit.

The re-ruralisation, the urban-rural migration (Figure 2a) of a part of the urban population (largely represented by inactive persons and long-term unemployed, discouraged in looking for a job) is the consequence of the first two changes in the Romanian transition (Teodorescu, 2005). The domestic migration of the urban population confronted

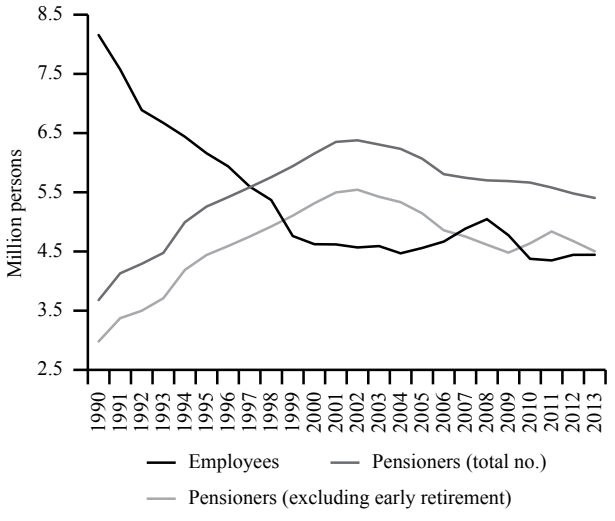

Figure 1: Numbers of employees and pensioners in Romania in the post-communist period (1990-2013).
Data source: NIS-TEMPO on-line database

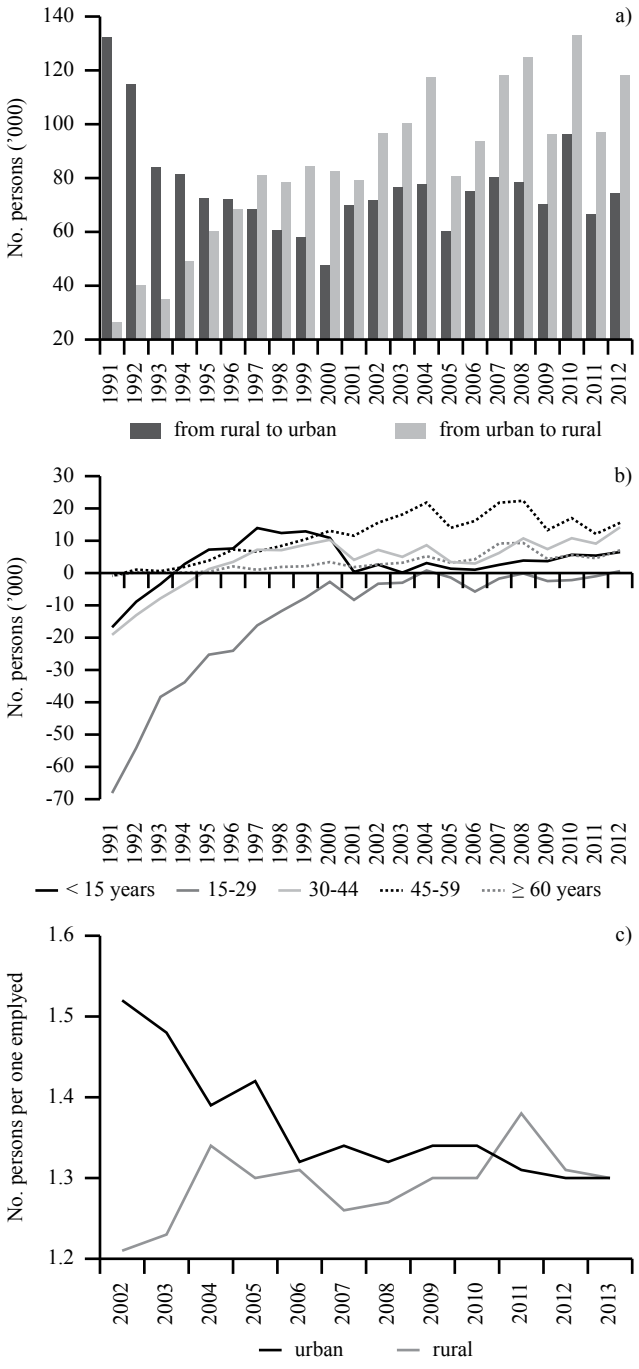

Figure 2: (a) urban-rural internal migration, (b) domicile change balance by age groups and (c) economic dependency by urban and rural residence areas in Romania, 1991-2013.
Data source: NIS-TEMPO on-line database

with severe difficulties in accessing the labour market and the rural withdrawal of the urban pensioners (through early retirement or not) greatly increased the size of the inactive rural population. After 1991, the balance of changes of domicile between the residence areas in Romania (urban-rural 'minus' rural-urban) remained positive in the case of the older population (over 45 years) and negative in the case of young population (15-29 years) (Figure 2b). As a consequence, a significant increase in economic dependency (number of inactive and unemployed persons per employed person) occurred in rural Romania. In 2006 the economic dependency ratio calculated for the rural population reached a level similar to that of the urban population, both being larger than 1 (Figure 2c). The difference between the two types of area lies in the population structure by age and the occupational structure by sector.

The urban-rural population movements accelerated the rural population ageing effect generated by a reduction in the birth rate. Thus, according to Romanian National Institute of Statistics (NIS) data for 2013, 19 per cent of the population in the rural areas is aged over 65 years, compared to 14 per cent in the urban areas. The population of working age is mainly urban, 72 per cent of the urban population being aged between 15 and 65 years, while in the rural area this figure is 63 per cent. In spite of this, rural areas continue to be the main demographic reservoir in Romania, the number of children under 15 years old being 5 percentage points higher than in the urban areas. Another argument in this respect is given by the perception of the occupational status of elderly people. While in rural areas one in five persons over 65 years old continues to work (in agriculture), in the urban areas the share of those who continue their active economic life after 65 years is only 2 per cent.

The lack of non-agricultural occupational opportunities in rural areas, which has been perpetuated in time, maintained the rural population's dependence on agriculture and on the production of small agricultural holdings around the rural households. The occupational structure of the Romanian rural population was and continues to be dominated by the primary sector (mostly represented by agriculture). Although the number of persons working in agriculture decreased by one-fifth in the period 2002-2012, in terms of residence-based data the share of agriculture in labour employment is above 60 per cent in rural Romania (Figure 3). In the analysed period, in the age structure of the population employed in agriculture, decreases were recorded mostly for younger persons (under 35) and seniors (over 50 years). In reality the population working in agriculture is underemployed. According to the data of the 2010 Agricultural Census[2], the average number of days per year effectively worked in agriculture by a person employed in this sector is 47, and most of these people perform agricultural work on their own holding.

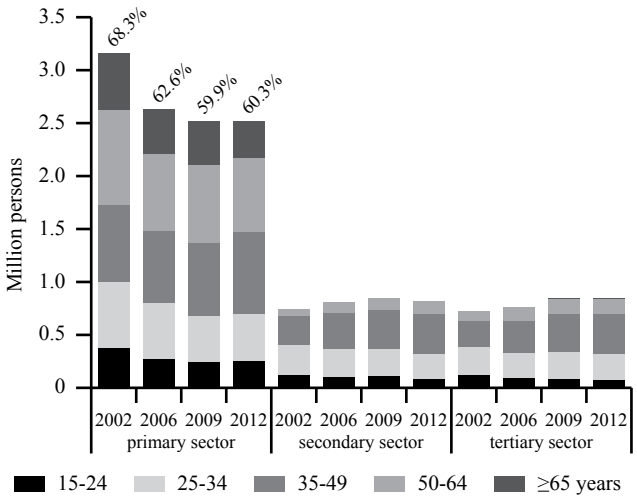

Figure 3: Rural employment in Romania by economic sector and age group, 2002-2012.

xx.x% - share of agriculture in total rural employment
Data source: NIS data-TEMPO on-line database

One of the main factors restricting the ascendant occupational mobility of the rural population is low education level. In 2012 the share of the rural population aged 15 years and over with low educational level (who graduated less than eight schooling years) was 56 per cent and only 3.1 percent of the rural population benefited from higher education[3].

Beyond the processes that marked the post-communist transition period in Romania, another contextual fact, the contribution of which can be considered equally important, is the design and operation of the farm system in Romania at present. According to the *dependency on the past* (as *path dependency theory* element), a stochastic process "evolves as a consequence (function of) the process's own history" (David, 2005, p.19). In other words, the structural and functional changes in the Romanian agricultural system during transition are determined partially by the previous experience of actors from this economic sector. The historical experience largely conditioned the expectations of the sector's exponents, which in their turn determined the result of the agricultural restructuring process.

The assumption is therefore made that the post-communist agriculture bipolarity is a historical fact, an internal structural organisation pattern of Romanian agriculture. Nowadays, more than 90 per cent of the agricultural holdings in Romania are small farms (having less than 5 ha agricultural land), accounting for about 30 per cent of the country's utilised agricultural area (UAA). At the other pole there are less than 1 per cent of agricultural holdings, which operate more than 100 ha each and together account for 50 per cent of the country's UAA. Throughout Romania's modern history (except for the communist period), Romania's agrarian structure was and continues to be a bipolar structure (Figure 4).

It seems that bipolarity is the historical pattern of the country's agrarian structure and its functions (socio-economic security in the case of small farms and the commercial function in the case of large farms) are also a continuation/return to the pre-communist pattern, whose internal operation rationale is the only one known and recognised by the rural world. In fact, the cooperation pattern in agriculture imposed by the communist system was not positively valorised and consequently it was not internalised either at the level of small agricultural land owners. But over forty years of communist cooperative experience in agriculture stopped the possible technical, technological and managerial evolu-

[2] National Institute of Statistics (2012)
[3] National Institute of Statistics -TEMPO on-line database

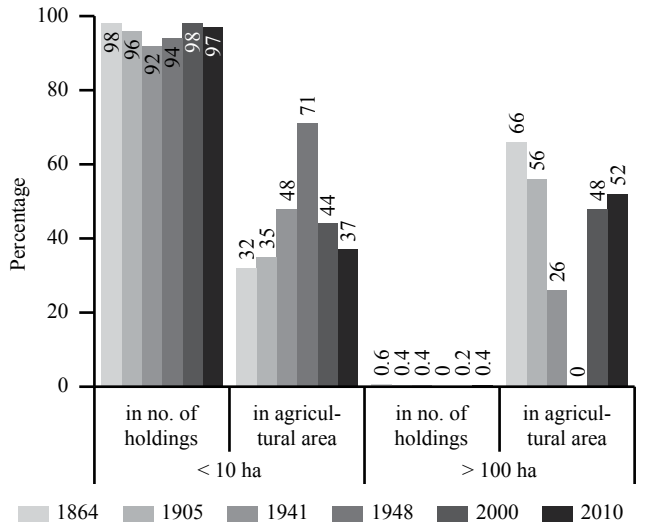

Figure 4: Historical evolution of the farm structure in Romania, 1864-2010*

* In 1948 there were no farms larger than 100 ha because in 1945, in Romania, the first communist government initiated a land reform that set a maximum limit for private agricultural properties (50 ha). At the level of each farm, the agricultural area that exceeded this limit was expropriated and ownership of the expropriated land areas were transferred into the state.

Sources: Axenciuc (1996) and NIS Agricultural Census 2010

Table 1: Importance of cooperation forms in Romania's agriculture, 1993-2010.

Year	Number of cooperation units	% of total agricultural area
1993	18037*	25.0
1999	9837*	15.6
2010	6546**	5.6

* agricultural associations with legal status and family associations without legal status (OECD, 2000)

** agricultural associations and cooperative units, authorised natural persons, individual enterprises (NIS Agricultural Census, 2010)

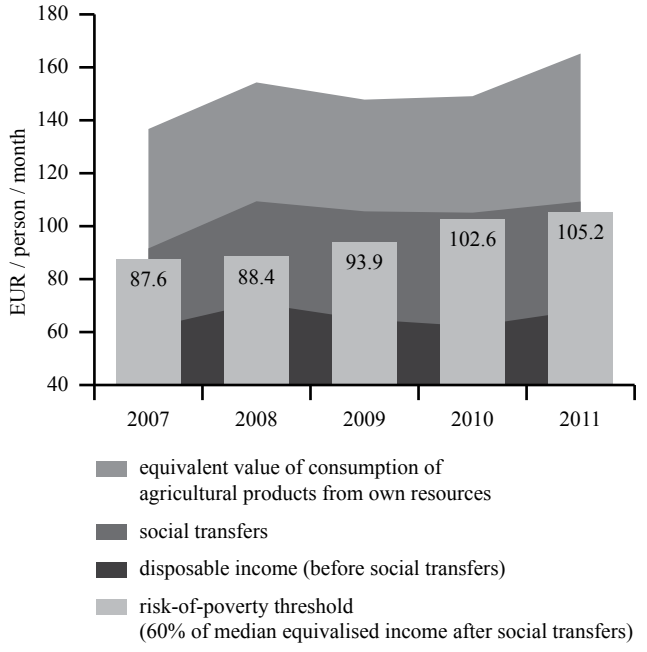

Figure 5: The contribution of own consumption to the welfare of rural households in Romania, 2007-2011.

Data source: NIS data-TEMPO on-line database

tions on the small agricultural holdings and froze their land size. The restitution of land ownership rights was synonymous, at the level of small farms, with a return to the only farming pattern that was known (i.e. the one practiced in the pre-war period).

The attempt to consolidate agricultural land management by supporting the establishment of land owners' associations failed for two reasons. The first reason is related to the lack of support for the consolidation of these organisational forms by increasing their opportunities to become economically viable (support for their capitalisation, creation of the framework for a functional agricultural market, support for managerial performance growth etc.) (Popescu, 2010). The second reason for the land owners' withdrawal from the agricultural associations had a strong social component. The disassociation was produced against the background of the return to rural areas of the land owners (direct owners or their heirs), due to labour rationalisation in the urban socialist industry for which the small rural household farm became an important source for meeting their primary consumption needs. This adds to the poor performance of the managers of the agricultural associations, accompanied by the deficiencies in the ethical conduct of managers who were perceived as acting in their own interest rather than in the common interest of the associated members (Popescu, 2001; Rusu *et al*., 2011). Thus, while in the early 1990s one quarter of the country's agricultural area was managed through cooperative-type agricultural entities, in 2010 their importance in Romania's agriculture declined to only 5.6 per cent (Table 1).

Small farms versus rural poverty

In the case of small agricultural holdings, the modernisation process evolves slowly, as these entities do not have a solely commercial purpose, but rather a social one (meeting the consumption needs of the family members). The high level of own consumption limits the commercial actions and consequently the possibilities to invest in farm modernisation.

In the conditions in which the remunerated job supply decreased almost by half compared to 1990 (Figure 1), the rural household and the small peasant farm around it became the main means to cover the primary consumption needs for almost half the country's population (45 per cent of Romania's population currently lives in the rural area). Owing to the lack of non-agricultural opportunities in the rural labour market and the prevalence of subsistence and semi-subsistence farms, the welfare of rural households depends very much on the consumption of their own agricultural products (Figure 5).

The statistical data show that, in general, without own consumption, the Romanian rural population would be at risk of poverty. At rural household level, the social transfers allow the rural population to surpass the poverty threshold (in 2011, the disposable income per adult equivalent exceeded the relative poverty threshold by only 4 per cent). The same data show that the value of consumption from own resources significantly contributes to the welfare of rural household members (Figure 5).

Discussion: arguments regarding the resilience of small-scale farming in Romania

If the meaning of 'socio-economic resilience' is *the ability of an individual, of a household, community, region or country to resist, to adapt, and to fast recover after a crisis, shock or change* (Gallopín, 2006), the socio-economic functions and roles assumed in the transition period by the Romanian rural households confer them the attributes of a resilient answer of Romania to the post-communist shocks.

The small farms have a 'social buffer' role (Dumitru *et al.,* 2004), which enabled Romania to go through the difficult period of the 1990s without major social disturbances. The negative effects of long-term unemployment resulting from the process of deindustrialisation were attenuated by subsistence farming (Luca, 2013). In addition, if the high share of own consumption on the Romanian households is taken into consideration these farms contribute to Romania's food security. The small farms make an important contribution to food security not only for the rural population but even for urban households, due to the family relationships on the basis of which the foodstuffs produced on the small farms are transferred to urban relatives. Thus, for a rural household, about half of total food consumption is represented by the value of own consumption, while in the case of an urban household this percentage represents one-fifth of the value of total food consumption.

However, many analysts see these farms as a loss of economic potential for Romania's agriculture (Otiman, 2012), representing an inefficient form of land resource allocation (Gavrilescu and Gavrilescu, 2007) by taking out of the agricultural circuit devoted to market production about 30 per cent of the country's agricultural land area; they also contribute to maintaining land fragmentation, which is a cause of low yields (Steriu and Otiman, 2013). These authors draw attention to the need to reform the agricultural system in Romania in order to operate the land resources with economic efficiency which, in these authors' opinions, should represent a fundamental objective of agricultural policies. The validity of these conclusions and recommendations cannot be denied, yet there are several counterbalancing arguments regarding the existence of the small family farms.

The first argument is linked to the European and world strategies of the *fight against poverty,* in which *self-consumption might have a lever effect* (which is perfectly applicable in rural Romania, as shown above). But supporting this type of farming (subsistence or semi-subsistence) comes into conflict with the objectives of agricultural restructuring. Pouliquen (2011) concluded that there is a need to reach an equilibrium between these two objectives that would allow the commercially oriented farming and that with social protection connotations to co-exist.

The second argument is linked to the fact that the small rural household farms are *the main providers of jobs in the countryside.* Hence, when jobs are scarce not only in the rural areas but also in the urban areas, their contribution to the social sustainability of the rural population cannot be denied. Thus, about 90 per cent of the regular labour force

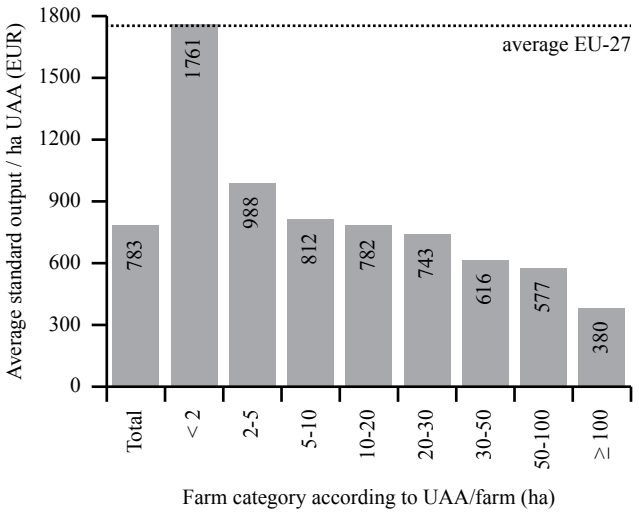

Figure 6: Disparities in farm performance in Romania according to their utilised agricultural area in 2010.
Data source: Eurostat

that performs farming activities in Romania works on farms with UAA smaller than 5 ha and only 1 per cent of them work on farms larger than 100 ha. Furthermore, the farms provide occupational opportunities not only for the farm head's family members but also for other, unrelated persons, thus contributing greatly to the agricultural labour market. According to Eurostat data, in the last five years the regular non-family labour force on small farms – under 5 ha – accounts for about 20 per cent of the total number of these persons in Romanian agriculture.

The third argument is linked to their *economic performance* which, per unit of UAA, seems to be *higher than that obtained on the large farms* on the basis of their production diversification. The data of the Agricultural Census 2010 show that the small farms in Romania have the highest economic performance per unit of UAA, the value of agricultural Standard Output (SO[4]) per hectare of UAA being three times higher for the farms under 5 ha compared to the farms over 100 ha (Figure 6). Furthermore, the farms smaller than 2 ha are the only ones in Romania that reach the EU-27 average of SO/ha UAA value. This efficiency difference in the utilisation of land resources in favour of small farms can be largely explained by the production structure adopted by the different categories of farms to which this article will next refer. In general, very small farms in Romania (i.e. under 2 ha) are not specialised in their agricultural production. They integrate their livestock and crop production, using own-produced crops as feed for their own animals and consequently the per-hectare value of their agricultural production is high. The larger farms, in terms of UAA, are specialised in field crops (cereals and oilseeds) and their yields per hectare are lower than the European average; therefore their SO/ha is lower (Steriu and Otiman, 2013).

The analysis of the same indicator according to farm economic size strengthens the conclusion about the higher economic performance of the small farms in Romania. Thus,

[4] The 'standard output' (SO) 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. There is a regional SO coefficient for each product, as an average value over a reference period (five years). The sum of all SO per hectare of crop and per head of livestock on a farm is a measure of its overall economic size, expressed in EUR.

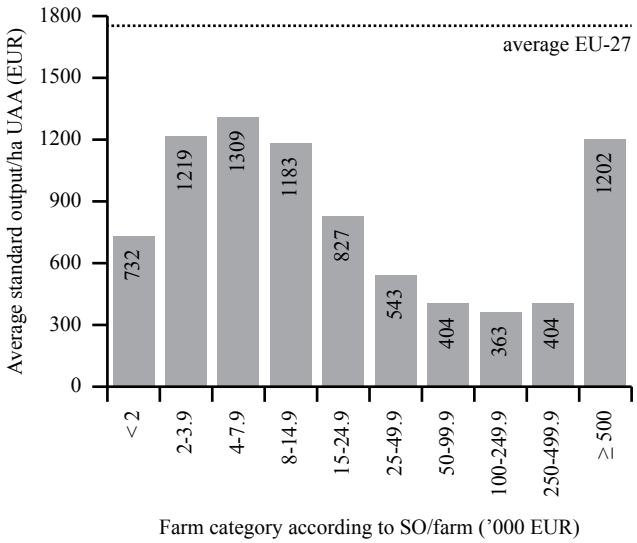

Figure 7: Disparities in farm performance in Romania according to their economic dimension in 2010.
Data source: Eurostat

at the level of farms whose standard value of annual economic output is lower than EUR 2000 (generally considered to be subsistence and semi-subsistence farms and representing 70 per cent of all farms and 19 per cent of UAA), the SO/ha is getting closer to the national average. The farms whose annual standard output ranges from EUR 2000 to 8000 (considered to be semi-subsistence farms and accounting for 24 per cent of all farms and 20 per cent of UAA) achieve the highest performance levels per unit of UAA of all size categories (Figure 7). The same data show that only 12 per cent of the country's agricultural area is managed by the large farms (with agricultural production whose standard economic value exceeds EUR 500,000 annually), and these also achieve a high level of productivity.

The fourth argument is linked to the *much more diversified production structure* on the small farms compared to the commercially-oriented farms, which better responds to the final consumption needs of the country's population and implicitly to the domestic food security requirements. Thus, while the small farms have quite diversified production structures, integrating crop and livestock production, as the farm land area increases there is a tendency of production specialisation and orientation towards crop production which can be organised on large fields with minimum technical and technological effort (Tudor, 2014).

The statistical data reveal that most livestock herds (expressed in livestock units[5]) and domestic meat and meat product production are located on what are considered to be subsistence and semi-subsistence farms (Figure 8a); it is also on these farms that the largest part of the production of fruit and vegetables at national level is obtained (Figure 8b). Thus, in 2010, about two-thirds of the areas under vegetables or under orchards and vineyards were operated by farms with economic sizes lower than EUR 8000 per year. The large farms are gearing their production structures more and more

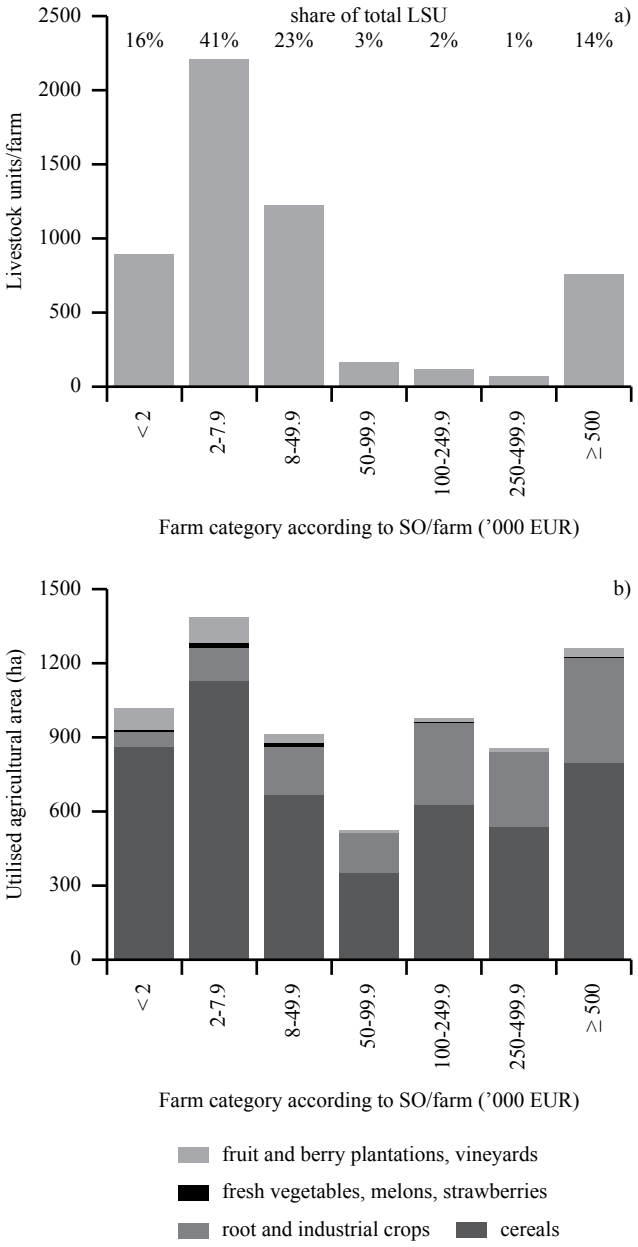

Figure 8: The production structures of Romanian farms according to their economic size – (a) livestock production and (b) crop, in 2010.
Data source: Eurostat

towards those activities that maximise economic output with minimum effort. Their almost exclusive orientation towards the large-scale field crops contributes to the scarcity on the domestic market of fruits and vegetables in particular (Figure 8b). The same conclusion can be extended to the livestock production. Following the prevalence of cereal crop production in Romanian agriculture, the agri-food balance of trade, except for cereals (maize, wheat) and industrial crops (soybean) was and continues to be increasingly negative. Significant deficits can be noted in meat, dairy, fruit and vegetables (Steriu and Otiman, 2013; Luca, 2014), products that are mainly produced on the small farms. Without the contribution of small-scale farming to livestock production and fruit and vegetable production, Romania's agri-food trade balance deficit could increase still further. As a result, the role of small farms in the domestic food security cannot

[5] The 'livestock unit' (LSU) represents a conventional reference unit that facilitates the aggregation of livestock herds from different species and ages, by using certain conversion coefficients established on the basis of nutritive or feed requirements for each category of animal in part.

be disputed. Moreover, the recognition and support of these farms is absolutely necessary, taking into consideration their social and economic importance.

Finally, the small Romanian farms are among the last in Europe that still use traditional farming techniques that contribute to the *conservation of archaic agrarian landscapes and biodiversity* that are long disappeared from Western European countries but that are highly appreciated by tourists (Page, 2010). Moreover, the Romanian rural area and its residents *preserve the traditions and culture of the Romanian people*[6] and provide traditional food that is perceived as a 'high quality' product by all Romanians. In this respect Hubbard *et al.* (2014) argue that there is a (conservative) public perception that food produced by relatives from the countryside is 'real' organic food and that, in terms of quality, food from villages is well above the food bought in supermarkets and which is mostly imported. For this reason some urban households prefer to procure their food directly from the producers through semi-formal supply chains, such as rural relatives, free peasant markets, at the farm-gate and roadside buying or through 'local wholesaling'.

Concluding remarks

Over the last quarter of a century the organisational and operational strategies of small farms in Romania have been characterised by inertia and even resistance to change, a situation that continues today. These patterns are well established, being replicated between generations, and were not induced by the changes in the transition period after the collapse of communism. Since 1989, the rural space and the small rural household have represented highly stable systems in Romania. Despite the expectations of some academics and policymakers of a gradual decline in importance of small farms and/or their market integration following Romania's accession to the European Union (EU), the process of structural change has been slow (Tudor, 2014). More than that, during the last economic crisis there was a proliferation of the farms smaller than 2 ha; their number increased from 2.49 million in 2007 to 2.73 million in 2010 before declining slowly to 2.59 million in 2013.

In (post-communist) Romania, the great economic and social changes which occurred for a large part of society were difficult to manage. The main vulnerabilities of the rural population that adversely affect their adaptive capacities are: dependence on agricultural resources, obsolete agricultural technologies, underemployment, lack of occupational alternatives, low level of education and poverty. The small farms and their own consumption have been a resilient response to the negative socio-economic effects of transition, helping to maintain social security by supporting food security, acting as a buffer against poverty and as a supplier of jobs. The last recession, which in Romania was accompanied by big cuts in wages (25 per cent for public sector workers) and increases in taxation (value added tax increased from 19 to 24 per cent for all products), further strengthened the role of small farms as suppliers of economic and social security.

At present, due to the low incomes they generate (production oriented to own consumption rather than to the market) and to the functional inertia, small-scale agriculture has limited resources to support investments, such as in education and life-long learning and/or the fast adoption of innovative practices. But EU membership has not succeeded in changing the role of these farms in the Romanian economy. To those who argued that direct payments under the Common Agricultural Policy (CAP) contributed to the rise in the number of small farms in Romania after EU accession, it should be pointed out that only the farms with more than one hectare are eligible for these subsidies (i.e. just over one million of the 3.6 million farms) and that over 90 per cent of the Romanian beneficiaries received less than EUR 500 per year due to their small agricultural land area (Alexandri and Luca, 2012). Most small farmers have not benefited from financial support through the CAP.

Small farms will not soon disappear from the Romanian rural picture. In fact it is not necessary for them to disappear completely, only for them to become more resilient. In order to face the changes and challenges of the globalised world, of the digital era etc., small-scale agriculture needs to be invested with new abilities to adapt and to find new equilibrium levels. This statement is supported by the conclusions of studies on resilience, according to which resilience is not a fixed characteristic, but under continuous dynamics, having to modify its parameters according to the evolution of human systems (Simmie and Martin, 2010). As a result, small-scale agriculture should be supported in order to overcome its vulnerabilities and the simple condition of 'socio-economic buffer' and to become a factor of progress.

The potential ways to increase resilience are generally subsumed to the intervention need through public policies targeting: (a) increase of the stock of knowledge and professional abilities and their diversification, so as to allow the increasing occupational mobility of the rural population in a modern knowledge-based society and to break up the opacity to technical and technological innovation; (b) support to increase technical performance while maintaining agricultural production structure diversity, which proved to best meet the domestic food consumption needs; and (c) reduced dependence on agriculture through on-farm activity diversification and increasing the value added of agricultural products through processing. The nature of the challenges in Romania means that they cannot only be addressed through the CAP; they should also be the subject of social policies.

There are some 'smart' solutions for turning the vulnerabilities of the Romanian rural area into a comparative advantage. One of these solutions is supported by the fact that these areas preserve the traditional agricultural production techniques and certain archaic agrarian landscapes (in the hilly and mountain areas, which represent two-thirds of the country's area). The Romanian small farms could be supported to become providers of (environmental) public goods and services through the development of 'green' agriculture, agri-tourism services, traditional agri-food products delivered through short supply chains, production of raw materials for 'green' energy and other alternative uses such as slow food etc. The result would be a mixed agrarian structure, economically and socially viable, that includes small farms with cultural, landscape, touristic attributes and capable to

[6] See *Wild Carpathia* series produced by Travel Channel.

provide traditional food (in hilly and mountainous areas, in particular) and large farms that specialise in supplying raw materials for the food industry (especially in plain areas).

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Technical and economic efficiency analysis on Italian smallholder family farms using Farm Accountancy Data Network dataset

More than 90 per cent of Italian farms have a usable agricultural area of less than 9 ha, even if over time there has been a growth of the average agricultural area per farm as a consequence of rural out-migration. This paper compares, using a non-parametric model, the technical efficiency of smallholder family (*diretto coltivatrice*), co-operative and limited company farms during the period 2000-2011. The *diretto coltivatrice* farms and the co-operative farms had higher levels of scale efficiency than the limited company farms, with a scale efficiency value equal to 100 per cent in ten years out of twelve. The average technical efficiency of *diretto coltivatrice* farms was higher than those of co-operative and limited company farms. The second part of the quantitative analysis used the self-organising maps (SOM) proposed by Kohonen. The SOMs indicated that the size of the agricultural area has a direct impact on the technical efficiency of farms and on their level of income.

Keywords: smallholder family farms, co-operative farms, limited company farms, Kohonen's maps, allocative efficiency

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Introduction

The average size of the usable agricultural area per farm in the 27 European Union (EU) Member States was 14.5 ha in 2010 (Eurostat, 2015). Nevertheless, in nine Member States, including Cyprus, Greece, Italy, Malta and Romania, the average usable agricultural area is below the EU mean value. In Italy, numerous farms have an average size of less than 9 ha. More than 95 per cent of Italian farms are family farms owned by only one farmer, a figure that similar to the EU-27 value of 96.9 per cent (Eurostat, 2015). The percentage of limited company farms and co-operative farms in Italy is around 4 per cent (Istat, 2011).

The United Nations recognised 2014 as the International Year of Family Farming, a label that encompasses many types of farms including small semi-subsistence enterprises and large farms, and those that rely on diversified activities such agritourism and other non-farming activities (FAO, 2014). The EU's rural development policy recognises the role of family farming in promoting multifunctionality and endogenous rural development which are key factors in protecting the rural space against environment threats.

In Italy the property of family farms belongs predominantly to smallholder farmers called in Italian *diretto coltivatori* farmers that run *diretto coltivatrice* farms. Such farms are a tiny unit of agricultural production, mostly fragmented, with an agricultural area of less than 5 ha, managed and owned by one farmer. The family farm has been criticised because of its small size and fragmentation, but the *diretto coltivatrice* farm has been able to mitigate rural out-migration, protecting the rural space against socio-economic marginalisation. Property, functions and gender relations in European family farms are hierarchically well codified even if since the late 1990s there has been a weakening of the prevailing position of male dominance on the farm (Brandth, 2002). As a consequence of rural out-migration, in Italy, Ireland, France and the Netherlands many family farms are in the hands of women with a consequent radical transformation of productive specialisation and the development of other activities such as agritourism being in many cases managed by female entrepreneurs (Di Domenico and Miller, 2012; Galluzzo, 2014a).

The role of family farms

In the early 1990s some studies investigated the role and the effect of the Common Agricultural Policy (CAP) on family farming using a specific analysis on a sample of farms belonging to the Farm Accountancy Data Network (FADN). Between EU Member States the role and the function of family farms are completely different with several and specific contrasting effects. Hill (1993) observed that in the United Kingdom there was a limited incidence of family farms compared to Italy where family farms are deep-rooted in the countryside and in its rural setting. The features of family farms are a low level of income, a shared labour capital and a production of almost 50 per cent of the total European agricultural output, which have implied, in order to allow maintain the economic sustainability of farmers, a diffusion of pluriactivity in family farms and a growth in the incidence of off-farm revenues in the total household income (Hill, 1993; Jervell, 1999; Sofer, 2001).

Together with their small size, one of the main constraints of family farms in Italy, Greece and other central European countries is the excessive land fragmentation which can have ruinous effects on farm efficiency, increasing variable and fixed costs and restricting the technical-economic development of farms (Lund and Hill, 1979; Alvarez and Arias, 2002; van Dijk, 2003; Gorton and Davidova, 2004; Zhu and Lansink, 2010). Some studies have investigated in depth whether big farms owned by limited companies and co-operatives are more efficient than small ones; therefore, between three variables (property of the farm, farm size and economic-technical efficiency) there is a strong nexus (Bravo-Ureta *et al*., 2007). Until now few studies have investigated the connections between typology of property and efficiency (Bravo-Ureta and Pinheiro, 1997; Chavas and Aliber, 1993). Other scholars in contrast have examined predominantly the role of farm size on efficiency (Carter, 1984; Galluzzo, 2013). Using a non-parametric quantitative approach on the FADN dataset in France, Latruffe and Nauges (2014) showed that farm size has a direct impact on technical efficiency and on the decision process of farmers on whether to transform their farming activities via a transition from a conventional cultivation system to an organic model.

Studies in many EU Member States have used the FADN dataset or a sample of farms to investigate the impacts of Pillars I and II of the CAP on farmers' incomes (Gorton and Davidova, 2004) and on the level of technical efficiency (Zhu and Lansink, 2010). Several authors have detected relationships between farm size, farming specialisation and technical-economic efficiency (Bielik and Rajcaniova, 2004; Latruffe *et al*., 2004; Latruffe and Nauges, 2014; Bojnec and Latruffe, 2007). In terms of efficiency defined by constant return to scale, large sized farms are more efficient than small ones (Van Zyl *et al.*, 1996). In particular, small family farms have been considered technically inefficient in terms of productive scale because of their size and their land fragmentation (Morrison Paul *et al.*, 2004). In Italy only few studies have investigated the nexus, using the FADN dataset, between the farm dimension and the technical and economic efficiencies (Galluzzo, 2013). The general view is that the *diretto coltivatrice* farms are not efficient but they maximise the labour factor of production and its organisation (Van Zyl *et al*., 1996), minimising, conversely compared to the large sized farms, entrepreneurial risk by diversification in the agricultural process, using the workforce more efficiently and by reducing socio-economic marginalisation (Galluzzo, 2013) by a reduction in farm unemployment (Latruffe *et al.,* 2004).

Factors influencing efficiency in family farms

The main theoretical neoclassical approach describes economic and technical performances of farms as being influenced by the legal type of management. Family farms are more efficient in terms of costs, productivity and profitability than large farms as a consequence of a different management process (Gorton and Davidova, 2004), which are dependent on acquiring some productive factors from outside the farm.

In general, there is no common and unique assumption about the role of family-owned farms in improving technical and economic efficiency. According to some scholars, the property of the farm rather than farm size is the most fundamental factor affecting efficiency. Small family farms in several EU Member States are more efficient than other types of farms such as co-operative and limited company farms (Schmitt, 1991; Gorton and Davidova, 2004). The good level of efficiency in small farms is tightly linked to the low level of transaction cost (Hagedorn, 1994). Nevertheless for other authors farm size is a major constraint on farm technical efficiency; hence, the traditional family farm is not an efficient productive organisation (Morrison Paul *et al.,* 2004) as it is not able to adapt itself to changing circumstances of production or to amortise its investments, diversifying its own production factors. Several authors have argued that family farms are not as well prepared as co-operative and limited company farms to face market challenges because of a poor level of capital investments (Allen and Lueck, 1998). Cropping specialisation is a key factor that can directly influence the level of efficiency and maximisation of output (Bojnec and Latruffe, 2008; Latruffe, 2010; Latruffe and Nauges, 2014), influencing the productive decision process on small farms.

Aim of the research

The main research question was to investigate, using a quantitative model, whether, because of their small scale structure, Italian *diretto coltivatrice* farms have been more efficient in recent years than limited company and co-operative farms. Another purpose of the research was to assess how much usable agricultural area is sufficient to gain in terms of technical efficiency. This research used and elaborated time series of microeconomic datasets published by the Italian National Institute of Agricultural Economics in the FADN database for the period 2001-2011. The purpose of the FADN is to evaluate farmers' incomes and to assess the impact of the CAP on a representative sample of European farms. In the research the sample was stratified both according to the type of property such as small family-owned farms or *diretto coltivatrice* farms, co-operative farms and limited company farms, and also according to the altimetry of farms as highland, hilly areas and farms on the plain, even though in the research the efficiency was assessed according to the typology of property only.

A second stage of the quantitative analysis used self-organising maps (SOM) or Kohonen's maps to estimate which size of farm is adequate to guarantee a satisfactory level of farmer's income in *diretto coltivatrice* farms. Another purpose of the SOMs was to detect among *diretto coltivatrice*, co-operative and limited company farms which of these was the best type of enterprise for improving the farm's net income.

Methodology

Data Envelopment Analysis

There are two approaches to assessing efficiency: a parametric or deterministic approach, which needs a function of production and other parametric variables, and a non-parametric model or Data Envelopment Analysis (DEA) (Farrell *et al*., 1957; Färe *et al*., 1985; Färe *et al*., 1994). The purpose of DEA is to define a hypothetical function of production or frontier of production and on the basis of the distance from the frontier of this hypothetical function of production to determine an index of technical efficiency (Forsund *et al*., 1980; Bauer, 1990; Bielik and Rajcaniova, 2004).

In a non-parametric model deviations from the frontier of productive functions are caused by inefficiencies and they are not connected to errors (Bojnec and Latruffe, 2007). The technical efficiency is described as the capability of a farm to maximise outputs and minimise inputs or vice versa on the basis of constraints in the business choices either in terms of disposable input or in terms of produced output (Coelli *et al*., 2005; Bojnec and Latruffe, 2007).

According to many authors (e.g. Farrel, 1957; Battese, 1992 and Coelli, 1996) the model of quantitative analysis and estimation of efficiency are not tightly linked to a specific frontier of production but rather to a parametric function. In this paper efficiency has been estimated by a non-parametric model, applied to different specification models

such as constant return to scale (CRS) and variable return to scale (VRS) and in two further orientations as input oriented and output oriented using the software PIM-DEA. As the outcomes of efficiency from using the input oriented model and the output oriented model were the same, in the paper the input approach has been used, aimed at assessing which factors in the productive process have been fundamental in improving technical and economic efficiency.

The DEA approach was used to estimate the economic efficiency in three types of Italian farms or Decision Making Units (DMUs): smallholder family farms (*diretto coltivatrice* farms), limited company farms and co-operative farms. The input variables used in the model were usable agricultural area in hectares, land capital, labour capital, invested agrarian capital and subsides allocated by the CAP in EUR; the output variable was the net farmer's income in EUR.

Self-organising maps

The SOMs are based on a method of unsupervised learning in a restricted space provided that the topological properties of an input space or stimulus come from the outside (Kohonen, 2001). The main benefit of the SOM approach is to obtain a unique pattern able to classify homogenous groups or clusters, preserving their dissimilarities and, as with Principal Component Analysis, reducing the complexity via a map that highlights the relationships among the variables (Mehmood *et al*., 2011).

The SOM is a neural network where the artificial output neurons (or nodes) are arranged in grids based on a lower dimension in connection to all neurons of input which in the analysis are the variables used in the model of efficiency: usable agricultural area in hectares, variable costs, fixed costs, added value and subsides allocated by the CAP. The output variable is the farmer's net income. Each input or stimulus is connected to the other neurons of the output by a weight vector assessed to define the position of the centroid in the space. In general this network in the SOM is characterised by a pattern in two connected layers; one layer is made up by input and the other layer (commonly called the Kohonen layer) is constituted by output (Kohonen, 2001).

Using the free software SPICE-SOM, the training of neurons (training is a method of analysis to find the best neuron in the dataset) used competitive learning. The model used an input training sample towards the network and the Euclidean distance among input and output neurons is calculated from all weight vectors (Kohonen, 2001). The neuron with a weight vector most similar to the input is called the Best Matching Unit (BMU) and the weights of the BMU and neurons close to it in the SOM lattice are the closest to the input vector. The intensity of the approach process decreases over time and is a function of the distance of neurons from the BMU. The formula used for updating the weights of a neuron Wv is (Kohonen, 2001):

$$Wv(t+1) = Wv(t) + \Theta(v,t)\,\alpha(t)\,(D(t) - Wv(t)) \qquad (1)$$

where $\alpha(t)$ is the monotonous descending learning coefficient and $D(t)$ is the input vector. The function that defines the neighbourhood $\Theta(v, t)$ depends on the distance in the hexagon between the BMU and the neuron v. In this simplified competitive network it is equal to 1 for all the neurons close enough to the BMU and 0 for the other, but the most common choice is the Gaussian function represented by the mathematical function similar to a Mexican hat where values are in a range from 0 to 1.

Results

Over the period of observation there has been a significant drop in the number of family farms in Italy and an increase in the average agricultural area per farm as a consequence of rural out-migration (Figure 1). Rural out-migration in Italy has affected several rural areas, including some upland territories where most *diretto coltivatrice* farms are located. The

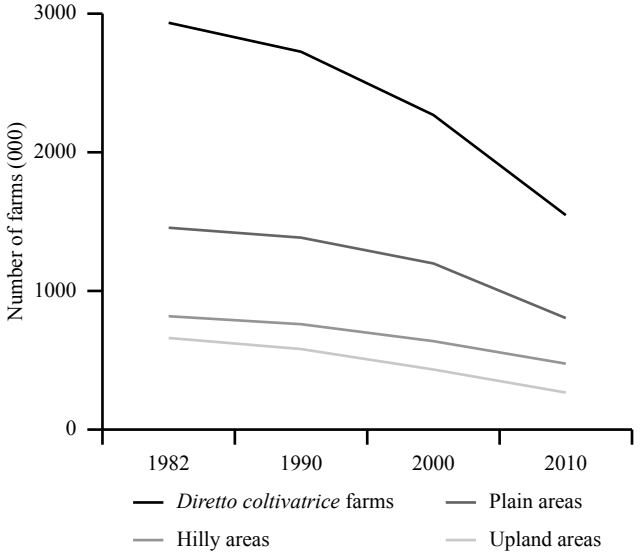

Figure 1: Evolution of family farm numbers in Italy as a function of topography, 1982-2010.
Data source: Italian National Institute of Statistics

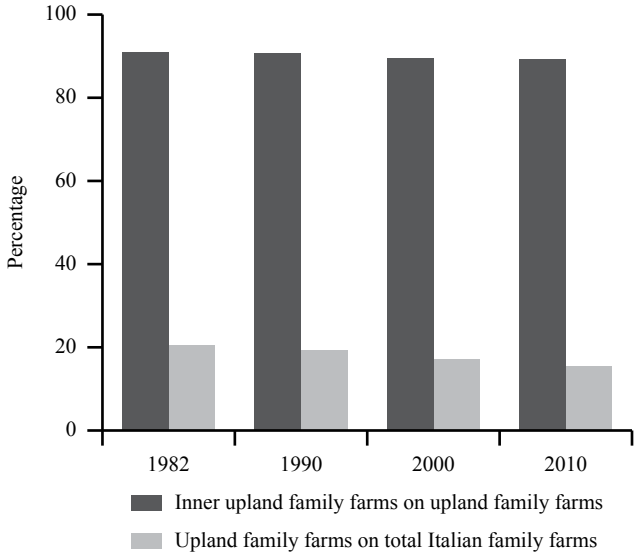

Figure 2: Incidence of family farms located in inner upland rural areas in Italy, 1982-2010.
Data source: Italian National Institute of Statistics

exodus from the countryside has been particularly intense in less favoured rural areas such as mountainous territories (Figure 2), the locations of more than 75 per cent of family farms.

Italian National Agricultural Census data have shown a significant fall in the usable agricultural area of family farms, from 13 million ha in 2000 to 9.7 million ha in 2010. The same trend can be observed with co-operative farms, which declined from 176,187 ha in 2001 to 127,909 ha in 2010. By contrast, the usable agricultural area of agricultural limited companies stabilised at 1.9 million ha as a consequence of some legislative interventions aimed at strengthening these types of farms.

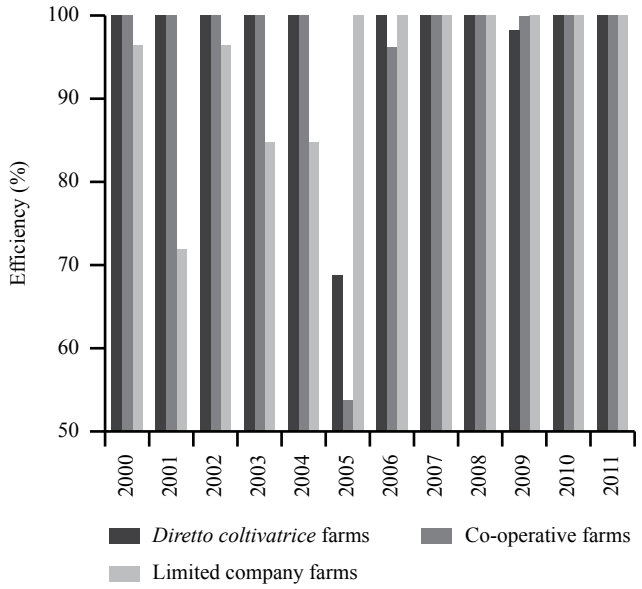

Figure 3: Scale efficiency of family farms, co-operative farms and limited company farms during the period 2000-2011.
Data source: Italian FADN database

Data Envelopment Analysis

The DEA analysis shows the *diretto coltivatrice* farms and the co-operative farms had higher levels of scale efficiency than the limited company farms (Figure 3) with a scale efficiency value equal to 100 per cent in ten years out of twelve. The scale efficiency such as the technical efficiency in family farms was close to the threshold value of 100 per cent, which is the optimal value in terms of use of inputs and produced outputs, and only in two years (2005 and 2009) was it below the maximum value equal to 100 per cent.

The average technical efficiency of Italian *diretto coltivatrice* farms was higher than those of co-operative farms and limited company farms, by 97 per cent and 93 per cent, respectively, even if the VRS efficiency has pointed out a higher value compared to CRS of 97 per cent and 90 per cent (Figure 4). For *diretto coltivatrice* farms the efficiency in CRS was lower than 1 or 100 per cent only in 2002 and in 2006; even if the economic efficiency was lower than the allocative efficiency, in particular in 2002. This suggests that *diretto coltivatrice* farms are able to maximise their output but they need to improve their management and their productive and managerial choices, taking into account (in the input-oriented model) the price of inputs in their production decisions.

Over the time of observation the efficiency in CRS of co-operative farms in Italy was less than 100 per cent in 2003, 2004 and 2006, and both the allocative efficiency and the technical efficiency in average terms were below 100 per cent with an average scale efficiency of less than 100 per cent (Figure 5). These findings show that co-operative farms are not able to maximise their output and at the same time they need to improve their productive process, minimising inputs and also increasing their control over input prices compared to other types of agricultural enterprises.

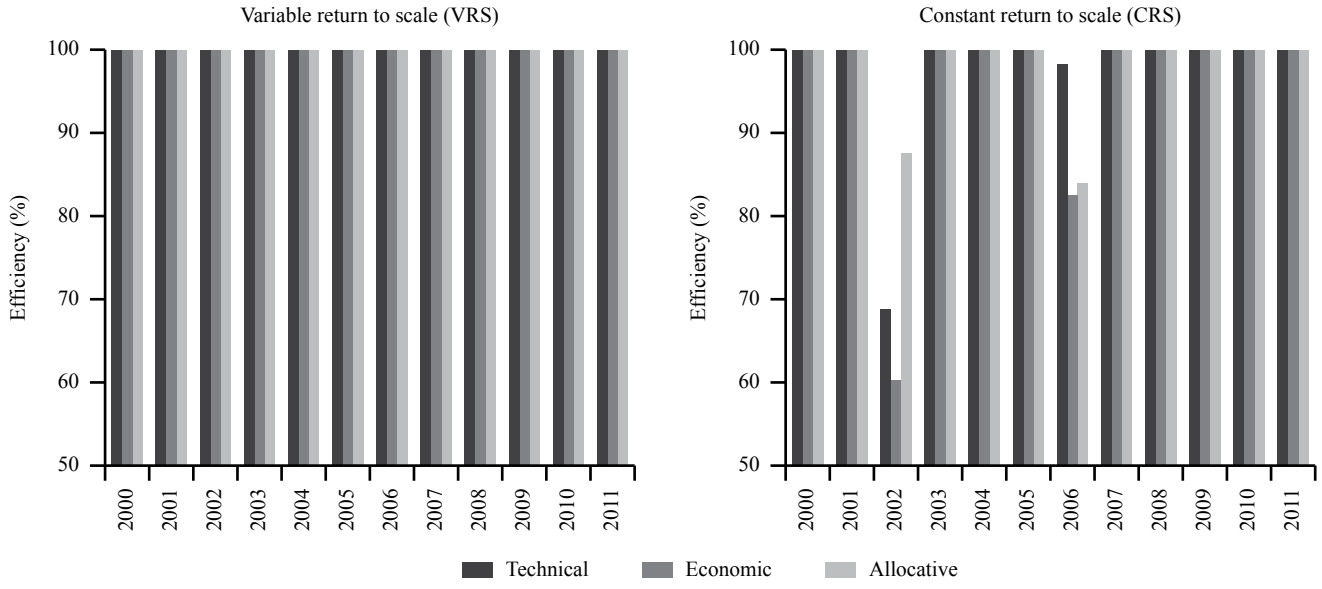

Figure 4: Technical, economic and allocative efficiencies of Italian *diretto coltivatrice* farms comparing variable and constant returns to scale during the period 2000-2011.
Data source: Italian FADN database

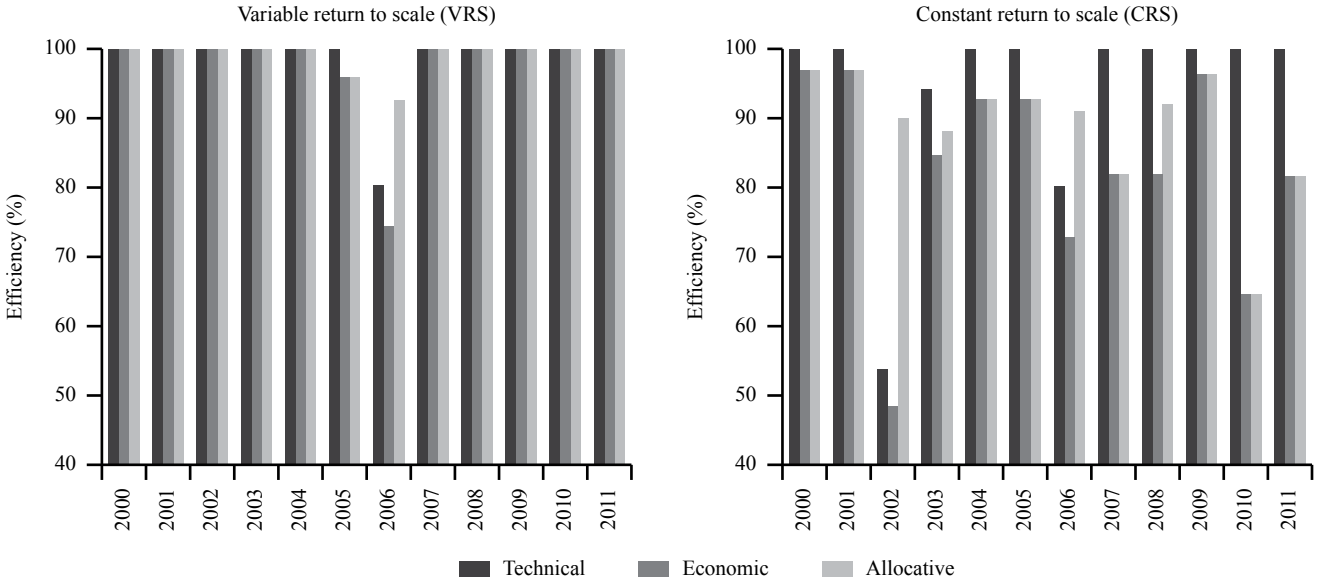

Figure 5: Technical, economic and allocative efficiencies of Italian co-operative farms comparing variable and constant returns scale during the period 2000-2011.

Data source: Italian FADN database

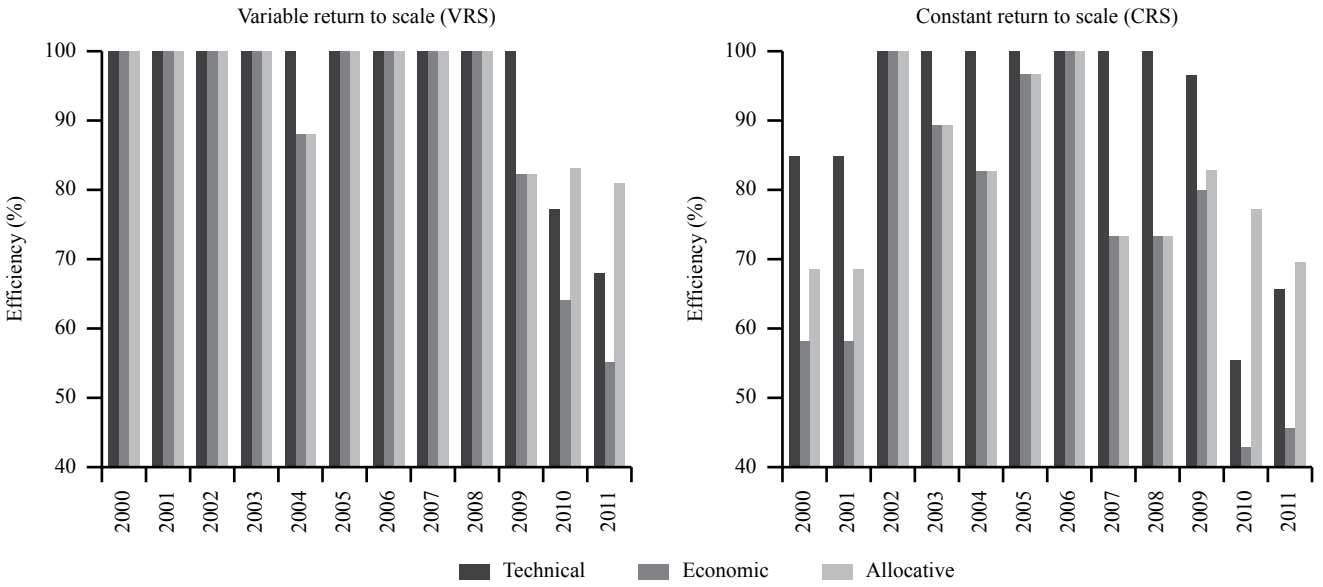

Figure 6: Technical, economic and allocative efficiencies of Italian limited company farms comparing variable and constant returns scale during the period 2000-2011.

Data source: Italian FADN database

The technical efficiency of agricultural limited companies both in CRS and also in VRS was below the optimal threshold of efficiency equal to 100 per cent. The technical efficiency in CRS was above 100 per cent in six years, with some values of allocative and economic efficiency below 100 per cent. This is particularly true in terms of CRS. The value of allocative and technical efficiency was below 100 per cent (Figure 6). This implies that the limited company farms in Italy are not able to maximise their levels of output; thus, they need meaningful actions both to improve management decisions and also to implement the productive choices connected to poor and inefficient control of input prices with financial and technical consequences for their economic sustainability.

Analysing the efficiency over the period 2000-2010 as a function of topography both in VRS and CRS, it was found that the average values were higher in the VRS model than the CRS, even if farms located in plain areas have an efficiency lower than those in upland areas (Table 1) and in particular in terms of cost and allocative efficiency.

The size of farm had an effect on efficiency in terms of CRS and VRS as well; in fact, the average efficiency was higher in farms of less than 5 ha, in some Italian farms with an area of 5-10 ha and in others larger than 50 ha (Table 2). Nevertheless, the small farms in terms of usable agricultural area, ranked as smaller than 5 ha, 5-10 ha and 10-20 ha, have levels of efficiency close to 100 per cent with some significant fluctuations in some years.

Table 1: Technical, economic and allocative efficiencies of Italian farms during the period 2000-2010 as a function of topography.

Year	Upland			Highland			Lowland		
	Technical	Economic	Allocative	Technical	Economic	Allocative	Technical	Economic	Allocative
Variable return to scale									
2000	92.8	80.5	86.7	100.0	100.0	100.0	100.0	100.0	100.0
2001	100.0	100.0	100.0	100.0	88.7	88.7	100.0	100.0	100.0
2002	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2003	100.0	100.0	100.0	100.0	100.0	100.0	33.8	14.7	43.5
2004	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2005	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2006	100.0	96.8	96.7	100.0	100.0	100.0	100.0	100.0	100.0
2007	100.0	99.6	99.6	100.0	100.0	100.0	100.0	100.0	100.0
2008	100.0	94.4	94.3	100.0	100.0	100.0	100.0	100.0	100.0
2009	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2010	100.0	60.6	60.6	100.0	100.0	100.0	100.0	36.1	36.1
Constant return to scale									
2000	70.4	59.1	83.9	92.1	87.0	94.4	100.0	100.0	100.0
2001	100.0	93.4	93.4	100.0	85.7	85.7	100.0	100.0	100.0
2002	100.0	86.9	86.9	100.0	100.0	100.0	100.0	76.9	76.9
2003	98.5	80.6	81.8	100.0	100.0	100.0	27.9	12.1	43.4
2004	100.0	100.0	100.0	63.1	61.3	97.2	100.0	80.7	80.7
2005	100.0	100.0	100.0	100.0	87.7	87.7	100.0	89.0	89.0
2006	100.0	93.9	93.9	98.8	93.8	94.9	100.0	100.0	100.0
2007	100.0	97.4	97.4	100.0	95.1	95.1	100.0	100.0	100.0
2008	100.0	74.7	74.7	100.0	100.0	100.0	100.0	57.7	57.7
2009	100.0	83.8	83.8	100.0	100.0	100.0	100.0	43.6	43.6
2010	100.0	44.9	44.9	100.0	100.0	100.0	97.7	25.3	25.9

Data source: Italian FADN database

Table 2: Technical, economic and allocative efficiencies of the usable agricultural area of Italian farms during the period 2000-2010.

Usable agricultural area (ha)	Technical	Economic	Allocative
Variable return to scale			
<5	100.0	89.9	89.9
5-10	99.3	98.1	98.7
10-20	94.1	89.7	94.9
20-50	91.9	84.6	88.8
>50	100.0	100.0	100.0
Constant return to scale			
<5	100.0	82.7	82.7
5-10	90.1	79.5	87.8
10-20	91.1	84.5	92.2
20-50	86.9	78.3	88.9
>50	86.7	70.7	80.3

Data source: Italian FADN database

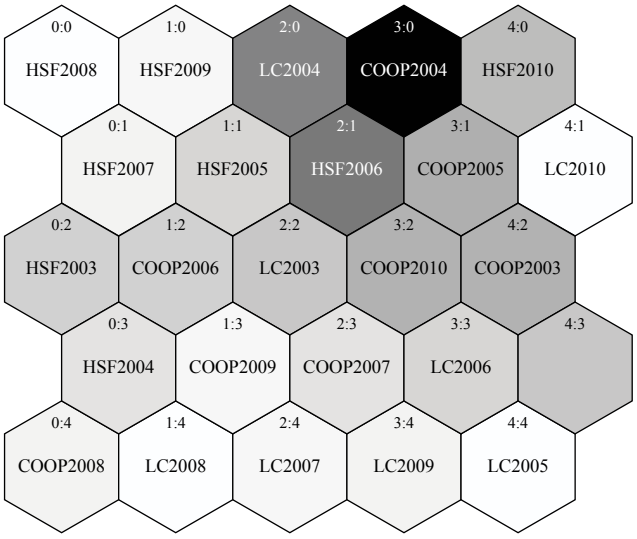

Figure 7: Typology of Italian farms in terms of net farmer's income stratified in three clusters, i.e. limited company (LC), cooperative (COOP) and *diretto coltivatrice* farms (HSF). The black hexagon (COOP2004) is the 'winner' neuron and the white ones are the 'losers'. The different scales of grey describe different levels of efficiency: dark grey hexagons are more efficient than light grey ones.
Data source: Italian FADN database

Self-organising maps

The first phase of Kohonen's map compares Italian *diretto coltivatrice* farms, co-operative farms and limited company farms. In 2004 the co-operative farms (indicated by a black hexagon) had the best performances in terms of farmer's net income (Figure 7). In 2006 the family farms and limited company farms, (indicated by dark grey hexagons), had high levels of farmers' net incomes. The *diretto coltivatrice* farms and limited company farms had the worst results in two years out of twelve (2008, 2009 and 2005, 2010 respectively).

In order to assess if the land capital in terms of usable agricultural area is a fundamental factor in influencing farmer's net income Italian family farms were stratified according to size. Farm size is the most important factor affecting the economic efficiency of Italian family-owned farms. The Kohonen's maps highlighted that the best results in terms of farmer's net income were achieved in 2003 by farms with a usable agricultural area of 20-50 ha (Figure 8); the worst results were achieved by family farms with an area of less than 5 ha.

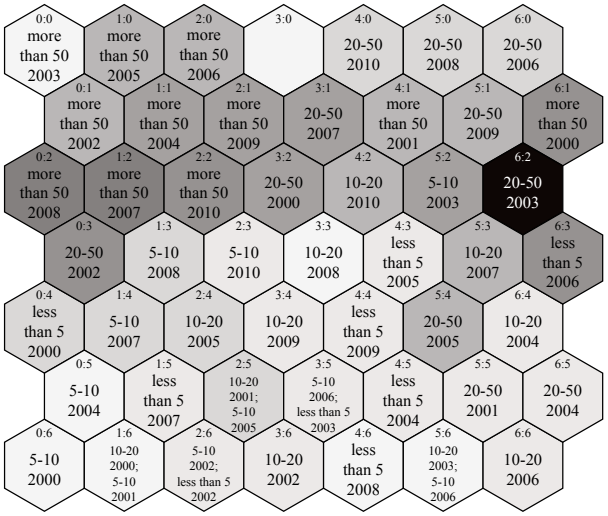

Figure 8: Effect of usable agricultural area on the farmer's net income of Italian family farms. In each hexagon the usable agricultural area per farm and year is indicated. The black hexagon (20-50 ha in 2003) is the 'winner' neuron. The different scales of grey describe different levels of efficiency: dark grey hexagons are more efficient than light grey ones.

Data source: Italian FADN database

Discussion

The analysis has identified usable agricultural area as one of the most important factors in farm economic performance. The findings have highlighted that property is another pivotal tool in influencing the economic results of Italian farms and specifically of Italian *diretto coltivatrice* farms. Over the study period, Italian farms have to some extent changed from being small farming units managed and owned by one person to farms with a usable agricultural area of around 50 ha that are able to guarantee adequate levels of income to farmers. In order to complement the farmer's income, to improve their efficiency and to stabilise farm net income, many dynamic farmers in Italy have diversified their agricultural revenues with some extra farm activities such as rural tourism and agritourism (Galluzzo, 2014b).

The efficiency of Italian farms is sensitive to the model of ownership even if the smallholder family farms have been efficient enough compared to co-operatives and limited companies, refuting the common view according to which smallholder family farms are not economically and technically efficient. Furthermore, the Italian *diretto coltivatrice* farms have given a positive return on EU funds by reducing the marginalisation of rural territories by means of diversification of on-farm activities such as agritourism.

The substantial drop in the scale efficiencies of co-operative farms and family farms in 2005 (Figure 3) can be attributed to the enforcement of changes in Pillar I of the CAP, which reduced the direct supports towards agrarian commodities, with the consequences that family farms and co-operative farms have been less sensitive than limited companies. In general the impact of changes in weather conditions has not been significant over the time of study. Even in 2003 the dry spring and summer weather did not have any negative impacts on scale efficiency of farms with the exception of the limited companies.

The findings from the SOM highlighted an increase of land capital in co-operatives as an important strategy in bettering the level of technical results. Furthermore, the economic crises in 2007-2008 had several consequences for the *diretto coltivatrice* farms, pointing out the pivotal role of farm size in countering new economic challenges. In fact, 20 ha of land is an efficient dimension in order to maximise a farmer's income, corroborating the role that financial supports should have in terms of increasing the usable agricultural area of farms.

In order to implement technical and allocative efficiency, family farms should also increase their land capital through the unification of their fragmented parcels as these do not allow greater capital investments to be made, and other labour saving technologies aimed at reducing the cost of inputs to be used. Some actions in the 2000-2006 and 2007-2013 Italian Rural Development Programmes were designed to stimulate a growth of more efficient farm production and management processes, strengthening the power of family farms in the countryside by means of specific subsides. The purpose of this financial aid was to raise the levels of scale efficiency and allocative efficiency through the introduction on the farm of new production technologies, and by farm consolidation and enlargement. Among the priorities of the Italian Rural Development Plan (RDP) 2014-2020 is to support a radical change in the production process by the introduction of new technologies that are able to reduce variable costs, even if findings from the previous RDP (2007-2013) have identified a poor tendency among family farms to adopt innovative technologies and to diversify their agricultural production.

In conclusion, Italian *diretto coltivatrice* farms are not obsolete enterprises but entities that require different multidisciplinary approaches aimed at protecting them from marginalisation and from isolation in the countryside. If the target of public investments in the primary sector is to enhance technical and economic efficiency in family farms by increases in usable agricultural area it is necessary to incentivise the generation turnover. The average age of Italian farmers, at close to 56 years (Istat, 2011), is a bottleneck in enhancing farm efficiency and is also linked to difficulties in taking over farms and in buying land capital by young farmers. Loans with a fixed low interest rate can help to increase the level of technical efficiency through investments in technology on family farms and in purchasing land. Furthermore, in order to restrict land fragmentation, a law and regulations to ensure the indivisibility of an inherited estate during the process of succession could be introduced, following the examples of other EU Member States such as Austria and Germany.

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Barbara WIELICZKO*

Investment in machinery, equipment and means of transport in Polish agriculture, 2009-2012: example of FADN region 785 (Pomorze i Mazury)

In the paper the scale of investment in agricultural equipment in Poland in the years 2009-2012 is investigated. The research concentrates on FADN region 785 as it has on average the largest farms in Poland. Thus its agriculture is the most advanced in terms of convergence with EU-15 agriculture and presents the highest potential to compete on the European Union (EU) market. Investment in machinery, equipment and means of transport is the most common kind of investment projects and the first that is undertaken by farmers who wish to develop their farms. The results show that although the average scale of investment is growing it is still insufficient given the average level of usage of fixed assets in Polish agriculture. The EU co-financed support for investment can be seen as an additional source of investment finance, with only about 12 per cent of farms making use of public support in their investment projects. The average value of such investment is several times higher than in the case of farms using other sources of financing their investments. Most investment projects are financed from own resources – retained profits.

Keywords: Polish agriculture, investment, public support

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Introduction

Since Poland's accession to the European Union (EU) the pace of change in Polish agriculture has significantly increased. This is for two main reasons, Common Agricultural Policy (CAP) support and membership of the EU common market, the latter providing both better marketing prospects and more competition. An increase in agricultural incomes has made agricultural production more profitable and thus raised the farmers' willingness to invest.

Farm investment is a subject of vast research related to numerous detailed issues and aspects of both investment behaviour and impact of investment projects on further business activity. Gallerani *et al.* (2008) review the research findings on factors affecting farm investment behaviour. Their findings show that a decision on undertaking an investment project depends on such variables as, *inter alia*: farm characteristics (i.e. location, specialisation debt/asset ratio), factor markets, product markets, public policy and household characteristics.

Investment as an increase in capital stock should be a positive factor leading to higher competitiveness. Yet, there are two main types of investment that are not equal in terms of their impact on a farm's situation in relation to other farms. Investment limited to the replacement rate of capital does not improve the farm's standing. However, with the competition among producers of different tangible and intangible goods it is hardly possible to expect a farmer to replace depreciated goods like-for-like and not with technologically more advanced ones. Thus, it seems that distinguishing between investments in more technologically advanced capital goods from those that simply substitute old capital goods with others of the same kind is in today's context pointless.

Investment is considered to be an important indicator of the situation in the economy and its branches. It does not only show the current perception of the future market situation but it also implies the future competitive potential of economic units. Moreover, "increasing the competitiveness of the agricultural sector requires an improvement of the productivity of physical capital" (EC, 2014, p.6). It is directly related to the fact that "modernisation of farms is crucial to improve their economic performance through better use of the production factors including the introduction of new technologies and innovation, farm diversification, etc." (EC, 2014, p.22).

The role of investment in increasing a farm's competitiveness is directly linked to technical progress that is an important factor of growth in modern agricultural growth models (Rembisz and Floriańczyk, 2014) and it drives productivity and efficiency in production and enhances firm profitability (O'Toole *et al*., 2011). The literature on investment in agriculture concentrates on two main issues, factors determining investment behaviour and sources of financing investment projects, although the second one is closely related to the first. Within the second branch of research there is a subsection related to analysing the impact of public support on the level of investment and characteristics of the investing farms. A large part of the research is also devoted to the impact of agricultural policy on investment decisions. Lefebvre (2014) reviews the impact of the CAP. Naturally there also other areas of research related to investment such as the analysis of investment risk or impact of investment on economic performance or competitiveness.

The aim of the paper is to assess the scale of investment in machinery and equipment in Polish agriculture in the period 2009-2012 and, using the example FADN region 785 Pomorze i Mazury, to answer the following questions: (a) do the farms co-financing their investment with public funds differ from those not using this source of financing; and (b) is there any correlation between the level of support and farm size and performance?

Methodology

Using Polish FADN data for individual farms between 2009 and 2012, the research is based on analysis of the changes in indicators over time and among farm types. The period analysed was determined by the availability of data as

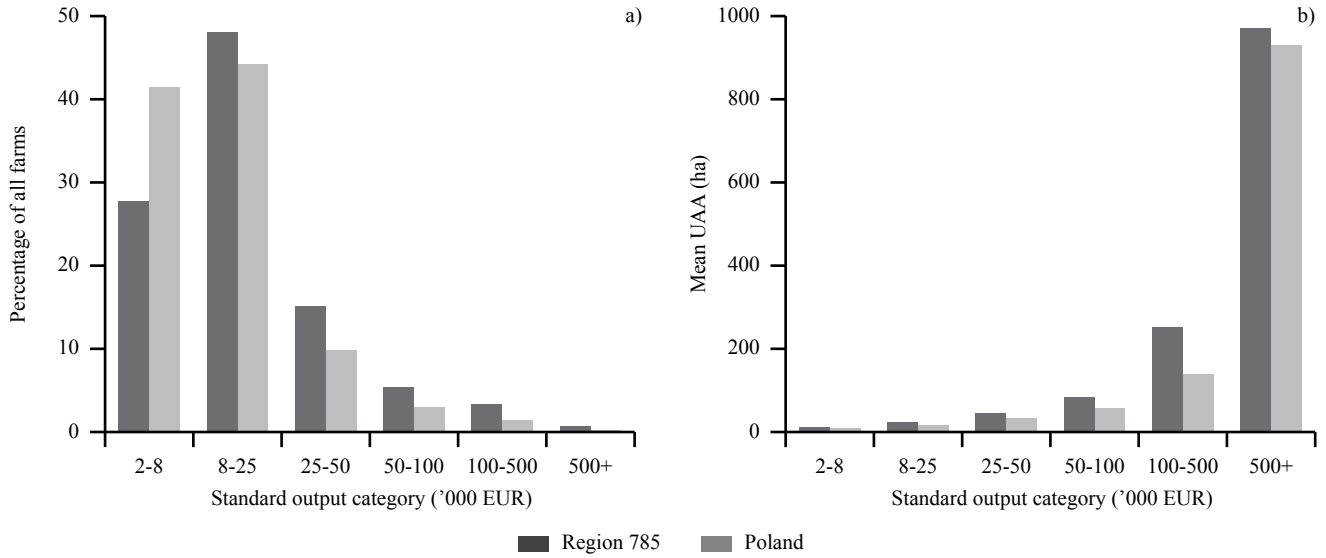

Figure 1: Structure of the FADN population by standard output category in region 785 and Poland in 2012 in terms of (a) percentage of farms and (b) mean utilised agricultural area.

Data source: Polish FADN data

it was not until 2009 that information on investment support was added to the data collected. FADN region 785 was chosen as it has the largest farms of all the Polish FADN regions. Therefore these farms are the most similar to the EU-15 average and are most able to compete with other farms in the EU. The agriculture in this region is also most advanced in terms of convergence with the most agriculturally advanced EU Member States[1].

For the analysis only investment in two categories was taken into account: (a) machinery and equipment, and (b) means of transport. These were chosen as only for these two types of investment projects are there sufficient numbers of farms receiving public support. Thus only in these cases can any analysis be made. Farms in region 785 show, on average, higher investment activity in machinery, equipment and means of transport than in Poland as a whole and are developing faster than their counterparts in other regions of Poland.

Results

Characteristics of the farms in FADN region 785

FADN region 785 Pomorze i Mazury (Hereafter referred to as 'region 785') is one of four Polish FADN regions. It consists of four Polish NUTS 2 regions or *voivodeships* situated in the northern and north-western parts of Poland (PL42 Zachodniopomorskie, PL43 Lubuskie, PL62 Warminsko-Mazurskie and PL63 Pomorskie). This is the region with the largest average size of farms in Poland, yet it includes only slightly over 10 per cent of farms represented by the Polish FADN sample. The average farm utilised agricultural area (UAA) in this region about is double the national average: in 2009 34.7 ha c.f. 17.8 ha and in 2012 39.6 ha c.f. 19.6 ha (FADN)[2]. The share of large farms is much higher in region 785 (4.0 c.f. 1.6 per cent) and that of the very smallest much lower (27.7 c.f. 41.4 per cent) than in the whole farm population (Figure 1).

The larger farm size is also the reason for a higher share of farms with a specialised type of farming. In 2012 the share of arable farms in the region was almost twice as big as in Poland as a whole, while the share of mixed farms was over 10 percentage points lower (Table 1).

Table 1: Type of production of the FADN population in region 785 and Poland in 2009 and 2012 (per cent).

Farm type	2009		2012	
	Region 785	Poland	Region 785	Poland
Arable	29.1	23.6	15.6	8.0
Horticulture	2.2	2.9	2.7	3.7
Permanent crops	0.7	3.4	0.6	2.6
Dairy	7.6	5.1	15.2	12.7
Other grazing livestock	9.1	6.6	7.3	4.2
Granivores	5.9	6.5	8.6	8.2
Mixed	45.4	51.9	49.8	60.6

Data source: Polish FADN data

Despite the size differences, in 2009 the farms in region 785 did not show higher cost efficiency than their counterparts in the whole Polish FADN population (Table 2). The relationship between total inputs (SE270)[3] and total output (SE131)[4] is similar in farms from region 785 and Poland specialising in a given type of production. In some cases (mixed farms and other grazing livestock farms in region 785) total inputs even exceed total output. This may be a result of a higher amount of total external factors (SE365) that include interest (SE380) paid on credits for purchase of land, machines and other inputs.

The situation was similar in 2012. In the case of most farm types the relationship of total inputs to total output was slightly higher for farms representing region 785 than for the

[1] The convergence process and comparisons with the EU-15 are common topics of research studies among researchers in the Eastern EU (e.g. Ziętara *et al*. 2013).

[2] These figures represent the FADN indicator SE025.

[3] Total inputs (SE270) are defined as a sum of: total specific costs, total farming overheads, depreciation and total external factors.

[4] Total output (SE131) is defined as a sum of: total output of crops and crop production, total output livestock and livestock products and other output.

Table 2: Total inputs (SE270) and output (SE131) in EUR in region 785 and Poland by farm type in 2009 and 2012.

Farm type	Region 785						Poland					
	2009			2012			2009			2012		
	SE270	SE131	SE270/ SE131 (%)	SE270	SE131	SE270/ SE131 (%)	SE270	SE131	SE270/ SE131 (%)	SE270	SE131	SE270/ SE131 (%)
Arable	40,266	40,273	100.0	85,794	104,157	82.4	21,580	22,301	96.8	47,450	60,573	78.3
Horticulture	22,132	27,730	79.8	33,225	42,134	78.9	32,743	43,635	75.0	30,736	39,771	77.3
Permanent crops*	35,449	39,944	88.7	-	-	-	17,639	19,980	88.3	-	-	-
Dairy	20,404	22,969	88.8	46,516	53,975	86.2	16,316	18,324	89.0	24,080	30,108	80.0
Other grazing livestock	20,262	19,286	105.1	13,633	13,727	99.3	21,130	21,621	97.7	12,834	13,343	96.2
Granivores	109,018	127,245	85.7	110,239	134,441	82.0	49,027	59,797	82.0	48,838	59,496	82.1
Mixed	25,958	24,640	105.4	26,055	29,173	89.3	16,262	16,383	99.3	19,206	21,872	87.8

* In 2012 there are no data for permanent crops as in region 785 the number of farms representing this type of farming is too low to be representative of the whole population.
Data source: Polish FADN data

Table 3: Farm net value added (SE415) and farm net value added/AWU (SE425) in EUR, and farm net value added per total utilised agricultural area (SE415/SE025) in region 785 and Poland (per cent) by farm type in 2009 and 2012.

Farm type	Region 785						Poland					
	2009			2012			2009			2012		
	SE415	SE425	SE415/ SE425 (%)	SE415	SE425	SE415/ SE425 (%)	SE415	SE425	SE415/ SE425 (%)	SE415	SE425	SE415/ SE425 (%)
Arable	17,389	9,394	185.1	54,897	25,146	218.3	9,473	5,425	174.6	32,810	16,930	193.8
Horticulture	8,746	4,417	198.0	15,402	5,783	266.3	15,856	6,368	249.0	14,146	5,964	237.2
Permanent crops*	16,555	6,024	274.8	-	-	-	7,506	3,762	199.5	-	-	-
Dairy	8,909	4,869	183.0	21,908	10,150	215.8	6,401	3,631	176.3	13,024	7,247	179.7
Other grazing livestock	7,502	4,182	179.4	7,228	4,533	159.4	7,530	4,284	175.8	5,705	3,675	155.2
Granivores	31,571	15,175	208.1	42,172	19,595	215.2	17,192	10,142	169.5	18,083	10,549	171.4
Mixed	8,125	4,543	178.9	12,503	7,085	176.5	5,337	3,328	160.3	8,589	5,119	167.8

* In 2012 there are no data for permanent crops as in region 785 the number of farms representing this type of farming is too low to be representative of the whole population.
Data source: Polish FADN data

whole Polish FADN population. Both total inputs and total output grew substantially in all farm types, but the highest increase was observed in arable farms. This was a result of their rapid growth in size: in 2012 they were about twice as big as in 2009. On average, the arable farms in region 785 operated on 94.5 ha UAA, while for Poland as a whole the figure was 50.7 ha UAA. These data include both own and leased land. In 2012 the average area of leased land per farm amounted to 39.4 ha UAA in region 785 (Mikołajczyk and Wituszyńska, 2014) and to 18.8 ha UAA in Poland as a whole (Floriańczyk *et al*., 2013). The average total UAA per farm in 2009 was: 51.3 ha in region 785 (including 20.1 ha of leased land) (Brzezik *et al*., 2011) and 23.7 ha (including 8.1 ha of leased land) in Poland as a whole (Goraj *et al*., 2010).

As the farms in region 785 are generally larger than their counterparts in the rest of Poland their farm net value added (SE415) is much higher. The value per annual work unit (AWU)[5] and UAA is also much higher, indicating higher efficiency and economies to scale.

In 2009 the horticulture farms were the only ones in region 785 that showed lower net value added as well as net value added per employee and per ha of UAA in comparison with the general population (Table 3). This was due to the fact that horticultural farms in region 785 were smaller than in other regions. Yet, the average size of the UAA was only slightly larger: 4.1 ha, while in region 785 it was 3.5 ha and the total labour input was very similar, so significant differences at the level of net value added can be explained only by differences in efficiency and the types of plants grown. In 2012 all the farm types analysed in region 785 had higher net value added and its indicators per employee and per ha of UAA. Only the figure of net value added per AWU was slightly lower in horticulture farms in region 785 than in the other regions. In this year horticulture farms in region 785 were on average larger than in the general population of these farms.

Scale of the investment in machinery, equipment and means of transport

In the analysed years the scale of investment was closely related to the farm size. This explains the differences in the level of investment expenditure among different farm types as well as between farms in region 785 and the whole Polish farm population. The highest gross investment was observed in arable farms in region 785 in both 2009 and 2012 (Table 4). Also in the case of farms specialising in granivores the difference between years in the average value of investment in region 785 is much higher than for the whole farming population in Poland. As for all the other types of farms the data do not show a clear pattern and change substantally with the year of analysis.

Data for gross investment (SE516) cannot be seen as a precise tool to assess the actual changes in the physical capital owned by a farm as they include depreciation. Therefore, it is necessary to analyse also the data on net investment,

[5] The formula to calculate farm net value added/AWU (SE425) is: farm net value added (SE415) divided by total labour input expressed in AWU (SE010), where total labour input is presented in the equivalent of full-time persons working on a farm.

Table 4: Average farm gross investment in region 785 and Poland in EUR by farm type in 2009 and 2012.

Farm type	2009		2012	
	Region 785	Poland	Region 785	Poland
Arable	10,676	4,243	19,328	14,216
Horticulture	817	4,627	5,493	4,569
Permanent crops	5,794	4,063	-	5,843
Dairy	3,324	3,080	11,075	6,371
Other grazing livestock	3,510	4,218	2,452	2,865
Granivores	11,509	5,460	8,327	5,021
Mixed	3,211	1,880	4,223	2,853

Data source: Polish FADN data

Table 5: Farm net investment in region 785 and Poland in EUR by farm type in 2009 and 2012.

Farm type	2009		2012	
	Region 785	Poland	Region 785	Poland
Arable	4,779	3,150	7,748	6,739
Horticulture	-2,996	-1,242	997	-505
Permanent crops	-6,944	-1,988	-	-1,231
Dairy	-1,237	-422	3,118	1,720
Other grazing livestock	-910	-526	-786	-179
Granivores	2,695	-228	-622	18
Mixed	-1.277	-982	45	-453

Data source: Polish FADN data

Table 6: Value of investment in equipment and means of transport in EUR on FADN farms in region 785 in the period 2009-2012.

Indicator	2009	2010	2011	2012
Median	6,620	6,263	6,288	7,938
Standard deviation	40,003	38,620	43,160	46,253
Mean	26,233	23,687	22,526	27,517
Minimum	119	151	114	124
Maximum	220,664	277,873	755,959	444,062

Data source: Polish FADN data

which is gross investment minus depreciation (SE521). The averages for the different farm types in region 785 and Poland as a whole indicate that the actual development is generally illusory as net investment is negative, thus in fact a process of disinvestment is taking place. In the analysed period only in the case of arable farms was there a steady increase in the value of physical capital as the net investment was positive (Table 5).

Data for the whole FADN population in region 785 show that the scale of investment in equipment and means of transport varies greatly. Therefore, it is worth assessing not only the mean value of investment, but also median and standard deviation. The median value of investment was about one quarter of the mean (Table 6). The value of standard deviation amounts to about 150 per cent of the mean, showing a great diversity in the scale of investment. The changes in these indicators are in line with the other data presented here on region 785, showing that a slight fall in the value of investment was observed in 2010 as a result of a worse market situation.

As the investment is related not only to business strategy and the farm's prospects but also to the availability of capital to undertake them, its scale and type depend on types and scale of external funding. Of special interest are the funds available within the public agricultural policy as it is important to assess their actual efficiency and effectiveness.

Characteristics of the farms investing with the public support in region 785

The first issue worth analysing is the structure of the beneficiaries as this can show whether the policy was implicitly or explicitly targeted to specific types of farms. The structure of farms whose investment projects related to purchase of machinery and equipment was co-financed with the public support does not reflect the structure of farms in region 785.

The profile by farm type of farms from region 785 whose investment in machinery, equipment and means of transport was co-financed by public funds differs greatly from that of all farms in this region (c.f. Tables 1 and 7). As the eligibility criteria for financial support within the Polish Rural Development Programme (RDP) for 2007-2013 did not exclude any type of production (MARD, 2007), the differences in structure of support beneficiaries cannot be explained by lack of access to the support measures. Also the criterion of minimum economic size generally did not apply to farms from this region as average farms of all types of farming activities were at least three times larger (12 European Size Units, ESU) than the RDP's threshold (4 ESU) for the most popular investment measure – modernisation of farms. Thus, the potential explanation of these differences can be the farms' willingness and capacity to invest. While this can be influenced by numerous factors, definitely one of the key issues are the projections of the future situation on a given agricultural market.

However, the average structure of the beneficiaries of public support and that of the whole farm population undertaking the analysed types of investments are very similar (Table 8). A difference of more than 1 percentage point between the two groups is observed only in the cases of dairy and mixed farms.

Yet, these small differences in the profile can be attributed to the size of the sample. Only several per cent of the

Table 7: Profile of the farms investing with public support funds in region 785 by farm type in the period 2009-2012 (per cent).

Farm type	2009	2010	2011	2012
Arable	44.7	29.5	25.8	15.9
Horticulture	0.8	0.0	0.0	0.0
Permanent crops	0.8	0.0	0.0	1.6
Dairy	5.7	16.7	36.4	57.1
Other grazing livestock	13.8	6.4	9.1	9.5
Granivores	11.4	11.5	10.6	3.2
Mixed	22.8	35.9	18.2	12.7

Data source: Polish FADN data

Table 8: Profiles of the farms investing with co-financing from public funds and of all investing farms in region 785 by farm type in the period 2009-2012 (per cent).

Farm type	Investment with public support	All investing farms
Field crops	31.8	32.1
Horticulture	0.3	0.9
Permanent crops	0.6	0.8
Dairy	24.2	19.0
Other grazing livestock	10.3	10.2
Granivores	9.7	9.8
Mixed	23.0	27.3

Data source: Polish FADN data

Table 9: Share of farms in region 785 undertaking investment in machinery, equipment and means of transport in the period 2009-2012 (per cent).

Year	Investment with public support	Investment irrespective of capital sources
2009	6.5	38.1
2010	4.5	36.9
2011	3.8	40.2
2012	3.7	38.8

Data source: Polish FADN data

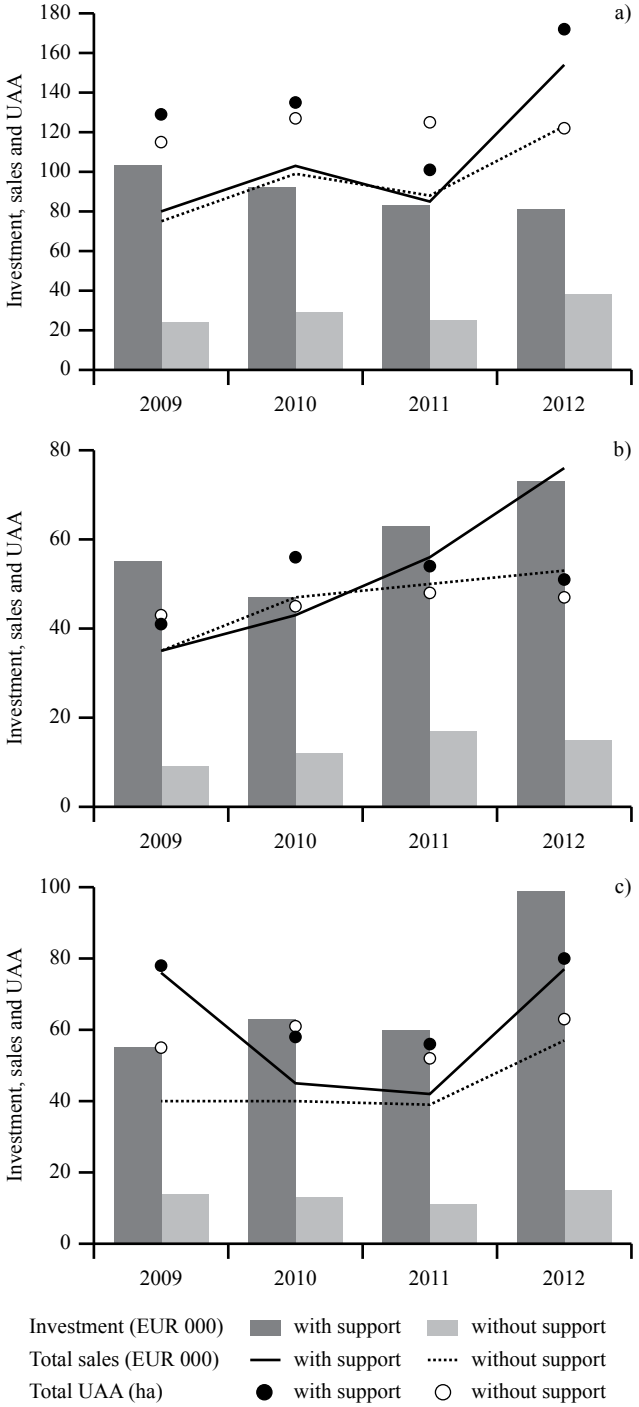

Figure 2: Values of investment, total sales and average utilised agricultural area per farm of (a) arable, (b) dairy and (c) mixed farms with and without public co-financing in region 785 in the period 2009-2012.

Data source: Polish FADN data

farms represented by FADN in region 785 undertook investment in equipment and means of transport co-financed with public funds in the period 2009-2012 (Table 9). This means that on average about 12 per cent of the investment in the assessed categories was conducted with the help of public funds. It is also clear that in a given year only about 40 per cent of farms had any investment in farm equipment.

As the share of farms using public support as a source of financing their investment is low, for further analysis of the difference between the group investing with public support and without it only three types of farms (arable, dairy and mixed) were chosen. The choice was based on their average share in the population of supported farms. However, although farm types with the largest share were chosen their number in specific case does not exceed 15.

In 2009 the values of investment by arable and mixed farms that were beneficiaries of public support were at least four times higher than in the group of non-beneficiaries (Figures 2a and 2c). In the case of dairy farms the difference was even larger and the amount of investments made with public support exceeded that of non-beneficiaries by over twelve times (Figure 2b). For arable farms the amount of total sales by support beneficiaries did not differ greatly from those for farms using other sources of capital for their investment. By contrast, for both dairy and mixed farms the amount of total sales of support beneficiaries showed figures about double those of non-beneficiaries. Similar relationships applied to the differences in the total (own and leased) UAA operated by them and (data not shown) total output. In 2010, for all three farm types the values of investment were around 4-5 times higher for the support beneficiaries than for the non-beneficiaries. Across all farm types, both groups of investing farms had similar levels of sales, UAA and (data not shown) total output.

In 2011 large differences in the values of investment remained in all farm types. Once again, in the case of arable farms, although the average UAA per farm of the beneficiaries of support was slightly smaller (101 ha c.f. 125 ha), the beneficiaries recorded very similar sales and output figures to the non-beneficiaries, Thus, these were already more effective farms. Among the dairy and mixed farms the non-beneficiaries had only slightly lower sales and output figures than their counterparts who received support. In 2012 very big differences in the scales of investment remained. For all three farm types, farms investing with public support had rather higher levels of sales than the ones investing without support, reflecting similar differences in UAA and (data not shown) total output.

The next issue to verify is the existence of any link between the scale of support and farm size and performance. To check whether smaller farms or farms with lower sales figures receive more investment support a correlation analysis was conducted. This analysis did not include farms specialising in horticulture and permanent crops as the numbers of support beneficiaries among these farms were low during the whole analysed period. Although in some instances there were quite strong correlations between the level of investment support and individual parameters for individual sectors (e.g. UAA in the dairy sector in 2010 and 2011), in general there is no clear relationship between the level of

Table 10: Correlation between the level of investment support and selected farm parameters.

Farm type	Parameter	2009	2010	2011	2012
Arable	UAA	0.57	0.39	-0.07	-0.31
	Total sales	0.27	0.32	-0.29	-0.16
	Total production	0.30	0.32	-0.20	-0.26
	Sales per ha UAA	-0.21	-0.16	-0.40	0.24
Dairy	UAA	0.23	0.75	0.74	0.03
	Total sales	0.17	0.59	0.61	0.21
	Total production	-0.49	0.66	0.60	0.17
	Sales per ha UAA	-0.36	-0.55	-0.16	0.24
Other grazing livestock	UAA	0.27	0.77	-0.22	0.81
	Total sales	0.10	0.38	0.46	0.65
	Total production	0.13	0.52	0.41	0.43
	Sales per ha UAA	-0.17	-0.46	0.65	0.14
Granivores	UAA	0.53	0.57	0.42	0.15
	Total sales	0.49	-0.23	0.50	0.44
	Total production	0.50	-0.04	0.49	0.47
	Sales per ha UAA	-0.24	-0.39	0.25	0.38
Mixed	UAA	0.67	0.26	0.14	0.48
	Total sales	0.13	-0.07	0.25	0.56
	Total production	0.17	0.01	0.23	0.50
	Sales per ha UAA	-0.08	-0.30	0.43	0.22

Source: own calculation based on Polish FADN data

support and farm size or performance (Table 10). Even for a given farm type the figures change year on year, showing neither a distinct direction of this relationship nor a stable strengthening of the correlation.

Discussion

Summing up the presented research it must be stated that the scale of investment in Polish agriculture is still insufficient. The data on net investment (Table 5) suggest that for many farm types in Poland the level of investment is lower than the rate of depreciation. This picture is made even worse when the usage level of the fixed assets in Polish agriculture is taken into account. Fogarasi *et al*. (2014), analysing the period 2000-2012, showed that despite the increase in investment and the inflow of CAP funds to the sector, the gross value of the fixed assets grew by over 20 per cent but the net value decreased during this period. During the same period the level of usage of these assets increased from around 10 to over 75 per cent. This is an observation specific not only to Poland but also to other countries struggling with modernisation of agriculture, such as Romania where "a rather limited volume of investment subsidies" is observed (Hubbard *et al*., 2014, p.104).

Comparing the figures for farm sales and UAA, especially for the period 2010-2012 (Figure 2), it is evident that the farms using public support generally have slightly lower levels of sales per ha UAA. Thus, they are less efficient than their counterparts investing without this support. In view of the small sample sizes used in this study, the results must be viewed with caution. However, Wigier *et al*. (2014) reported that the Polish farms undertaking investment projects financed from their own resources or credits perform better than their counterparts making use of public support for investment. In order to reach a more conclusive insight into the actual role played by public investment support in agricultural development the starting point of the investing farms must be taken into account. An in-depth case study would be needed to verify whether the farms without public support already had better equipment before making this investment and whether in the case of support beneficiaries the investment made enabled them to improve their efficiency significantly.

It is also difficult to access the increase in gross value added of the farms as the impact of external factors plays a crucial role in shaping this indicator. Trying to take into account the fluctuations in the market situation is even more complicated as it is not always the general market situation in a given agricultural market that counts, but in some case a specific set of conditions either on the local market or the ones related to any part of food chain that can affect prices and other market conditions. Thus, it seems that to achieve conclusive findings on the impact of investment support much longer time series and much more detailed data are required. Any further research could both tackle all four Polish FADN regions as well as apply more sophisticated research methods to verify the conclusions stemming from this analysis. Yet, the analysis of one region has the advantage of lower diversity among farms analysed given more homogenous environmental conditions and historically shaped farm sizes and farming traditions.

Furthermore, the results of a study on investment support in Slovenia also point out that "impacts of investment support on agricultural productivity growth … remain inconclusive" and the growth in labour productivity was in this country the main aim of the support (Travnikar and Juvančič, 2013, p.102). The results of the study on the investment support under rural development policy commissioned by the European Commission (EC, 2014) state that the availability of data is limited not only because the time series is short, but also because it is limited to a non-crisis period so the changes throughout the whole business cycle could not be observed. Therefore, it is not possible to come to substantial conclusions even by applying such methods of comparing beneficiaries and non-beneficiaries of investment support as propensity score matching or difference-in-difference. Moreover, different methods should be used for different types of impact assessment. For regional and national scale research the most suitable method is input-output analysis and for micro scale research more advisable is using propensity score matching.

Notwithstanding the general conclusions set out above, rapid changes are visible in many Polish farms, meaning that the process of constant growth in the scale of diversification of Polish agriculture is progressing.

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The effects of a participatory approach on the adoption of agricultural technology: Focusing on the social network structure in rural Ethiopia

This study empirically examined the effects of the participatory approach on the adoption of new crop varieties and agricultural practices. Particularly, we focused on the social network structure and examined how the introduced technologies diffused through networks in rural Ethiopia. Our empirical results indicate that if farmers knew and trusted fellow participants, the probability of adopting a new maize variety increased by 25 percentage points. However, this network had no statistical impact on the diffusion of new agricultural practices. We conclude that the participatory approach has great potential in the adoption of new crop varieties through the social networks of farmers in Ethiopia.

Keywords: participatory research and extension, farmer research group, impact evaluation

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Introduction

In the past, mainstream rural development efforts have focused on technical innovations delivered by research through extension to farmers in a top-down model (Waters-Bayer *et al*., 2004). However, many studies have found that such interventions through formal research institutions generally do not necessarily provide farmers with more secure access to new technologies or improve their livelihoods (Van de Fliert and Braun, 2002; Waters-Bayer *et al*., 2004; Hoffmann *et al*., 2007). In particular, agricultural research in Africa has failed to provide useful outputs to poor small-scale producers (Mosley, 2002; Sumberg and Reece, 2004; Breisinger *et al*., 2011).

One possible reason for this failure of diffusion of technologies through formal institutions was that the technologies were not developed based on farmers' needs or constraints. Thus, most newly introduced technologies have been inappropriate for poor farmers in marginal, rain-fed areas (Hall and Nahdy, 1999, Waters-Bayer *et al*., 2004). More precisely, Collinson (2001) documented that, while formal researchers tend to prioritise physical productivity, improving labour and capital productivity are the primary goals from producers' point of view. To understand the problems farmers face and minimise the gap between researchers' priorities and farmers' needs, the idea that farmers should participate in the process of agricultural research, innovation and extension was first proposed in the 1970s (Johnson *et al*., 2003). Since then, this Participatory Research and Extension (PRE) approach has become a leading principle of sustainable rural development (Leeuwis, 2000; Mog, 2004).

Several theoretical studies have explored the advantages of the PRE approach (Leeuwis, 2000; Van de Fliert and Braun, 2002; Mog, 2004; Waters-Bayer *et al*., 2004). Hellin *et al*. (2008) suggested that the use of participatory approaches is one way to enhance rural innovation capacity, where such approaches may involve increased accessibility by farmers to externally developed technology, the joint development of relevant and appropriate technology by farmers and scientists, or the enhancement of local capacity to address problems and devise solutions. Hoffmann *et al*. (2007) argued that the PRE approach may yield many innovations and new kinds of knowledge because farmers have far more opportunities than researchers for experimentation under different cultural and environmental conditions.

In contrast, several studies have documented constraints and limitations of the PRE approach. Firstly, it is difficult to generalise a given PRE practice, as technologies innovated through the PRE are locally developed to fit particular biophysical and socio-economic settings and usually cannot be transferred in exactly the same forms to other settings, notably, to the highly varied environments in which many poor farmers live (Waters-Bayer *et al*., 2004). Secondly, there is a power difference between stakeholders; in particular, the gender issue is important. Akerkar (2001) observed that "gender was often hidden in participatory research in seemingly inclusive terms: the people, the community, the farmers" (p.4). Similarly, farmers' groups of PRE projects in Uganda and Latin America were found to be dominated by men (Hall and Nahdy, 1999; Humphries *et al*., 2000; Ashby *et al*., 2000). Thirdly, the professional identity of scientists can have an adverse effect. Hall and Nahdy (1999) documented that "the scientists felt their status would be in some way diminished by passively listening to what farmers had to say" (p.5). The loss of 'superiority' with respect to knowledge decreases scientists' motivation to be involved in PRE projects.

Another major problem of the PRE approach is that its impact has not been clarified because of the absence of impact evaluations based on statistical analysis. Although many studies have shown how PRE projects have influenced productivity and income in various regions, all these are qualitative case studies (Humphries *et al*., 2000; Classen *et al*., 2008; Kaaria *et al*., 2008; Humphries *et al*., 2012). One quantitative study by Sanginga *et al*. (2006) applied statistical techniques to data from a survey of 170 producers in Uganda. However, the objective of these authors was to identify the factors that motivate farmers to participate in PRE projects, not to evaluate the impact of the PRE. Because the effects of the PRE method have rarely been systematically analysed or reported (Johnson *et al*., 2003), there remains disagreement regarding the roles of formal and informal research and development (Hoffmann *et al*., 2007).

In addition, the impact of the PRE approach on farmers not involved in the programme through technology diffusion from participant farmers has never been fully examined. Many studies have found that agricultural technology diffuses through social networks, especially in rural areas of less developed countries (Munshi, 2004; Todo *et al*., 2011). However, the spillover effects of PRE projects, such as whether new technologies introduced by the PRE approach diffuse to non-involved farmers through social networks, remain unclear.

Therefore, the objective of this study is to quantify the impact of the PRE approach on the diffusion of agricultural technologies, with a particular focus on whether and how new knowledge and agricultural practices introduced by a PRE project diffuse through social networks to community members who are not involved in the project.

Although there are many variants of the PRE approach – such as Participatory Technology Development (PTD) and Farmer Participatory Research (FPR) – in the present study, we focus on a PRE approach that particularly utilises Farmer Research Groups (FRGs) to involve farmers in the research process and strengthen the link between farmers' needs and research outcomes (Probst, 2000; Probst *et al*., 2003). Under the FRG approach, participating farmers identify their needs and test possible solutions by conducting on-farm trials. They are trained to collect the necessary data in a scientific way, which increases the credibility of their findings. In the present study, one FRG project conducted in Ethiopia is selected for detailed examination.

Data

Description of the FRG project

The FRG project (hereafter, "the project") selected for our case study was conducted in Ethiopia by the Japan International Cooperation Agency (JICA) and the Ethiopian Institute of Agricultural Research (EIAR). Like other sub-Saharan African countries, agriculture remains the main source of income for most rural households in Ethiopia. However, the agricultural productivity is fairly low due to low adoption of agricultural technologies (Todo and Takahashi, 2011).

To promote better understanding of agricultural knowledge among farmers, the project implemented the FRG in three zones in the Oromia region, namely East Shewa, Arsi, and West Arsi, from 2004 until 2009. During the implementation period, a total of 40 farmers' groups were established and a total 1,186 individuals participated in the project. While the gender issue has frequently been observed in FRG projects (Hall and Nahdy, 1999; Ashby *et al*., 2000; Humphries *et al*., 2000), in the present case the gender balance was successfully addressed: among the 1,186 participants, 633 (53.4 per cent) were women.

After the farmers' groups were established, each group chose its main focus from among 15 categories that covered a broad range of topics, namely agro-forestry, dairy products, pulses, maize, teff (a small grain cereal crop commonly produced in Ethiopia), vegetables, parthenium control, forage seeds, beehives, water harvesting, sweet potatoes, groundnuts, choppers, milk churners and market information. FRG participants then experimented with and evaluated new agricultural practices and improved technologies.

In the present study, we focused on two villages involved in the project: Awash Melkassa and Awash Bishola, located in southwest Ethiopia (approximately 100 km from the capital city of Addis Ababa). In the study area, the project established several farmers' groups that tested both new and conventional practices relating to teff, maize and vegetable (i.e. tomato, onion and pepper) production. More precisely, the project provided information on the new varieties of maize, soil compaction management technique for teff production, and row planting of vegetables. Therefore, for the impact evaluation, we examined the implementation by each group of three technologies: improved maize varieties, soil compaction for teff and row planting.

During the primary stage of the project, FRG participants evaluated the performance of two improved maize varieties, namely Melkassa-2 and Melkassa-3, by comparing them with a local variety, Awassa-511. The participants prepared trial plots and evaluated the productivity of each variety. According to the project report, the participants observed that Melkassa-2 yielded more maize grains than either Melkassa-3 or the local variety. More precisely, the average yield of Melkassa-2 was 36 qt/ha (ca. 34 l/ha), while Melkassa-3 and the local variety were 31 and 23 qt/ha (ca. 29 and 22 l/ha), respectively.

Soil compaction treatments were introduced potentially to impact germination and growth in teff production. Participants prepared trial plots (10 m by 10 m), employing different practices: no compaction, compaction before sowing, compaction after sowing, compaction before and after sowing, and traditional practices. To implement soil compaction treatments, roller-compactors were dragged by oxen or donkeys. The participants found that, while soil compaction increased plant numbers and germination rates, it did not affect productivity. Additionally, row planting and broadcasting were compared with respect to time spent, yield and germination. Until relatively recent years, direct broadcasting was common practice in rural areas of Ethiopia and diffusion rate of row planting was low. Therefore, the participants of the project first learned how to implement row planting and increased their awareness and knowledge of the technique. As a result, they learned that although row planting required more manual labour and labour hours, it increased productivity and reduced germination the day after planting. The project report shows one example of the haricot bean production; manual row planting requires 230.2 minutes/person and yields 99 kg/ha, while the time spent for preparation and average yield for broadcasting is 101.3 minutes/person and 93 kg/ha respectively.

Household survey

To collect socioeconomic information on both FRG participants and non-participants, we conducted a household survey from January to February 2012. Firstly we collected a complete list of the farming households in both villages. In total, 213 names were listed for Awash Melkassa and 208 for Awash Bishola.

In Awash Melkassa, we investigated all farmers on the list. However, owing to missing variables, seven farmers

were omitted; hence the number of observations in Awash Melkassa used in the analysis was 206. In the case of Awash Bishola, we randomly selected 150 people for the household survey from the list of 208 individuals. Unfortunately, because some data for 16 individuals were missing, data for only 134 people were available for the analysis. Hence, the total number of observations in our study was 340. Among these 340 interviewed households, 42 individuals participated in the FRG.

Table 1 presents basic information on FRG participants and non-participants. Although there were no significant differences between the two groups with respect to any variables, the proportion of female household heads among FRG participants was relatively high compared to that of non-participants.

Table 1: Summary statistics for Farmer Research Group project participants and non-participants.

Variable	Participants	Non-participants	Total
Number of observations	42	298	340
Age of the household head	45.62	45.18	45.23
	(13.43)	(16.40)	(16.05)
Female household head (%)	40.5	28.9	30.3
Educational years of the household head	3.69	3.12	3.19
	(3.64)	(3.54)	(3.55)
Number of household members	6.05	5.82	5.85
	(2.35)	(2.53)	(2.50)
Total area of agricultural land (ha)	1.60	1.33	1.36
	(1.33)	(1.11)	(1.14)
Proportion of maize plot	0.11	0.12	0.12
	(0.13)	(0.19)	(0.18)

Note: standard deviations are in parentheses

Network variables

To identify the social network within each village, we asked each household to list up to five trustworthy persons in the same village and the names of each of these individual's household heads. By comparing the names of each person and each person's household head, we determined whether the listed people participated in the FRG. We found that 46 non-participating respondents mentioned at least one FRG participant as a trustworthy person. In addition to these 46 individuals, 14 FRG participants mentioned at least one FRG participant's name too. We define this social network of respondents and FRG participants as a FRG network.

In addition to the FRG network, we investigated the network of respondents and agricultural extension agents, locally known as 'development agents' (hereafter, 'extension agents'). In Ethiopia, extension agents promote new agricultural technologies developed by researchers to farmers in rural villages. Each village has between one and three extension agents, and there are about 50,000 agents in Ethiopia as a whole, forming a widespread extension system. The extension agents have completed three years of college and are trained as agricultural specialists. Extension agents are assigned to villages and regularly visit farmers to provide training at extension centres in their regions. Therefore, extension agents are officially designated as one of the major channels of dissemination of new agricultural technologies in Ethiopia.

In this study, we employed two types of indicators of networks with extension agents. The first is by simply knowing any extension agent. Here, knowing an agent is defined as a mutual relationship. In other words, if the respondent knows an extension agent, then that agent should also know the respondent. The second indicator relates to knowing and trusting any extension agent. Following the study by Todo *et al*. (2013), we employed two dummy variables to identify the level of trust: being able to borrow ETB 200 (approximately USD 10) from the extension agent and being able to lend the extension agent ETB 200. If the respondent could borrow and lend ETB 200, we presumed that there was a trust network between the respondent and the extension agent. To avoid confusion, we define the first indicator as 'knowing any extension agent' and the second indicator as 'trusting any extension agent'.

Empirical framework

We used a probit model to evaluate the impact of the FRG network on the adoption of improved maize varieties and agricultural practices, such as soil compaction and row planting.

To identify the determinants of improved maize variety adoption, we estimated two non-linear probability models: one that employs the variable 'knowing any extension agent' and one that employs the variable 'trusting any extension agent'. As the dependent variable, we used a dummy variable that took a value of one if the respondent adopted improved maize varieties during the last cropping season and zero otherwise.

In addition, as an independent variable, we employed a dummy variable that takes a value of one if the respondent is part of the FRG network and zero otherwise, enabling us to capture quantitatively the impact of the FRG networks. To control the effects of participating in the project, we used a participation dummy variable that takes a value of one if the respondent participated in the FRG project (defined as the FRG dummy). Additionally, we included the following as independent variables: the age of the household head, a female household head dummy, the educational years of the household head, the number of household members, the total area of agricultural land, and the area of the maize plot as a proportion of the total area of agricultural land.

In the cases of the two agricultural practices (soil compaction and row planting), we estimated two probit equations: one to investigate the determinants of knowledge of how to implement a technology (knowing the technology) and one to investigate the determinants of adoption of a technology (using the technology), where the latter is conditional on knowing the technology. We tested both equations, which are similar to the equations used to examine the adoption of improved maize varieties, by changing the extension-agent-network variables. As independent variables, we used the same variables as those used in the maize variety equations, except the area of the maize plot as a proportion of the total area of agricultural land.

Results

The adoption of improved maize varieties

The estimation results for the probit model of the adoption of improved maize varieties are presented in Table 2. Columns 1 and 2 present results obtained under inclusion of the 'knowing any extension agent' variable and the 'trusting any extension agent' variable, respectively.

The results obtained when the 'knowing any extension agent' variable was included, in column 1, indicated that the FRG network had a significant and positive effect on adoption of improved maize varieties. This result indicates that involvement in the FRG network increases the probability of adopting improved maize varieties. This positive effect was also observed consistently in results obtained when the 'trusting any extension agent' variable was included. These results suggest that the reputation of the improved maize varieties may diffuse through the FRG network. Hence, farmers within the FRG networks may decide to use new maize varieties even if they do not participate in the project. In fact, more than 70 per cent of the respondents involved in the FRG network reported that they had discussed the new agricultural technologies with their close friends and mentioned that 'friends' is one of the major information source of new crop varieties. In contrast, we found no significant effect from the FRG dummy. However, the insignificant result implied that the knowledge of new varieties was fully diffused from FRG participant to farmers involved in the network, and thus there is no difference between the participants and involved farmers on the adoption rate, resulting the insignificance of the FRG dummy.

In addition, we found that 'knowing any extension agent' did not affect the adoption behaviour of respondents, whereas 'trusting any extension agent' had a significantly positive effect. These results indicate that trust increases the likelihood of adoption.

Furthermore, we did not find any significant effects of the other variables, including the female household head dummy variable. The insignificant effect of the female household head dummy indicates that female heads do not face disadvantages regarding technology adoption, although such disadvantages been observed in other areas (Hall and Nahdy, 1999; Ashby *et al*., 2000; Humphries *et al*., 2000).

Next, to quantify the impact of the FRG network, we used the results of the probit estimation to calculate marginal effects; these calculations are shown in columns 3 and 4. The marginal effects obtained for the second equation in column 4 indicate that the magnitude of the FRG network was 0.250, which implies that being part of the FRG network increased the probability of adoption by 25.0 percentage points compared with farmers outside the FRG network. In the case of the network with the extension agent, the marginal effect of trusting any extension agent was 0.218. In other words, trust in the extension agent increased the probability of adopting improved maize varieties by 21.8 percentage points.

Table 2: Determinants of adoption of improved maize varieties by farmers.

Variable	Equation 1	Equation 2	Marginal effects for (1)	Marginal effects for (2)
	(1)	(2)	(3)	(4)
Age of the household head	-0.007 (0.009)	-0.003 (0.009)	-0.003 (0.003)	-0.001 (0.003)
Female household head dummy (1=Yes)	0.408 (0.299)	0.356 (0.301)	0.148 (0.102)	0.129 (0.104)
Educational years of the household head	-0.021 (0.036)	-0.017 (0.036)	-0.008 (0.013)	-0.006 (0.013)
Number of household members	0.013 (0.052)	0.015 (0.053)	0.005 (0.020)	0.006 (0.020)
Total area of agricultural land (ha)	-0.077 (0.118)	-0.051 (0.118)	-0.029 (0.045)	-0.019 (0.045)
Proportion of maize plot	-0.886 (0.617)	-0.531 (0.629)	-0.335 (0.233)	-0.200 (0.237)
FRG dummy (1=Participate)	0.168 (0.336)	0.019 (0.349)	0.062 (0.121)	0.007 (0.131)
FRG network	0.646*** (0.310)	0.738** (0.315)	0.224** (0.095)	0.250*** (0.091)
Knowing any extension agent	0.325 (0.521)		0.127 (0.207)	
Trusting any extension agent		0.581** (0.258)		0.218** (0.095)
Constant	0.387 (0.745)	0.050 (0.630)		
Observations	136	136	136	136
Log likelihood	-83.66	-81.28		

Note: Standard errors are in parentheses; **, and *** indicate statistical significance at the 5 and 1% levels respectively.

The adoption of agricultural practices

Table 3 presents the estimation results for the adoption of soil compaction. The determinants of knowing the practice of soil compaction are presented in columns 1 and 2, and those of using soil compaction are presented in columns 3 and 4. We found that the FRG dummy had a slight positive impact on knowing and using soil compaction. However, the

Table 3: Determinants of diffusion of soil compaction.

Variable	Knowing soil compaction		Using soil compaction	
	(1)	(2)	(3)	(4)
Age of the household head	0.006 (0.005)	0.007 (0.005)	0.012** (0.006)	0.012** (0.006)
Female household head dummy (1=Yes)	-0.149 (0.169)	-0.195 (0.172)	0.013 (0.183)	-0.021 (0.186)
Educational years of the household head	0.083*** (0.023)	0.070*** (0.023)	0.104*** (0.025)	0.093*** (0.025)
Number of household members	-0.037 (0.031)	-0.036 (0.031)	-0.016 (0.033)	-0.017 (0.034)
Total area of agricultural land (ha)	-0.031 (0.067)	-0.028 (0.071)	-0.015 (0.071)	-0.007 (0.075)
FRG dummy (1=Participate)	0.352* (0.214)	0.282* (0.220)	0.425* (0.219)	0.344 (0.226)
FRG network	0.061 (0.190)	0.042 (0.193)	0.092 (0.199)	0.073 (0.202)
Knowing any extension agent	0.668** (0.315)		0.685* (0.363)	
Trusting any extension agent		0.677*** (0.148)		0.687*** (0.160)
Constant	-1.309*** (0.445)	-0.942*** (0.331)	-2.187*** (0.515)	-1.845*** (0.371)
Observations	340	340	340	340
Log likelihood	-209.3	-201.2	-176.0	-168.6

Note: Standard errors are in parentheses; *, **, and *** indicate statistical significance at the 10, 5 and 1% levels respectively.

involvement in the FRG network did not significantly impact either knowing or using soil compaction.

These results indicate that the probability of adopting soil compaction increases by participating in the FRG, whereas involvement in the FRG network does not significantly influence the adoption behaviour. We assume that the reason for not having the spillover effect relates to lack of actual experience. One important component of the FRG method is that participants conduct on-farm trials and experience new agricultural technologies first-hand. Because of this field experience, participants can evaluate the final outcomes of technologies and decide whether to adopt them. However, such experience cannot be shared with others by verbal communication and thus the new practices did not disseminate through the FRG network.

In contrast, the effects of both extension agent network variables on knowing and using soil compaction were significantly positive. Additionally, we found that the number of years of education of the household head had a significant positive effect on the diffusion of soil compaction information and adoption. This finding implies that highly educated farmers are more likely than less-educated farmers to be familiar with and adopt soil compaction technology. One possible reason for the positive correlation between the educational level of the household head and adoption of soil compaction may be the complexity of the technology. Indeed, implementing soil compaction is more complicated than using improved varieties, as farmers must know when and how to draft the compactor. As farmers are required to understand the components of the relevant technology before they can implement it, educational level plausibly strongly influences adoption of this technique.

With respect to the diffusion of row planting, we found no significant effects from the FRG dummy, as well as the FRG network dummy (Table 4). In contrast, the extension agent network variables were found to affect positively adoption of row planting techniques. The insignificant effects from the FRG variables and positive correlation between the extension agent network variables and adoption of row planting are reasonable. While row planting is common agricultural practice in many areas and countries, many farmers in rural Ethiopia continuously preferred to use the low labour input method, such as direct broadcasting, during the project implementation period. Although the FRG participants observed the increase in the productivity by adopting row planting, they also faced the requirement of more manual labour and labour hours. Such additional inputs may diminish farmers' interest in row planting, which explains the insignificance of the FRG variables. However, recently, the Ethiopian government started rolling out row planting technique by utilising extension agents (Vandercasteelen *et al*., 2013). In fact, we observed many agricultural workshops held by extension agents to encourage the use of row planting technique to community members. We assumed that such political decision advocating row planting enhanced the diffusion effect of the extension agent, resulting in the positive effect from the agent network dummy.

Furthermore, in the case of the number of years of education of the household head, we observed trends similar to that observed with respect to soil compaction. The educational years were found to influence positively adoption of row planting, although this correlation was not as strong as that observed in the case of soil compaction. In addition, we found that the total area of agricultural land managed was positively associated with knowledge of row planting techniques, although this association was insignificant in the adoption. We assume that because adoption of row planting requires increased labour inputs, farmers who own large amounts of agricultural land are unlikely to adopt row planting, even if they know how to implement it.

Table 4: Determinants of diffusion of row planting.

Variable	Knowing row planting		Using row planting	
	(1)	(2)	(3)	(4)
Age of the household head	0.001 (0.005)	-0.001 (0.005)	0.005 (0.005)	0.004 (0.005)
Female household head dummy (1=Yes)	0.152 (0.197)	0.121 (0.199)	0.215 (0.161)	0.191 (0.162)
Educational years of the household head	0.061** (0.028)	0.039 (0.027)	0.045** (0.022)	0.036 (0.022)
Number of household members	-0.042 (0.035)	-0.028 (0.034)	0.015 (0.029)	0.020 (0.029)
Total area of agricultural land (ha)	0.216** (0.105)	0.228** (0.104)	-0.021 (0.064)	-0.014 (0.064)
FRG dummy (1=Participate)	-0.185 (0.258)	-0.141 (0.270)	0.126 (0.213)	0.099 (0.217)
FRG network	0.204 (0.237)	0.161 (0.236)	0.148 (0.185)	0.135 (0.185)
Knowing any extension agent	1.079*** (0.276)		0.580** (0.279)	
Trusting any extension agent		0.705*** (0.184)		0.396*** (0.142)
Constant	-0.373 (0.451)	0.431 (0.373)	-1.171*** (0.411)	-0.781** (0.318)
Observations	340	340	340	340
Log likelihood	-147.9	-147.8	-228.9	-227.3

Note: Standard errors are in parentheses; **, and *** indicate statistical significance at the 5 and 1% levels, respectively.

Discussion and conclusion

In this study, we have empirically examined the effects of a Farmer Research Groups (FRG) project using a Participatory Research and Extension (PRE) approach on the adoption of such agricultural technologies as improved maize varieties, soil compaction and row planting, focusing on the social network structure in rural Ethiopia.

In the case of improved maize varieties, we found an indirect impact of the FRG project. Our empirical results indicate that knowledge of and trust in fellow FRG participants positively affected variety adoption. More precisely, involvement in a FRG network increased the probability of adopting improved maize varieties by 25.0 percentage points. Although the trust network with extension agents also had a positive effect, the magnitude of the FRG network's impact was greater than that of the trust network with extension agents. These results suggest that new varieties diffuse through the reputations of farmers and that FRG networks can play an important role in farmers' adoption behaviour.

However, we found that the FRG network had no statistical impact on the diffusion of selected agricultural practices, such as soil compaction. We assume that the reason for this insignificant result relates to lack of actual experience. Even if participants observed a positive outcome of a new agricultural practice, such knowledge from experience is difficult to share with others through verbal communication, limiting the effects of the FRG network on the diffusion of such practices. With respect to row planting, there were no statistically significant differences in both FRG dummy and FRG network variables, although row planting is a simple technology. One possible reason of the insignificance is because of the additional inputs, such as increased manual labour and labour hours. During the project implementation period, since many farmers in rural Ethiopia prefer to use less labour intensive technologies, row planting provided by the present FRG approach may not meet the needs of farmers.

In contrast, the social network with extension agents had a significantly positive impact on the adoption of new agricultural practices. Because extension agents regularly visit farmers to provide training, farmers involved in social networks that include extension agents may have more opportunities than those not involved in such networks to learn about new agricultural practices in their fields. These results suggest that extension agents contribute to the dissemination of new agricultural practices, especially practices requiring experience before they can be adopted. With respect to row planting, we found a strong correlation between the farmers' adoption choice and extension agent network variables. This strong correlation is most likely due to political decisions. In recent years, the Ethiopian government decided to advocate row planting through the extension agent, and thus we may observe such diffusion efforts by the extension agents in our estimation results.

Overall, our empirical results suggest that the FRG approach affects differently the technology diffusion depending on the characteristics of technologies. The FRG approach has great potential in the diffusion of simple agricultural technologies, such use of new varieties, via the social networks of farmers. However, the estimation results of adopting row planting suggest that if introduced technologies require additional inputs, the FRG approach may not affect the adoption behaviour of farmers, even if technologies are simple. Furthermore, the spillover effects of the FRG would be limited if technologies are complex and require experience to properly employ, as suggested by the results of the adoption of soil compaction. Enhancing dissemination to non-participant community members represents additional challenge of the present FRG approach.

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Adee ATHIYAMAN*

Biomass residential heating: semantic structure and implications for advertising

For a business, knowing current stakeholder product knowledge is essential to influencing behaviour. What do consumers think and feel about biomass residential heating? An assessment of consumers' semantic structure about a biomass residential heating product: pellet stove/furnace, reveals that consumers perceive the product as natural but laborious to maintain, and dirty/smelly. An exploratory analysis of the industry's marketing communications suggests that the industry is not addressing the 'ease-of-use' issue.

Keywords: marketing communications, pellet fuel, HVAC systems

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Introduction

"Smoke from (wood) burning is a major risk factor for respiratory infections and the fever that often accompanies them" (Smith, 2008, p.97). Chemically, biomass such as wood is mostly carbon, hydrogen and oxygen. In special combustion conditions (c.f. the pellet stove for residential heating[1]) it can be burned to non-toxic carbon dioxide and water. However, if combustion is incomplete, as it is in many household fire places and wood stoves, biomass releases much of its carbon as irrespirable particles and carbon monoxide (Naeher *et al*., 2007).

But what is it that the consumer is learning? It is now an established principle in consumer behaviour that information exposure energises the consumer's attitude which results in product purchases (see the buyer-response steps in Rossiter and Percy, 1997). However, since only 3 per cent of households in the United States use biomass for space heating (Athiyaman, 2014), it appears that only a small proportion of consumers view 'burning biomass' positively.

For a business, knowing current stakeholder product knowledge is essential to influencing behaviour; to reach a desired perception of stakeholders, a business manager should take into account stakeholders' existing product knowledge. What do consumers think and feel about biomass residential heating? What are the choice criteria for biomass heating-appliance purchase? What are the communication objectives of biomass residential heating equipment manufacturers? This paper addresses these and similar questions.

Theoretical framework

What is the consumer learning? From a systems view, marketing information is the input to consumer learning and purchase is the output. The learning process is concept formation, or concept utilisation (Hilgard, 1987).

Concept formation and utilisation

Assume that a person gets exposed to a new product such as the biomass pellet stove. Since humans learn by grouping and distinguishing (c.f. the contrast theory conceptualisation in 'categorisation' studies (Smith and Osherson, 1995)), the consumer has to group the product with something it resembles (for example, a space-heating device) and distinguish it from other things in the product class (for example, unlike fossil fuel furnaces, the biomass pellet stove is 'eco-friendly' or 'green'). In this way, consumers form a concept of a product class called 'biomass heaters'. Thus, concept formation is defined as the process of developing the criteria for identifying and evaluating a product. In contrast, concept utilisation occurs when the consumer has formed criteria – that is, the consumer is aware of the product class and has a positive, neutral or negative attitude towards it (Rossiter and Percy, 1997).

Analysis of consumer learning

Theory on mental representation differentiates between verbal representations (for example, human languages) and non-verbal, object representations (for example, maps and images) (Barsalou, 1999). In marketing, most work focuses on consumer semantic memory – verbal, categorical and conceptual knowledge consisting of abstract, context-free information and general facts about an object (Epstein, 1994; Tulving, 2002). For example, Keller (1993) posits that brand image consists of perceptions about attributes and benefits.

While semantic memory is explicit, behaviours that consumers acquire non-reflectively (for example, nostalgic feelings elicited by household fireplaces) are part of the implicit, episodic memory system (Paivio, 1986). The episodic memory system contains event-specific, personal experiences with the product. Figure 1 illustrates the explicit/implicit memory dichotomy using the product, 'biomass heaters' as an example.

The contents of customers' semantic and episodic memory could be used to create a favourable product attitude which then causes purchase behaviour. We make the leap from data to wise action in the future using relevant princi-

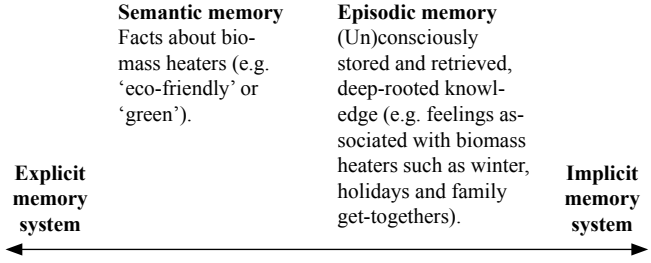

Figure 1: Consumer product knowledge representation: biomass heaters.

[1] http://www.pelletheat.org/assets/docs/fact.pdf

ples or rules from consumer behaviour put forward by theorists such as Ajzen (1988) and Fishbein and Ajzen (1975). To elaborate, attitude towards a concept could be defined as an overall evaluation of the concept (Athiyaman, 1997). Mathematically,

$$A_o = \sum_{i=1}^{n} b_i \times e_i \quad (1)$$

where A_o = the overall attitude toward the object *o*, b_i = belief about the attribute *i* in relation to the object (think of it as a fact stored in the consumer's semantic memory such as 'green' product), and e_i = the evaluative consequence of the belief (for example, having a less polluting residential heating system is good for environment).

Thus, for product (biomass heater) purchase to take place, the buyer's *need* should be *met by the specific benefits* that the product offers, for example cost efficiency, eco-friendly etc. Put simply, the buyer has a belief about where the brand is located on each criterion. These beliefs are weighted for desirability and then summed to yield a single estimate called 'attitude'. Consumers are likely to buy the product if their attitude is favourable. This is why large advertising agencies recommend clients to think of product positioning in statement form as follows:

> To the target audience _____ /
> _____ is the product of (need) /
> that offers benefits _____.

Methodology

Methods for retrieving consumer product knowledge differ for the memory systems. For semantic memory, it is the free association technique (Deese, 1965). For episodic memory, there are the projective tests (Barsalou, 1992). To assess consumer semantic structure for biomass residential heating, a sample of households in Macomb IL, USA were interviewed. Heads of households were the population of interest; or raters of the product, 'biomass residential heaters'. As word association studies require at least 30 respondents (Deese, 1965; Wells, 1993), we chose 37 specific addresses, with designation of a particular member of the family to be interviewed. Technically, this amounts to specifying the residential block and some rule for picking out certain households within it for the interviews (Deming, 2006). The heads of households were asked to answer the following question:

> "Please write down your thoughts (one per space provided) when you think of biomass residential heaters such as the one illustrated here".

As the question implies, a picture of a biomass heater was included on the survey sheet. The respondents were given the opportunity to write down the words that came to mind. As mentioned earlier, the focus was on retrieving 'conscious' product knowledge.

To assess consumers' 'deep-rooted' product knowledge we used an indirect approach. Specifically, two shopping lists for heating, ventilation and air conditioning (HVAC) systems were prepared. They were identical in all respects, except that one specified 'biomass heater' and another 'gas-fired heater'. They were administered to a new group of 69 subjects (all home owners/renters residing in Macomb IL), with no subject knowing of the existence of the other list. The instructions were as follows and the two shopping lists are shown in Table 1:

> "Read the home improvement shopping lists below. Try to project yourself into the situation as far as possible until you can more or less characterise the homeowner who bought the heating, ventilation and air conditioning (HVAC) system. Then write a brief description of the homeowner's personality and character. Where ever possible indicate what factors influenced your judgment".

Table 1: Shopping lists included in the survey designed to assess consumers' 'deep-rooted' product knowledge.

Shopping list 1	Shopping list 2
1. Biomass central furnace: burns biomass such as sawdust, wood chips, bark, agricultural crop waste, waste paper, and other organic materials. Heats air and distributes it throughout the house using ducts; 2. Programmable thermostat; and 3. New ductwork.	1. New gas-fired, energy-star rated, central furnace: heats air and distributes it throughout the house using ducts; 2. Programmable thermostat; and 3. New ductwork.

Finally, to understand the product's positioning, we content analysed biomass residential heating industry advertisements. These advertisements were from the residential heating industry companies highlighted by Consumer Reports (2015). The content analysis measure was the frequency of mention of words such as 'cost' and 'quality' in the advertisements. The author performed the role of 'clinician'; observing and then inferring to reach a diagnosis about product positioning in the marketplace.

Results

Consumer semantic structure

The 37 respondents produced a total of 280 words as response to the stimulus *biomass heater* (Table 2). These words can be sorted into four groups: (a) nominal words of the same type, (b) nominal words of a different type, (c) attributive words, and (d) other words. *Nominal words of the same type* include: energy, fire, hot, smoke, stove and warm. These can be intuitively arranged in a superordinate-subordinate hierarchy or tree which shows how consumers conceptualise biomass heaters (Figure 2). *Nominal words of a different type* include words such as: Amish, conversation, eggnog, marsh-mellows, time with family, winter and Christmas. These words tend to represent the context surrounding biomass heating. *Attribute words* both identify and evaluate a product. In general, the respondents perceive the product as natural, and visually appealing (nice to look at) – all positive evaluations. The negatives include: dirty, smelly, fire hazard, splinters, and the laborious acts of cutting wood

Table 2: Word association task: summary findings.

Knowledge aspect	Frequency
Functional benefits (benefits of use such as non-polluting, high efficiency etc.)	35
Facts about the product	50
Sample size	37
Elements per informant - high	10
Experiential benefits (e.g. sensory pleasure such as "wood-burning smells good" etc.)	21
Usage imagery	24
Total knowledge elements uncovered	280
Elements per informant – low	3

Table 3: Word association frequencies.

	Green	Efficient	Laborious	Smelly/dirty	Hazardous	Nostalgic
Green	–	8	7	0	2	5
Efficient	8	–	12	8	3	6
Laborious	5	12	–	8	6	9
Smelly/dirty	4	3	15	–	5	13
Hazardous	1	0	3	8	–	4
Nostalgic	9	8	8	15	0	–

Table 4: Examples of survey respondents' perceptions of biomass furnace and gas furnace purchasers.

Biomass furnace purchaser	Gas furnace purchaser
1. A wealthy, eco-conscious individual who has the financial resources needed to purchase and install a biomass furnace. A vegan hipster doing what is right for the earth; 2. A person who farms in rural America.	1. An individual more concerned about faster heating than the environment; 2. A city or suburban dweller; is not living in the middle of nowhere. Does not care about the environment; probably a member of the Republican Party.

Table 5: Advertising attributes: frequency.

Attribute	Frequency	Attribute	Frequency
Price	10	Availability	7
Quality	14	Special offers	10
Performance	19	Warranties	4
Components	20	Safety	6

and cleaning out the ash. Note that these are the choice criteria for the product. *Other words* are echh, good, hate and old. They are general evaluative terms that do not identify specific attributes.

Table 3 shows the frequently occurring words across all respondents. The most commonly evoked words are laborious and smelly/dirty. If we assume that the association frequency represents proximity measures, then we can use multidimensional scaling to represent the concepts in a semantic map. The meaningful directions in the space correspond to 'emotion' and 'cost/work efficiency' (Figure 3).

Projective tests

Thirty-three per cent of the respondents to the shopping lists described the homeowner who bought the biomass furnace as 'green'; 18 per cent described the homeowner who bought gas-fired furnace as 'green'. Seventeen percent of the respondents described the homeowner who bought

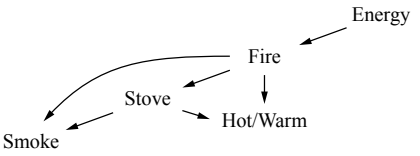

Figure 2: Superordinate-subordinate hierarchy of nominal words of the same type.

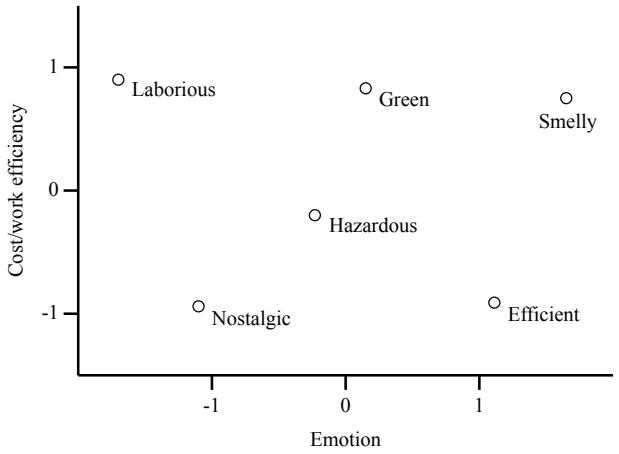

Figure 3: Representations of biomass residential heater in consumer memory.

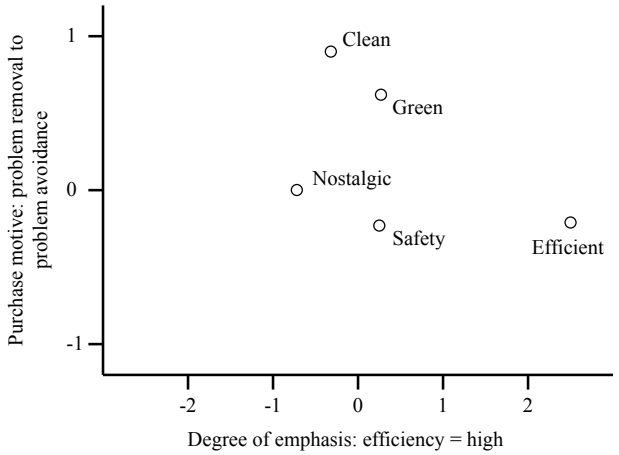

Figure 4: Industry advertising: word associations.

the biomass furnace as 'wealthy'; 9 per cent described the gas furnace purchaser this way. Less than 6 per cent of the respondents thought of the biomass furnace purchaser as 'technologically savvy'; the equivalent figure for the gas furnace purchaser is 19 per cent. One in ten respondents perceive the biomass furnace purchaser as a rural inhabitant and the gas furnace purchaser as an urbanite. Some examples of the responses are given in Table 4.

Positioning

To understand the product's positioning, we content analysed biomass residential heating industry advertisements. The results suggest that the mean number of cues in advertising is two, and these relate to product components, performance and product quality; price and special offers are also prominent cues (Table 5). When plotted on a two-dimensional map (Figure 4), the proximity analysis of advertising

cues reveals that the efficiency aspects of the product are highly emphasised compared to emotional attributes (the x axis). The y axis focuses on purchase motivations: safety and efficiency are related to problem removal (to avoid high fuel oil prices, one needs biomass heating), and green and clean are related to problem avoidance (to preserve the ecosystem one needs to use renewable fuels for residential heating).

Discussion

To categorise an object is to think of it as an instance of a category. Our research shows that the stimulus *biomass heater* is categorised as a subordinate category to the energy/fire concepts. Furthermore, this categorisation has generated inductive inferences about the product such as "using biomass heaters is laborious since one needs to clean out the ash" and "it is dirty and smelly". Positive effects related to the product include 'happiness' that is related to family get-togethers and holidays.

What do consumers think and feel about biomass residential heating? In general, consumers perceive the product as natural and visually appealing (nice to look at) – all positive evaluations. The negatives include: dirty, smelly, fire hazard, splinters, and the laborious acts of cutting wood and cleaning out the ash.

What are the product purchase criteria? Analysis of consumer knowledge about the product reveals that other than beliefs associated with the product (semantic structure), there are also free-standing emotions (episodic memory) associated with it that stimulate product purchase. Technically, creation and maintenance of positive attitude through advertising could be achieved by highlighting the efficiency aspects of the product (that it is cost efficient and it requires little or no effort in day-to-day maintenance) along with visual imagery such as family get-togethers that evoke positive emotions.

Do biomass residential heating advertisements address consumer choice criteria? Industry's communication objectives do focus on brand attitude related benefits such as 'clean', 'green' and 'safe'. However, the industry advertisements do not emphasise the 'ease of use' of the product which, as mentioned earlier (Figure 3), is a major concern for the consumers.

How could the biomass heating industry benefit from this research? This research provides customer insights; a mini-theory of marketing action that can be used to position the industry. In today's marketplace, it is difficult for biomass residential heating companies to differentiate on the 'green' theme alone. Present advertisements do not emphasise the 'ease of use' of the product and the industry should fill this gap in positioning to improve consumer attitude towards biomass heaters.

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- **Reference to a book.** Strunk Jr., W. and White, E.B. (1979): The Elements of Style (3rd edition). New York: Macmillan.
- **Reference to a chapter in an edited book.** Mettam, G.R. and Adams, L.B. (1999): How to prepare an electronic version of your article, in Jones, B.S and Smith, R.Z. (eds), Introduction to the Electronic Age. New York: E-Publishing, 281–304.

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