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Contents

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Foreword

Where are all the women in economics? This was the question posed in a recent article[1] on the BBC website. In the USA, only about 13 per cent of academic economists in permanent posts are women, while in the UK the proportion is only slightly better at 15.5 per cent. The article explores some of the possible reasons for this gender imbalance. Of particular concern is that the fact that the lack of women in senior roles has meant that many young women do not view themselves in those positions.

An extensive study of the composition of the editorial boards of 57 management journals by Metz and Harzing (2009)[2] showed that 80 per cent of the journals had 20 per cent or fewer women on their editorial boards, a situation that has subsequently improved only modestly. They also demonstrated a strong correlation between female first authorship and the proportion of female editorial board membership. They point to the 'pipeline effect' of the former enhancing the latter, but there is also evidence that the composition of a journal's editorial board influences the willingness of prospective authors to submit their work to it.

For *Studies in Agricultural Economics*, an aspiration towards gender balance on the editorial board is an integral part of a holistic approach that also includes diversity of academic expertise and geographical location. As a consequence, the percentage of women on the board has increased from 7 in early 2011 to 39 currently. Coincidentally, 41 per cent of papers in this volume of the journal (i.e. number 119) have female first authorship.

Fittingly, the first three papers in this issue have female first authors. The results of a survey of Hungarian consumers of short food supply chain (SFSC) products reported by Szabó showed that almost 70 per cent of the respondents are potential customers of SFSC products. Support rises with increasing age, and is higher among women, the more highly educated, those that are economically active or retired, and those with an average income.

Hooks, Macken-Walsh, McCarthy and Power present a critical discussion of the concepts of farm-level viability, sustainability and resilience, which are typically discussed separately in the literature. While farm viability and sustainability are important for family farms to survive, resilience is most deterministic of long-term survival. The authors conclude that agricultureal development models should be focused on all three concepts.

A survey by Kerekes, Pirău, Kis and Abrahám identified the following main factors influencing the decisions regarding educational choices of rural youth from Cluj county, Romania: the parents' attitude towards continuing education, the age, the number of siblings, the school performance and the computer skills of the respondents. To be effective, corrective measures will require adequate resources and continuity of implementation.

In the first of two papers on the dairy value chain, Gërdoçi, Skreli, Zhllima and Imami found that that trust, uncertainty and investment in specific assets are key determinants of sustainable relationships between small ruminant farmers and milk buyers in Albania. Dairy owners/managers should improve communication and increase information exchange with farmers, while government subsidy schemes should be further refined.

Price transmission on the Slovak dairy market after the end of European Union milk quotas was studied by Kharin, Lajdova and Bielik. The estimation of the price transmission elasticity supports the assumption that price changes are not transmitted efficiently from one level to another. However, symmetric price transmission exists between farm-gate and processor prices for whole milk in the long term.

This issue concludes with two international papers. Ejimakor, Quaicoe and Asiseh investigated agricultural factor use and substitution in the south-eastern United States. A substantial reduction in the use of farm chemicals could be achievable by increasing their price. Most of the factors are substitutes with the exceptions of capital and energy, and land and chemicals, which were found to be complements.

Finally, the impact of participation in micro-irrigation development on households' welfare in northern Ethiopia was measured by Gebrehiwot, Makina and Woldu. Their model takes the possibility of selection bias into account. The impact of irrigation use on the two outcome variables was positive and significant: income by 8.8 per cent and asset formation by 186 per cent as compared to non-users.

All readers are welcome to submit their research for possible publication in *Studies in Agricultural Economics*, a journal that attaches great importance to the principle of inclusiveness.

Andrew Fieldsend
Budapest, November 2017

[1] http://www.bbc.com/news/business-41571333
[2] https://www.jstor.org/stable/27759191?seq=1#page_scan_tab_contents

SZABÓ Dorottya*

Determining the target groups of Hungarian short food supply chains based on consumer attitude and socio-demographic factors

Consistent with the trend witnessed in other European countries, in recent years there has been an increasing demand among Hungarian consumers for products purchased directly from farmers. However, no research has been published on the determination of clusters of consumers of short food supply chain (SFSC) products in Hungary. This study describes which groups of consumers are more likely to purchase such products, and their reasons for doing so. In the summer of 2013, 1,015 randomly-sampled adults were asked to complete questionnaires during face-to-face, on-street meetings with trained staff. The survey explored their willingness to support direct sales and production of local foods, their perceptions of product reliability, and their attitudes toward global supply-driven systems. As it was not possible to identify a clear structure of factors determining opinions, perceptions and attitudes directly from the results of the questionnaires, principal component analysis was performed, and K-mean cluster analysis was used to partition the respondents into five clusters. These were labelled '*Favouring imports and large farms*', '*Favouring small farms*', '*Informed and empowered consumers group in favour of local farms*', '*Universally positive*' and '*Unconcerned*'. This method was effective in identifying groups of potential target consumers. The level of support for local foods rises with increasing age, and is higher among women, the more highly educated, those that are economically active or retired, and those that consider themselves as having an average income. The results can be used to promote the demand for SFSC products in Hungary through more effective targeting of marketing activities by farmers involved in direct selling, and their organisations.

Keywords: consumer behaviour, consumer clusters, food consumption, local foods

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Introduction

Analysis of consumer behaviour is primarily a marketing instrument that can help to understand how consumers think, feel valued and choose from among a variety of alternatives on offer. The results obtained can also provide information on how consumers are influenced by their environment, and how they make decisions based on what motivations and preferences and purchase products. Analysis of consumer behaviour is a multidisciplinary field: an understanding of economics, psychology, social psychology and sociology are all necessary for interpreting the results (Solomon, 2004). The social and cultural environments, personality and psychological factors can all influence the individual consumer when making a decision, and these factors can be important in understanding the elements of marketing strategies that will satisfy consumers' needs (Rani, 2014).

Examining consumer behaviour is also an important tool in food consumption, including short food supply chains (SFSC). These can be defined as supply chains "involving a limited number of economic operators, committed to co-operation, local economic development, and close geographical and social relations between producers, processors and consumers".[1] The direct or one-intermediary marketing forms of SFSC are of four main types: via intermediary, via delivery, in open farms and in points of sales, and in which there are two sub-categories: traditional and modern. This classification by logistical aspects indicates which SFSC participant should travel to carry out the sale.

Farmers' markets belong to the group of modern points of sales. For these, Williamson (2014) showed that the analysis of consumer attitudes may assist both the market organisers and producers selling at the market. The results of his consumer survey conducted in Kentucky and Ohio, USA indicated that consumers' behaviour as well as their values and orientation are related to the frequency of purchases from farmer's markets. Visiting farmers' markets is not only determined by the food consumption habits, but also other ethical and social considerations such as supporting the local small farmers, protecting natural ecosystems for future generations and/or more appropriate distribution of agricultural products.

Other research has identified several reasons why consumers buy from farmers' markets. Surveys in the United States (Wolf *et al*., 2005; Lyon *et al*., 2009) have shown that consumers choose farmers' markets mainly for fresh, high-quality agricultural products. Among the motivating factors are: better taste of products (Teng *et al*., 2004); local production (Baker *et al*., 2009); support for the local economy (Gumirakiza, 2013); free-range and organic production (Holloway and Kneafsey, 2000; Dodds *et al*., 2014); wide range of commodity in markets (Onianwa *et al*., 2006); and markets as public space (Gao *et al*., 2012).

Studies on producer markets initially focused on economic aspects; however, attention then shifted from producers to consumers. The research mainly sought to determine the typical customer profile of the markets, primarily the demographic characteristics of consumers, the factors motivating the selection of the place of purchase and the extent of preference for local products. The results of international studies (e.g. Varner and Otto, 2008 and Onianwa *et al*., 2006 in the United States) have mostly shown the customers of producer markets to have similar features. The most loyal purchasers of producer markets typically are women, people aged between 45 and 65, and those with higher education.

Cluster analysis has been widely used to examine consumer attitudes and to analyse customer groups. This approach can be used to determine the profiles of groups of

[1] Regulation (EU) No 1305/2013 of the European Parliament and of the Council of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005.

potential target consumers, particularly their demographic characteristics, the factors motivating the choice of the place of purchase and the extent of preference for local products. The information gathered can be valuable both for marketing and public policy, as different consumer behaviours require different strategies to enhance the importance of organic and local food products in food consumption for more people. For example, while an emphasis on the health impact of the foods concerned may be especially important for one group, the interest of other segments in organic and local foods might be enhanced by highlighting their ethical values.

These ideas are confirmed by Nie and Zepeda (2011) who examined the attitudes of 956 consumers to the consumption of organic and local food. They showed that the preference for the products concerned is correlated with the degree of environmental awareness and health awareness of consumers, and demographic factors such as age, gender, education and income, all of which are not equally accessible to all consumers. Four food-related lifestyle groups were identified: '*Rational consumers'* (29.2 per cent), '*Adventurous consumers'* (24.1 per cent), '*Careless consumers'* (17.8 per cent) and '*Conservative, uninvolved consumers'* (28.8 per cent). The '*Adventurous consumers'* were enthusiastic about shopping, preparing and consuming food. All the following aspects were very important to them, such as the healthiness, freshness and safety of food. Both '*Adventurous'* and '*Rational'* consumers were active organic and local food shoppers. The demographic characteristics that predicted the lifestyle choice of '*Rational consumers'* were: more children living in the household, being middle aged, being white and having a high income. They were also more likely to have a farmers' market in their neighbourhood. '*Adventurous consumers'* were more likely than the average population to be female, minority and to be in a lower middle-income household. Like '*Rational consumers'*, they could easily access farmers' markets in their neighbourhood.

Elepua and Mazzocco (2010) distinguished five consumer groups based on the popularity of urban and suburban producer markets in the United States. '*Market enthusiasts*' were the second biggest cluster (8.2 per cent of 379 respondents), and for them the most important criteria were the market environment, its services, cleanliness and the quality of organisation of the market. They were characterised by older age, higher educational level and income, and the majority were females.

Rocchi *et al*. (2011) evaluated the importance of sustainable agriculture for 94 customers of farmers' markets and shops in Toscana, Italy. An attitude scale was used and two consumer clusters were created using hierarchical cluster analysis. Group 1 (21.3 per cent) was formed primarily by consumers aged between 34 and 56 years, with a high level of education and good economic status. Their participation in farmers' markets was mainly motivated by a positive attitude towards environmental and rural development goals, and by a willingness to participate in a particular 'social' event. In group 2 (82.2 per cent), most consumers had a lower education level and a modest economic status. Consequently, the most important motivation in participating in farmers' markets was the direct relationship with producers, considered as the main guarantee of quality offered by this marketing form. Overall, the survey confirmed the methodology as suitable for providing evidence about attitude, motivations and purchasing behaviour of consumers participating in farmers' markets.

As far as is known, cluster analysis has not been applied to SFSC consumers in Hungary, but the methodology has been used on two related topics. Among consumers of traditional food products, Szakály *et al.* (2010) identified five groups from among a representative national sample of 1,000 participants. Of these, the '*Young trend makers*' (36.3 per cent of the total) combined care for the environment with pride in their Hungarian nationality and a willingness to support domestic industry by purchasing Hungarian products. This mostly young group was the one with the largest share of those with higher education. Most considered their income to be average, and some considered it above the average. By contrast, the small study by Szabó and Juhász (2013) looked at customers' attitudes to service levels in public markets. Again, five groups were identified. Seven per cent of respondents belonged to the group '*Market lovers*': this was the only cluster that collectively rated the markets with a score above 4 on a 1-5 Likert scale. Its members were typically economically-active metropolitans with a family and a higher level of education. In general, economically-inactive participants with low educational level and living in villages did not prefer this purchase option.

The important lesson learned from the literature is that the demographic characteristics of the communities living close to the markets should be considered when mapping the potential and existing purchasers. The information collected, based on the experiences and feedback according to existing consumer needs, enables markets to decide which products to stock. In Hungary, National Regulation 51/2012. (VI. 8.) VM, introduced in 2012, simplified the criteria for starting farmers' markets and the number of such markets more than doubled from 118 in 2012 to 237 in 2016. Despite the highly topical nature of the subject, no research has been published using cluster analysis specifically on SFSCs in Hungary. The purpose of this study is to fill this gap in the literature by identifying groups of potential target consumers of SFSC in Hungary, and their purchasing habits. The results obtained may provide valuable guidance to farmers and market organisations with an interest in SFSC in Hungary.

Methodology

A wide-ranging survey of the consumer shopping habits of 1,015 adults (i.e. over the age of 18) was conducted in the summer of 2013, during which respondents were asked to complete questionnaires during face-to-face, on-street meetings with trained staff. The survey was carried out at the main railway stations and public spaces of Budapest and four other (NUTS 3) county seats (Debrecen, Győr, Kaposvár and Szeged) distributed across Hungary. Firstly, the respondents were asked to indicate their gender, age, educational level, economic status, subjective income level, household size, the type of settlement in which they live (farm, village, town, county seat, capital) and their NUTS 3 (i.e. county) region of

residence. Of the respondents, 40.3 per cent were male and 59.7 per cent were female. The interviewers sought to make the sample demographically representative and, in most respects, it reflected the profile of the Hungarian adult population. However, people under 35 years of age, the higher educated and those living in cities were over-represented (Table 1).

One section of the questionnaire was designed to assess consumers' views on sustainable food production, including the purchase and consumption of local and/or traditional food products. This paper reports the results obtained and their subsequent analysis.

Based on evidence from the literature (Nie and Zepeda, 2011; Rocchi *et al*., 2011; Williamson, 2014) and the experience of several experts, 26 statements were compiled which explored (a) respondents' willingness to support direct sales and production of local foods; (b) their perceptions of the reliability of these products; and (c) and their attitudes toward global supply-driven systems. The respondents were asked to evaluate the statements using a five-point Likert scale where a score of 1 meant that the person did not agree with the statement, and a score of 5 meant that he/she agreed with it fully. For the results of each question, a mean value and the standard deviation were calculated.

Principal component analysis was performed to study the relationships between the 26 statements. Based on the results of earlier research (Nie and Zepeda, 2011; Williamson, 2014), these statements were sorted into groups which covered four main topics: *supporting domestic small farms*, *supporting bigger farms and food imports*, *supporting local foods and direct sales*, and *informed and empowered consumer*. K-mean cluster analysis involving the four principal components was then used to partition the respondents into five clusters. In line with the literature (e.g. Vanhonacker *et al*., 2007; Elepua and Mazzocco, 2010), the clusters were analysed in terms of the collected data on gender, age group, educational level, economic status subjective income level, household size, the type of settlement in which they live and their region of residence.

During the data collection, in a second set of questions the respondents were asked to indicate how often they purchased food at a particular type of retail outlet. A five-point Likert scale again was used: a score of 1 applied to those who did not buy food at all in this type of outlet, and 5 indicated that the respondents always visited this type of outlet. The outlets listed in the questionnaire covered both the 'long' and 'short' food supply chains. The types of outlet where the members of each cluster generally do their food shopping were then examined.

Data were processed using the SPSS 19 software package (IBM Corporation, Armonk, NY, United States). Chi-square test and F-test were used to quantify the strength of the relationships, and only those results which were significant at the 95 per cent confidence level (sig <0.05) are presented here.

Results

Consumer survey data

On average, the survey respondents attach great importance to supporting Hungarian small farms, direct sales and the production of local foods (Table 2, statements 1-12) because they recognise the social as well as the economic benefits. The most important factor for them is that Hungary and the European Union (EU) should support farmers' markets through project financing (mean: 4.4). The second and the third highest scores reflected the importance attached to the role of small farms in economic and social terms (mean: 4.3). The importance of Hungary becoming self-sufficient in food was also rated highly (mean: 4.2). Additional statements with scores exceeding 4.0 (5, 6, 8, 10, 11) further emphasise the importance attached by the respondents to local foodstuffs and to supporting small farms (7, 9, 12).

Factors that reflect the consumers' perceptions of the reliability of these products (statements 16-18) attracted a mean score of less than 4.0. Respondents believe that the food products from small farms are produced in a traditional way. They do not always trust that these foods are always safe and that the food products the farmer sells are always self-produced (mean: 3.8). While participants 'agree' with these statements on average, around 15 per cent of participants either 'tended to disagree' or 'absolutely disagreed' with them. By comparison, for the statements discussed earlier reflecting support for direct sales and local food, this figure was around just 5 per cent. The statements prioritising global supply-driven systems (21-23, 26) are ranked the lowest, with a substantial proportion of the participants either 'tending to disagree' or 'absolutely disagreeing' with them.

Four principal components were calculated from the 26 statements. Numbers 14, 22, 24 and 25 are excluded as their communalities are below 0.25, which is the limit value of the variable in the main component. The four principal components were:

- PC1: *Supporting domestic small farms*: emphasising the economic, social and environmental roles of domestic small farms, preferring Hungary's aspiration to self-sufficiency;

Table 1: Profile of the survey respondents and of the Hungarian adult population by age, educational level, economic status and subjective income level, per cent (n = 1,015).

Age			Educational level			Economic status			Income level	
	Survey	Census		Survey	Census		Survey	Census		Survey
Under 25 years old	35.0	26.7	Primary school	8.6	35.7	Employed, self-employed	44.2	39.7	High	1.7
25-35 years old	19.8	15.6	Vocational school	9.3	14.2	Retired	20.0	29.7	Above average	10.5
36-50 years old	18.9	21.1	Secondary school	38.9	32.1	Out of work	7.0	5.7	Average	59.8
51 years or older	26.4	36.6	College, university	43.2	18.8	Homemaker	2.0	2.0	Below average	18.9
						Student	26.8	24.9	Low	9.1

Note: Subjective income data are not collected by the Hungarian Central Statistical Office
Data sources: own survey and national census, 2011

Table 2: Degree of importance attached by Hungarian consumers to factors influencing their attitudes towards food production, purchase and consumption.

No.	Item	Mean	SD	No.	Item	Mean	SD
1	Hungary and the EU should support the local farmers' markets (963)	4.4	0.91	14	Hungary imports too much food from other countries (966)	3.9	1.18
2	Small farms are important for the country's economy (959)	4.3	0.87	15	I like to taste new types of food (960)	3.9	1.10
3	Small farms play an important role in the social life of rural areas (962)	4.3	0.92	16	Food products from small farms can be characterised by special home-made flavours, traditional methods and recipes (949)	3.8	1.07
4	Hungary should make more efforts to be self-sufficient in food (966)	4.2	1.08	17	Food products from small farmers are safe (941)	3.8	0.98
5	There are benefits to consumers in buying local foods (960)	4.2	1.05	18	I am confident that small farmers sell only their own products in the market (946)	3.8	1.08
6	Delicious, fresh products are available from small farmers (950)	4.2	0.92	19	I always read the label carefully before trying new products (961)	3.6	1.27
7	Small farms can be modernised and increase their competitiveness by receiving appropriate financial support (960)	4.1	0.98	20	I pay special attention to my diet (963)	3.5	1.11
8	Customers receive direct information about products from the farmers (949)	4.1	1.04	21	Hungary should make greater efforts to export more food (954)	3.5	1.36
9	SMEs should be preferred for financial support over big enterprises (953)	4.1	1.03	22	Products from small farmers are too expensive to buy regularly (949)	3.2	1.19
10	When purchasing, trust between farmers and consumers is important (953)	4.0	1.10	23	Imported food is necessary because it ensures a wide range of products is available (964)	3.0	1.17
11	Using labels to mark local products would be helpful for consumers (954)	4.0	1.08	24	Food products from small farmers are produced organically (942)	3.0	1.28
12	Small farms contribute to the beauty of the countryside (958)	4.0	1.07	25	As a consumer, I can easily define the origin of the product (960)	2.9	1.27
13	I care about what I eat (952)	4.0	1.01	26	Financial support should be given to enterprises based on scale – the larger the business the more it should get (955)	2.7	1.25

5 = fully agree; 1 = completely disagree; number of respondents shown in parentheses
Source: own data

- PC2: *Supporting bigger farms and food imports*: preferring global supply systems and supporting large enterprises;
- PC3: *Supporting local foods and direct sales*: emphasising the benefits of local products and direct sales;
- PC4: *Informed and empowered consumer*: paying attention to nutrition and the nature of the food purchased.

The minimum and maximum values of the principal components are shown in Table 3. The variables to be standardised form new principal components, therefore the mean is equivalent to zero in all cases and the standard deviation should be 1. The positive values of the new variables mean that the respondents agree with the concept embodied in the principal components; the negative values indicate the contrary.

Development of the consumer clusters

Differentiating the respondents into clusters allows the groups of consumers with a positive interest in SFSC products to be identified and described. Five clusters were distinguished, based on the interpretation and using the well-defined group features (Table 4). Each cluster was given a name. To identify cluster-specific attitudes related to purchasing and products, the principal component mean values for each cluster were compared using variance analysis. The key features of the preferences of each cluster are as follows:

- Twenty-two per cent of the respondents belong to the cluster *'Favouring imports and large farms'*. They

Table 3: The parameters of the principal components, the composition and communality of the variables that make up the principal components, and the amount of information saved by the aggregated factor.

	PC1	PC2	PC3	PC4
Number of respondents	927	939	914	943
Saved amount of information (%)	54.2	43.9	43.7	54.2
Minimum	-4.443	-2.499	-4.524	-3.383
Maximum	1.117	2.325	1.434	1.493
Item	**Communality**			
4	0.298			
9	0.466			
3	0.662			
2	0.705			
12	0.543			
7	0.578			
23		0.465		
26		0.456		
21		0.396		
1			0.405	
5			0.375	
11			0.302	
10			0.338	
8			0.424	
6			0.591	
17			0.506	
18			0.520	
16			0.473	
13				0.556
15				0.411
20				0.658
19				0.543

See Table 1 for identities of items and text for descriptions of principal components
Source: own calculations

Table 4: Sample size and distribution of consumer clusters, and the mean values of principal components based on clusters.

Cluster name	Sample size (persons)	Share of total (%)	PC1	PC2	PC3	PC4
Favouring imports and large farms	190	22.0	-0.852	0.338	-0.506	0.102
Favouring small farms	174	20.1	0.161	-0.386	-0.110	-1.064
Informed and empowered consumers' group in favour of local farms	212	24.5	0.618	-0.916	0.560	0.481
Universally positive	219	25.3	0.646	0.981	0.669	0.703
Unconcerned	70	8.1	-1.726	-0.385	-1.974	-1.274
Entire sample			0.021	-0.011	0.014	0.001

Source: own calculations

disagree with the ideas of supporting the Hungarian small farms and small enterprises, and prioritising local food as well as direct sales. They prefer global food supply systems, and in parallel with that they are mindful of the importance of prudent food consumption.

- The *'Favouring small farms'* cluster (20.1 per cent) consider it important only to support small farms; everything else was evaluated negatively. Attention to nutrition and the nature of the food purchased is low.
- The third cluster is the '*Informed and empowered consumers' group in favour of local farms*' (24.5 per cent). They object to the idea of supporting large farms and encouraging imports, but they positively evaluated all other factors, although none of the components received an exceptionally high score.
- The *'Universally positive'* group was the largest in the survey (25.3 per cent). These respondents consider both the support and development of local foods, and global food security to be important. They also attach high priority to local sales and pay attention to the nature of the food purchased. All components received the highest positive value from this group.
- The fifth group *'Unconcerned'* has the fewest participants (8.1 per cent). They disagree with all the principal component statements. In this group, apart from the support for large farms and imports (PC2), all components were far below the mean values for the entire sample (Table 4).

Demographic features of the clusters

The five clusters were stratified according to the demographic factors for which statistically significant differences between the groups were identified, namely: gender, age, educational level, economic status and subjective income level.

In terms of gender, slight differences occurred between two clusters (Figure 1). A larger share of men (22.7 per cent) than women (18.1 per cent) belonged to the cluster '*Favouring small farms*', while 27.1 per cent of women belonged to the '*Informed and empowered consumers' group in favour of local farms*' cluster, compared to 21.0 per cent of men. The '*Unconcerned*' cluster accounted for 9.2 per cent of the men surveyed and just 7.4 per cent of the women, but this difference was not statistically significant.

The differences according to age groups were bigger. While 30.9 per cent of those under 25 years belonged to the cluster *'Favouring imports and large farms'*, among people 25-35 years old the figure was 23.5 per cent, and among participants aged 36-50 and those over 51 years old the percentages were 14.7 and 13.2 respectively (Figure 2). Similarly, the share of respondents in the '*Unconcerned*' cluster ranged from 9.9 per cent of those under 25 years old to just 5.4 per cent of those aged 51 years or older. For the group *'Favouring small farms*' the differences were smaller; the largest share of respondents (22.6 per cent) were under 25 years old, and the smallest shares were in the age groups 36-50 and 51 years or older, with 18.2 and 17.6 per cent respectively. By contrast, in the cluster '*Informed and empowered consumers' group in favour of local farms*', representation of respondents was inversely correlated with age: almost 30 per cent of the members were aged 51 years or over, compared to just 17.2 per cent of those under 25 years old. A similar pattern was observed in the '*Universally positive*' cluster.

Distribution of the respondents by their level of education shows a less consistent picture than for age. At 19.4 per cent, the share of '*Unconcerned*' was the highest among participants with primary school education only, three times higher than among those with college or university education (5.8

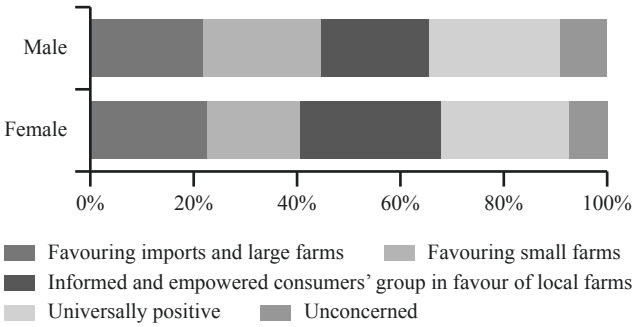

Figure 1: Distribution of the respondents between consumer clusters according to gender.
Pearson Chi-Square sig.: 0.19
Source: own data

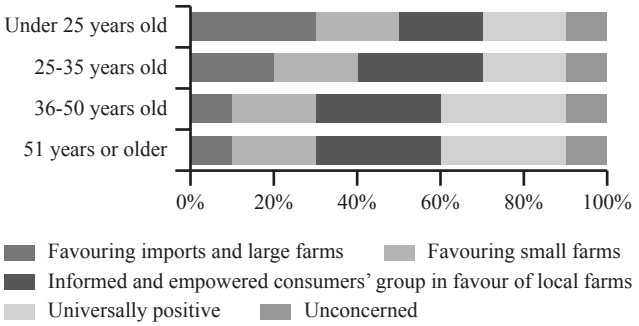

Figure 2: Distribution of the respondents between consumer clusters according to age groups.
Pearson Chi-Square sig.: 0.00
Source: own data

per cent, Figure 3). Among this latter educational group, the largest share (30.0 per cent) belonged to the '*Informed and empowered consumers' group in favour of local farms*' cluster, while, with 35.8 per cent of respondents, the '*Universally positive*' cluster was dominant among those with vocational school education (skilled workers). 24.8 per cent of respondents with secondary school education belonged to the '*Favouring small farms*' cluster, and the '*Informed and empowered consumers' group in favour of local farms*' cluster claimed the largest share (30 per cent) participants having higher education.

As regards economic status, a substantial share (43.8 per cent) of full-time homemakers belonged to the '*Favouring imports and large farms*' cluster, while the equivalent figure was just 11.0 per cent among the retired respondents (Figure 4). This latter group was dominated (38.7 per cent) by the '*Universally positive*' cluster. Twenty per cent of students identified with the '*Universally positive*' cluster, but among this group '*Favouring imports and large farms*' accounted for the largest share (29.6 per cent). Around ten per cent of students and out of work respondents fit within the '*Unconcerned*' cluster. The '*Informed and empowered consumers' group in favour of local farms*' cluster accounts for substantial (ca. 29 per cent) shares of employed and self-employed, and retired respondents, but only 6.3 per cent of full-time homemakers.

There is a clear, positive relationship between subjective income level and the percentage of respondents in the '*Favouring imports and large farms*' cluster (Figure 5). Fifty per cent of respondents with very high incomes, but only 13.2 per cent of those with low incomes, are included here. By contrast, the clusters '*Favouring small farms*' and '*Informed and empowered consumers' group in favour of local farms*' each accounted for only 7.1 per cent of respondents with very high incomes, the lowest percentages in these two clusters of any income group. In all other groups, the combined percentages of these two clusters ranged from 40.0 to 46.5. In each of the three groups with the lowest subjective income levels the shares of respondents in the '*Informed and empowered consumers' group in favour of local farms*' cluster exceeded 22 per cent. A very high (35.5 per cent) proportion of respondents with low incomes formed part of the '*Universally positive*' cluster, and these respondents also had the biggest share (10.5 per cent) in the '*Unconcerned*' cluster, although in this case the differences between the income groups were not substantial.

The research also looked for statistically-significant differences between the attitudes of the respondents on the basis of the type of settlement and NUTS 3 region of residence, but none were identified. However, it can be noted that the group with the highest proportion (30.8 per cent) in the '*Universally positive*' cluster was those living in villages, while only 21.9 per cent of those living in Budapest were part of this cluster. By contrast, 26.6 per cent of Budapest residents were part of the '*Favouring imports and large farms*' cluster, compared to just one fifth of respondents living in villages.

Purchasing habits of consumer clusters

The types of retail outlet most frequently visited by the respondents were specialised shops, discount stores and supermarkets, and hypermarkets, followed by small grocery

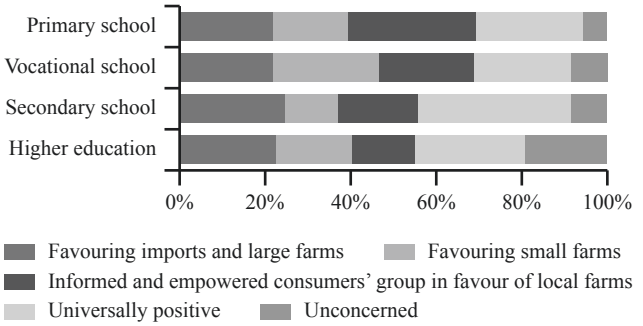

Figure 3: Distribution of the respondents between consumer clusters according to educational level.

Pearson Chi-Square sig.: 0.00
Source: own data

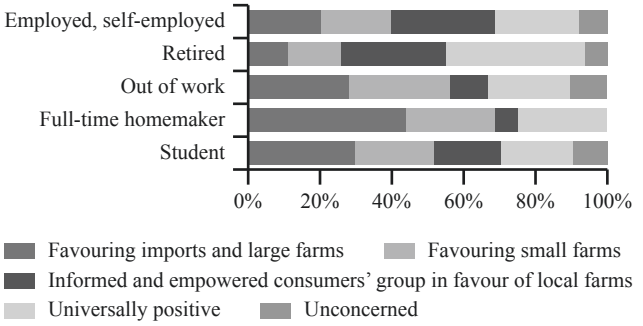

Figure 4: Distribution of the respondents between consumer clusters according to economic status.

Pearson Chi-Square sig.: 0.00
Source: own data

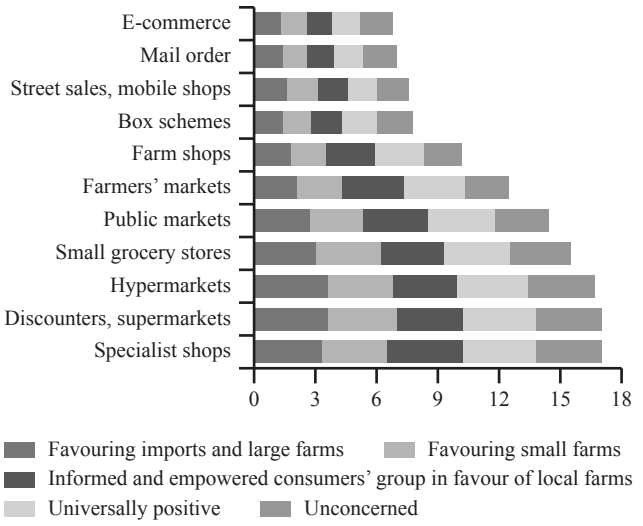

Figure 5: Distribution of the respondents between consumer clusters according to subjective income level.

Pearson Chi-Square sig.: 0.04
Source: own data

stores and markets (Figure 6). Among the options for buying food directly from the producer, farmers' markets and farm shops were the most popular. Other options scored low average values, with purchasing options from the Internet (mail order and e-commerce) being the least popular.

Members of the various clusters used particular types of retail outlets with different average frequencies. Outlets belonging to the so-called 'long' supply chains (e.g. hypermarkets, discounters and supermarkets) were – perhaps

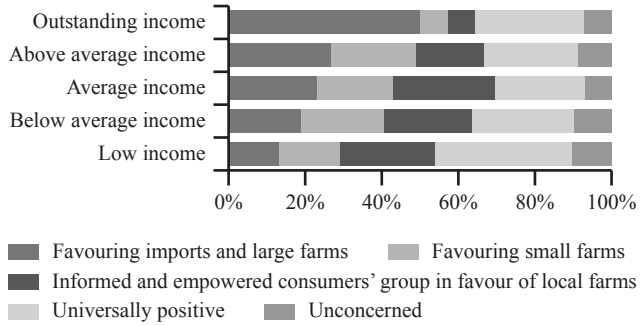

Figure 6: Average frequency of patronising food retail outlets by consumer cluster.
F-test sig.: 0.000
Source: own data

not surprisingly –the most popular among the '*Favouring imports and large farms*' cluster (mean: 3.6), but the '*Universally positive*' cluster also frequently patronised these shops (mean: 3.5-3.6). The '*Informed and empowered consumers' group in favour of local farms*' group visited these outlets less frequently (mean: 3.1-3.2). In general, the outlets where sales take place through an intermediary among 'short' supply chains (especially speciality shops, small grocery stores and public markets) were the most popular with the '*Universally positive*' and the '*Informed and empowered consumers' group in favour of local farms*' clusters and, in the case of small grocery stores, also the '*Favouring small farms*' cluster. Mobile shops seem to be an exception among this group of outlets. Among the direct supply chain outlets, farmers' markets and farm shops are the most often visited by the members of these two groups (mean: 3.0-3.3 vs. 2.1-2.7 among '*Favouring imports and large farms*' cluster), however, opportunities which do not necessarily require personal contact (such as the box system and on-line sales) were the most popular among the '*Unconcerned*' cluster.

Discussion

In recent years, especially since 2012, there has been an increasing demand among Hungarian consumers for SFSC products and, consequently, a growing need to characterise the profile of these consumers. Until now, no such analysis has been reported in the scientific literature. Previous research in Hungary (e.g. Szakály *et al*, 2010; Szabó and Juhász, 2013) has been carried out only on related topics. This study used principal component analysis involving a set of 26 variables (designed to measure consumer attitudes related to food production, purchase and consumption) to produce four aggregated variables (PC1-PC4). Cluster analysis was conducted using these aggregated variables and five distinct groups of consumers were identified in terms of their attitudes, preferences and consumer habits. The five groups, *'Favouring imports and large farms'*, *'Favouring small farms'*, '*Informed and empowered consumers' group in favour of local farms*', *'Universally positive'* and *'Unconcerned'*, differed not only in the way they are thinking, but also according to several demographic characteristics, namely gender, age, subjective income status, educational level and economic status. Only the type of settlement and NUTS 3 region of residence did not appear to influence consumer attitudes significantly, although even here some indicative trends were detected.

Almost 70 per cent of the respondents in the survey can be considered as potential customers of SFSC products, and these belong to three of the five clusters. Members of the '*Favouring small farms*' cluster (20.1 per cent) consider it important only to support small farms, while those belonging to the '*Informed and empowered consumers' group in favour of local farms*' (24.5 per cent) are favourably disposed to small farms, local products and food quality. This cluster may be the most accessible target group for products sold through SFSC. Members of the most populous cluster, the '*Universally positive*' group, to which 25.3 per cent of the respondents belonged, also attach high priority to local sales and pay attention to the nature of the food purchased. This is undoubtedly a very encouraging result for the future further development of SFSCs in Hungary.

People under 35 years of age and the higher educated were somewhat overrepresented in the survey sample, but it should be noted that the former group includes the consumers of tomorrow while the members of the latter group tend to have higher disposable incomes. Thus, the sampling errs towards the over-inclusion of the economically more 'important' groups in Hungarian society. In any case, the analysis of the clusters involved the stratification of the sample according to, *inter alia*, age and educational level. For example, among the respondents in the cluster of most interest, namely '*Informed and empowered consumers' group in favour of local farms*', there are higher shares of females, those aged above 35 years, with a high level of education, economically active or retired, and having an average income. In Hungary, the support for products of SFSCs increases according to these parameters, and this result is mostly consistent with the findings of studies in other countries. Of interest is that the results from these other studies have not been consistent regarding income. Most research suggests that consumers of SFSC products typically have high incomes (Onianwa *et al*., 2006; Varner and Otto, 2008; Elepua and Mazzocco, 2010; Rocchi *et al*., 2011). On the other hand, Nie and Zepeda (2011) described their '*Adventurous consumers'* cluster as having a level of income similar to the results of the current survey. This is a point where further research is needed.

Accurate knowledge of purchasing habits is necessary to determine the potential target groups of SFSC products. Yet the study of customer attitudes is location-specific because the characteristics of consumer behaviour can differ between countries depending on their history, development and economic status. Empirical studies published to date on consumer attitudes to SFSC have mostly been conducted in economically advanced countries, and no similar research from central and eastern European countries has previously been reported. The purpose of this study was to redress the lack of information currently available for this region of Europe.

In addition to the analysis of socio-demographic factors, this study has shown that there are measurable differences between clusters regarding the choice of the place where the food is purchased. Such information allows the extent and target groups of potential demand for each SFSC product range to be defined. Taken together, the socio-demographic

and retail outlet results represent a first step towards aligning the needs of producers and consumers by allowing both the food chain operators and the decision makers to develop and use a set of tools adapted for the motivation of each cluster according to the identified characteristics.

In conclusion, these results show that the method reported here is an effective way of identifying groups of potential target consumers of SFSC in Hungary, and their purchasing habits. But this research is only the first step towards identifying the characteristics of the existing and potential buyers of SFSC products. Further investigation of the consumer attitudes towards SFSC products and exploration of the causes of differences between the groups is needed. This knowledge will allow more concrete tools for SFSC products, consumers, organisers and public policy to be identified which can help increase the share of SFSC products in the food retail market both in the short and long term. The potential demand among almost 70 per cent of the Hungarian population clearly indicates the value of such studies.

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Farm-level viability, sustainability and resilience: a focus on co-operative action and values-based supply chains

This paper presents a critical discussion of the concepts of farm-level viability, sustainability and resilience, which are typically discussed separately in the literature. While farm-level viability frequently focuses on measurable economic factors, sustainability is comparatively more elusive because of its added social, cultural and ecological dimensions. Resilience, in turn, is unambiguous in the sense that it requires particular conditions, but is achieved in dynamic ways. A traditional resilience strategy in agriculture globally is co-operative action, involving farmers working together to enhance their viability and sustainability, often achieving resilience. We draw attention to agricultural development models that are distinctive because they leverage co-operative action in and between family farms in agricultural communities while pursuing integrated viability, sustainability and resilience strategies. We focus on the prospect of such rural development models, particularly a values-based supply chain approach, and identify crucial considerations and future research needs.

Keywords: viability, resilience, sustainability, co-operatives, family farms, values-based supply chains

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Introduction

Agricultural sustainability is positioned at the core of political debate on global challenges such as food security, energy security and climate change. Regions within the European Union (EU) and elsewhere are experiencing pressures to address these challenges. Recent reforms of the Common Agricultural Policy (CAP) and individual EU Member State policies, such as Ireland's *Food Wise 2025*, seek to increase the value of the agri-food industry by furthering process and product innovation while adhering to principles of 'Smart, Green Growth' (DAFF, 2010, p.4). Within such policy rhetoric, tensions can arise between economic goals (e.g. increasing agricultural output), social goals (e.g. preserving rural population density and diversity), and environmental goals (e.g. protecting ecological land health) (Barbieri and Mahoney, 2009; Selvi *et al*., 2012). It is recognised that family farms are pivotal actors in the agriculture sector and, globally, are challenged with furthering economic, social and environmental development goals in an integrated way (Piedra-Munõz *et al*., 2016). While there is no universal definition for family farms, defining criteria usually relate to a reliance on family members in providing labour and the intergenerational transfer and ownership of the farm business (Gasson and Errington, 1993; Bjørkhaug and Blekesaune, 2008).

Family farms are noted to be particularly tenacious, despite often experiencing low economic viability (Saraceno, 2013). Charting routes towards farm viability remains a central research and policy challenge; however, viability represents just a narrow component of broader sustainability goals. Farms that are economically viable can nonetheless face serious threats such as insufficient incorporation of social and environmental sustainability concerns to their business models that are necessary to survive in the long term (Hennessy *et al*., 2008). On the other hand, many farms that are categorised as economically unviable have high social and environmental sustainability attributes and can demonstrate remarkable resilience. Such farms are often resourced by strong social and cultural capital within the farm family and farming community, as well as alternative economic resources such as off-farm employment (Hill, 1993; Hennessy and Rehman, 2008; Darnhofer *et al*., 2010b; Davidova *et al*., 2013; Cush and Macken-Walsh, 2016; Sekabira and Qaim, 2017).

The interchanges between theories of viability, sustainability and resilience are the central focus of our paper, which mainly draws on Irish and European contexts but is broadly relevant to developed countries worldwide. Firstly, we discuss the concept of farm-level viability, which is typically focused on measurable factors. We then discuss the broader concept of sustainability, which is comparatively more elusive in its social, cultural and ecological dimensions. Our discussion then turns to the concept of resilience, which, although is unambiguous in the sense that it must fulfil particular conditions, can be achieved in dynamic ways. We argue that understanding the distinctions between farm viability, sustainability and resilience and their interchanges is supportive to effective agricultural development policy design. Through the lens of the conceptual framework presented in this paper, we discuss two main agricultural development paradigms that rely on co-operative action in the promotion of integrated farm viability, sustainability and resilience.

Farm viability

Economics is the dominant discipline in discussions of farm viability, where quantitative methodologies are typically used to measure universally-applicable indicators across a wide variety of farm types and contexts (Seghezzo, 2009). Family farm income (FFI) is a central determinant of farm viability and can vary due to differences in farm size, specialisation, output and access to off-farm income, among other factors (O'Brien *et al*., 2008). Frawley and Commins (1996) define farm viability as providing the average agricultural wage for family labour in addition to providing a 5 per cent return on non-land assets. O'Donoghue *et al*. (2016) outline several definitions of viability across a range

of countries in the global north (see Table 1 on p.164), but it is recognised that in the global south different measurements are used to conduct viability analysis (Saravia-Matus and Gomez y Paloma, 2014). Even within these different viability measurements there are different types and varying degrees of market integration (Tisenkopfs *et al*., 2017), further complicating viability measurement. For instance, while small farms can struggle with viability due to restrictions on scale and thus output, semi-subsistence farms only sell part of their output and retain significant proportions for their own needs (Davidova *et al*., 2013; Tisenkopfs *et al*., 2017).

The problem of poor economic viability of farms is a global issue (Weis, 2007). Focusing on farm viability in the United States (US), a phenomenon termed as 'bifurcation' refers to the expanding number of large farms producing undifferentiated commodity products on one the hand and, on the other, the expanding specialist premium foods sector. Implicated in this bifurcation is the loss of medium and small family farms that are neither sufficiently large to compete in the undifferentiated commodity markets nor adequately specialised to compete in premium food markets (Kirschenmann *et al*., 2008). Kirschenmann *et al*. (2008, p.3) state that, in today's market, mid-sized farms operating alone are particularly economically vulnerable because they are too small to compete in and provide sufficient volume of product in 'highly consolidated commodity' markets and too 'conventional' to supply direct speciality food markets. This decline in the number of farms across much of the world is a problem that is not determined solely by scale but by market structures.

Porter (1990) highlights two main routes to being competitive in a global economy and states that, while not impossible, it is difficult to pursue both routes: being the lowest cost supplier of an undifferentiated commodity or providing the market with unique and superior value in terms of product quality, special features or after-sales service. While economic viability is one helpful indicator of whether family farms are likely to survive into the future, an understanding of other indicators is also influential, explaining why so many family farms have remained in operation in the long term despite low economic viability. The broader concept of sustainability, which will now take our focus, goes some way towards understanding these wider dimensions.

Farm-level sustainability

Sustainability is frequently referred to in national and international policies that attempt to balance economic priorities with social issues, while safeguarding ecological conditions (Seghezzo, 2009). However, the concept of sustainability remains controversial as few policy regimes succeed in achieving the requisite balance between social, economic and ecological priorities. Definitions of sustainability are diverse and fluid according to different actor perspectives, creating challenges for the mainstreaming of sustainability mandates in political and civil structures. Because the sustainability concept is open to wide interpretation, it is argued that it can become bland in meaning, devoid of a coherent theoretical framework and clear means of practical realisation (Giddings *et al*., 2002).

It is accepted overall that sustainable agriculture is multifaceted, responding to pressing economic, environmental and social challenges (van der Ploeg and Marsden, 2008; Piedra-Munõz *et al*., 2016). Numerous 'buzzwords' with sustainability connotations have become mainstreamed in agricultural discourses, relating to both agricultural processes and products, for instance: 'environmentally sensitive', 'sustainably intensive', 'extensive', 'ecological', 'community', 'organic' and 'free range' (Pretty, 2008).

Methods of measuring sustainability are evolving (Dillon *et al*., 2010; Dillon *et al*., 2016), going beyond measurement of FFI which is acknowledged as failing to provide an "accurate indicator of the long-term sustainability of farming as it does not account for the level of resource utilisation on farms, nor does it account for the farm household's reliance on farm income" (Hennessy *et al*., 2008, p.35). The inclusion of social and innovation indicators of sustainability coincides with increasing emphasis of EU policy on the vital role of social networks in rural areas. Family farming is crucial to the maintenance of social capital and the economic, social and cultural fabric of rural areas (Hill, 1993; McDonagh, 2013). Social indicators of sustainability such as the demographic viability of households and social isolation are salient issues in many agricultural communities, where a reliance on family farms to retain rural population and services is highlighted across the third and public sectors (Shucksmith and Rønningen, 2011; Dillon *et al*., 2017). Additionally, it is claimed that intergenerational family farmers' knowledge of local production conditions makes them an intrinsic part of the sustainability agenda (Calus and Huylenbroeck, 2010). Macken-Walsh (2011, p.182) cites Kirschenmann and Stevenson (2004) who, in a US context, highlight practical reasons why family farming is valuable, arguing: "this is not just about "saving" the family farm. It is about the associated social, economic, and environmental costs to society. With the loss of each family farm, a rural community loses approximately USD 720,000 in related economic activity. Ecologists now affirm that the only way we can manage farmland in an ecologically sound manner is by having the farmer living on his/her land long enough and intimately enough to have learned how to manage it properly. With the loss of ecological land health, we see the loss of soil quality, wildlife, and recreational areas. And with the loss of rural populations, the loss of public services – education, health-care, transportation – inevitably follow".

Family farms are recognised as fundamental to the functioning of rural society (Hill, 1993; Delgado *et al*., 2003; Woods, 2011; Davidova *et al*., 2013) with over 12 million operating across the EU, according to Eurostat data. However, the vast majority of these family farms are dependent on EU subsidies to survive economically (Shucksmith and Rønningen, 2011; Woods, 2011; Davidova *et al*., 2013; McDonagh, 2013), yet they are proving to be tenacious. Measurements of viability and concepts of sustainability often fall short in explaining this tenacity, despite economic vulnerability, and it is in this context that we turn to the concept of resilience for its explanatory value.

Resilience

Resilience is defined as "the capacity of a system to absorb disturbance and reorganise while undergoing change so as to easily retain essentially the same function, structure, identity and feedbacks" (Walker *et al*., 2004, p.2). Resilience incorporates three main features: persistence, adaptability and transformability (Folke *et al*., 2010). Resilience not only implies the ability to bounce back from a disturbance but also adaptive capacity (adaptability) and transformative capacity (transformability) in maintaining system stability (Walker *et al*., 2004; Darnhofer *et al*., 2010b; Folke *et al*., 2010).

Resilience is impossible to measure or quantify (Buchmann, 2010). However, measurements of viability and sustainability may be used to gauge proxies of resilience such as adaptive capacity. Membership of cultural institutions, social capital, financial capital, systems of governance and resource availability are all determinants of the ability of farmers to achieve resilience (Buchmann, 2010). Various characteristics of resilience have been identified, including (a) learning to live with change and uncertainties, (b) nurturing diversity for reorganisation and renewal, (c) combining different kinds of knowledge and (d) creating opportunity for self-organisation (Folke *et al*., 2003).

Ungar (2008) draws attention to an ultimate characteristic of resilience, which is the ability to respond effectively to a threat or situation of adversity (Macken-Walsh and Byrne, 2014). It follows, therefore, that a precondition for recognising resilience is the presence of a threat or situation of adversity, which in turn catalyses responses in the form of new action(s) and/or the leveraging of new resources, whether material or non-material. Often these shocks and disturbances that trigger resilience may be viewed as 'windows of opportunity' (Folke *et al*., 2003). In understanding the resilience strategies of farm families, attention must be paid to the social domain of the farm family and, specifically, to the power-dynamics and relationships between family members and how different members can influence decision-making in relation to farm development (Darnhofer *et al*., 2010a; Macken-Walsh and Byrne, 2014). As noted by Vanclay (2004), farm family decision-making is not entirely informed by profit maximisation but by broader social and cultural goals and values. Farm families' reluctance to take financial risks that may jeopardise social and cultural forms of capital (such as ownership of the inter-generational farm) is attributed to their peculiar tenacity and resilience by comparison to industrial farms (Galdeano-Gómez *et al*., 2016; Macken-Walsh and Byrne, 2014).

Flexibility and adaptability, by adopting new organisational strategies and production methods, has aided the resilience of farms across the EU (Macken-Walsh and Roche, 2012). Parts of this literature focus on how the adaptability of farms depends not only on the farm and its components (resources, workers etc.) but also on the ability to mobilise resources outside of the farm (Almås, 2010). Darnhofer *et al*. (2010a, p.550), citing Chia (2008), assign the term 'relational reflexivity' to the process of mobilising or utilising external resources outside of the farm unit to increase resilience, focusing specifically on collective action. This resonates with a growing literature on collective action, within farm families and between them, as a strategy of resilience in family farming (Kirbak and Egil, 2005; Almås, 2010; Ingram and Kirwan, 2011; Macken-Walsh and Byrne, 2014).

Co-operative action as a model for family farm viability, sustainability and resilience

The co-operative is defined as "a self-help business, owned and democratically controlled by the people who use its services and share in its benefits" (Briscoe and Ward, 2006, p.10). Historically, the co-operative is a strong and enduring institution of the agricultural economy (Fulton and Hueth, 2009), combining economic and social goals (Briscoe *et al*., 1982; Bijman *et al*., 2016). Agricultural co-operatives have emerged to counteract the power disparities of the market place (Kirschenmann *et al*., 2008; McCarthy *et al*., 2010), and they play an important role in providing farmers with better access to markets, enabling them to improve overall efficiency, securing a higher share of the product value by creating scale, pooling market risks, and allowing for the development of product and market innovation (NCFC 2005, in Ortmann and King, 2007; Fulton and Hueth, 2009; Bernard *et al*., 2010; ICA, 2015). Co-operatives can build resilience to market volatility especially in times of economic crisis (Birchall and Ketilson, 2009; Wanyama *et al*., 2009), and are seen to perform particularly well in higher-value markets (Merel *et al*., 2009; McCann and Montabon, 2012).

Co-operation is, in its own right, an adaptation (Walker *et al*., 2004), potentially facilitating people to improve their quality of life and to enhance their viability, sustainability and resilience through social organisation (Hooks *et al*., 2017; Ortmann and King, 2007). The co-operative model must be adaptable as a resilience strategy in meeting members' viability and sustainability needs and to the design of the processes and products that meet these needs.

The 'Agriculture of the Middle' (AotM) movement (Kirschenmann *et al*., 2008) is a contemporary co-operative development model that emphasises the need to transition from a supply chain approach to a Values-Based Supply Chain (VBSC) chain approach. The term 'supply chain' places focus on the "costs and efficiencies of supply and the flow of materials from their various sources to their final destinations" (Feller *et al*., 2006, p.4). The term 'value chain' or VBSC focuses on the creation of added value within a chain, and the roles of different actors in the chain in creating value. Incidentally, VBSCs are also defined by a distinct commitment to the welfare of all partners in the supply chain, including principles of equitable profits, equitable wages, and business agreements of appropriate extended duration (Stevenson *et al*., 2011). An AotM VBSC involves cooperation between farmers and other actors (including processors, retailers and consumers) in bringing family farm produce to the market. A central aim of VBSCs is that farmers transition from the role of 'input suppliers' to 'part owners' of the chain (Kirschemann *et al*., 2008). In addition to the critical importance of forging values-based multi-actor relationships, this

transition in the status of the family farmer in the food chain is identified as a necessary foundation for developing family farm viability, sustainability and, ultimately, resilience.

AotM (Figure 1) emerged in the context of a 'bifurcation' of US farm structures, resulting in the loss of 'middle' family farms. The increasingly poor economic viability and losses of 'middle' family farms annually is explained by their lack of scale in competing with large, efficient producers of undifferentiated commodity products on one hand and their lack of differentiation by comparison to 'boutique' producers of branded speciality foods on the other (Kirschenmann *et al*., 2008; Kirschenmann, 2012). These underpinning causes of the bifurcation problem in US farm structures are evident worldwide, prompting debates about the future of family farms and wider sustainability issues (Davidova *et al*., 2013).

The loss of family farms, according to authors of the AotM literature, has negative economic, social, cultural and ecological impacts on society and such arguments are echoed in multiple national and international studies in the EU (EC, 1988; Phelan and O'Connell, 2011; Shucksmith and Rønningen, 2011; Forney and Stock, 2014). A primary concern of the AotM model is to harness the socio-cultural and ecological branding capital of family farms as a route for enhancing the market value of farm products and services. Family farm produce is identified as having competitive advantage in the space between commodity and specialised food products as there is a "burgeoning market demand for foods – neither cheap commodity foods or luxury expensive speciality foods – that are somewhere in the middle and are produced in accordance with sustainable agriculture standards. It is precisely the farmers of the middle who are in the best position to produce those products" (Kirschenmann *et al*., 2008, p.4). In more developed societies, there has been a mass social movement away from the consumption of undifferentiated commodity products towards foods with provenance attributes (Ilbery and Maye, 2005; Dilley, 2009; Moore *et al*., 2014). From consumers' perspectives, foods imbued with the social, cultural, economic and ecological benefits that non-intensive family farms deliver to society are increasingly desirable (Bell and Shelman, 2010).

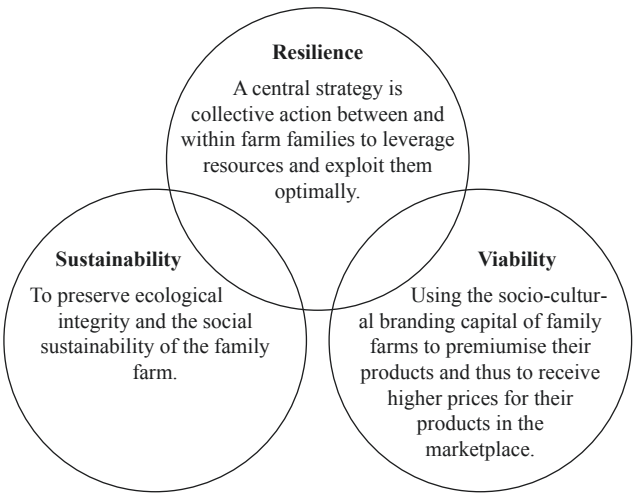

Figure 1: The AotM development model for family farms.
Source: own composition

Such a rationale is consistent with international agricultural development models such as the New Paradigm of Rural Development (NPRD). NPRD arose out of the rural development era of the European Union's agricultural policy when there was a realisation that there was a need not just to support agricultural production but also to support 'consumption' of rural areas. It is similar to the AotM model in how it offers an alternative to mainstream commodity agricultural production and draws on co-operative action and sustainability as core principles (Tovey, 2006). Tovey (2006, p.173) explains that NPRD "restates rights and possibilities of rural inhabitants to generate a livelihood for themselves from a sustainable use of the natural, cultural and social resources specific to their own rural locale". Instrumental stages in the realisation of NPRD include the deepening, re-grounding and broadening of agricultural production processes (Van der Ploeg *et al*., 2000) as a means of adding value. Similar to AotM, the realisation of NPRD is dependent on both the cultural and sustainability attributes that food products embody and the empowerment of actors (and relationships between them), which are so critical for resilience.

Conclusion

This paper reviews the literature defining family farm viability, sustainability and resilience, identifying key indicators of farm viability and sustainability and conditions for resilience. While farm viability and sustainability are important for family farms to survive, resilience is most deterministic of long-term survival. Underpinning family resilience is a capacity to leverage resources within and outside the farm family, necessary to respond to shocks and threats to farm viability and sustainability in the short and long terms. In this context, agricultural development policies informed by motivations to achieve farm viability and/or sustainability alone appear insufficient.

The co-operative model is theorised as capable of simultaneously enhancing viability, sustainability and resilience. An agriculture development model that is fundamentally based on principles of co-operation is presented in this paper: Agriculture of the Middle. Adopting a VBSC approach, value is added to products through production processes which adhere to principles of ecological, social and cultural integrity, increasingly sought after by consumers/ 'food citizens'. Principles of fairness and commitment demonstrated by contracts between chain partners, often including consumers, form an important part of the marketing strategy. This route toward economic viability culminates in farm families 'deepening' and 're-grounding' their production processes in socio-cultural identity and ecological integrity in order to receive a higher price for their product. Such an approach represents an alternative to scaling up in size and production output and is consistent with sustainability goals.

The review of the crucial inter-relationships between farm viability, sustainability and resilience presented in this paper highlights that it is prudent for agricultural development models to be focused on all three concepts. AotM is reviewed as one such model which demonstrates a balancing and mutual reinforcing of viability, sustainability and

resilience goals. However, AotM has only in recent years been transposed to the EU context and discussions of such applicability in the EU context are emerging just now in the literature (Fleury *et al*., 2016; Hooks *et al*., 2017). Pertinent research questions are how the triad of viability, sustainability and resilience concepts remain integrated in practice and, crucially, how they are achieved at the level of family farms.

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KEREKES Kinga*[1], Horațiu PIRĂU*, KIS Brigitta-Ágota* and ÁBRAHÁM Beáta*

Factors influencing educational choices of Romanian rural youth

This paper attempts to identify the main factors influencing the decisions regarding educational choices of rural youth from Cluj county, Romania. In order to achieve this, data collected in three waves of survey, in 2007, 2011 and 2015, were combined. The three surveys used the same methodology, thus allowing us to test the stability of the outcomes over a period of eight years, to highlight the main changes occurring in this period and to test statistically the factors of influence on a larger sample. The results show that the share of those who intend to study further slightly increased in the period 2007-2015. Regression analysis lead us to five factors that have a statistically significant influence on continuing education: the parents' attitude towards continuing education, the age, the number of siblings, the school performance and the computer skills of the respondents. Some other individual, family and locality-related variables also correlated significantly with the intention to study further. Based on the conclusions, some policy implications are discussed.

Keywords: factors influencing further studying, early school leaving, Cluj county

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Introduction

Smart, sustainable and inclusive growth are the main priorities defined by the European Union (EU) in its 'Europe 2020' strategy (EC, 2010). The results of this paper are relevant for two out of the 'smart growth' targets set for Romania (EC, 2017), namely: (a) school drop-out (early school leaving) rates below 11.3 per cent, and (b) at least 26.7 per cent of the population aged 30-34 years should have completed tertiary education. These targets are lower than those for the EU-28 Member States (below 10.0 per cent and at least 40.0 per cent respectively), as Romania is lagging behind most EU Member States with respect to these indicators.

Over the past decade, Romania has recorded a high rate of early school leavers among those aged 18-24: 18.5 per cent overall and 26.6 per cent in the rural areas in 2016 (Eurostat, 2017) − and the trends are not decreasing. The share of the Romanian population aged 30-34 with tertiary education was 25.6 per cent in 2016 (Eurostat, 2017) and has increased over the last decade. Thus the overall target of 26.7 per cent seems to be realistic, but there are no separate data for the rural areas. At the last Romanian Census (INS, 2011), the share of the rural population aged 30-34 with tertiary education was only 9.7 per cent, and 61.8 per cent of the rural population over ten years old had a low level of education (at most, lower secondary school). The quality of education is lower in rural areas due to the undeveloped educational infrastructure and the inadequate number, lower qualification and high turnover of the teaching staff. By grouping schools, the primary and secondary schools in rural areas became less accessible, and several pupils have to commute every day (EC, 2006; Bertolini *et al.*, 2008).

Poorly-educated people face more difficulties in meeting job requirements and earn less when employed; thus, the likelihood of them becoming poor is much higher than for their better educated peers (Kertesi and Varga, 2005; Berryman *et al.*, 2007; Ékes, 2007; Fazakas and Kézdi, 2007; Bertolini *et al.*, 2008; OECD, 2009). A World Bank report on Romanian labour market vulnerabilities (WB, 2008) pointed out that "returns to schooling remain low for those with less-than-tertiary education" (p.23), and those who complete tertiary education earn on average 55 per cent higher salaries than those who completed only basic education. OECD (2009) shows that the school-to-work transition is easier for youth who have obtained at least an upper secondary school qualification. Educational level was also found to play an important role in non-farm diversification (Meyer *et al.*, 2008). Tudor (2015) considers the increase of the stock of knowledge and professional abilities of the rural population a potential way to increase resilience, as it allows an increasing occupational mobility.

Ginzberg (1977) outlined three distinct stages or periods in the career-choice process: the fantasy stage (childhood before age 11), the tentative stage (from ages 11 to 17) when the individual becomes more aware of work requirements and of his/her own abilities and values and makes decisions regarding vocational likes and dislikes, and the realistic stage (ages 17 to young adult), when the person, after narrowing his/her choices to a few possibilities, selects a job or a specialised training.

Studies of educational inequalities correlate academic success and access to higher education with several factors. One is family background, the most important aspect being the parents' education (Boudon, 1974; Bourdieu and Passeron, 1990; Coleman, 1990; Jigău and Surdu, 2002; Dávid-Kacsó, 2010; Jakimovski, 2010; Voicu and Vasile, 2010). Women's education is positively associated with investments in children's education (WB, 2007). Being born in the rural area is associated with a significant lower probability to attend and graduate from university courses (Voicu and Vasile, 2010), and rural location significantly increased the risk of school failure for girls (Dávid-Kacsó, 2010). Because continuing education means extra costs for rural families (paying for travel to the city and/or accommodation), the parents' approach and the financial welfare of the family have an important influence on the decision regarding continuing education (Jigău and Surdu, 2002; Kapitány *et al.*, 2005; Jakimovski, 2010; Vincze and Harbula, 2011).

A higher rate of school abandonment was registered in rural schools with a higher share of Roma children. The school advancement of Roma children is hindered by several factors, such as the parents' low level of and negative attitude towards education, poor housing conditions, family tra-

ditions (nomadic way of life or early-age marriage of girls), lack of identity documents, the deficit of qualified teachers and a high turnover of teaching staff (Jigău and Surdu, 2002; Vincze and Harbula, 2011).

Poor employment opportunities may reduce the returns to education in rural regions and can reinforce the tendency to underinvest in education. The migration of highly-educated towards places with high concentrations of people with similar skills (mostly urban areas) may further decrease the return to education in rural areas (Green and Hardill, 2003; Bertolini *et al.*, 2008). Romanian rural young people have a strong preference for living and working in the urban area (Kerekes and Pakucs, 2013). In the words of older farmers, "young people don't want to be the slaves of the land and of the animals" (Vincze *et al.*, 2005. p.283).

The aim of this paper is to identify the main factors influencing the decisions regarding educational choices of rural youth from Cluj county, Romania. Based on the available evidence, we hypothesise that individual factors (such as the age, the gender and the school performance of the young person), family factors (the parents' educational level and their attitude towards education, the number of siblings) and locality-related factors (remoteness, level of development, ethnic structure) influence the decision related to continuing education.

Methodology

Our analysis uses primary data collected through three waves of survey carried out among rural young people from Cluj county, Romania. Empirical data were collected in 2007, 2011 and 2015, in the eighth forms of 31 lower secondary schools from 21 communes (28 per cent of the communes in Cluj county).

The main reason to choose pupils from the eighth form (the last year of the lower secondary school, also called *gymnasium* in Romania) is that in most rural localities that is the highest level of schooling which can be achieved locally. Another reason behind this choice is that the school enrolment rate of young people aged 15-18 (corresponding to higher secondary education) is much lower than those aged 11-14 (corresponding to lower secondary education). In 2015 the difference was over 12 percentage points, i.e. 78.2 per cent versus 90.4 per cent (INS, 2017), showing that a substantial share of the young people quit education after completing lower secondary education. Our respondents belong the 13-17 years' age group, thus they are in the tentative stage according to Ginzberg (1977), when young people are more aware of the consequences of their decisions regarding educational choices.

The communes were selected using the following criteria: accessibility (measured by the average time to reach the county capital city Cluj-Napoca by road and the existence of a railway station on the territory of the commune)[1], the geographical location (mountain areas being characterised by a lower share of arable land), the size and age structure of the population (measured by number of inhabitants and the share of those aged 0-14 years in the total population), as well as the level of development, measured with the complex development coefficient (CDC) calculated both from six and twelve indicators, as described by Kerekes (2005). For all indicators, commune-level (LAU 2) data from 2002 were used, the year of the most recent Census at the time of the first round of the survey (2007). The 21 selected communes present a great variety, but the averages of the chosen indicators for the sample are very close to the county-level averages calculated for all communes (Table 1).

The following main issues were tackled in the questionnaire: choice for continuing education, aspiration for university studies, chosen profession and future place (locality) of work. In addition, questions referred to the age, gender, health status, domicile, school results, opinion about the school, main values, family structure, educational level of the parents and siblings, parents' occupation, and the size and structure of the family farm.

A total of 1,280 pupils (646 female and 634 male) completed the questionnaires. The 2007 survey involved 170 female and 169 male pupils from 26 schools from 19 communes. In 2011, when 256 female and 229 male pupils were surveyed, two additional communes were added in order to compensate for the decrease of the number of pupils in the originally selected communes. In 2015, the 220 female and 236 male pupils were drawn from 29 schools from 20 communes, leaving out one of the two schools added in 2011. The number of schools visited varies because the classes can be regrouped within the different village schools according to the number of children in the respective age group.

Results from 2007 and 2011 were published by Kerekes (2007, 2013) and Kerekes and Pakucs (2013), where further details can be found about the preliminary results and the research methodology. The current article analyses the factors influencing the decision regarding continuing education using a database composed of all responses collected during the three waves, completed with data related to the characteristics of the communes gathered from the Tempo Online database of the National Institute of Statistics.

From all the available data, we have selected those indicators which, based on the results of the literature review and in our own judgement, could be influential for continuing

Table 1: The values of the indicators used for selection at sample level, compared to Cluj county averages.

Indicator	Sample average (n=21)	County average (n=75)	Distribution of the communes from the sample within all communes from Cluj county, by quintile				
			Q1	Q2	Q3	Q4	Q5
Share of arable land, per cent	44.6	43.4	5	6	2	4	4
Number of inhabitants	3,282	3,068	5	5	4	5	2
Share of the population aged 0-14, per cent	16.2	15.8	6	3	3	4	4
CDC_6	0.2810	0.2810	4	3	6	2	6
CDC_{12}	0.3639	0.3543	6	1	6	4	4

Source: own calculations

[1] For calculating accessibility, we did not consider distances expressed in kilometres, because distances to Cluj-Napoca from the different villages within the same commune differ greatly. Five communes from the sample can be reached within 30 minutes by car, nine communes between 30-60 minutes and six of them in over one hour. Four of the communes from the sample have operational railway stations (19 per cent), while the county average is 21 per cent (16 out of the 75 communes).

education. We grouped these potential factors of influence into four groups:

- *Individual characteristics of the respondent*, such as the gender, age, school performance, computer skills, and values (the importance of being educated, having a family and a job);
- *Family characteristics*, such as the educational level of parents, the attitude of parents towards the education of their children and the number of siblings;
- *Data related to the localities where the respondents live*: the size of the commune, its demographic and ethnic structure (the share of the Roma population), its distance from Cluj-Napoca (the county capital city), its land structure (the share of forests);
- *School-related factors*, such as the number of teachers, the number of school-age children per teaching staff, the share of lower secondary school graduates and the distance from the nearest school.

Data were processed with the SPSS program (IBM Corporation, Armonk, New York, USA). Descriptive statistics (frequencies, shares and crosstab analysis and linear regression) were used to identify the main factors of influence.

Results

Influence of the respondents' individual characteristics

About three quarters of the pupils (922) were living in the same locality as the school and 358 commuted to school from neighbouring villages or – as in the case of some pupils from two schools located in mountain villages – they were staying in the school college during the week, because they live too far to commute daily.

Continuing education is the choice for 95.2 per cent of the pupils and 4.8 per cent plan to quit education after completing the eighth year of study. Of the respondents, 79.6 per cent would like to study further in a high school and 15.6 per cent in a vocational school. Because of the transformation of vocational schools into technical high schools in the 2009/2010 school year, no choice for vocational school was registered in 2011 but, after some more reforms, in the school year 2014/2015 studying in a vocational school was again an option. There are statistically significant differences among the different waves: in 2007, the share of those opting to quit education was bigger, while in 2015 more pupils were opting for vocational education.

Answers related to continuing education and the type of school chosen are significantly related to the gender of the respondents (Pearson Chi-Square = 0.000). Girls are more likely to continue education (87.4 per cent chose high school, 9.0 per cent vocational school) and only 3.6 per cent planned to drop out. Boys also prefer high school (71.8 per cent), but a much higher share (22.3 per cent) chose vocational school and plan to quit school (6.0 per cent). The preference for high school has increased both for girls (from 79.5 per cent in 2007 to 81.6 per cent in 2015) and boys (from 54.5 per cent in 2007 to 59.1 per cent in 2015), as well as for vocational school (from 13.7 per cent in 2007 to 16.1 per cent in 2015 for girls and from 32.7 per cent in 2007 to 37.0 per cent in 2015 for boys), both contributing to the decreasing share of those who plan to drop out of school.

Regarding their wish to enrol for university studies, 65.1 per cent of the respondents gave an affirmative and 34.9 per cent gave a negative answer. The inconsistency between the choice for university studies and the preferred profession (a different item from the questionnaire) suggests that many respondents have no information about the professions universities qualify for. Gender influence is evident in this case, too: 78.2 per cent of girls want to go to university compared to 51.9 per cent of boys (Pearson Chi-Square = 0.000).

We present in Table 2 the correlation coefficients between continuing education and some individual characteristics which proved to be statistically significant.

Computer literacy increased over the period 2007-2011 from 54.3 per cent to 81.5 per cent, and then declined slightly to 78.5 per cent in 2015, but this small decrease is not statistically significant. Altogether in the three waves 72.8 per cent of the pupils (72.2 per cent of the girls and 73.5 per cent of the boys) declared that they can use a computer (for verification, we also asked them to list some programmes they are using). Computer skills and continuing education proved to be positively correlated (Pearson Correlation = 0.236).

The age of respondents varied from 13 to 17 years, but 91.1 per cent of them were 14 or 15 years old. There is a negative correlation between age and the educational choice; older pupils opted to a greater degree for vocational school or for quitting education.

School performance was also relevant. From the average grades obtained by the pupils in the seventh form (as declared by the respondents in the questionnaire) we formed three categories: good results (over an average of 8.5) were achieved by 50.1 per cent of the respondents, medium results (7.0 – 8.5) by 40.7 per cent and poor results (below 7.0) by 9.2 per cent. A larger share of those with good results continue education in high schools and those with poor results

Table 2: Correlation between continuing education in a high school or a vocational school and the respondents' individual characteristics.

Characteristic	Continuing education (1 = yes, 0 = no)		
	Pearson correlation	Sig. (2-tailed)	N
Computer skills (1 = yes, 0 = no)	0.236	0.000	1,234
Age (in years)	-0.213	0.000	1,248
School performance (3 = good, average over 8.50, 2 = medium (7.00-8.50), 1 = poor, average lower than 7.00)	0.187	0.000	1,044
Planned age of starting to work (in years)	0.128	0.000	1,164
Importance of being educated (1 = very important to 3 = not important)	-0.111	0.000	1,232
Importance of having a job (1 = very important to 3 = not important)	-0.101	0.000	1,239
School is easy (1 = easy to 3 = difficult)	-0.065	0.026	1,182
Importance of establishing a family (1 = very important to 3 = unimportant)	-0.057	0.045	1,232

Source: own calculations

drop out from school to a much higher degree than the average (Pearson Correlation = 0.187).

The age when the respondents plan to start working is also positively correlated with the decision to continue education, which is a realistic expectation, as those who stay longer in education will enter the labour market when they are older.

The pupils were asked to express their opinion regarding some value-related issues. Being educated is very important for 84.5 per cent of them, while 14.3 per cent consider it important and only 1.1 per cent believe that it is not important. However, the share of those who believe education is very important has declined from 87-89 per cent in 2007 and 2011 to 78.4 per cent in 2015. There is a statistically significant correlation between the importance given to being educated and the choice to study further. The importance of other values, such as having a job or establishing a family, is also correlated with continuing education.

The final individual characteristic which was statistically significantly correlated with continuing education was the ease of learning for the respondent. As expected, those who consider school difficult are more likely to drop out.

Influence of the respondents' family characteristics

The highest share (38.0 per cent) of the respondents are part of families composed of four people, typically formed by the parents and two children (29.7 per cent); 23.3 per cent of the families have five members and in 20.8 per cent at least six people live together. The largest household has 14 members.

Regarding the attitude of their parents to further education, 89.1 per cent of the pupils answered that both of their parents want them to study further and only 13 respondents, of which 11 were boys, declared that neither of their parents wants them to continue education. Naturally, these latter pupils all declared that they would quit education. We scored parents' agreement on a scale from 0 (none of the parents agree with further education) to 4 (both parents agree). Intermediary values were given as follows: 1 = one parent does not agree and the respondent is undecided about the other parent's opinion, 2 = one parent agrees, the other does not, 3 = one parent agrees and the respondent is undecided about the other parent's opinion. Parents' agreement proved to have the strongest correlation (Pearson Correlation = 0.406) with the decision regarding further education (Table 3).

Table 3: Correlation between continuing education in a high school or a vocational school and the characteristics of the respondents' family.

Characteristic	Continuing education (1 = yes, 0 = no)		
	Pearson correlation	Sig. (2-tailed)	N
Parents' agreement to continue education (0 = both parents no, 1 = one parent no, the other undecided, 2 = one parent yes, the other no, 3 = one parent yes, the other undecided, 4 = both parents yes)	0.406	0.000	1194
Fathers' education (1 = tertiary education to 5 = utmost lower secondary education)	-0.133	0.000	967
Number of siblings	-0.127	0.000	1253
Mothers' education (1 = tertiary education to 5 = lower secondary or less education)	-0.098	0.002	1023

Source: own calculations

Among the pupils, 23.3 per cent were not aware of the educational level of their parents. Of the mothers, 12.7 per cent have completed tertiary education, compared to 9.3 per cent of the fathers, while similar shares of each have completed high school with baccalaureate exam (27.8 per cent of the mothers and 29.1 per cent of the fathers) and ten years of education (23.4 per cent of the mothers and 20.4 per cent of the fathers). Vocational school was mostly attended by the fathers (25.4 per cent, compared to 11.6 per cent of the mothers). The share of the parents with at most lower secondary education (eight years of schooling or less) is also rather high (24.4 per cent of the mothers and 15.9 per cent of the fathers) and has increased over the years, from 13.5 per cent in 2007 to 30.5 per cent in 2015 for mothers and 14.0 per cent in 2007 to 20.5 per cent in 2015 for fathers. The decision to continue education correlates with the educational level of both parents. The negative sign in Table 3 is due to the decreasing scale attributed to this indicator (from 1 = tertiary education to 5 = at most lower secondary education). In addition, children of more educated parents opted to a higher degree for high school than those of the less educated parents.

Another important family characteristic is the number of siblings. Among the respondents, 48.0 per cent have one brother or sister, 18.2 per cent have two and 16.6 per cent have three or more, while 17.3 per cent have no siblings at all. There was a statistically significant correlation between the number of siblings and the decision to study further: those who have more siblings are less willing to continue education.

Combined effect of the individual and family factors

To calculate the combined effect of the individual and family factors influencing the educational choices of rural youth, regression analysis was performed with the SPSS program. The model summary is presented in Table 4 and the coefficients in Table 5. Only five variables out of the individual and family characteristics discussed above were statistically significant. The R^2 of the best fitting model explained was 0.236, and the best explanatory variable proved to be the parents' agreement to continue education ($R^2 = 0.187$), followed by age ($R^2 = 0.026$), the number of siblings ($R^2 = 0.014$), school performance ($R^2 = 0.009$) and computer skills ($R^2 = 0.004$).

Influence of the locality and school characteristics

Of the 21 communes in the survey, 19 were included in all three waves, Gilău in 2011 and 2015, and Țaga only in 2011. All these communes are composed of more than one

Table 4: Summary of the linear regression model for the dependent variable: continuing education (high school or vocational school).

Model	R	R^2	Adjusted R^2	SE of the estimate	Change statistics				
					R^2 change	F change	df1	df2	Sig. F change
1	0.432[a]	0.187	0.186	0.127	0.187	228.442	1	993	0.000
2	0.461[b]	0.213	0.211	0.125	0.026	32.636	1	992	0.000
3	0.476[c]	0.226	0.224	0.124	0.014	17.367	1	991	0.000
4	0.486[d]	0.236	0.233	0.123	0.009	12.154	1	990	0.001
5	0.490[e]	0.240	0.236	0.123	0.004	5.057	1	989	0.025

Predictors: [a] (constant), parents' agreement to continue education; [b] (constant), parents' agreement to continue education, age; [c] (constant), parents' agreement to continue education, age, number of siblings; [d] (constant), parents' agreement to continue education, age, number of siblings, school performance; [e] (constant), parents' agreement to continue education, age, number of siblings, school performance, computer skills
Source: own calculations

Table 5: Coefficients of the linear regression model for the dependent variable: continuing education (high school or vocational school).

Model no.		Unstandardised coefficients		Standardised coefficients	t	Sig.	Correlations			Collinearity statistics	
		B	SE	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	0.464	0.034		13.500	0.000					
	Parents' agreement	0.133	0.009	0.432	15.114	0.000	0.432	0.432	0.432	1.000	1.000
2	(Constant)	0.996	0.099		10.050	0.000					
	Parents' agreement	0.128	0.009	0.417	14.743	0.000	0.432	0.424	0.415	0.991	1.009
	Age	-0.036	0.006	-0.162	-5.713	0.000	-0.201	-0.178	-0.161	0.991	1.009
3	(Constant)	0.976	0.098		9.912	0.000					
	Parents' agreement	0.125	0.009	0.407	14.451	0.000	0.432	0.417	0.404	0.984	1.017
	Age	-0.033	0.006	-0.150	-5.322	0.000	-0.201	-0.167	-0.149	0.981	1.019
	Number of siblings	-0.002	0.000	-0.118	-4.167	0.000	-0.172	-0.131	-0.116	0.981	1.019
4	(Constant)	0.892	0.101		8.854	0.000					
	Parents' agreement	0.122	0.009	0.398	14.137	0.000	0.432	0.410	0.393	0.975	1.026
	Age	-0.030	0.006	-0.137	-4.825	0.000	-0.201	-0.152	-0.134	0.963	1.038
	Number of siblings	-0.002	0.000	-0.114	-4.044	0.000	-0.172	-0.127	-0.112	0.980	1.021
	School performance	0.021	0.006	0.099	3.486	0.001	0.170	0.110	0.097	0.966	1.035
5	(Constant)	0.870	0.101		8.604	0.000					
	Parents' agreement	0.122	0.009	0.395	14.072	0.000	0.432	0.408	0.390	0.974	1.027
	Age	-0.029	0.006	-0.132	-4.654	0.000	-0.201	-0.146	-0.129	0.958	1.044
	Number of siblings	-0.002	0.000	-0.113	-4.023	0.000	-0.172	-0.127	-0.112	0.980	1.021
	School performance	0.019	0.006	0.087	3.057	0.002	0.170	0.097	0.085	0.938	1.066
	Computer skills	0.021	0.009	0.064	2.249	0.025	0.124	0.071	0.062	0.957	1.045

Source: own calculations

village. Primary schools operate in more localities, while lower secondary schools (fifth to eighth forms) operate usually in the commune centre and in the villages with a higher number of children from the respective age groups. In all three waves, we visited all schools where eighth form children were studying, thus the total number of villages reached was 33 (26 in 2007 and 2011, 29 in 2015). As most statistical data are only available at the commune (LAU 2) level, we characterise the communes, and not the villages, as localities of origin.

The first commune-specific indicator we tested is the number of inhabitants, which in the Census from 2011 ranged from 1,218 (Palatca) to 10,317 (Baciu). Our hypothesis was that settlement size would have a positive effect on children's decision to continue education but, according to our data (Figure 1), the number of inhabitants does not correlate with the share of school drop-outs ($R^2=0.001$), calculated as an average of the pupils from the respective commune who do not want to continue education, nor with the overall educational choice ($R^2=0.012$), calculated as a weighted average of the chosen school type (2=high school, 1=vocational school and 0=no school).

The vitality index of the commune (calculated as the ratio of births to deaths) correlated neither with the share of the school drop-outs ($R^2=0.001$) nor with the educational choice ($R^2=0.002$). The only population-related characteristic which proved to be relevant regarding the educational outcomes is the share of Roma population within the total population of the commune. There was a negative relation-

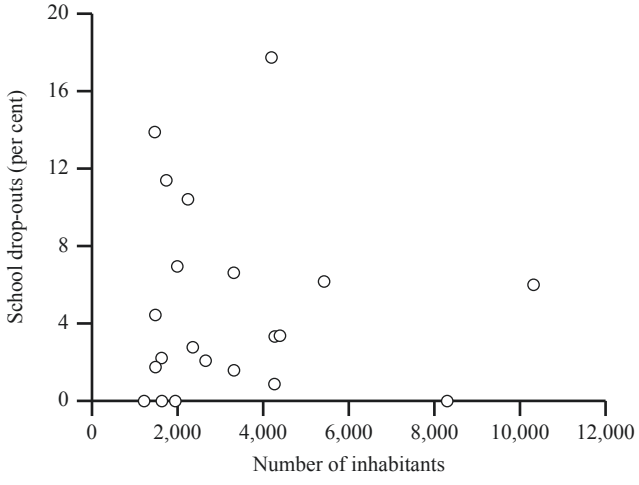

Figure 1: The percentage of school drop-outs according to the total number of inhabitants in the commune.
Data sources: INS (2017) and own research

ship (Figure 2) between the share of Roma population and the share of gymnasium (lower secondary school) graduates among the 10-14 years old ($R^2=0.268$). Successful graduation is a precondition for further studying.

The share of the Roma population is significantly correlated (Figure 3) with the share of those who plan to drop out after graduating lower secondary school ($R^2=0.178$), as well as with the educational choice (high school, vocational school or no school) ($R^2=0.107$).

Other indicators tested were intended to measure the geographical remoteness of the communes: the distance to the county capital city, Cluj-Napoca, the distance to the nearest high school and the share of woodland in total land cover (as a proxy for mountain areas). Correlation coefficients among the distance to the nearest high school and the distance to Cluj-Napoca were calculated both with the individual answers and with the commune-level aggregated values related to continuing education and the chosen school type. Among these, only between the distance to the nearest high school and the individual-level educational choice (high school, vocational school and no school) was a very weak negative correlation found (Pearson Correlation=-0.067, statistically significant at the 0.05 level), showing that the long distance can be an obstacle for continuing education in a high school. The same conclusion can be drawn from Figure 4, which shows the share of children who continue to study (calculated at commune level), according to the distance to the nearest high school, where the negative influence can be observed, especially for longer distances (over 21 km).

The share of woodland in total land cover correlates (Figure 5) with the commune-level educational choice ($R^2=0.138$). As the high share of woodland is characteristic of mountain areas, we arrive to the somehow contra-intuitive result that young people from mountain areas prefer high schools more than the average.

One further commune-level characteristic which was statistically significant is related to the local school system. The share of gymnasium graduates among 10-14 years old is decreasing as the number of children per gymnasium teacher

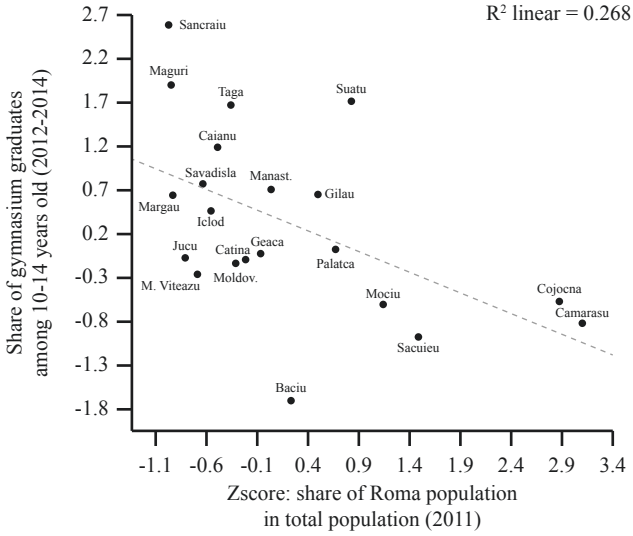

Figure 2: The share of gymnasium graduates among 10-14 years old according to the share of the Roma population in the commune.
Data source: INS (2017)

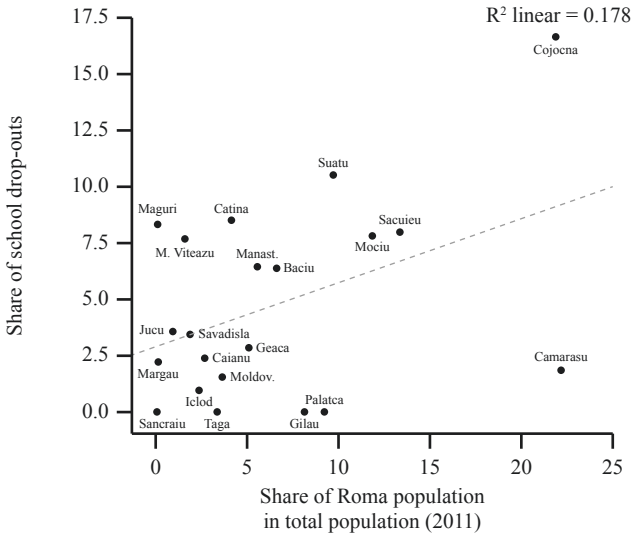

Figure 3: The percentage of school drop-outs according to the share of the Roma population in the commune.
Data sources: INS (2017) and own research

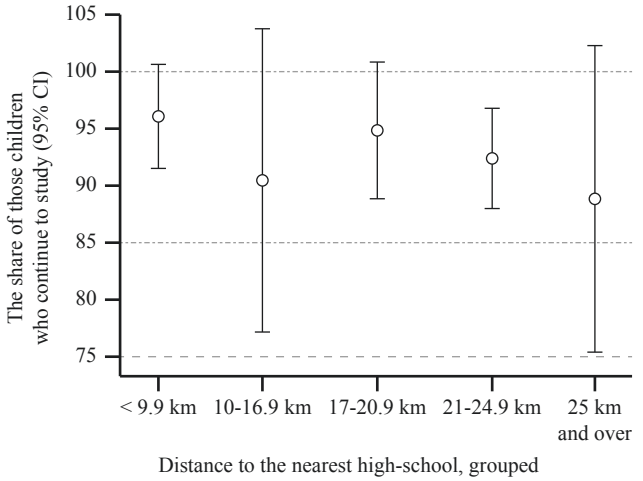

Figure 4: The percentage of pupils continuing education according to the distance from home to the nearest high school. Error bars indicate 95 per cent confidence index.
Data sources: INS (2017) and own research

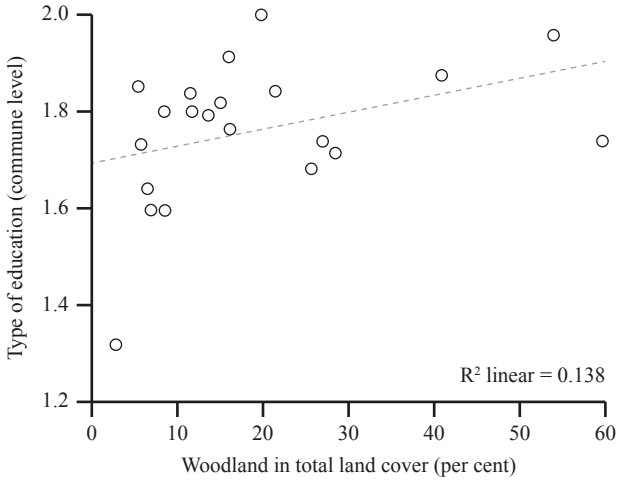

Figure 5: Educational choices of pupils according to the share of woodland in the commune by land cover.
Data sources: INS (2017) and own research

increases (R^2=0.258), showing the importance of teachers' attention for the performance of the pupils (Figure 6). A high number of children per teacher can also signal that some of the teachers have their main job in a school located in a different commune, which also means a lower level of teachers' involvement.

Discussion and conclusions

The low level of education of the rural population in Romania and the alarmingly high rate of early school leavers among those aged 18-24 in the rural area requires both researchers and policy makers to try to understand the causes behind these unwanted phenomena. Our paper offers some hints, based on empirical research carried out in three waves over a period of eight years, reaching 1,280 young people in 21 communes of Cluj county.

Our first result is that quite a substantial share (9.8 per cent of the pupils in 2007, and 3.1 per cent in 2011 and 2015) do not want to continue their education after completing the eighth form (lower secondary education), which means that they will have no professional qualification and their chances of gaining employment outside agriculture are very low.

The educational choices of rural youth from Cluj county have changed during the period 2007-2015. The share of those who declared they want to continue education increased by six percentage points from 2007 (when the Romanian economy was growing) to 2011 (just after the global economic crisis), which supports the view that in an economic slowdown young people are more likely to stay in education than look for work (OECD, 2009). In the period 2011-2015, characterised by economic recovery, the share of planned school drop-outs stabilised at around 3 per cent. Those who do not want to continue education explained their choice with the low school achievements, the negative feelings towards school, the lack of money, the parent's negative attitude towards continuing education or their own wish to work on the family farm.

Background information collected through the questionnaire and official statistical data allows us to identify the factors which influence the choice of a young person from a rural area to study further or not (Figure 7).

Regression analysis lead us to five factors having a significant influence on continuing education: the parents' attitude towards continuing education, the age, the number of siblings, the school performance and the computer skills of the respondents. Other variables, such as the parent's education, the age when the respondents plan to start working, the importance given to some values (being educated, having a job and establishing a family) also correlate (one-by-one) with the decision to continue education. Gender significantly influences the choice of a specific school type (high school for girls and vocational school for boys to a greater degree), and the share of girls who would like to enter tertiary education is also significantly higher than for boys. Even though these variables were not statistically significant in our regression model, we believe that they should be taken into account as factors of influence by projects addressing the improvement of rural education.

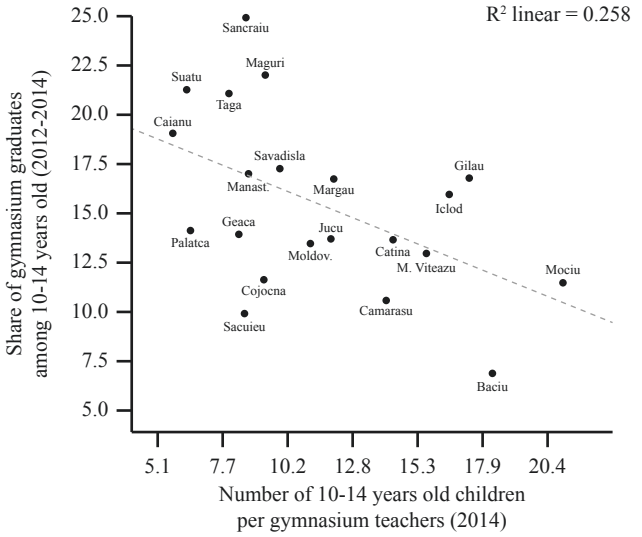

Figure 6: The share of gymnasium graduates among 10-14 years old according to the number of 10-14 years old children per gymnasium teacher.
Data source: INS (2017)

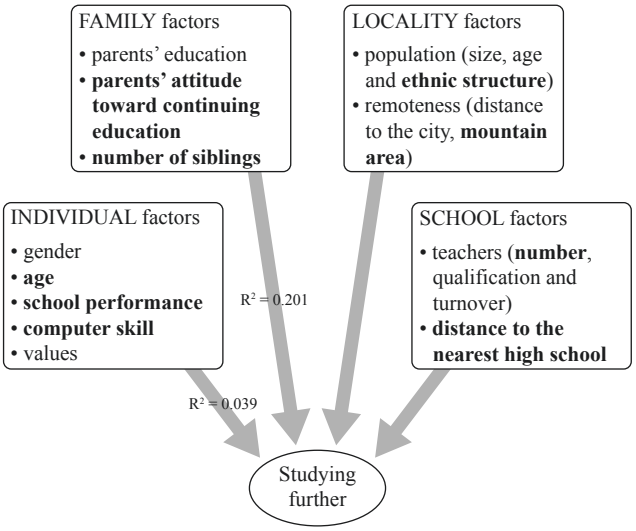

Figure 7: Factors influencing pupils' decision to continue education.
Source: own composition

Our results related to the importance of family characteristics are strongly supported by the literature cited above. The negative attitude of the parents and the number of siblings are closely associated with the financial welfare of the family. Larger families are more likely to face poverty, which can be an obstacle for continuing education. Poverty can also be a reason behind the negative attitude of the parents towards further education, because of the costs implied.

The negative influence of age was expected, as older pupils are usually those who had to repeat a year, or who interrupted education for a while and who are therefore less likely to continue education after graduating lower secondary school.

School performance indicates the interest of the young person towards education, thus the positive influence of this factor is self-explanatory. Still, it is important to point out this relationship, as poor performance at school can signal already at an early age the risk of school drop-out and the

need for intervention by teachers and parents. The positive influence of computer skills could be considered as a side effect of school performance, but the correlation between the two is quite weak (Pearson Correlation = 0.198), thus we can assume that the development of computer skills can be a way to prevent the school drop-out of pupils with lower general school performance.

Concerning the influence of commune-level characteristics, our results are consistent with those of Jigău and Surdu (2002), who concluded that general locality-related indicators, such as the number of inhabitants, the distance to the closest city, the development level and the occupational structure of the locality do not have a significant influence on school abandonment.

Being a sensitive issue, we did not ask questions regarding the ethnic background of our respondents, thus we cannot differentiate between the options of Roma and non-Roma pupils. Still, we can state that in the communes with a high percentage of Roma population the share of school drop-out is also higher, confirming the results of earlier studies regarding the educational disadvantages faced by the Roma community.

The availability and the quality of education in the locality of domicile have a positive influence on the decision to study further. Qualified and committed teachers who spend enough time with each child could contribute in the prevention of school drop-out. The distance to the closest high school influences in a negative way the decision to continue education in a high school, meaning that pupils from more remote villages need extra support to overcome the negative impact of commuting.

To ensure a well-trained workforce for a knowledge-based, innovative economy, all children, including those from remote rural areas, must have access to quality education. Pre-school, primary and lower secondary school education must be organised as close as possible to where the children live, because transportation time and cost are limiting factors of school attendance.

Recognising the importance of parents' support in the decision regarding continuing education, educational policies must address the families in need, ensuring that no children are left out of education because of financial hardship or lack of information.

Recent strategies elaborated by the Romanian Ministry of Education (MEN, 2015, 2017) show that the authorities are aware of the problems faced by rural young people (higher rate of school failure and early school leaving, lower rate of successful baccalaureate exams, and lower rate of participation at all levels of education than for urban young people). Several measures have been proposed, starting from the modernisation of the educational infrastructure (e.g. 60 per cent of rural schools have no libraries and 72 per cent have no laboratories), to improve school transportation and accommodation facilities for those who have to travel to school, but also to recruit teachers willing to serve in more remote areas, to organise afterschool activities and to involve parents of children at risk of school abandonment. The long-term impact of these measures will depend on the resources allocated to and the continuity of the programmes implemented.

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Determinants of long-term business relationships in the dairy value chain in transition countries: the case of Albania

Building on transaction cost economics theoretical framework, we examined the determinants of long-term business relationships between farmers and buyers in the Albanian dairy chain in a context characterised by weak institutions and lack of formal contract. Logistic regression analysis was employed to test the model on primary data collected from a sample of 315 Albanian farmers engaged in the production of sheep and goat milk. The study results support our hypotheses that trust, uncertainty and investment in specific assets are key determinants of long-term relationships. Implications at managerial and policy-making levels are discussed. At a managerial level, dairy owners and managers need to build trust with farmers and mitigate uncertainties as a precondition for long-term relationships. At the policy level, the government subsidy schemes need to be further refined in order to motivate farmers to increase flock size and strengthen vertical relationships in the dairy value chain, the latter being a precondition also to achieve traceability and improve standards.

Keywords: trust, uncertainty, asset specificity

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Introduction

Effective vertical coordination among value chain actors, from raw material producers to distributers, is considered to be a key source of competitiveness for firms operating in the agriculture sector (Hendrikse, 2007; Reynolds *et al*., 2009). Much of the research focused on exchange relationships (e.g. Ménard and Valceschini, 2005; Reynolds *et al*., 2009; Jang and Olson, 2010) emphasises the benefits of vertically-coordinated business relationships. Improved coordination can lead to higher business productivity (Dyer and Singh, 1998), reduce the uncertainty in food safety demand (Ménard and Valceschini, 2005) and improve farm profitability (Jang and Olson, 2010).

While the benefits of effective vertical coordination appear to be clear, building and maintaining such relationships poses considerable challenges. In the agriculture sector, coordination requires the development of sustainable business relationships (Perez *et al*., 2010; Fischer, 2013), defined by Fischer and Reynolds (2010) as high-quality and stable inter-firm relationships. In addition, understanding the mechanisms and key driving forces that shape such relationships is of crucial importance. As argued by Williamson (1979), the type of variation in governance choices can be explained by the characteristics of transactions, thus mainly (a) the level of uncertainty, (b) the likelihood of recurrence and (c) the degree of asset specificity.

In addition to Transaction Cost Theory (TCT) original arguments (Williamson, 1979), the network in which a firm operates (suppliers, customers and competitors) affects its environment and behaviour, and thereby the type of governance (Powell and Smith-Doerr, 1994). As Ring and Van de Ven (1992) point out, exchange partners establish behavioural rules for processes such as conflict resolution, monitoring and renegotiation. Relational norms between exchange partners can develop with the intent of minimising bargaining costs stemming from asset specificity and uncertainty (Dow, 1987). Trust, as the main social component of relational exchange (Macneil, 1980), reduces both ex ante and ex post opportunism (Zaheer and Venkatraman, 1995). In addition, trust is a key factor influencing the level of satisfaction, commitment and long-term orientation of exchange relationships (Geyskens *et al*., 2006).

Our paper focuses on one of the two dimensions of sustainable relationships: its durability (Fischer and Reynolds, 2010). We focus on repeated interactions and transactions over time, investigating factors influencing such long-term (durable) relationships, namely uncertainty, trust and asset specificity. While much research has been carried out in developed countries which are characterised by solid market institutions and regulative and legal infrastructure on determinants of long-term vertical business relationships (e.g. Batt and Wilson, 2000; Fischer, 2013), less evidence has been collected from developing or transition countries which face higher institutional voids (Bouis and Haddad, 1990). By testing our model in the Albanian dairy sector with data from a structured survey with farmers engaged in production of goat and sheep milk, we aim to bridge this gap. In addition, to the best of our knowledge, this is the first study focusing on the supplier side of the Albanian dairy sector to apply a TCT perspective. We integrate social context into the TCT perspective by explaining how social mechanisms influence exchange relationships. Furthermore, the operationalisation of some constructs (e.g. asset specificity) brings new insights on the sector-specific characteristics that determine exchange business relationships with a focus on durability. Theoretical contributions and implication at a managerial and policy level are further discussed.

In the next section of this paper we provide an overview of the dairy sector, focusing on its importance, major trends, actors involved, value chain coordination dynamics and other relevant information. The subsequent literature review considers the role played by uncertainty, asset specificity and trust on sustainable relationships using the TCT perspective. The later sections cover methodology, analysis of the results, discussions of conclusions and policy and managerial implications.

Dairy sector overview

The livestock sector is the most important agri-food sector in Albania as it accounts for about half of the output value of agriculture. Within the livestock sector, dairy production is considered a priority sector for Albanian agriculture (MARDWA, 2014) as well as an important source of income and food, particularly for remote rural areas.

Milk production has been growing during the last decade: sheep milk production increased by 13 per cent and goat milk by 26 per cent during the period 2010-2015, while the increase in cow milk production for the same period was only 3 per cent. According to Albanian Institute of Statistics data, small ruminant (goat and sheep) milk production makes up around 15 per cent of the total milk production (the remaining 85 per cent comes from cows). While cow milk is produced throughout the year and is the basis for all types of local dairy products, sheep and goat milk is typically seasonal and almost exclusively used to produce cheese; the two main and traditional types of cheeses are white (feta-like) and *kashkaval* (hard yellow) cheese. The domestic market is dominated by locally-produced cheese, but exports are low or non-existent due to high production costs and lack of compliance with international safety standards.

The milk production, collection and distribution system is still very fragmented and characterised by small farms and dairies. Albanian Ministry of Agriculture data show that, during early 2010s, 85 per cent of farms with sheep had up to 50 heads and the situation is similar for goat farms. There are about 430 milk processing units in Albania, of which approximately 25 are large processors, processing more than 10 tonnes per day, 220 are traditional, seasonal dairy processing plants relying only on goat milk; however, the number of informal processors might be much higher.

The selected regions (targeted by our survey) account for slightly more than 50 per cent of the total small ruminant milk production. On the other hand, about half of the seasonal dairy processing units are located in these selected regions (dairy processors of various sizes). For large dairy processing units, it is not possible to delineate the region of supply, as they often buy milk from farms located in other regions too, while smaller/seasonal processors rely exclusively on local raw milk.

Exchange relationships in the Albanian agri-food sector are largely based on spot market or informal agreements; however, other forms of chain coordination are emerging in some sub-sectors. For example, agreements, both written and verbal (informal) types, are more common for greenhouse tomatoes (which have a strong export orientation) than for fruits/apples or other important sub-sectors (ISETNJ, 2017). In the dairy sector, farmers tend to sell directly to processing plants, usually small dairies (1-3 thousand litres per day), while selling to collectors or other intermediaries is a very rare practice. However, in some regions, large dairies have been building more complex cold chains that include milk collection points. Written contracts between cattle dairy farmers and processers are limited to only 4 per cent, while oral agreements are quite common (two thirds of farmers stated that they agree upon them). There are no available data regarding written contracts for goat and sheep milk.

As the domestic agri-food production is increasing, food safety is becoming a growing concern, particularly for the livestock/dairy value chain (Gjeci *et al*., 2016). The causes for the lack of quality and safety standards vary, but one main determinant is the weak coordination in the value chain (Dries *et al*., 2009). Despite the slow consolidation trend, the milk production, collection and distribution system is still fragmented and characterised by high levels of informality (from farm, processers, down to retail) and weak monitoring from state authorities, hence resulting in a lack of product traceability. Policy makers are aware of the need to improve supply chain coordination mechanisms and governance. The Albanian Intersectoral Agriculture and Rural Development Strategy 2014-2020 emphasises the importance of coordination by proposing specific support measures to strengthen vertical (and horizontal) cooperation (MARDWA, 2014).

Rationale and hypothesis development

Asset specificity and long-term business relationships

Asset specificity refers to durable and specialised investments in support of particular transactions with limited value in an alternative use (Williamson, 1985). The presence of specific assets can be thought of as creating switching costs (ibid). Asset specificity is the result of thin markets (Dorward and Kydd, 2004), leading firms to adopt governance structures that mitigate such risks. Dyer (1996) suggests that the presence of specific assets can lead to enhanced coordination and cooperation between business partners. Empirical research in the dairy sector shows that the rise in human, physical and site-specific assets increases the degree of vertical co-ordination (Banterle *et al.*, 2006). Hence, we posit that:

- *Hypothesis 1: Investment in specific assets increases the likelihood of long-term business relationships.*

Uncertainty and long-term business relationships

Uncertainty is a multi-faceted dimension of exchange relationships with a very diverse effect on governance choices. As Klein (1989, p.256) noted, "It appears that uncertainty is too broad a concept and that different facets of it lead to both a desire for flexibility and a motivation to reduce transaction costs". Hence, in analysing governance choice, we take into account different facets of uncertainty that might affect long-term relationships between dairy farmers and their buyers.

Milk producers face environmental and behavioural uncertainty in transactions with their buyers. Local supply and demand mismatch may contribute to price volatility and volume uncertainty (the volume requirements especially during the peak season are difficult to forecast). Farmers face behavioural uncertainty too, because of the unbalanced negotiating power compared to dairy owners, resulting in contractual (although only verbal) commitment uncertainties. However, these different facets of uncertainty are very often

seen by farmers as intertwined with each other. Uncertainty about volumes and price is often linked with opportunistic behaviour of dairy owners (behaviour uncertainty), not to the external market factors, although this might be the case. Hence, in our study, a comprehensive and separate assessment of the role played by different facets of uncertainty in determining governance choice was quite challenging. However, we can hypothesise opposite outcomes depending on the role played by different facets of uncertainty.

Uncertainty can encourage the adoption of hierarchical or hybrid forms of governance as mechanisms to reduce transaction cost, since uncertainty can instigate adaptation and evaluation problems (Heide, 1994). This tendency is stronger when business partners are engaged in recurrent transactions, which is typical for the dairy sector. While non-cooperative behaviour can be a proper strategy for discrete exchanges, the expectation of reciprocity encourages business partners to cooperate in on-going exchanges (Parkhe, 1993). As argued by Geyskens *et al*. (2006) we can expect parties to set up vertical coordination or relational types of governance in order to mitigate opportunism.

Volume uncertainty can also lead to hierarchical forms of governance (Walker and Weber, 1984). When suppliers perceive the market as unstable in terms of demand volumes, they might experience excess capacity. For milk producers, this situation can result in income loss. Since suppliers' volume variation can be managed more efficiently when both suppliers and buyers coordinate with each other, volume uncertainty increases the likelihood for hierarchical governance modes to arise (ibid.). From the buyer's perspective, increasing coordination is a way to reduce both food safety risks as suggested by Ménard and Valceschini (2005) and volume uncertainty (Walker and Weber, 1984). Hence, we posit:

- *Hypothesis 2a: Uncertainty increases the likelihood of long-term business relationships.*

On the contrary, some facets of uncertainty can encourage flexibility, leading business partners to choose spot market exchange over hierarchical or hybrid forms of governance. Behaviour uncertainty and environmental uncertainty might have this kind of impact on the exchange relationship.

In contrast to the arguments of Heide (1994) and Parkhe (1993), Suh and Kwonb (2006) argue that the presence of behaviour uncertainty lowers trust with detrimental effects on relational ties and the durability of the exchange relationship. Lack of fairness can seriously affect the relationship between business partners (Das and Teng, 2001; Ring and Van de Ven, 1992) and, finally, the outcome of such a relationship.

On the other hand, high levels of perceived environmental uncertainty may negatively affect the willingness of exchange partners to invest in durable relationships (Joshi and Campbell, 2003) motivating them to remain flexible and develop temporary relationships only (Ganesan and Hess, 1997). This reasoning is in line with the self-enforcing range of the contractual relationship, defined by Klein (1996) as the magnitude of the private sanctions that can be imposed on each transactor who attempts a hold-up. The author argues that an exchange relationship will continue as long as market prices stay within a certain range. On the contrary, if price volatility is high, beyond the self-enforcing range, the gains of breaching the contract exceed the sanctions, hence, eventually, breaking down the relationship.

Anecdotal evidence from Albania suggests that some dairy owners have (mis)used their stronger bargaining position, especially during periods characterised by supply-demand mismatch, lowering prices for raw milk. In some cases, they have also changed quality requirements and transport arrangements, leading to uncertainty among farmers. Farmers that are faced with opportunistic behaviour by a buyer might tend to search for alternative buyers. Even when prices change because of market factors and the change is not attributed to the dairy owner's opportunistic behaviour, commitment to long-term relationships is eroded. Therefore, based on this line of reasoning, our alternative hypothesis is that uncertainty, both related to market price volatility or buyer's behaviour, has negative effects on long-term relationships:

- *Hypothesis 2b: Uncertainty lowers the likelihood of long-term business relationships.*

Trust and long-term business relationships

In general, trust is an expectation into the future behaviour of others; it emerges after positive personal experiences (Luhmann, 2000). Governance will be enhanced with increasing levels of trust (Joshi and Stump, 1999). The expected pay-offs from cooperation deter trustworthy business partners from the pursuit of short-term gains, thereby limiting opportunistic behaviour (Poppo and Zenger, 2002). On the other hand, relational exchange is often based on informal agreements based on trust and reputation; thus trust serves as a substitute for contracts since the latter are too costly to write, monitor and enforce (Bromiley and Cummings, 1995). Thus, trust reduces both *ex ante* and *ex post* transaction costs by mitigating or eliminating opportunism (Zaheer and Venkatraman, 1995). Based on this reasoning, we expect trust to affect positively the durability of exchange relationships.

Empirical research confirms the role of trust in shaping exchange relationships. Sustainable and long-term relationships based on trust have been found to be an alternative to vertical integration and contracts for the German pork sector (Schulze *et al*., 2006). Claro and Claro (2004) argue that mutual trust, joint actions and long-term orientation, in addition to formal contracts, are informal safeguard mechanisms adopted by partners in international coffee supply chains. Based on this evidence, our third research hypothesis is as follows:

- *Hypothesis 3: The existence of trust between business partners increases the likelihood of long-term business relationships.*

Methodology

Data

A structured farm survey using two-stage sampling took place during spring 2015. The first stage was purposive, consisting of a piloting process in various regions (with different characteristics), namely Shkodër, Kukës, Dibër (located in northern Albania), Berat, Korçë and Elbasan (located

in central and eastern Albania). SPPS module of Complex Sample was used to select the sample. A sample of 15 villages was selected from all the villages in each region. In order to have a statistically solid subsample, 315 farmers were interviewed. The margin of error based on small ruminants' value chain subsamples is ±5.6 per cent with a 95 per cent confidence interval (Israel, 1992). The questionnaire was designed to operationalise the constructs discussed in the following sub-section. The information was collected on: relationships between supplier and buyer, volume, price as well as level of uncertainty, trust and commitment of farmer towards his/her buyer. Information such as demographics (age, education, gender, household size and main employment), presence negotiation costs and horizontal cooperation was also gathered.

Measurements

The constructs and the operationalisation of variables are listed in Table 1 and discussed below.

Long-term business relationships. Following Fischer and Reynolds (2010), conceptualisation of sustainable relationships as a construct composed by a two dimension-quality and durability, we focus on the latter so as to capture the dynamicity of the relationship. Considering the lack of contractual governance and relational nature of the relationships, we build on operationalisation of Klein (1996) who refers to relational ties as the degree of a supplier's dedication to its buyer. Hence, we use repeated exchange with one or, very rarely, few (no more than two) selected buyers to measure a long-term relationship (in rare cases, when one dairy is seasonal, farmers that produce cow milk (in addition to goat and sheep milk) tend to sell their produce to two different dairies depending which one is operating in a particular season). Farmers were asked to state if they sell (usually) to one or very few selected buyers (in the above-mentioned circumstances), or if they are inclined to engage in spot market type of exchange relationships. The respondents were informed that the exchange needed to extend over a period of at least one year to be considered as repeated exchange with one buyer. This operationalisation is consistent with the empirical work of John and Weitz (1988) and Zaheer and Venkatraman (1995) who used similar measures. We use a binary variable to measure the level of repeated exchange to one/few partners.

Specific assets: Purchase of dairy-specific equipment and investment in a large flock of small ruminants is undertaken by farmers usually with the firm intent to specialise in milk production. These investments can be diverted to alternative uses only at a substantial cost. We argue that the more farmers specialise in milk production as their main agricultural activity and invest to increase their flock and other related investments (e.g. stables), the more their assets are specialised to the exchange relationship (e.g. quality requirements, milk source and type, storage and transport requirements). Hence, the flock size can be considered as an adequate measure of investment in specific assets for milk producers.

Empirical research confirms this important role of flock size in defining the nature of exchange relationships. Tsourgiannis *et al*. (2008) found that farm and farmers' characteristics such as the size of the flock, volume of milk production, farm income and debt affect the market channels choice of the small ruminant milk producers. Similar results were obtained by Bardhana *et al*. (2012). Following Dries and Swinnen (2010), who measured investment in specific assets in the dairy sector in Poland (including flock size) and the rationale above, we operationalise specific assets as the number of small ruminant heads and measure it as a logarithm of this number in order to linearise the relationship and avoid heteroscedasticity.

Trust: Consistent with the reasoning of Anderson and Narus (1990) and Zaheer and Venkatraman (1995), we included two items that measure the mutuality of trust and two others that measure behavioural trust. Each item is measured on a five-point Likert scale. The four-item construct yielded a Cronbach Alpha of 0.829.

Uncertainty: Zaheer and Venkatraman (1995) operationalised uncertainty through two indicators reflecting perceived

Table 1: Constructs and measures.

Construct and concept	Operationalisation	Measurement
Dependent variable		
Long-term business relationship	• Repeated exchange with selected buyer	*Binary*, 1 = sell to reliable buyers, 0 = spot market exchange type of relationships
Independent variable		
Specific assets	• Flock size	Logarithm of flock size
Uncertainty	• The demand for our products is unstable • The prices for our products are very unstable • My buyer/s frequently changes/change the request for products qualities and standards	Five-point Likert scale (1 = strongly against; 5 = strongly agree)
Trust	• I (as a supplier) can be trusted by my buyers • I am very committed to the relationship with my main buyers • The relationship with my buyers deserves maximum attention. • Buyer/s is/are satisfied with my products	Five-point Likert scale (1 = strongly disagree, 5 = strongly agree)
Controls		
Bargaining power of buyers	• The farmer operates in a region characterised by the presence of large buyers	*Binary*, 1 = farmer conducts business in a region characterised by the presence of large dairy firms, 0 = farmer conducts business in a region characterised by presence of small dairies
Cow milk production	• The farmer is engaged in production and selling of cow milk	*Binary*, 1 = income from cow milk, 0 = no income from cow milk

Source: own construction

uncertainty related to pricing and the new product introduction. However, in our case, farmers' uncertainty is also closely related to the volumes of milk bought by the processor. Based on this reasoning, we operationalise the construct using three items: uncertainty regarding volume, price and product specifications. Each item is measured on a five-point Likert scale. The Cronbach Alpha for this construct (0.793) is acceptable.

Controls

Bargaining power of buyers: Fischer (2013) argues that equal power distribution leads to sustainable relationships. Hence, strong bargaining power from buyers might negatively affect the long-term relationship. However, the presence of large dairies and their strong purchasing power might mitigate the farmers' perception of volume uncertainty, incentivising farmers to engage in long-term relationships. Consequently, we do not hypothesise a direction for this variable in our model, but rather include it as a control variable.

Cow milk production: Our research is focused on farmers engaged in small ruminant (goat and sheep) milk production. However, many farmers produce cow milk too. Using the same rationale for asset specificity, we might expect that production of cow milk might motivate farmers to build long-term relationships.

Empirical model

A binary logistic regression model is used to assess the determinants of farmers' likelihood to engage in long-term relationships. This model was selected considering the dichotomous nature of the dependent variable. This model has the following form:

$$\ln\left(\frac{P_i}{1-P_i}\right) = a + b_i x_i + \ldots + c_i z_i + e \quad (1)$$

where P_i, the probability that the supplier i is engaged in long-term relationships; $1-P_i$, the probability that the supplier i engages in spot market exchange; a, a constant; x_i, z_i, the variables standing for dependent variables, specific assets, trust and uncertainty; and b_i, c_i, vectors of parameters to be estimated.

$$\frac{P}{1-P} = e^{a+b_i x_i + c_i z_i} \quad (2)$$

The odds ratio for the case at hand should be interpreted as follows: one unit increase – says – in the level of uncertainty increases by e^{b_1} the ratio of probability that supplier engages in long-term exchange relationships to the probability that farmer does engage in spot market exchange.

Construct validity for the two perceptual independent variables

We performed a factor analysis with varimax rotation to test the validity of our perceptual independent variables (Annex). The results for trust design variable loaded reasonably high (0.893, 0.772, 0.843, 0.837). For uncertainty, all three factors also loaded high (0.796, 0.884, 0.840). Loadings were above the acceptable standard of 0.32 proposed by Tabachnick and Fidell (2007). After the validity tests, we concluded that the measures could be accepted to test the hypotheses.

Variables correlations and multicollinearity

The correlation coefficients between the independent variables are not significant (data not shown). In addition, Variance Inflation Factors (VIF) are around 1. Thus, there are no problems with multicollinearity.

Results

Descriptive statistics

The average size of the small ruminants' herd is small, around 87 animals (Table 2). There is a strong variability in flock size (SD=53.5). Both uncertainty and trust have means above average measurements used (Likert scale 1-5). This might appear counter-intuitive, but it can indicate that farmers trust their buyers at a personal level (behaviour trust) but are uncertain about price and quality requirements due to environment factors that affect both parties. Hence, we can assume that environmental uncertainty plays a significant role in the overall level of uncertainty perceived by farmers.

Of the 315 farmers, 173 (56 per cent) engage in spot market exchange and 139 (44 per cent) have long-term relationships with dairy owners and managers (Table 3). These data suggest a strong reluctance among farmers to coordinate with their buyers, showcasing the lack of coordination and resulting challenges in the dairy and livestock sector. These results appear to be consistent across the regions included in the survey. The only outlier is the region of Berat. This is one of the regions renowned for the presence of large processors in almost all agri-food sectors, including the dairy sector. Erzeni, a large milk processing company, for instance, has established long-term relationships with dairy farmers, including written contracts (ISETNJ, 2017). Anecdotal evidence suggests that large milk processors tend to invest more in supply chain coordination than smaller ones.

Table 2: Descriptive statistics (N=315)**.**

Variables	Minimum	Maximum	Mean	SD
Flock size	30	200	86.7	53.5
Uncertainty	1.00	5.00	3.59	0.84
Trust	1.00	5.00	4.10	0.59

Source: own data

Table 3: Numbers of farmers in long-term relationships versus spot market exchange by region.

Region	Sport market exchange	Long-term relationship
Shkodër	32	27
Kukës	35	13
Dibër	31	15
Elbasan	32	17
Berat	11	36
Korçë	35	31
Total	176	139

Source: own data

Regression model results: hypotheses tested

Table 4 depicts the results related to hypotheses 1, 2 and 3. There is a statistically significant, positive relationship between variables representing trust and flock size and the variable representing long-term business relationship, and a negative relationship between uncertainty and long-term business relationship.

The Hosmer and Lemeshow test, assessing the goodness of fit of a model, shows $p > 0.05$ (0.445), confirming the validity of our model. The classification table shows that 69.5 per cent of the outcome was predicted by our model compared to 55.9 per cent of the initial model. The Nagelkerke R Square shows that around 22 per cent of the variance can be attributed to the independent variables (only 7.4 per cent can be attributed to controls). The following interpretation is based on the final results of our analysis.

Investment in specific assets and long-term business relationship

As expected, the larger the flock size (investment in specific assets), the more likely farmers are to establish long-term business relationships with their buyers ($p < 0.01$ and $\exp(B) = 1.956$), as shown in Table 4 (i.e. *Hypothesis 1 is supported*). More accurately, for one unit change in flock size (or for an increase of 2.7 heads increase; we used the natural logarithm to the base of mathematical constant) the odds ratio of engaging in sustainable relationships almost doubles ($\exp(B) = 1.956$).

Flock size appears to be strongly related to long-term business relationship (Pearson's Chi square test shows a $p < 0.05$). Around 40 per cent of the farmers that engage in long-term relationships own more than 100 animals versus just 23 per cent of farmers engaged in spot market exchange (Table 5). These results suggest that farmers who have invested relatively large financial resources, owning sizable flocks, tend to mitigate uncertainty and the risk by building long-term business relationship with their buyers. Specialisation in milk production appears to make farmers more inclined to deal regularly with one buyer, since their investment has limited value in an alternative use compared to smaller farmers who can switch to other activities (e.g. homemade cheese).

Uncertainty and long-term business relationship

As hypothesised, the presence of uncertainty is negatively and significantly associated with long-term relationships (i.e. *Hypothesis 2b is also supported)*. The parameter $\exp(B)$ is 0.886, statistically significant at $p < 0.5$ (Table 4), showing that farmers are more likely to change buyers and engage in spot market type of exchange if uncertainty increases.

Descriptive statistics show that farmers who perceive higher levels of uncertainty tend to engage in spot market exchange. Chi square analysis shows a significant association between uncertainty and long-term business relationship ($p < 0.05$). Of the 176 farmers who engage in spot market exchange, 133 (i.e. around 76.0 per cent) perceive levels of uncertainty above the average, versus only 80 (57.5 per cent) out of the 139 farmers that engage in long-term relationships with their buyers. However, despite the expected differences, the level of uncertainty, as explained earlier, is quite high due to market factors.

Trust and sustainable relationships

Trust is positively and significantly associated with sustainable relationships (i.e. *Hypothesis 3 is supported as well)*. The parameter $\exp(B)$ for *Trust* is 1.284 and it is statistically significant at $p < 0.01$ (Table 4), showing that farmers that trust their buyers are more inclined to engage in long-term business relationships. Descriptive analysis shows clearly that farmers engaged in long-term relationships have higher levels of trust in their buyers compared to those that engage in spot market exchange. Around 47 per cent of farmers engaged in long-term relationships claim to perceive high levels of trust compared to just 29 per cent of farmers that engage in spot market relationships (Table 6). Chi square analysis provides further confirmation of the significant association between trust and long-term relationships – the p-value is smaller than 0.05.

Finally, our results for the control variables (Table 4) show that our proxy for bargaining power of buyers is positively and significantly related to long-term business relationships ($\exp(B) = 2.521$ and ($p < 0.001$), while the variable standing for a mixed farm (versus a small ruminants farm) producing both sheep and goat milk and cow milk does not affect long-term relationships between farmers and their buyers ($p > 0.1$).

Table 4: Results of the logistic regression.

Variable	*B*	S.E.	Wald	Sig.	exp(*B*)
Bargaining power of buyers	0.925	0.262	12.436	0.000**	2.521
Cow milk production	0.197	0.261	0.571	0.450	1.218
Flock size	0.671	0.204	10.840	0.001**	1.956
Uncertainty	-0.121	0.051	5.591	0.018*	0.886
Trust	0.250	0.058	18.878	0.000**	1.284
Constant	-6.547	1.476	19.676	0.000**	0.001

Dependent variable: long-term business relationship; ** $p < 0.01$, * $p < 0.1$
Source: own data

Table 5: Numbers of farmers in long-term relationships versus spot market exchange by flock size.

Flock size	Sport market exchange	Long-term relationship
30-50	83	42
51-100	52	41
101-150	27	31
151-200	14	25
Total	176	139

Source: own data

Table 6: Numbers of farmers in long-term relationships versus spot market exchange by level of trust.

Level of trust	Sport market exchange	Long-term relationship
Low	2	1
Average	123	73
High	41	65
Total	176	139

Source: own data

Discussion

Our study analysed the factors that influence the propensity of goat and sheep dairy farmers in Albania to build long-term relationships with their buyers using the TCT perspective. This is the first in-depth study focusing on the dairy sector exchange relationships in Albania, a research setting characterised by significant institutional voids and lack of contracts.

The research found that farmers' propensity to build long-term and sustainable relationships with their buyers is determined by mutual trust, uncertainty and investment in specific assets. The positive role of trust in shaping the exchange relationship gives credit to sociologists and network theorists arguing that relational ties based on trust will yield long-term relationships (e.g. Zaheer and Venkatraman, 1995; Dyer and Sing, 1998; Claro and Claro, 2004; Schulze *et al*., 2006). However, long-term relationships and the recurrence of transactions can be viewed as the right conditions for trust between business partners to grow. Repeated exchange can allow for informal control through embeddedness (Granovetter, 1992) leading to higher levels of trust as suggested by Heide and John (1990). Hence, to understand better the causality of this relationship longitudinal, studies are needed.

Our research found that uncertainty is a strong predictor of exchange relationships and it has a significant negative effect on farmers' propensity to engage in long-term relationships. We argue that perceived behaviour uncertainty may have a detrimental effect on exchange relationships (see Ring and Van de Ven, 1992; Suh and Kwonb, 2006), leading farmers to opt for a spot market exchange. Furthermore, in particular periods of time and some local contexts, uncertainty might not be related to buyers' behaviour but rather to market dynamics. Price volatility can affect the exchange relationship as suggested by some scholars (e.g. Klein, 1996; Joshi and Campbell, 2003) leading farmers to break down the relationship. Unfortunately, in our study we are not able to separate the different effects of environment from behavioural uncertainty. Further research might address this shortfall.

Investment in specific assets is found to affect positively long-term relationships in line with TCE arguments (Williamson, 1983) and empirical research (e.g. Anderson and Weitz, 1992; Dyer, 1996; Banterle *et al*., 2006). Flock size appears to be an adequate measure for specific assets (see Dries and Swinnen, 2010), constituting also an important factor that determines farmers' willingness to engage in long-term relationships. Long-term relationships appear to represent an 'insurance policy' that provide protection from the risk of not being able to sell high volumes of milk to dairies. On the contrary, smaller farmers whose small quantity can be processed on the farm and used for self-consumption have the 'luxury' to engage in spot market exchange.

Finally, our study appears to corroborate the role of buyer's bargaining power on exchange relationship. The result shows that farmers operating in areas characterised by the presence of large buyers tend to engage in long-term relationships. We can take some licence to speculate on the reasons behind such controversial findings, based on anecdotal evidence. Large buyers tend to pay on time and in full. Furthermore, they appear to apply fixed prices (at least, less volatile than smaller ones). Finally, having a strong purchasing power and large market share appears to serve as a guarantee for farmers. However, buyers' characteristics, behaviour and their role in exchange relationships should be further investigated.

Our results can help dairy owners/managers to build durable, long-term relationships with farmers and ultimately improve the outcome of their exchange relationships. They should consider improving communication and increasing information exchange with farmers in order to reduce uncertainty and build trust for both partners. On the buyers' side, especially large dairies, improved coordination and durability of the exchange relationship can mitigate volume uncertainty during the low season. Milk can be found relatively easily during the peak of production but it is rather difficult to 'scout' for new suppliers, hence increasing volumes, during the low season. Anecdotal evidence from the region of Berat and the results of our research indicate that large dairies in these areas tend to build long-term relationships with their supply base. As a result, they can manage volume uncertainties better. On the farmers' side, the role of the buyer in mitigating uncertainties, related to both behaviour and environment, can have beneficial effects on the durability of the relationship. Our results show that when farmers perceive low levels of uncertainty and high levels of trust, they tend to engage with one buyer only in durable relationships. Hence, price and quality specifications should not be very susceptible to eventual temporary supply and demand changes, such as seasonal production surpluses. Anecdotal evidence suggests that changes in the quality standards and price are not a rare phenomenon. Such practices adopted by dairy owners may lead to a farmer's lack of commitment to sustain a long-term exchange relationship. Buyers should make clear their terms and communicate with farmers on eventual changes in the market prices.

At the policy level, the impact of flock size on farmers' inclination to engage in long-term relationships may help the government to improve its policy instruments aiming to support farmers owning large flocks. The current policy of paying a price premium per litre delivered to dairies and milk collection points based on recorded transactions[1] may also be used for incentivising commercial (larger) farmers to establish closer relationships with buyers. A support scheme based on payments per head of small ruminants (minimum 100 to maximum 300 heads per farm) has been one of the main components in the government budgetary support (Volk, 2017). Conditioning this direct producer support scheme to the application of formal transactions between farmers and dairy owners might result in better chain coordination, formalisation of the sector and improved food safety.

This study has some limitations that caution against generalising the findings. Firstly, it focuses only on the small ruminant dairy value chain and the findings may not be entirely relevant to the rest of the dairy sector (relying on the cow milk). Secondly, our model explains a relatively small part of the variability of exchange relationships, focusing on only three, albeit important, variables. Future research should consider other explanatory variables related to exchange relationships in the dairy sector such as physical proximity (i.e. site specificity) (Joskow, 1985) of alternative

[1] Decision of the Council of Minister's No 91 dated 10 February 2016: "On determining basic criteria, sectors to be supported and measures of support, for year 2016".

clients (dairy processors) for dairy farmers, specialisation of both farm and dairy on some specific products that require a certain degree of coordination (i.e. inter-firm co-specialisation) (Dyer, 1996), power distribution (Fischer, 2013) as well as other regional and farm characteristics. Thirdly, the study investigated only the (farmer) supplier's side at a given moment – future research using longitudinal data collected by both sides of the dyad might help to better understand the dynamics of long-term business relationships including feeding back of long-term relationships on investment in specific assets and trust. And, lastly, while in our sample spot market exchange overweighs long-term relationships, there are areas where a sustainable relationship is clearly more widespread than in the rest of the sample. Understanding the determinants of such phenomena calls for further research, including the use of qualitative methods.

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Annex: Factor analysis for perceptual measures with varimax rotation.

Items of three constructs	Factor*	
	F1	F2
I (as a supplier) can be trusted by my buyers	0.893	-0.089
I am very committed to the relationship with my main buyers	0.772	-0.068
The relationship with my buyers deserves maximum attention	0.843	0.019
Buyer/s is/are satisfied with my products	0.837	0.063
The demand for our products is unstable	0.050	0.796
The prices for our products are very unstable	-0.003	0.884
My buyer/s frequently changes/change the request for products qualities and standards	-0.112	0.840
Percentage variance explained	39.5	30.2

*Underlying dimensions as two factors: F1 = trust, F2 = uncertainty
Source: own data

Sergei KHARIN*, Zuzana LAJDOVA and Peter BIELIK****

Price transmission on the Slovak dairy market

There are problems in the functioning of the food supply chain related to price transmission and value-added distribution. Vertical price transmission analysis is an important research area in the aspect of the assessment of impact on the welfare at the producer, processor and retailer levels. The paper investigates vertical price transmission along the whole milk supply chain after the end of European Union milk quotas in the Slovak market using a vector error correction model. Monthly farm-gate, processor and retail prices in the Slovak Republic covering the period from 2010 to 2016 were used in the analysis. Using the Johansen co-integration technique, empirical evidence has been found for two co-integration equations between farm-gate, processor and retail prices. We show that short-term and long-term bilateral causal relationships exist between prices at different market stages. The estimation of the price transmission elasticity supports the assumption that price changes are not transmitted efficiently from one level to another. However, symmetric price transmission exists between farm-gate and processor prices for whole milk in the long term. The perfect price transmission may also be due to recently emerging and strengthening the producer organisations that enable producers support their bargaining position in the supply chain.

Keywords: dairy sector, elasticity, price, vector error correction model

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Introduction

Prices drive resource allocation and output mix decisions by economic actors, and price transmission integrates markets vertically and horizontally (Meyer and von Cramon-Traubadel, 2004). As noted by Fousekis *et al*. (2016), vertical price transmission has attracted considerable attention in agricultural economics research for almost 50 years due to the fact that the magnitude and/or the speed at which shocks are transmitted from one market level to another has important welfare and policy implications. Likewise, Goodwin (2006) points out that the degree to which market shocks are transmitted along the marketing chain has long been considered to be an important indicator of the performance of the market.

Bakucs *et al*. (2014) studied explanations for the existence of price (a)symmetries and showed that asymmetric price transmission exists in farm-retail relationships with more fragmented farm structure, higher governmental support and more restrictive regulations on price controls in the retail sector. By contrast, more restrictive regulations on entry barriers in the retail sector and the relative importance of the sector can be favour symmetric farm-retail price transmission. Similarly, Santeramo and von Cramon–Taubadel (2016) mentioned that asymmetric vertical price transmission has been stimulated in several ways such as market power, adjustment costs, inventory management, government interventions, asymmetric information and perishability.

Early analyses typically used simple correlation statistics or ordinary least square regressions to evaluate the links between prices at different markets or processing stages, but these methods have been criticised for not recognising the non-stationary nature of data. Therefore, techniques such as co-integration and error correction models (Akdi and Berument, 2006; Lambert and Miljkovic, 2010; Baek and Koo, 2014; Castillo-Valero and García-Cortijo, 2015; Zhang *et al*., 2017), dealing with non-stationary properties of time series, have been applied since 1987. Recently, nonlinear behaviour in price transmission has been tested using nonlinear threshold techniques (Goodwin and Harper, 2000; Ning and Sun, 2014; Hassouneh *et al*., 2015). The relationship between variables might be locally linear, however globally it exhibits nonlinear behaviour due to the existence of structural changes in the relationship (Ihle and von Cramon-Taubadel, 2008).

Awokuse and Wang (2009) studied the effect of nonlinear threshold dynamics on asymmetric price transmission for U.S. dairy products (butter, cheese and fluid milk) and confirmed the presence of asymmetric price adjustments for butter and fluid milk, but not for cheese prices. Fałkowski (2010) investigated price transmission between farm and retail levels in Poland by using a vector error correction model (VECM) framework and found that price transmission is influenced by both short- and long-term asymmetries; moreover, the behaviour of prices in the fluid milk sector acts in accordance with the use of market power by the downstream sector. Further evidence of short-term and long-term asymmetries between milk prices of the marketing channel for Poland is provided by Bakucs *et al*. (2012), who concluded that the causality runs from the retail industry to the farm gate and considered, among others, dairy farm structure (individual farms and excessive herd fragmentation in Poland), market structure at the processing level (dairy cooperatives in Poland) and concave spatial demand as causes of (im)perfect pass-through of prices. Similarly, Reziti (2014) used an error correction model to test for asymmetric adjustments in the Greek milk sector and found that retail prices adjust if the producer price increases, not decreases, in the short term. Furthermore, the results confirm asymmetry in the long term, suggesting that retailers exercise market power over producers. Weber *et al*. (2013) show that the time lags in which changes are passed on between the different levels vary and conclude that price asymmetries occur within the supply chain of the German cheese market. In addition, asymmetric threshold VECMs, applied by Serra and Goodwin (2003), reveal asymmetries among farm and retail markets for a variety of dairy products in Spain. The reasons behind the weak response of farm prices to retail price shocks

may be partly explained by the lack of an organised contracting system and a scarcity of dairy farmer cooperatives that may limit the market power of farmers relative to the dairy industry, as well as their capacity to negotiate prices.

On the other hand, Weaver and Rosa (2016) provided strong evidence of symmetry in co-movement for the vertical dairy chain in Italy by using a parametric test of asymmetry in a multivariate VECM. Likewise, the price transmission was strong and symmetric for Danish milk from wholesale to retail in the long term (80-85 per cent), surveyed by Jensen and Møller (2007). Additionally, symmetric price transmission was found both in both the long and short terms in Hungary, due to the dominant position of large-scale agricultural enterprises, and FDI in the Hungarian dairy industry and emerged producer organisations; moreover the causality between Hungarian milk prices runs from the farm to the retail sector (Bakucs *et al.*, 2012).

Weldesenbet (2013) demonstrated asymmetric price transmission in the Slovak milk market from 1993 to 2010 in both short and long terms, meaning that retailers and wholesalers react more quickly to producer price increases than to declines. Similar results were obtained by Pokrivcak and Rajcaniova (2014), who stated that the retail sector has strong market power to influence upstream prices. Lajdová and Bielik (2015) used the VECM method to examine price asymmetries for liquid milk (semi-fat and durable semi-fat milk) in the Slovak dairy sector. Their research confirms asymmetric price adjustments and the imperfect market structure with the prevailing power on the demand side.

Milk production in Slovakia decreased significantly during the period 2007-2013 as a consequence of an increase in competitive pressure in the European Union (EU) market, growing imports of milk and milk products to Slovakia, unprofitable production of milk as well as under-capitalised Slovak agriculture (Matošková and Gálik, 2016). Under these circumstances, Slovak raw cow milk producers have suffered significant financial losses. This trend may continue, due to the Russian import ban on EU dairy products and the abolition of the EU milk quota in 2015. The EU market has been flooded by surplus milk and this was followed by a sharp fall in prices. In addition, processors may cancel or not renew existing supply contracts with raw cow milk producers. The past ten years of milk crises caused huge damage to the milk producers: the number of dairy cows fell by almost 31 per cent; milk deliveries declined by almost 15 per cent; the losses of milk producers reached almost EUR 450 million, and almost 35 per cent of enterprises exited milk production (Štefániková, 2017). Even if Slovak agriculture is dominated by large farms, the disproportionate power between small and large farmers who, in the partnership relationship, the mutual distrust between small and large-scale farmers leads to a lack of cooperation or poor cooperation and their weak bargaining power. Moreover, differences in purchase prices (average milk prices in Slovakia do not reach the EU average level, according to Štefániková, 2017) and unequal support mechanisms (the contribution from the national budget the lowest among all surrounding Member States) worsen the competitiveness of the Slovak dairy sector. Retailers can sell imported dairy products at competitive prices, thus the pricing decisions of producers are also driven by contractual relationships between the processors and retailers.

The main aim of this paper is to investigate vertical price transmission along the dairy supply chain in Slovakia in the light of price developments after the abolition of milk quotas in the EU. By focusing on the latest price developments after milk quota abolition, this study seeks to fill a gap in the literature. It also explores how market changes have altered vertical price transmission, and whether asymmetric price transmission still prevails in the supply chain.

Methodology

Econometric time series techniques were adopted for vertical price transmission analysis. The influence of price at one market stage on price at another is investigated using multiple linear regressions. Vertical price transmission analysis follows the algorithm outlined in Table 1. For the whole milk prices (farm-gate, processor and retail), the following steps have been implemented to identify the appropriate econometric model.

To avoid model misspecification, as a preliminary step of our price series analysis, we tested all the variables for the presence of unit root. For this purpose, several methodological options are available including the Augmented Dickey-Fuller [ADF] test (Dickey and Fuller, 1979) and the Phillips-Perron [PP] test (Phillips and Perron, 1988).

As a standard procedure to test the non-stationarity of price series the ADF test uses following regression:

$$P_t = c + \beta_t + \alpha P_{t-1} + \sum_{i=1}^{k} \psi_i \Delta P_{t-i} + \varepsilon_t \quad (1)$$

where P_t is the natural logarithm of the price, c is the intercept and t is the linear time trend.

In order to select the highest number of lags for our test, we applied the common rule suggested by Schwert (1989). The number of the optimum lags in the models is chosen based on the Akaike (1973) information criterion (AIC).

The PP test builds on ADF test. While the ADF test uses a parametric autoregression, a great advantage of the PP test is that it is non-parametric. The main disadvantage of the PP test is that it works well only in large samples. And it also

Table 1: Algorithm for conducting the vertical price transmission analysis.

Step	Test	Result	Action
1	*Stationarity* test of time series for unit root	Stationarity	Perform test for Granger Causality and estimate vector autoregressive[VAR]model with stationary data.
		Non-stationarity	Move to step 2.
2	*Cointegration* test	Exists	Estimate the long- and short-term relationships within the framework of a VECM.
		No	Perform the Granger Causality test and estimate VAR model using logarithmic prices in first differences

Source: based on Kharin (2015)

shares disadvantages of ADF tests: sensitivity to structural breaks, poor small sample power resulting.

There might be a linear combination of same integrated time series that is stationary. Co-integration analysis is used to estimate long-term price relationships between non-stationary and same integrated variables. Given that some price series might be non-stationary, we applied the Johansen approach to determine whether the three series are co-integrated and to identify the number of co-integrating equations by providing likelihood ratio tests based on the trace statistic and maximum eigen value (Johansen, 1988; Johansen and Joselius, 1990). We relied on trace statistic because it tends to have superior power in empirical papers (Lutkepohl *et al*., 2001). Although co-integration implies that causality exists between price series, it does not indicate the direction of the causal relationship.

If the presence of the long-term relationships between variables is detected, then the vector error correction (VEC) model is estimated.

VECM is a restricted vector autoregressive (VAR) model. The VEC modelling can be written by specifying an unrestricted VAR of order *k* as follows:

$$P_t = c + A_1 P_{t-1} + \ldots + A_k P_{t-k} + \gamma_0 Y_t + \gamma_1 Y_{t-1} + \ldots + \gamma_m Y_{t-m} + \upsilon_t \quad (2)$$

where c is the intercept, P_t is a (3x1) vector of all endogenous variables defined in the model (natural logarithms of the farm-gate, processor and retail prices); Y_t is a vector, including all exogenous variables; $A_1 \ldots A_k$ and $\gamma_0 \ldots \gamma_m$ - matrices, including the coefficients to be estimated; υ_t - (3x1) vector of i.i.d normal disturbances with zero mean and covariance matrix $\sum$.

The lag length is determined based on the AIC, the Schwartz-Bayesian Information Criterion (BIC; Schwarz, 1978) and Hannan-Quinn Information Criterion (HQIC; Hannan and Quinn, 1979). When all three agree, the selection is clear, but there may be conflicting results. Ivanov and Kilian (2001) suggest that, in the context of VAR models, AIC tends to be more accurate with monthly data, HQIC works better for quarterly data on samples over 120 observations and BIC works fine with any sample size for quarterly data. Having monthly data, we rely on AIC.

Equation 2 can be adjusted in the form of vector autoregressive in differences and error correction components:

$$\Delta P_t = \sum_{i=1}^{k-1} \Gamma_i \Delta P_{t-i} + \Pi P_{t-1} + \sum_{j=0}^{m} \gamma_j Y_{t-j} + \upsilon_t \quad (3)$$

Equation 3 is obtained from the level VAR (equation 2) by subtracting P_{t-1} from the both sides. Γ_i is the (3x3) matrix of parameters for an *i* order lag process that capture short-term relationships. Π is the (3x3) matrix that represents long-term dynamics, where $\Pi = \alpha\beta'$, α includes the speed of adjustment coefficients to equilibrium (or error correction term, ECT) and β' is the co-integrating vector in the long term. Since the prices are expressed in logarithms for our analysis, the coefficient β is the long-term elasticity of price transmission.

The VECM indicates the direction of causality among prices and allows us to distinguish between 'short-term' and 'long-term' Granger causality. When the variables are co-integrated, then in the short term, deviations from this long-term equilibrium will feed back on the changes in the dependent variable so as to force the movement towards the long-term equilibrium.

The Wald χ^2-tests (or F-tests) of the differenced explanatory variables give us an indication of the short-term causal effects, whereas the long-term causal relationship is implied through the significance or t-test(s) of the lagged ECT, which contains long-term information since it is derived from the long-term co-integrating relationships. The long-term causality can be tested by looking at the significance of the speed of adjustment (α), which is the coefficient of the ECT.

Results

The price transmission analysis was carried out using monthly observations from January 2010 to November 2016 at the farmer, processor and retailer levels in the Slovak Republic. Observations relate to nominal prices for cow whole milk. The data sources are the 'Price indices and average prices in agriculture and forestry' data of the Statistical Office of the Slovak Republic (available online at http://www.statistics.sk/pls/elisw/MetaInfo.explorer?cmd=go&s=1003&sso=3&so=16) and the online database of the Research Institute of Agricultural and Food Economics in Bratislava (www.vuepp.sk). We use the logarithmic transformation of monthly prices measured in EUR per litre (excluding VAT). From an economic point of view, the transformation allows us to interpret the results in percentage change terms and calculate the price elasticity. Analyses between prices commonly use logarithms because, with trending data, the relative error declines through time (Banerjee *et al*., 1993).

The development of whole milk prices at various levels during the period 2010-2016 is shown in Figures 1 and 2. The mean value of farm-gate price of raw cow milk (class I in quality) equals EUR 0.27 per litre, whereas the average value of processor and consumer prices is EUR 0.52 and 0.72 per litre respectively (Table 2). The coefficient of variation is higher for farm-gate price series in comparison with another price series. Processor and retail prices are less dispersed around the mean value. The standard deviation is rather low (Table 2), so prices are close to the mean of our samples.

Using the methodology described above, we started the price series analysis with the unit root tests. Visual examination of the price series graphs suggests that the model for unit root test should contain a constant and a time trend. Price series stationarity was checked with the ADF and PP tests.

Table 2: Descriptive statistics of whole milk prices (EUR per litre), January 2010 – November 2016.

	Farm-gate	Processor	Retail
Mean	0.26759	0.51566	0.72301
Median	0.28	0.52	0.73
Minimum	0.20	0.40	0.63
Maximum	0.30	0.62	0.82
Std. Dev.	0.028737	0.048795	0.055188
Skewness	-0.68724	-0.28163	-0.11008
C.V.	0.10739	0.094626	0.07633
Kurtosis	-0.87501	-0.17711	-1.2161

Data source: Statistical Office of the Slovak Republic

Table 3: Unit root test results.

Logged price variable	Model	Augmented Dickey-Fuller test				Phillips-Perron test			
		Lag	Levels	Lag	First difference	Lag	Levels	Lag	First difference
Farm-gate	Trend & Intercept	3	-2.276	9	-4.689***	3	-2.280	9	-8.633***
	Intercept only	3	-1.984	9	-2.096	3	-1.897	9	-8.293***
Processor	Trend & Intercept	2	-2.439	1	-5.081***	2	-2.452	1	-10.297***
	Intercept only	2	-1.919	1	-5.118***	2	-1.903	1	-10.326***
Retail	Trend & Intercept	4	-0.418	3	-4.475***	4	-0.479	3	-8.640***
	Intercept only	4	-1.777	3	-2.751*	4	-1.453	3	-8.098***

Note: */**/*** null hypothesis of non-stationarity rejected at the 10%, 5% and 1% levels of significance
Source: own calculations

The optimal lag order was determined based on AIC. The null hypothesis is rejected if the critical value is greater than the test statistic (p-value is less than level of significance). The results are summarised in Table 3. The null hypothesis of stationary price series in levels was rejected for all variables. Tests based on first differences show that all the test statistics are significant. Hence, we can conclude that all price variables are integrated of the order one, I (1).

After establishing the order of integration for each variable, we checked whether they are co-integrated. Given non-stationary price variables of the same order, we ran a Johansen co-integration test in order to reveal if the price series are co-integrated and to determine the number of co-integrating equations. The lag length was identified based on the AIC as a result of VAR modelling with constant and a linear trend. The Johansen co-integration technique discovered two co-integrating equations, according to the *trace* and L_{max} test, as the null hypotheses of $r=0$ and $r\leq 1$ (against the alternatives $r>0$ and $r>1$ respectively) are rejected at the 5 per cent significance level, whereas the null of $r=2$ cannot be rejected (Table 4). Hence, the price series are co-integrated and demonstrate long-term relationships within the analysed period. Therefore, we estimated a VECM with two co-integrating relationships.

The co-integration analysis does not identify any information about the causality direction; however, causality is investigated by means of VECM. Co-integration implies causality in at least one direction. This is indicated by the significant α-parameter. Given co-integration between variables, the VECM is estimated (Table 5). The VECM form with unrestricted constant consists of 12 lags order, which was set by AIC in the VAR model, and three endogenous variables. Ljung-Box (1978) and ARCH tests indicate that the VECM is well specified, residuals do not suffer from serial autocorrelation and there is no heteroscedasticity at the 1 per cent or 5 per cent levels of significance. The Doornik-Hansen (2008) test on the residuals was performed to check whether the residuals are normally distributed. The null hypothesis of multivariate normality cannot be rejected at only the 1 per cent of significance level according to the p-value (0.0141) and the residuals are normally distributed, that is desirable.

Theoretically, the VEC model reveals expected signs for explanatory variables in the long-term period. The coefficients in the long-term relationship are long-term elasticities. Each coefficient measures the corresponding magnitude of change in the dependent variable following a percentage change in a particular explanatory variable. Thus, a 1 per cent increase in retail prices leads to a 0.39 per cent and 0.4 per cent increase in farm-gate and processor prices respectively.

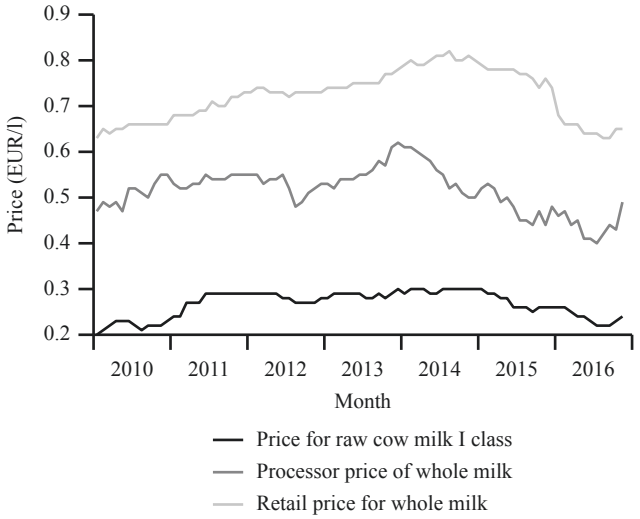

Figure 1: Price series for whole milk in the Slovak Republic, January 2010 – November 2016.
Data source: Statistical Office of the Slovak Republic

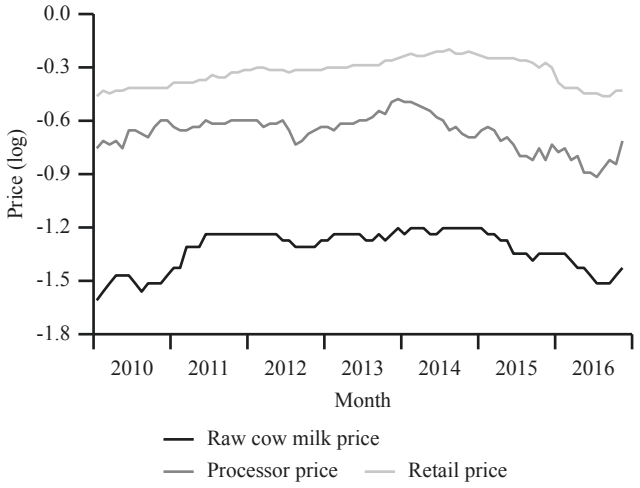

Figure 2: Price series in logarithms for whole milk in the Slovak Republic, January 2010 – November 2016
Data source: Statistical Office of the Slovak Republic

Table 4: Johansen co-integration test.

Hypothesised number of co-integrating equation(s)	Eigen value	Trace test	p-value	Lmax test	p-value
None (r=0)**	0.27284	42.716	0.0008	22.621	0.0284
At most 1 (r≤1)**	0.22887	20.095	0.0083	18.452	0.0087
At most 2 (r≤2)	0.02287	1.6424	0.2000	1.6424	0.2000

Note: ** denotes rejection of the null (0 or 1 co-integration vectors) at the 5% significance level
Source: own calculations

Table 5: Results of VECM estimates.

Co-integrating equation	**Model 1**		**Model 2**	
	CointEq1	**CointEq2**	**CointEq1**	**CointEq2**
L_FP_{t-1}	1.0000 (0.0000)	0.0000 (0.0000)	-2.5013 (0.55765)	-1.0006 (0.18824)
L_WP_{t-1}	0.0000 (0.0000)	1.0000 (0.0000)	0.0000 (0.0000)	1.0000 (0.0000)
L_RP_{t-1}	-0.39979 (0.21176)	-0.40003 (0.16784)	1.0000 (0.0000)	0.0000 (0.0000)
Error Correction Term (α)	DL_FP	DL_WP	DL_RP	DL_WP
CointEq1	-0.36287***	0.20625	-0.08511**	0.12774
CointEq2	0.10224	-0.52546**	0.27129**	-0.52546**
Intercept	-0.36987***	-0.03761	0.07415	-0.03761
ΔL_FP_{t-1}	-0.17688	0.30883	0.13875	0.30883
ΔL_FP_{t-2}	-0.06701	-0.10640	-0.05759	-0.10640
ΔL_FP_{t-3}	0.31348**	-0.05179	-0.07421	-0.05179
ΔL_FP_{t-4}	0.18059	-0.39200*	0.05744	-0.39200*
ΔL_FP_{t-5}	0.10377	0.02094	-0.08029	0.02094
ΔL_FP_{t-6}	0.02265	0.43063*	0.01208	0.43063*
ΔL_FP_{t-7}	0.15574	0.48106*	0.11198	0.48106*
ΔL_FP_{t-8}	-0.32855*	-0.74252***	0.18651	-0.74252***
ΔL_FP_{t-9}	-0.02483	-0.06440	0.02716	-0.06440
ΔL_FP_{t-10}	-0.08709	0.00015	-0.04159	0.00015
ΔL_FP_{t-11}	0.10142	0.14376	0.07482	0.14376
ΔL_WP_{t-1}	0.00661	0.44795*	-0.23661*	0.44795*
ΔL_WP_{t-2}	0.07403	0.74568***	-0.19613*	0.74568***
ΔL_WP_{t-3}	0.04870	0.05501	-0.09010	0.05501
ΔL_WP_{t-4}	-0.22968*	0.35608*	-0.15389	0.35608*
ΔL_WP_{t-5}	-0.08944	0.36324*	-0.16923*	0.36324*
ΔL_WP_{t-6}	-0.09985	0.08928	0.03784	0.08928
ΔL_WP_{t-7}	-0.33538**	0.10483	-0.13890	0.10483
ΔL_WP_{t-8}	0.05485	0.41680*	-0.07207	0.41680*
ΔL_WP_{t-9}	-0.00878	0.05248	-0.01379	0.05248
ΔL_WP_{t-10}	-0.10496	-0.08057	-0.12147	-0.08057
ΔL_WP_{t-11}	0.15161	0.60315***	0.00036	0.60315***
ΔL_RP_{t-1}	0.39840	0.91610***	0.06806	0.91610***
ΔL_RP_{t-2}	0.47626**	0.14982	-0.30448*	0.14982
ΔL_RP_{t-3}	0.19113	-0.17617	-0.00286	-0.17617
ΔL_RP_{t-4}	0.42682*	1.05387***	0.04856	1.05387***
ΔL_RP_{t-5}	0.03961	-0.24015	-0.05203	-0.24015
ΔL_RP_{t-6}	0.29301	-0.29509	0.02264	-0.29509
ΔL_RP_{t-7}	0.11392	0.36956	-0.27381	0.36956
ΔL_RP_{t-8}	-0.03783	-0.64339*	-0.20325	-0.64339*
ΔL_RP_{t-9}	0.10722	0.22455	-0.34467**	0.22455
ΔL_RP_{t-10}	-0.10541	0.29304	-0.43781**	0.29304
ΔL_RP_{t-11}	0.50256	0.43628	0.10969	0.43628
R^2	0.75784	0.73669	0.67987	0.73669
Adj R^2	0.51567	0.47338	0.35975	0.47338
F-statistic, *p-value*	3.53e-19	7.97e-24	2.03e-18	7.97e-24
DW-statistic	2.01719	2.10986	2.02855	2.10986
Sum squared residuals	0.01411	0.02701	0.00638	0.02701
S.E. of regression	0.02008	0.02778	0.01351	0.02778
Autocorrelation (Ljung-Box test), *p-value*	0.98	0.351	0.929	0.351
ARCH test, *p-value*	0.8742	0.86146	0.78916	0.86146
Normality of residuals (Doornik-Hansen test), *p-value*	0.0141	0.0141	0.0141	0.0141

Note: */**/*** – statistically significant at the 10%, 5% and 1% levels of significance; standard errors in parentheses; L_FP – farm-gate price in logarithms, L_WP – processor price in logarithms, L_RP – retail price in logarithms
Source: own calculations

In return, a 1 per cent rise of farm-gate price results in an increase in the retail price of 2.5 per cent; therefore, an imperfect market structure is demonstrated, where retailers have a stronger market power than other agents. Interestingly, perfect price transmission exists between farm-gate and processor prices for whole milk. A 1 per cent rise of processor prices leads to an approximately 1 per cent increase in farm-gate prices. The findings also indicate that the ECT coefficients are statistically significant at the 5 per cent level. All the coefficients carry the negative sign, indicating the stability of the

system and the convergence towards equilibrium if any disturbance appears in the system. Thus, we can see long-term causality from variable *L_RP* to *L_FP* and vice versa, from *L_RP* to *L_WP* and from *L_FP* to *L_WP*, because the speed of adjustment towards long-term equilibrium is significant and the sign is negative. The ECTs show how fast each variable reaches equilibrium. The higher the value, the faster the reaction. The ECT of Δ*L_WP* is statistically significant at the 5 per cent level and carries the negative sign. This implies that the restoration to the equilibrium path will not take a long time due to the fact that the α-value (0.52546) is high enough. The ECT of Δ*L_FP* is statistically significant at the 1 per cent level and carries the negative sign; however, the restoration to the equilibrium path will take longer than the processor price restoration due to the fact that the α-value (0.36287) is smaller. In the case of the retail price movement to equilibrium, it will take rather long time because the α-value (0.08511) is quite small. Thus, the co-integrating vector, in combination with significant and negative error correction terms, indicates long-term causality. The remaining lags in first differences in the VECM are used to test for short-term Granger causality by means of the Wald test. The null of no causality for all the price pairs can be rejected at the 5 per cent level of significance (Table 6). In summary, we found reasonable evidence of short-term causality from the farm-gate to retail prices and vice versa; from processor to farm-gate prices and vice versa; from retail to processor prices and vice versa.

Table 6: Short-term Causality Wald Test results (df = 11).

Dependent variable	Excluded variables	χ^2	p-value
ΔL_FP	ΔL_WP	26.8334	0.00487
	ΔL_RP	34.6938	0.00028
ΔL_WP	ΔL_FP	53.2896	0.00000
	ΔL_RP	54.7952	0.00000
ΔL_RP	ΔL_FP	32.7590	0.00058
	ΔL_WP	22.1784	0.02303

Source: own calculations

Discussion

In this paper, we investigated price transmission along the whole milk supply chain in the Slovak Republic by taking into account the price development after the abolition of milk quotas in the EU. Monthly farm-gate, processor and retail prices in natural logarithms during the period from January 2010 to November 2016 were used in our analysis. Vertical price transmission was evaluated in the co-integration framework, using the Johansen approach, which confirmed the co-integration between price variables and determined two co-integrating vectors. Based on the VECM, we found evidence that market power is on the demand side and retailers have a dominant position, therefore, imperfect price transmission is confirmed. In the long term, a 1 per cent increase in retail prices leads to a 0.39 per cent and 0.4 per cent increase in farm-gate and processor prices respectively. Similarly, the existing studies on the period before the end of milk quota suggest that retail prices respond asymmetrically to increases and decreases in producer prices (Weldesenbet, 2013; Lajdová *et al*., 2015). Interestingly, the findings of Bakucs *et al.* (2013) that (a) the less balanced the bargaining power of farmers and retailers, the more likely one should observe asymmetric price transmission, and (b) farm-retail price transmission asymmetry is likely to occur when retailers' turnover relative to food manufacturing turnover (per enterprise) is higher, might also explain the asymmetry in the Slovak dairy sector. However, perfect price transmission exists between farm-gate and processor prices for whole milk in the long term. Given this, the findings reveal that the recent emergence and strengthening of the producer organisations enable producers to support their bargaining position in the supply chain. The unfavourable situation after the end of milk quota, resulting in a fall in the number of milk producers, might also have contributed to the increased willingness for cooperation. There is evidence, provided by Lajdova *et al.* (2015), that opposite results held for semi-fat milk prices during the period 2003-2011, where the price adjustment from processor to producer was symmetric, but asymmetric vice versa. This may indicate that the lack of an organised contracting system before the abolition of the EU milk quota may have limited the market power of farmers relative to the dairy industry and their capacity to negotiate prices (Serra and Goodwin, 2003). The retail price movement to equilibrium is slow due to the small α-value (0.08511); meanwhile, the processor and farm-gate price restoration to the equilibrium path will take a comparatively short time. There is a two-way short-term Granger causality between processor and retail prices, farm-gate and retail prices, processor and farm-gate prices. These results are consistent with the findings of Weldesenbet (2013) and Pokrivčák and Rajčániová (2014), who conclude that the changes in producer prices cause changes in the retail prices as well as there is a causality feedback from the retail to producer prices.

We suggest the following measures in order to stabilise the dairy sector and mitigate the price asymmetry. Firstly, it is important to balance the subsidy and regulatory environment and avoid cutting off state support: the support system for the milk producers must be effective and sustainable. It is also necessary to prevent the import of milk and dairy products at dumping prices. Besides, there is also scope for improving the transparency in price formation along the supply chain; furthermore; distribution margin and the abuse of the dominant market position of retailers must be solved at the EU level.

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Agricultural factor use and substitution in the south-eastern United States

A study of the agricultural factor markets that support the farm economy of the southeastern United States aids the understanding of how farmers change the mix of factors as product and factor prices change. Factor demand elasticities were estimated for capital, land, labour, chemicals, energy and other intermediate inputs. On average, labour accounted for USD 0.410 of every USD 1 spent on agricultural inputs followed by other intermediate inputs, which accounted for USD 0.255. The demands for farm labour and other intermediate inputs were inelastic. The demand for farm chemicals was elastic, which indicates a lack of pricing power by companies that sell them. A substantial reduction in the use of farm chemicals could be achievable by increasing their price. Most of the factors are substitutes with the exceptions of capital and energy, and land and chemicals, which were found to be complements.

Keywords: agricultural factor/input, factor share, elasticity, substitution

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Introduction

The volatility in agricultural product markets has been accompanied by volatility in the factor markets. Changes in the prices of crops and livestock products have resulted in changes in the demand for agricultural inputs. These changes have been confounded by those in the market for fossil fuels. Higher prices for fossil fuels result in increased demand for maize and other agricultural products used for biofuels, thereby affecting agricultural factor markets. In addition, fossil fuels are farm inputs so changes in their prices also affect agricultural input markets. As demand and prices for farm inputs change, sellers of agricultural inputs such as equipment and chemicals must find ways to adjust due to the substitution of some inputs for others and complementarity between some inputs. In addition, changing prices affect the revenues of such companies. Farm-level responses to changes in factor prices have implications for public policy.

The application of inputs such as chemicals and fertilisers has been associated with the impairment of streams and aquifers (Parris, 2011). Despite the concerns over runoff and leaching that have encouraged the promotion of best agricultural management practices, anecdotal evidence indicates that the use of conventional practices, especially in crop production, has changed little since the early 1990s. An opportunity to substitute for some of these harmful inputs could improve environmental quality by reducing water pollution and the carbon footprint associated with their use. Information on input use and substitution could be used to determine the appropriate levels of taxes or subsidies on given inputs that will achieve reductions in the use of potentially harmful agricultural chemicals that can compromise environmental quality, and the health of consumers and farm workers. This study explored the types and magnitudes of the relations between agricultural inputs in the agricultural sector of south-eastern U.S. Specifically, the study estimated the input demand elasticities for south-eastern U.S. agriculture.

The work of Allen (1938), supplemented by Varian (1994) and Takayama (1993), established the fundamental concepts on the economics of input substitution. Ferguson and Pfouts (1962) and Berndt and Christensen (1973) developed the theoretical background of applied substitution in production while Sato and Koizumi (1973) developed the link between Allen relative elasticities and cross price elasticities. Several studies (Hudson and Jorgenson, 1974; Berndt and Wood, 1975; Fuss, 1977; Magnus, 1979) on factor substitution have examined the substitution between energy and non-energy inputs, with emphasis on the role of energy in production.

Most of the preceding studies on factor demand and substitution may be dated and, as a result, findings from such studies may no longer be relevant. In addition, the changes in demand for agricultural commodities and corresponding changes in the demand for agricultural inputs in recent years are unprecedented relative to the period during which most of these studies were done. Also, most of these studies focused on U.S. agriculture as a whole, but there could be regional differences in factor demand, possibly due to differences in regional agricultural production practices and weather. Therefore, conclusions drawn for U.S. agriculture may not necessarily be applicable to south-eastern U.S. agriculture. This study revisits factor demand and input substitution in agriculture from a south-eastern U.S. perspective, and investigates the relationships between agricultural factors. We hypothesise that capital are complements to land, energy and chemicals, and a substitute to labour.

Methodology

Theoretical model

Translog cost functions developed by Christensen *et al*. (1973) are very useful in studies of factor demand. In general, the translog cost function may be represented as:

$$\ln C = \beta_0 + \beta_q \ln Q + \frac{1}{2}\beta_{qq}(\ln Q)^2 + \sum_i \beta_{qi} \ln Q \ln w_i + \sum_i \beta_i \ln w_i + \frac{1}{2}\sum_i \sum_j \beta_{ij} \ln w_i \ln w_j \quad (1)$$

where C is cost, Q is output, w_i is the price of input i, w_j is the price of input j; and $i, j = 1,2,...,n$.

The first derivative of the translog function with respect to input prices (w_i) is:

$$\delta \ln C / \delta \ln w_i = (\delta C / \delta w_i) * (w_i / C) \quad (2)$$

By use of Shephard's lemma, equation 2 could be expressed as a system of factor share equations (S_i) that are functions of factor prices (w_i) and output (Q) where S_i is the proportional share of the i^{th} input relative to total cost.

$$\frac{\partial \ln C}{\partial \ln w_i} = S_i = \beta_i + \beta_{qi} \ln Q + \sum_j \beta_{ij} \ln w_j \quad (3)$$

Homogeneity restrictions require that the sum of the price effects as well as the product effects be each equal to zero. Symmetry also requires the respective cross price effects to be equal.

The translog cost function can be applied to multiproduct, multifactor production processes. However, estimating the cost function as a single-equation model even with restrictions imposed for linear homogeneity in the input prices may be either impossible or inappropriate. Therefore, estimating the system of equations leads to much higher efficiency (Subhash, 1982).

The Allen elasticity of substitution between any two inputs in a multiple input production system is defined as the effect of a change in relative factor prices on the relative factor quantities, holding output and other input prices constant (Sato and Koizumi, 1973). The parameters from a system of factor share equations could be used to compute the own price and Allen elasticities of substitution. The own price elasticity (ε_{ii}) is given by:

$$\varepsilon_{ii} = (\beta_{ii} - S_i + S_i^2) / S_i^2 \quad (4)$$

where β_{ii} is the own price coefficient of input i; and S_i is the share of input i. The Allen elasticity of substitution (ε_{ij}) between input i and input j is given by:

$$\varepsilon_{ij} = (\beta_{ij} + S_i * S_j) / S_i * S_j \quad (5)$$

where β_{ij} is the cross price coefficient of input i with respect to the price of input j and S_j is the share of input j.

Empirical model

Data on input prices and output levels used in this study were obtained from USDA (2009) and USDA (2010). Data on the prices of capital, labour, land, energy, chemicals and other intermediate inputs for each year from 1960 to 2004 were collected for each of the eleven states (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee and Virginia) in the south-east U.S. In addition, data on the output of crops and livestock were collected for the region for each of the years. This yielded a total of 495 observations. The price variables used in this study were measured as indices from 1960 to 2004 with 1996 as the base year. The output variables (crop and livestock) were also measured as indices for the 45-year period (1960-2004) with 1996 as the base year. All the relevant data for more recent years are not available.

Factor shares used in south-eastern US agriculture were computed for capital, labour, land, energy, chemicals and other intermediate inputs. The factor share for each input is the ratio of the expenditure on the input to the expenditure on all inputs for a given year:

$$S_{it} = e_{it} / E_t \quad (6)$$

where S_{it} represents factor share of agricultural input i in year t; e_{it} represents expenditure on agricultural input i in year t and E_t is the overall or total input expenditure in year t.

The effects of output and input price changes were obtained from the estimation of a system of factor share equations (equation 3). To estimate the system of factor share equations as related to agriculture in south-eastern U.S., agricultural output (Q) is specified to be a function of six inputs such that:

$$Q = f(\textit{Capital, Labour, Land, Energy, Chemicals, Other intermediate inputs}) \quad (7)$$

It was assumed that the individual inputs in the production function (equation 7) are weakly separable from other input materials. Profit maximisation by farms and competitive agricultural product and input markets were assumed.

The impact of changes in input prices and output quantities on the factor share of each input (equation 3) were estimated as a system of the following six equations:

$$S_{capital} = f(w_{capital}, w_{land}, w_{labour}, w_{energy}, w_{chemicals}, w_{other\ intermediate\ inputs}, \textit{crop, livestock, trend}) \quad (8)$$

$$S_{land} = f(w_{land}, w_{capital}, w_{labour}, w_{energy}, w_{chemicals}, w_{other\ intermediate\ inputs}, \textit{crop, livestock, trend}) \quad (9)$$

$$S_{labour} = f(w_{labour}, w_{capital}, w_{land}, w_{energy}, w_{chemicals}, w_{other\ intermediate\ inputs}, \textit{crop, livestock, trend}) \quad (10)$$

$$S_{energy} = f(w_{energy}, w_{capital}, w_{land}, w_{labour}, w_{chemicals}, w_{other\ intermediate\ inputs}, \textit{crop, livestock, trend}) \quad (11)$$

$$S_{chemical} = f(w_{chemicals}, w_{capital}, w_{land}, w_{labour}, w_{energy}, w_{other\ intermediate\ inputs}, \textit{crop, livestock, trend}) \quad (12)$$

$$S_{other} = f(w_{other\ intermediate\ inputs}, w_{capital}, w_{land}, w_{labour}, w_{energy}, w_{chemicals}, \textit{crop, livestock, trend}) \quad (13)$$

where $S_{capital}$ = factor share of capital: capital is defined to include depreciable assets and beginning inventories of livestock and crops; S_{labour} = factor share of labour: labour includes self-employed and unpaid family labour as well as hired workers; S_{land} = factor share of land: land constitutes land area and values; S_{energy} = factor share of energy: energy includes petroleum fuels, natural gas, renewable energy and electricity; $S_{chemical}$ = factor share of all chemicals; S_{other} = factor share of other intermediate inputs: other intermediate inputs include feed, seed, fertiliser, livestock purchases, maintenance and repairs as well as irrigation water. $w_{capital}$ = log of the index of annual capital price; w_{land} = log of the index of annual land price; w_{labour} = log of the index of annual wage rate for farm labour; w_{energy} = log of the index of annual energy price; $w_{chemicals}$ = log of the index of annual agricultural chemical price; $w_{other\ intermediate\ inputs}$ = log of the index of annual other intermediate inputs price. *crop* = log of the index of annual crop production: crops include an aggregate measure of all

Table 1: Estimated coefficients of factor share equations for agricultural inputs in the south-eastern United States.

Equation no.	Dependent variable		Independent variables								
	Variable	Mean	*Constant*	$w_{capital}$	w_{land}	w_{labour}	w_{energy}	$w_{chemicals}$	*crop*	*livestock*	*trend*
8	$S_{Capital}$	0.123	-2.561***	-0.036***	0.035***	-0.017***	0.007***	0.025***	-0.029***	-0.013***	0.001***
			(-8.630)	(-5.640)	(16.31)	(-4.160)	(-4.550)	(6.460)	(-9.910)	(-4.680)	(9.120)
9	S_{Land}	0.106	-0.288	0.035***	-0.015***	-0.014***	0.003***	-0.009***	0.009***	-0.010***	0.0002*
			(-1.360)	(16.31)	(-9.540)	(-5.460)	(6.630)	(-5.550)	(4.300)	(-5.270)	(1.770)
10	S_{Labour}	0.411	4.763***	-0.017***	-0.014***	0.025***	-0.000008	0.005	0.020***	-0.099***	-0.002***
			(11.970)	(-4.160)	(-5.460)	(4.040)	(-0.010)	(1.540)	(2.630)	(-13.650)	(-11.120)
11	S_{Energy}	0.032	-0.242***	-0.007***	0.003***	-0.000008	-0.012***	0.016***	0.001**	0.003***	0.0001***
			(-3.140)	(-4.550)	(6.630)	(-0.010)	(-10.820)	(16.770)	(2.280)	(5.650)	(3.600)
12	$S_{Chemicals}$	0.073	-0.671***	-0.025***	-0.009***	0.005	0.016**	-0.037***	0.028**	-0.016***	0.0004***
			(-2.450)	(6.460)	(-5.55)	(1.540)	(16.77)	(-10.150)	(11.570)	(-6.870)	(2.670)
13	S_{other}	0.255	-0.00001	-0.000002	-0.000003	-0.000003	0.000003	-0.000001	-0.029	0.135	0.0003

***, **, * statistically significant at the 1%, 5% and 10% levels, respectively; T-values are in parenthesis; N = 4
Source: own calculations

crop production; *livestock* = log of the index of annual livestock production: livestock includes an aggregate measure of all livestock production; *trend* = trend (technology) and is measured as the years of data collection (1960 to 2004).

Trend (in years) was included to measure changes in knowledge during the period of study (1960 to 2004). Since factor shares must add up to one, five $(n-1)$ of the six factor share equations containing five input prices (excluding the price of other intermediate inputs) in each equation were estimated. This helps to avoid the problem of singularity. The equation for other intermediate inputs (equation 13) and the coefficients of the price of other intermediate inputs in each of the five factor share equations were estimated based on the parameters of the first five equations. The five factor share equations were estimated with Statistical Analysis System software using a nonlinear Seemingly Unrelated Regression technique, which ensures efficiency in estimation by combining information on different equations (Moon and Perron, 2004). Estimates of parameters in the system of factor share equations were used to derive the own price and Allen elasticities of substitution matrix using equations (4) and (5).

Results and discussion

Our results and discussion are presented in three subsections. In the first subsection, we discuss the estimated regression coefficients for each of equations 8 to 13. The second subsection contains the discussion of the estimated Allen own-price elasticities. Finally, we discuss the estimated Allen elasticities of substitution in the third subsection.

Estimated factor share coefficients

Table 1 contains the results of the six estimated factor share equations. Labour (S_{labour}) and other intermediate inputs (S_{other}) accounted for the largest factor shares at 41.1 and 25.5 per cent respectively. The regression results indicate that an increase in the price of capital ($w_{capital}$) will result in decreases in the factor shares of capital ($S_{capital}$), labour (S_{labour}), energy (S_{energy}), chemicals ($S_{chemicals}$) and other intermediate inputs (S_{other}), and result in a 0.035 point increase in the factor share of land (S_{land}). Increases in the price of land (w_{land}) will result in reductions in the factor shares of land, labour, chemicals and other intermediate inputs and increases in those of capital and energy. Increases in the farm wage rate (w_{labour}) will increase the factor shares of labour and chemicals and reduce the factor shares of each of the other four inputs. Increases in the factor shares of land, chemicals and other intermediate inputs will result from increases in the price of energy (w_{energy}) while reducing those of capital, labour and energy. An increase in the price of chemicals ($w_{chemicals}$) will result in reductions in the factor shares of land, chemicals and other intermediate inputs and increases in each of the shares of capital, labour and energy. Increases in crop production (*crop*) will result in decreases in the shares of capital and other intermediate inputs while reducing the factor shares of each of the other inputs. Increased livestock production will result in reductions in the factor shares of all inputs except those of energy and other intermediate inputs. The factor shares of all inputs except for those of labour increase with the passage of time.

Table 2: Estimated own and cross price elasticities of substitution for factors of production in south-eastern United States agriculture.

Factor	$w_{capital}$	w_{labour}	w_{land}	w_{energy}	$w_{chemicals}$	$w_{other\ inputs}$
Capital	-1.17	0.27	0.39	-0.02	0.28	0.25
Labour	0.08	-0.53	0.07	0.03	0.09	0.25
Land	0.45	0.28	-1.04	0.06	-0.01	0.25
Energy	-0.10	0.41	0.20	-1.34	0.57	0.26
Chemicals	0.47	0.48	-0.02	0.25	-1.43	0.25
Other inputs	0.12	0.41	0.11	0.03	0.07	-0.74

Note: row 1 indicates source of price change
Source: own calculations

Estimated Allen own-price elasticities

Table 2 contains the estimated Allen own-price elasticities (diagonal elements) and substitution elasticities (off-diagonal elements) for the various inputs. The estimates indicate that the demand for capital, land and energy in south-eastern U.S. agriculture are elastic. The own-price elasticity coefficients range from -1.43 for chemicals to -1.01 for land. The own-price elasticity coefficient of -1.43 for chemicals suggests that agricultural chemical companies have limited pricing power, as a 10 per cent increase in price will result in a 4.3 per cent reduction in revenue. Likewise, the estimated

own-price elasticity of -1.17 for capital implies that a 10 per cent increase in the price of capital equipment will result in a 1.7 per cent reduction in the revenue of companies that sell them to the farm sector. The own-price elasticity coefficient for energy is -1.34, suggesting that a 10 per cent increase in the price of energy will reduce energy use on farms by 13.4 per cent. This finding differs from that of Miranowski (2005), which indicates that energy demand in U.S. agriculture is inelastic. The demand for agricultural labour and other inputs were found to be inelastic with coefficients of -0.53 and -0.74 respectively.

Estimated Allen elasticities of substitution

The estimated Allen elasticities of substitution suggest that most of the inputs are weak substitutes. The Allen elasticity of substitution of chemicals with respect to energy prices is 0.25 per cent, suggesting that a 10 per cent increase in the price of energy will result in a 2.5 per cent increase in the use of agricultural chemicals in south-eastern U.S. agriculture. Likewise, a 10 per cent increase in the price of chemicals will increase energy use by 5.7 per cent. The results also suggest that energy and labour are substitutes which is consistent with the findings of Hudson and Jorgenson (1974), Berndt and Wood (1975), Fuss (1977), Magnus (1979) and Gopalakrishnan *et al*. (1989). However, they contradict the findings of Carlson *et al*. (1993). Capital and energy were found to be complements, suggesting that their substitution for each other is technically infeasible in south-eastern U.S. agriculture. The estimated elasticity of substitution of -0.02 implies that a 10 per cent increase in the price of energy will result in a 0.2 per cent decrease in the use of capital, which is consistent with our hypothesis. An elasticity of -0.10 implies that a 10 per cent increase in the price of capital will be accompanied by a 1.0 per cent decrease in the use of energy. In addition to being consistent with our hypothesis, this finding is also in agreement with those of Hudson and Jorgenson (1974), Berndt and Wood (1975), Fuss (1977) and Magnus (1979), who also found energy as a complement for capital in U.S. agriculture. However, the finding is inconsistent with those of Griffin and Gregory (1976) who found energy and capital to be substitutes in U.S. agriculture.

Conclusions

Sellers of most agricultural inputs used in south-eastern U.S agriculture have limited pricing power and could increase their total revenues by charging lower prices. Efforts to reduce environmental damage from the use of agricultural chemicals through the use of a tax will be effective as every 10 per cent increase in the price of chemicals will reduce the use of agricultural chemicals by 14.3 per cent and increase the use of capital, labour, land and energy. However, such a tax will adversely affect the revenues of firms that sell farm chemicals. Additionally, the inelastic nature of farm labour suggests that actions or events that increase farm wage rates in the region will be mostly at the expense of farm sector profits.

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The impact of micro-irrigation on households' welfare in the northern part of Ethiopia: an endogenous switching regression approach

The paper uses an endogenous switching regression model to measure the impact of participation in micro-irrigation development on households' welfare. The model takes into account selection bias associated with programme participation and endogeneity problems often encountered in most programme evaluations. A total of 482 households (195 irrigation users and 287 non-users) were used to generate all the necessary variables. To capture the impact of the irrigation on household welfare, two indicators were considered, namely household farm income (Y) and household fixed asset formation (F) (evaluated at market price during the survey period). The results show a positive and significant impact of irrigation use on the two outcome variables: income by 8.8 per cent and asset formation by 186 per cent as compared to non-users. This shows how important the micro-irrigation schemes are in improving the welfare of poor farmers in the research areas. Furthermore, the empirical results show that the probability of using one of the water sources (irrigation scheme) is associated with farm experience (age as proxy), farmer-to-farmer contact (the existence of an irrigation user neighbour), family size, the state of credit constraint, the number of visits by extension agents and the cost of irrigation development. As a robustness check, different models were applied and results were found consistent, both qualitatively and quantitatively.

Keywords: micro-irrigation, household farm income, household fixed asset formation

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Introduction

Ethiopia, despite achieving economic growth continuously in excess of 10 per cent per annum in the last decade, is one of the poorest countries in Sub-Saharan Africa (SSA). Poverty is widespread and deep-rooted and constitutes the development priority of the country. About 30 per cent of the population lives below the poverty line (set at USD 1.25 per person per day) (WB, 2013). The challenges that Ethiopia face, in terms of poverty and food insecurity, are associated with both inadequate food production and natural crop failure due to erratic rainfall (Awulachew *et al*., 2007).

In a study conducted to assess the impact of climate change on production at sub-national level for SSA, Liu *et al*. (2008) identified countries such as Ethiopia, Uganda and Rwanda as future drought hotspots. However, less than 4 per cent of renewable water resources in Africa are withdrawn for agriculture. To reverse the current underdeveloped nature of irrigated agriculture in SSA, there is a strong theoretical argument for expanding small-scale irrigation schemes to increase agricultural production in support of economic development and the attainment of food security in the region (de Fraiture and Giordano, 2014). In Ethiopia, special focus has been given since 2003 to household-level water harvesting schemes such as ponds, deep and shallow wells, and river diversions, as an integral part of programmes aimed at breaking the cycle of food insecurity. The aim is to make water available to supplement rainfed agriculture through small-scale irrigation during the critical stage of plant growth when rainfall is inadequate (Hagos *et al*., 2006).

The economic literature on adoption of agricultural technologies (including irrigation) uses various household, farm, social and economic variables to explain the level as well as the intensity of adoption and the impact of these technologies on adopters' welfare. In general it has been found that (a) an increase in the price or cost of technology reduces a farmer's likelihood to adopt (Caswell and Zilberman, 1985; Feder *et al*., 1985); (b) households with larger farms are more likely to adopt (Feder, 1980; Rahm and Huffman, 1984; Putler and Zilberman, 1988); (c) an adopter's human capital endowment variables such as age, gender, education and experience affects the likelihood to adopt (Huffman, 1977; Rahm and Huffman, 1984; Putler and Zilberman, 1988); (d) social capital (membership of social networks) and institutional capital (access to institutional services such as credit and extension service) are also likely to induce farmers to take some risks and adopt technologies.

Several studies have been conducted to assess the impact on household welfare after the adoption of new technologies, including irrigation. In India, access to irrigation has had a positive impact on poverty reduction (Fan *et al*., 1999; Narayanamoorthy, 2001; Shah and Singh, 2002). Gebregziabher *et al*. (2012) found that, in terms of their technical efficiency, irrigator farmers in northern Ethiopia operated on a higher production frontier with significant inefficiencies, while rainfed farms were on a lower production frontier with high efficiency levels. Hussain and Hanjra (2003) showed that irrigation enabled households to improve crop productivity so that they can grow high-value crops that generate higher incomes and employment as well as a higher implicit wage rate for family labour. A comparison between irrigators and non-irrigators in China showed that irrigation contributed to increased yields for almost all crops and higher income for farmers in all areas (Huang *et al*., 2006).

Dillon (2011), using a panel from northern Mali household data, found a positive and significant effect of access to irrigation on household consumption, assets and informal insurance as outcome indicators. Access to irrigation increased household consumption by 27-30 per cent relative to water-recession and rainfed cultivators. Hagos *et al*. (2012), using 1,517 sample households drawn from four regional states of Ethiopia, reported that access to selected

agricultural water management technologies had a significant effect on poverty reduction. However, despite the data richness in terms of sample size and geographical representation, the model specification and estimation process did not address the selection bias that could arise between the adoption decision and the outcome equation. Using a household data set from the Tigray region in northern Ethiopia, similar results were reported by Gebregziabher *et al*. (2009). Lipton *et al*. (2003) documented the various ways in which the benefits of irrigation can improve the livelihoods of both irrigators and non-irrigators. These included increased production and income, reduced risk and application of agricultural inputs and additional job creation for rural landless people.

Bhattarai *et al.* (2002) could not establish a straightforward relationship between irrigation and poverty alleviation in selected Asian countries. Similar results were echoed by Berhanu and Pender (2002) who showed the limited impact of irrigation development on input use and farm productivity. Using time series data, Jin *et al*. (2002) could not find a link between irrigation and total factor productivity growth in the major grain producers in China. In a study conducted in Ghana, Burkina Faso and Niger on whether government support for different water management systems has any impact on rice productivity, Katic *et al*. (2013) showed that policy interventions did not significantly enhance the profitability of rice-producing beneficiary farmers. Depending on the nature of the selection problem, if the technology adopters are from the already better off community, the impact will be upward bias, and vice versa.

Most of these studies have relied on income and/or consumption to measure poverty (flow variable) and did not address the selection bias problem between the adoption process and the second stage outcome equation. In this paper, we assess the impact of the micro-irrigation[1] project on household welfare in the Tigray region of northern Ethiopia. We endeavour to address the self-selection bias by using a relatively more robust model and, to address the measurement error, we tried to use alternative welfare indicators, income (flow) and fixed asset holding (stock), to measure the welfare implication of irrigation adoption.

Methodology

Study area

The study was conducted in three districts of the Tigray region. The climate of Tigray is broadly arid and semi-arid, with around nine or ten dry months and rainfall concentrated during July and August. Most parts of the region experience very erratic and inadequate rainfall (even during the two rainy months) that is precarious for crop production (Hagos *et al*., 2006). Moreover, the region encounters severe drought almost every five years. Despite all these challenges, during 'normal' rainy seasons (i.e. when drought does not occur) the region has an annual runoff of around 9 billion m^3 and can irrigate its potential irrigable area of 300,000 ha (Awulachew *et al*., 2007). However, the developed irrigable land of the region currently does not exceed 75,000 ha. The three districts used in this study were selected because they are known to have both rainfed farming and micro-irrigation schemes such as ponds, wells and river diversions. Moreover, these districts have irrigation users and non-users sharing the same natural and agro-climatic conditions. Except for some small areas which practice dry season cultivation using micro-irrigation, rainfed agriculture predominates which involves the cultivation of wheat, teff (*Eragrostis tef*), maize, oilseeds and pulses. Both exotic and indigenous vegetables and crops are irrigated and these include onions, tomatoes, pepper, garlic and maize.

Study design and data

A survey of 482 farmers comprising 287 non-users and 195 users of the different irrigation schemes was conducted in March 2012. In obtaining the sample for the survey, a multistage sampling technique was used. Firstly, three districts with good distribution of different irrigation schemes were sampled purposefully. In the second stage, five sub-districts were randomly selected. Thirdly, using extension workers' lists, farmers in each sub-district were stratified into two groups, namely irrigators (river diversion, wells and ponds) and non-irrigators (rainfed farmers). A questionnaire was used to gather data on households' income and asset holdings, household characteristics, and farm characteristics from both users and non-users, and sub-district level information.

Model specification

Microeconomic evaluations of the impact of an intervention (for instance, irrigation use) on the final outcome (household welfare) were based on the model developed by Becker (1964) and Mincer (1974). However, the decision to adopt new technology, in our case, irrigation scheme, is voluntary; the familiar problem of sample selection bias may result: farmers who use irrigation are also likely to be the ones who find it most profitable (Fuglie and Bosch, 1995). For example, farmers who are more wealthy and productive are more likely to be those who use irrigation. Hence, the self-selection into irrigation scheme utilisation would be the source of endogeneity, and failure to account for this will overstate the true impact of irrigation (Alene and Manyong, 2007).

Lee (1978) developed an approach for estimating models of this type which he called endogenous switching regression (ESR). In this approach, the decision is modelled by standard limited dependent variable models, and the second stage outcome variables are then estimated separately for each group (irrigation users and non-users), conditional on having made the decision. Let the decision to use one of the micro-irrigation schemes be a dichotomous choice, where a farmer decides to have irrigation when there is a positive perceived difference between using the scheme and not having the scheme.

Let this difference be denoted as I^* so that $I^*>0$ corresponds to the net benefit of having the scheme exceeding that

[1] Micro-irrigation is the slow application of water on, above, or below the soil by surface drip, subsurface drip, bubbler and micro-sprinkler systems. Water is applied as discrete or continuous drips, tiny streams or miniature spray through emitters or applicators placed along a water delivery line adjacent to the plant row (Lamm *et al.*, 2007).

of not using the scheme, and it is under this condition that the farmer decides to use the scheme. However, I^* is not observable; what is observed is I, which represents the observed farmer's decision choice. The expected utility of having an irrigation scheme, I_1^* (adopters or regime 1) compared to the utility of not having, I_0^* (non-adopters or regime 2), and the decision to own irrigation occurs if $I_1^* > I_0^*$. Based on Lokshin and Sajaia (2004), the relationship can be expressed as:

$$\begin{aligned} &I = 1 \text{ if } \alpha Z'_i + U_i, \text{ if } I^* > 0 \\ &I = 0 \text{ if } \alpha Z'_i + U_i, \text{ if } I^* < 0 \end{aligned} \tag{1}$$

$$\textit{Regime } 1: \ln W_{1i} = \left.\begin{matrix} \ln Y_{1i} \\ \ln F_{1i} \end{matrix}\right\} = X\beta_1 + \varepsilon_1 \,;\; \textit{if } I = 1 \tag{2}$$

$$\textit{Regime } 2: \ln W_{2i} = \left.\begin{matrix} \ln Y_{2i} \\ \ln F_{2i} \end{matrix}\right\} = X\beta_2 + \varepsilon_2 \,;\; \textit{if } I = 0 \tag{3}$$

where Z is a vector of explanatory variables (which includes household and farm characteristics; social and institutional variables); α is a vector of unknown parameters to be estimated; and U_i is a random error term and factors not observed by the researcher but known to the household, with mean zero and variance σ_U^2 (Alene and Manyong, 2007). $\ln W_{1i}$ and $\ln W_{2i}$ are the natural logs of welfare indicators (outcome variables) for regime 1 and regime 2 respectively. Welfare is captured by household income (Y) and fixed assets (F); where $\ln Y_{1i}$ and $\ln F_{1i}$ represent natural logs of income and fixed assets for adopters, $\ln Y_{2i}$ and $\ln F_{2i}$ are natural logs of income and fixed assets for non-adopters. ε_1 and ε_2 are error terms for regime 1 and 2 functions respectively.

Since the first stage decision variable I (to have an irrigation scheme) is endogenous, OLS estimates in equations (2) and (3) will suffer from sample selection bias, namely the error terms in equations (2) and (3), conditional on the sample selection criteria, have non-zero expected values (Lee, 1978; Maddala, 1983; Fuglie and Bosch, 1995). Lee (1978) treats sample selection as a missing-variable problem. For identification purposes, and to satisfy the usual order condition, Z_i contained one variable (whether household has a neighbour/s or not) not in X_i so as to impose an exclusion restriction on equations (2) and (3). Having a neighbour who adopts any modern technology may help fellow farmers to observe, learn and, if they become convinced of the benefits, eventually adopt the technology; thus technology diffusion will continue. In our situation, the presence of a neighbour who adopts one of the irrigation schemes is expected to affect the decision to adopt or not, but not the welfare status (income and asset holdings of a household). Hence, the *IrrigationUserN* neighbour adopter variable is used as an instrumental variable. In developing countries, social networks such as neighbours, friends and families are the main sources of information and confidence in the process of technology or new practice adoption. Hence, the existence of a neighbour adopter (farmer-to-farmer) is expected to influence peer fellow neighbours to adopt one of the irrigation schemes, but not the income and asset holdings of households. Moreover, OLS estimates do not explicitly account for potential production function differences between households with irrigation and rainfed farmers. Hence, the variable whether a household has a neighbour/s or not is used as an instrument (identification variable). Assuming U_i, ε_2 and ε_1 to have a trivariate normal distribution with mean vector zero and covariance matrix will have the following variance-covariance structure:

$$\operatorname{cov}(\varepsilon_1, \varepsilon_2, U_i) = \begin{bmatrix} \sigma_U^2 & \sigma_{1U} & \sigma_{2U} \\ \sigma_{1U} & \sigma_1^2 & \cdot \\ \sigma_{2U} & \cdot & \sigma_2^2 \end{bmatrix} \tag{4}$$

where $\operatorname{var}(\varepsilon_1) = \sigma_1^2$, $\operatorname{var}(\varepsilon_2) = \sigma_2^2$ and $\operatorname{var}(U_i) = \sigma_U^2$, and $\operatorname{cov}(\varepsilon_1, U_i) = \sigma_{1U}$, $\operatorname{cov}(\varepsilon_2, U_i) = \sigma_{2U}$. The covariance between ε_2, and U_i is not defined, as Y_2 and Y_1 are never observed simultaneously (Lokshin and Sajaia, 2004). Since probit maximum likelihood is used to estimate α, it is estimable only up to a scalar factor and hence it can be assumed that $\sigma_U^2 = 1$ (Maddala, 1983). Given the assumption with respect to the distribution of the disturbance terms, the logarithmic likelihood function for the system of (2 and 3) is:

$$\begin{aligned} \ln L = \sum\nolimits_i (I_i w_i [\ln\{F(\eta_{1i})\} + \ln\{(\varepsilon_{1i}/\sigma_1)/\sigma_1\}] + \\ (1 - I_i) w_i [\ln\{1 - F(\eta_{2i})\} + \ln\{f(\varepsilon_{2i}/\sigma_2)/\sigma_2\}]) \end{aligned} \tag{5}$$

where F is a cumulative normal distribution function, f is a normal density function, w_i is an optimal weight for observation i and

$$\eta_{ji} = \frac{(\gamma Z_i + \rho_j \varepsilon_{ji}/\sigma_j)}{\sqrt{1 - \rho_j^2}} \text{ where } j = 1, 2$$

where $\rho_1 = \frac{\sigma_{1U}^2}{\sigma_U \sigma_1}$ is the correlation coefficient between ε_{1i} and U_i and $\rho_2 = \frac{\sigma_{2U}^2}{\sigma_U \sigma_2}$ is the correlation coefficient between ε_{2i} and U_i.

After estimating the model's parameters, the following conditional (the focus of analysis) and unconditional expectations could be calculated:

Unconditional expectations:

$$E(\ln W_{1i} \mid x_{1i}) = x_{1i}\beta_1 \tag{6}$$

$$E(\ln W_{2i} \mid x_{2i}) = x_{2i}\beta_2 \tag{7}$$

Conditional expectations:

$$E(\ln W_{1i} \mid I = 1, x_{1i}) = x_{1i}\beta_1 + \sigma_1 \rho_1 f(\gamma Z_i)/F(\gamma Z_i) \tag{8}$$

$$E(\ln W_{1i} \mid I = 0, x_{1i}) = x_{1i}\beta_1 - \sigma_1 \rho_1 f(\gamma Z_i)/\{1 - F(\gamma Z_i)\} \tag{9}$$

$$E(\ln W_{2i} \mid I = 1, x_{2i}) = x_{2i}\beta_2 + \sigma_2 \rho_2 f(\gamma Z_i)/F(\gamma Z_i) \tag{10}$$

$$E(\ln W_{2i} \mid I = 0, x_{2i}) = x_{2i}\beta_2 - \sigma_2 \rho_2 f(\gamma Z_i)/\{1 - F(\gamma Z_i)\} \tag{11}$$

Given the above formulation, the following can be calculated and compared:

- The effect of adoption on adopters (treatment effect on the treated – TT) as the difference between equations (8) and (10), which represents the effect of having irrigation on the two welfare indicators:

$$TT = E(\ln W_{1i} \mid I = 1, x_{1i}) - E(\ln W_{2i} \mid I = 1, x_{2i}) \tag{12}$$

- The effect of adoption on non-adopters (treatment on the untreated – TU) as the difference between equations (11) and (9):

$$TU = E(\ln W_{2i} \mid I = 0, x_{2i}) - E(\ln W_{1i} \mid I = 0, x_{1i}) \quad (13)$$

- The policy-relevant treatment effects can also be differentiated from the heterogeneity effect. For example, farm households that adopted micro-irrigation may have achieved a higher level of welfare (measured by the selected two welfare indicators) than farm households that did not adopt although they decided to adopt; because of unobservable characteristics such as their risk-taking behaviour. Following Carter and Milon (2005), 'the effect of base heterogeneity' (BH_N) is defined for the group of farm households that decided to adopt as the difference between equations (8) and (9):

$$BH_N = E(\ln W_{1i} \mid I = 1, x_{1i}) - E(\ln W_{1i} \mid I = 0, x_{1i}) \quad (14)$$

- The second type of base heterogeneity (BH_2) can be calculated for the group of farm households that decided not to adopt as the difference between equations (10) and (11):

$$BH_2 = E(\ln W_{2i} \mid I = 1, x_{2i}) - E(\ln W_{2i} \mid I = 0, x_{2i}) \quad (15)$$

- The third type of heterogeneity is the 'transitional heterogeneity' (TH), that is whether the impact of having micro-irrigation is larger or smaller for the farm households that owned or for the farm household that did not own in the counterfactual case that they did own, that is the difference between equations (12) and (13), i.e. (TT) minus (TU):

$$TH = TT - TU = [E(\ln W_{1i} \mid I = 1, x_{1i}) - E(\ln W_{2i} \mid I = 1, x_{2i})] - [E(\ln W_{2i} \mid I = 0, x_{2i}) - E(\ln W_{1i} \mid I = 0, x_{1i})] \quad (16)$$

The switching regression model accounts for both endogeneity of technology adoption and possible sample selection, and allows the different household and farm characteristic variables to play differential roles, both in terms of qualitative and quantitative effects on the respective varietal technologies (Fuglie and Bosch 1995; Alene and Manyong, 2007). To our knowledge, no study has explicitly accounted for underlying technological differences among farmers in assessing the effects of irrigation on the impact of household welfare.

Results and discussion

Descriptive results

Seventy-nine per cent of irrigator households are headed by males, compared to 71 per cent of non-irrigators (Table 1). In terms of literacy status, 32 per cent of irrigator household heads are literate compared to 26.7 per cent of non-irrigators. On average, irrigation adopters have a 9 per cent bigger family size than non-adopters. The overall picture indicates that the irrigators have better quality and quantity of labour that might have helped them to engage in labour and capital-intensive activities.

Non-users are located far away from a development extension office. Moreover, users are more connected to various social networks where they can get information, which might have helped them to use the irrigation service. There was a significant difference between irrigators and non-irrigators in credit utilisation. Approximately 63 per cent of irrigators had applied for credit and 58 per cent of them had access to credit service, while the corresponding figures for non-irrigators were 57 per cent and 51 per cent respectively.

Table 1: Household-, farm- and village-level characteristics of irrigators and non-irrigators surveyed in the research.

Variable	Variable definition	Irrigators		Non-irrigators		t-test
		Mean	SD	Mean	SD	
Welfare indicators						
Ln Y	Log transformed crop income (ETB)	2825.84	141.85	2534.3	101.8	-1.66**
Ln F	Log transformed per capita total asset value (ETB)	702.94	57.62	503.26	92.44	-1.84**
Household characteristics						
Headgender	Household head gender (1=male and 0 otherwise)	0.79	0.02	0.7118	0.03	-2.21**
Lnheadage	Log transformed age of the household head (in years)	52.89	0.84	52.95	0.88	0.054
HHedu	Household head literacy status: dummy (1=literate and 0 otherwise)	0.32	0.03	0.27	0.03	-1.51*
Familysize	Family size (number)	5.93	0.14	5.46	0.14	-2.33***
Adultequivalent	Family size (adult equivalent)	4.33	0.10	4.04	0.10	-1.98**
tryloan	Access to credit (if the household is credit constrained=1, 0 otherwise)	0.51	0.03	0.52	0.04	-0.23
Farm and village characteristics						
Lnplotsize	Log transformed farm size (tsemad; 1 ha=4 tsemad)	2.85	0.10	2.28	0.08	-4.43***
IrrigationUserNgb	If the household had an adopter neighbour prior to his adoption (yes=1, 0 otherwise)	0.85	0.02	0.37	0.03	-13.59***
Tabiacode	Village dummy 1=Adiqsanded; 2=Genfel; 3=Tsenkanet; 4=D.Birhan; 5=my-Kado					
Number_visits_EA	Visits by extension agents (number)	5.83	0.57	3.25	0.282	-4.48***
Lncost	Average cost per irrigation scheme (ETB)	2.46	3.4	-		
howmnysnw	In social network associations (number)	1.4	0.07	1.29	0.05	-1.365

Source: own calculations

On average, irrigators had a 25 per cent larger plot size than non-irrigators, suggesting a clear wealth difference.

There are statistically significant differences between the two groups with respect to household income and total asset holdings. The per capita asset holding was about ETB[2] 621 for irrigators, whereas for non-irrigators it was approximately ETB 361. The mean per capita consumption expenditure for irrigators was ETB 1,880 per annum, while the corresponding figure for non-irrigators was ETB 1,748. Finally, the per capita income of households using irrigation was ETB 1,473, which was approximately 37 per cent higher than that of non-irrigators. On other hand, non-irrigators had higher off-farm participation (97 per cent) than irrigators (95 per cent). With regard to off-farm income, irrigators derive slightly higher income (ETB 2,360) than non-irrigators (ETB 2,069)[3].

Econometric results

Factors affecting adoption of irrigation

The adoption of an irrigation scheme and its outcome for household welfare in terms of household income and asset formation can be modelled as a two-stage framework. In the first stage, a selection model for irrigation adoption was estimated using probit and, in the second stage, the household welfare outcome was estimated with equations using different models. The model diagnostic statistics (Table 2) show goodness-of-fit measures that indicate that the estimated models fit the data reasonably well. Likelihood ratio tests show that the parameter estimates are statistically significantly different from zero at less than one per cent significance level. The model correctly predicts 92.5 per cent of the cases; and the pseudo R-squared measure of 0.70 is also reasonably high, given the cross-sectional nature of our data.

The analysis of the probit regression shows that seven of the 11 explanatory variables are significant and most of them have the expected sign, except adult labour force, due to its high correlation with family size, and cost of irrigation, which is only observed for irrigation users. The significant variables include: neighbour irrigation user (IrrigationUserN), credit constraint (tryloan), head age (lnHeadage), family size (lnFamily_size), cost of irrigation scheme, and number of visits by extension agent (Number_visits_EA).

The parameter estimates of the probit model provide only the direction of the effect of the independent variables on the dependent (response) variable: estimates do not represent the actual magnitude of change or probabilities. Thus, the marginal effects from the probit, which measures the probability of being an irrigation user with respect to a unit change in an independent variable, was calculated using the mfx stata command.

The relationship between technology adoption and household age (Headage) has remained mixed. This result is in line with the published literature. Lapar and Pandey (1999), for adoption decisions of soil conservation in the Philippines uplands, Baidu-Forson (1999), regarding the adoption of land-enhancing technology in the Sahel; Fufa and Hassan (2006) and Chirwa (2005), in terms of fertiliser adoption in Ethiopia and hybrid seed for Malawi respectively, found negative relationships. This implies that, as farmers grow older, they become more risk averse and less willing to adopt new farming technologies. On the other hand, Polson and Spencer (1991) and Abay and Admassie (2004) found positive relationships between age and improved cassava variety adoption in Nigeria and chemical fertiliser adoption in Ethiopia respectively. Age when taken as proxy for farm experience (human capital theory) will be positive; but older farmers with a very short planning horizon and high risk averse age can be negatively associated with technology adoption (Zepeda, 1990). Hence, the sign of the household head age is very difficult to predict a priori.

The family size variable was significant (at the 5 per cent level) and positive. This is again consistent with our expectation. Developing an irrigation scheme as well as irrigable fields requires high labour input, and, in view of imperfect labour market, farmers are dependent on their family labour.

Contact with extension services gives farmers greater access to information on technology, via communications and more opportunities to participate in demonstration tests. Accordingly, access to extension services (captured by the number of visits by an extension agent) showed a positive and significant effect. The result is consistent with our expectations and the findings of Gebrehiwot (2017) who found a positive relationship between extension service and farmers' technical efficiency in the northern part of Ethiopia.

Credit is very important in that it helps farmers to acquire all the necessary inputs in the right quantities and qualities at the right time. However, when are farmers are credit constrained, consistent with our expectation, they were among the non-adopters and this result was statistically significant. Similar results were also reported by He *et al*. (2007) and Deressa *et al*. (2009).

Finally, having access to farmer-to-farmer extension (the existence of a neighbour adopter) increased the likelihood of using one of the irrigation schemes by 41 per cent, consistent with our expectation. Similar results were reported by Deressa *et al* (2009).

Table 2: Probit model estimates of adoption of irrigation schemes (Irrigation_user): marginal effects.

Variable	Marginal effects (dy/dx)
Lnheadage	5.924 (3.373)*
Lnheadage^2	-10.967 (3.373)*
Headgender	0.071 (0.098)
HHedu	0.037 (0.013)***
Familysize	0.107 (0.054)**
Adultequivalent	-0.126 (0.072)*
Lnplotsize	-0.097 (0.108)
IrrigationUserN	0.430 (0.067)***
Number_visits_EA	0.185 (0.086)**
tryloan	-0.150 (0.085)*
Lncost of irrigation	0.186 (0.019)***
Wald ($\chi^2_{0.99}$ = 11) df=186.65 Prob.>chi^2=0.0000	
Percentage of correct predictions	
Irrigation_user (I=1)	97.5%
Irrigation_user (I=0)	91.5%
Overall correctly classified	93.5%
Pseudo R^2	0.71

*, ** and *** represent significance at 0.1, 0.05, and 0.01 levels respectively
Source: own calculations

[2] Ethiopian Birr; USD 1=approximately ETB 17.12 at the time the study was conducted.

[3] Data available from the corresponding author upon request.

Welfare estimation results

The ESR model was estimated by an efficient method of full information maximum likelihood (Lokshin and Sajaia, 2004), as compared to the alternative two-step procedure proposed by Madalla (1983). The estimated coefficient of correlation between the irrigation adoption decision and the household income (ρ_{1cY}) for regime 1 and household asset formation (ρ_{2cF}) for regime 2 are statistically different from zero (Table 3). The results suggest that both observed and unobserved factors influence the participation in irrigation and welfare outcomes. The significance of the coefficient of correlation between the first stage equation and the welfare equation indicates that self-selection occurred in the participation of irrigation schemes. The differences in the household income and asset formation equation coefficients between the farm households of those participating in irrigation schemes and those not participating illustrate the presence of heterogeneity in the sample.

An important question is whether farm households that adopted the different irrigation schemes gained benefits in terms of household income and fixed asset formation (estimating impact of adoption). The results, obtained using equations (12)-(16), are presented in Table 4. The observed difference in income and fixed asset formation between households who adopt and do not adopt was 0.145 ((a)-(b) in Table 4) and 0.898 ((e)-(f) in Table 4) respectively. However, this simple comparison is misleading because it does not account for other unobserved factors that may have impacted the two outcome variables (households' income and fixed asset formation).

Hence, to account for the potential unobservable effect on the outcome variable column [3] is included which adjusts the 'base heterogeneity'[4] and gives the differences in expected household income and value fixed asset formation (Carter and Milon, 2005). With the counterfactual condition that, the adopters placed in the non-adopters status BH_{1Y} and BH_{1F} in Table 4; the households would be expected to earn 0.346 points less income and to own 0.814 points less fixed assets on average. Similarly, with the counterfactual condition that the non-adopter households adopt irrigation BH_{0Y} and BH_{0F} in Table 4 and equation (15), the households would earn more income (0.061) but own less asset (-0.053). Under both counterfactual conditions, irrigation using households perform better (with the exception of BH_{2F}) than non-irrigation using households. These differences reflect systematic sources of variation between the two groups that could not be fully captured by the observable variables in the model specifications. Information regarding adoption status alone does not explain households' performance in the two outcome indicators (Y-income and F-fixed asset formation).

Table 4 column [3] presents the treatment effects of irrigation adoption as expected change in income and fixed asset value for a randomly-selected household in each group. For the household group with access to irrigation, the first entry in column [3] measures that the mean effect of access to irrigation (*TT* in equation (12)) was an increase of 0.084 point in income and 1.051 point in fixed asset formation. Since our outcome variables are expressed in natural logarithm it represents 8.8 per cent for income and 186 per cent for asset formation. This implies that participation in the micro-irrigation programme has a positive effect on household welfare in the research area. Similarly, the households without access

Table 3: Full information maximum likelihood estimates of the switching regression model.

	Ln Y R 1	Ln Y R 2	Ln F R 1	Ln F R 2
tryloan	-0.012	0.176**	-0.056	0.316*
	(0.09)	(0.07)	(0.22)	(0.19)
headgender	0.353**	0.406***	0.995***	0.895***
	(0.14)	(0.08)	(0.32)	(0.23)
lnheadage	-0.546***	-0.860***	-1.234***	-0.960***
	(0.17)	(0.12)	(0.40)	(0.33)
Adultequivalent	0.103***	0.055**	-0.160**	-0.153**
	(0.03)	(0.02)	(0.07)	(0.06)
lnplotsize	0.624***	0.691***	0.565*	0.247
	(0.13)	(0.09)	(0.29)	(0.25)
HHedu	-0.005	0.016	0.085**	0.012
	(0.02)	(0.01)	(0.03)	(0.03)
howmnysnw	0.160	-0.117	0.033	0.033
	(0.12)	(0.09)	(0.26)	(0.24)
_Itabiacode_2	0.266*	-0.373***	-0.328	-0.553
	(0.16)	(0.11)	(0.36)	(0.29)
_Itabiacode_3	0.148	-0.126	0.082	0.184
	(0.17)	(0.11)	(0.39)	(0.28)
_Itabiacode_4	-0.140	0.031	-0.719**	-0.269
	(0.15)	(0.11)	(0.35)	(0.28)
_Itabiacode_5	0.019	-0.332***	-0.175	0.061
	(0.15)	(0.12)	(0.36)	(0.30)
$\rho_{1cY/F}$	-0.367**		0.096	
	(0.17)		(0.19)	
$\rho_{2cY/F}$		-0.176		-0.306**
		(0.14)		(0.13)

Dependent variables: ln *Y*; and ln *F* for regime 1 and regime 2
*, ** and *** represent significance at 0.1, 0.05, and 0.01 levels respectively
Source: own survey

[4] For the definition of the different heterogeneity (base and transitional) see equations (14)-(16).

Table 4: Expected income and asset level and treatment effects.

Sub-sample	Decisions stage		Treatment effect	PSM	OLS		
	Irrigation user	Non-irrigation user		ATT	Irrigation user	Non-irrigation user	Difference
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Ln Y							
Irrigation user	(a) 8.723	(c) 8.639	0.084***				
Non-irrigation user	(d) 8.375	(b) 8.578	-0.203***				
Heterogeneity effects	BH_{1Y}=0.348	BH_{2Y}=0.061	0.287	0.23**	8.62**	8.41***	0.25
Ln F							
Adopters	(e) 7.170	(g) 6.119	1.051***				
Non-adopters	(h) 6.356	(f) 6.172	0.184***				
Heterogeneity effects	BH_{1F}=0.814	BH_{2F}=-0.053	0.867	0.48***	7.09***	6.45**	0.64

Source: own calculations

to irrigation were placed into the status of with access (*TU* in equation (13)); the implication would be a mean decrease in income (0.203 points) and increase in fixed asset formation (0.184 points). Access to irrigation effects is larger for irrigation user households, resulting in a positive value for the transitional heterogeneity effect (equation (16), Table 4). The estimated treatment effects portray that, except in one case, access to irrigation places households in a better welfare position (income and fixed asset value level).

To check the robustness of our results, we estimate alternative models with different model specifications and distributional assumptions: propensity score matching (PSM) and OLS for each regime (Table 4). The results were very similar qualitatively but with lower coefficients. This could arise from differences in estimation efficiencies between ESR on the one hand and PSM and OLS on the other hand. The PSM, which estimates based on observables and does not provide consistent estimation of causal effects in the presence of hidden bias, might result in slightly downward estimates for PSM and OLS.

Summary and conclusions

To measure the impact of participation in micro-irrigation development on households' welfare we used an ESR model, which considers selection bias associated with endogeneity of programme participation as well as self-selection often encountered in most programme evaluations. A total of 482 households (195 participants and 287 non-participants) were used to generate the necessary variables. The first stage decision (whether to use one of the irrigation schemes) was estimated using household and farm characteristics covariates. Among the variables which were statistically significant and have some policy relevance are farmer-to-farmer extension service (neighbour irrigation user) and credit constraints. Hence, given the positive influence of farmer-to-farmer to disseminate information, government should encourage and support farmers' networks, in addition to the conventional extension worker-led extension system. Moreover, to encourage the use of irrigation facilities and thereby improve the income and asset position of rural households, the liquidity constraint should be addressed sustainably, through the provision of micro-credit services.

To capture the impact of the participation on household welfare, two indicators were considered, namely household farm income and household fixed asset formation (evaluated at market price during the survey period). The results show that estimated coefficients of correlation between the irrigation adoption equation and the outcome equations (income and asset formation) were statistically significant. This implies that bias would have resulted in the welfare function had it been estimated without correcting for selection bias associated with programme participation in the study.

Furthermore, the empirical results show that the probability of participating in the irrigation programme is associated with farm experience (age as proxy), household level of education, family size and labour force availability in the household, credit constraint and cost of irrigation development. After controlling the selection bias in the estimation process, the different model estimated results showed that participation in the irrigation programme had increased household welfare of participants: income by 8.8 per cent and fixed asset formation by 186 per cent as compared to non-participants. Given this, we suggest that the government of the Tigray region should extend its support (through extension, access to road and marketing information and credit schemes) so as to increase access to micro-irrigation schemes to other parts of the region and to areas with good ground water potential.

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Technical report

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An analysis using FADN methodology of Hungarian farms in the EUR 2,000-4,000 SO size class

The Hungarian Farm Accountancy Data Network (FADN) consists of around 1,600 individual and almost 400 corporate sample farms. The Research Institute of Agricultural Economics (AKI) is responsible for the collection of micro-economic data on the costs and incomes of these. The results are published annually by AKI and may be downloaded from the AKI website (www.aki.gov.hu) or requested in printed form from aki@aki.gov.hu. These farms are representative of the approximately 106 thousand commercial Hungarian agricultural producers in terms of farm type, economic size and legal form, but smaller farms are not normally included in the analysis. This report presents the results of a first attempt by AKI to apply the FADN methodology to these smaller farms.

The primary task of the Farm Accountancy Data Network (FADN) system is to provide information about the full-time, market- and profit-oriented agricultural holdings. In recent years the FADN system has received several critical comments for not providing information on the smaller farms that play an important role from the perspective of rural development. There are two main reasons for that. One is that FADN data collection rules have been set to target only those agricultural holdings which can be reached and influenced by traditional agricultural policy measures. The other is cost efficiency, as significant cost savings in one of the European Union (EU)'s most expensive data collection exercises can be achieved by concentrating only on those bigger, commodity producer holdings which are relevant to the most important indicators (output, profit generation, utilisation of human resources).

Taking into account these considerations, in 2012 and 2013 we attempted to gather information from below-threshold level farms of EUR 2,000-4,000 Standard Output (SO) size. For this, we used a simplified version of the regular FADN data collection methodology, gathering not all the financial data. On the other hand, our questionnaire was extended to include household statistics elements.

The sample was based on the 2010 Hungarian Agricultural Census, according to which there were 73,203 small farms (14.9 per cent of the total population) in the EUR 2,000-4,000 SO size category. However, their agricultural output was only 1.06 per cent of the sector's total agricultural output. Data collection was done on 300 sample farms using regular FADN selection and weighting methodology.

The size of the small farms corresponds to size class 2 of the EU farm typology. Farms with 3.1 ha of wheat, 2.3 ha of maize, 1.2 ha of grapes or fruits, one cow or four sows can fall into this category. This farm size, on the other hand, is not big enough to provide a decent living for a family, therefore it is probable that agricultural production plays rather a supplementary role in these households. The main goal is not commodity production but fulfilment of the family's own needs as well as supplementation of earnings.

The average utilised agricultural area (UAA) of the analysed farms was 1.86 ha/farm. Most (1.44 ha/farm) of the UAA was accounted for by arable land. In second place was meadows and pastures, with 0.33 ha/farm on average, while the area of permanent crops (grapes and fruits) was only 0.09 ha/farm. As regards the animal herd, there were 0.89 livestock units per farm. The most significant of these were pigs (0.28 livestock units/farm), sheep (0.25 livestock units/farm) and poultry (0.20 livestock units/farm).

The smallest farms above the FADN threshold (size class 3) cultivated more than 3.5 times as much land (6.79 ha/farm) as those in size class 2 (Table 1). The mid-size and big farms above the EUR 8,000 SO threshold had 66.9 ha of land on average. By contrast, farms of size class 2 used only 32 per cent fewer human resources for agricultural production than

Table 1: Important indicators of Hungarian farms in size classes 2, 3 and 4, 2012 and 2013.

Indicator	Unit of measurement	Class 2 EUR 2,000-4,000 SO	Class 3 EUR 4,000-8,000 SO	Class 4 > EUR 8,000 SO
Utilised agricultural area	ha/farm	1.86	6.79	66.91
Labour force	AWU/farm	0.35	0.51	2.14
Livestock	Livestock units/100 ha UAA	48.0	18.6	28.5
Total assets	HUF 1,000 per ha UAA	1,873	1,390	1,081
Gross investments	HUF 1,000 per ha UAA	59.3	31.4	100.8
Net sales	HUF 1,000 per ha UAA	555	307	454
Gross production value from agriculture	HUF 1,000 per ha UAA	694	443	605
Material costs	HUF 1,000 per ha UAA	313.4	160.3	61.4
Total costs of farming	HUF 1,000 per ha UAA	614	349	490
Pre-tax profit	HUF 1,000 per ha UAA	80.1	94.0	112.2
Pre-tax profit	HUF 1,000 per AWU	430	1,261	3,510
Return on total output	Per cent	11.54	21.19	0.19
Return on labour	HUF 1,000 per AWU	637	1,648	5,055

Source: own data

farms of size class 3, meaning that they used almost three times as much labour per hectare. Either they were involved in more work-intensive activities or they were compensating for the lack of machinery with hand work which reduced their labour efficiency.

In terms of livestock, farms below the threshold had 2.5 times as many animals per hectare as above-threshold farms, highlighting the significantly higher animal stocking density of below-threshold farms. Compared to size class 3 farms, animal husbandry in size class 2 farms was much less profitable and sometimes not profitable at all, owing to high prices of feedstuffs. Thus, the higher stocking density of the below-threshold farms was not intended to achieve higher profits, but only to satisfy the family's own needs.

Owing to the 3.5 times smaller area as projection base and to the higher animal stocking density representing higher value, below-threshold farms achieved higher sales and gross production value per hectare compared to those above the threshold level (EUR 4,000-8,000 SO). On the other hand, the rates of the material and total costs per hectare were even higher and almost double those of the values of the above-threshold farms. The lower cost efficiency caused by the smaller farm size prevailed on the analysed small farms, too.

Overall, the profitability of the size class 2 and 3 farms differed in terms of pre-tax profit by only 17 per cent (HUF 80 cf. 94 thousand per ha respectively). Thanks to the lower labour efficiency of the below-threshold farms, pre-tax profit per agricultural work unit (AWU) was only one third of that of the above-threshold farms. Differences between the two classes regarding the return on labour and return on total output were 2 and 2.5 times respectively.

Based on these data, it is evident that, owing to the low economy of scale and to the inefficient utilisation of labour, below-threshold farms were producing at high cost, hindering the profitability of their agricultural activities. In view of the seemingly high willingness to undertake livestock production despite the weak profitability, we can conclude that for farms of size class 2, self-sufficiency rather than outstanding profitability is the main motivation for production.

In the great majority of the analysed small farms, the produced goods were meant to supplement the rural household income and the own consumption of the family. Therefore, we attempted to assess the income of these households (Table 2).

The average number of people living in one household was 2.5 and the average annual net income was HUF 1,704 thousand. In those households where crop production is dominant, the annual net income was 20 per cent higher (HUF 2,051 thousand) than the average, while in households with animal husbandry or mixed farming activities net incomes were lower (HUF 1,493 and 1,582 thousand respectively).

Half of the income came from non-agriculture-related employment, indicating that this was the most important source of household income. The second most important source was pension, making up one quarter of the annual net income. Still noticeable was the income from agriculture-related employment (7.3 per cent) and self-employment (5.38 per cent).

Although these households produced a share of their foodstuffs, a sizeable amount of their incomes was spent on food. On average, 30 per cent of income was spent on food purchases but, because of the specific nature of the produced foodstuffs, for mixed farms this share was higher, at 37 per cent.

We also categorised the households according to other dominant sources of income. The relative asset value was the highest on the farms with the biggest income from self-employment. These farms are typically innovative and open to making risky investments. Conversely, the assets of farms with high social allowances had the lowest asset value. In general, these farms used more labour and fewer machines (Table 3). These differences were mirrored also in the index of gross output value per hectare. The output value of self-employed farms (HUF 1,204 per ha) was twice as much as that of farms (HUF 481 per ha) with high social security payments.

Table 2: The income situation of Hungarian size class 2 rural households, 2012 and 2013.

Indicator	Unit of measurement per farm	Total	Crop producers	Animal managers	Mixed farms
Number of family (people in a household) members	Head	2.50	2.65	2.55	2.48
of which: people between 18-62 years of age	Head	1.69	1.83	1.75	1.66
Output	HUF 1,000	1,142	1,209	1,221	969
Income from self-employment	HUF 1,000	91.8	96.6	89.6	33.9
Income from interest and rental fees	HUF 1,000	15.74	71.61	4.79	1.26
Income (wages) from agriculture-related employment	HUF 1,000	126	223	130	217
Income (wages) from non-agriculture-related employment	HUF 1,000	937	932	703	971
Pension	HUF 1,000	428	564	464	239
Social allowances	HUF 1,000	58.8	105.1	65.8	104.5
Other income	HUF 1,000	47.9	58.9	35.7	15.8
Money spent on food (gross)	HUF 1,000	516	646	484	587

Source: own data

Table 3: The most important farm indicators according to other income sources, 2012 and 2013.

Indicator	Unit of measurement	Income from			Pension	Social allowances
		self-employment	agriculture related employment	non-agricultural activities		
Utilised agricultural area	Hectare per farm	1.35	2.00	1.66	2.05	2.25
Labour force	AWU per farm	0.29	0.41	0.29	0.37	0.37
Livestock	livestock unit per 100 ha UAA	36.6	72.8	50.5	42.1	64.0
Total assets	HUF 1,000 per ha UAA	4,086	2,467	1,830	1,716	1,068
Net sales	HUF 1,000 per ha UAA	908	462	603	504	397
Gross production value from agriculture	HUF 1,000 per ha UAA	1,204	575	738	644	481
Material costs	HUF 1,000 per ha UAA	51.2	77.8	82.3	71.8	53.0
Total costs of farming	HUF 1,000 per ha UAA	725	699	688	530	438
Pre-tax profit	HUF 1,000 per ha UAA	479.6	-123.7	50.0	112.6	43.4
Pre-tax profit	HUF 1,000 per AWU	2,244	-609	286	626	264
Return on total output	Per cent	39.83	-21.52	6.77	17.50	9.01
Return on labour	HUF 1,000 per AWU	2,244	-258	573	791	436

Source: own data

AKI-NAK-FAO REU conference report

The environmental sustainability dimension of short-term outlooks for agricultural markets

Budapest, 9 May 2017

In Hungary, there is yet little awareness among stakeholders concerning the effects of agricultural production on natural resources. Sustainability issues are gaining more importance, and regulations aimed at mitigating the negative environmental impacts of the sector, as well as voluntary standards reflecting commitments, will inevitably influence market developments even in the near future. To this end, AKI, in cooperation with the FAO Regional Office for Europe and Central Asia (REU) and supported by the Hungarian Chamber of Agriculture (NAK), brought together experts from across Europe as speakers who, from their professional experience, shed light on agricultural market trends in the context of environmental sustainability, focusing on the animal feed and livestock product chains. The conference, which had almost 300 registered participants, offered unique industry insights: it drew the attention of stakeholders to the challenges posed by environmental sustainability requirements, both governmental and in the frame of Corporate Social Responsibility, and considered innovative ways and means to cope with these challenges to enhance competitiveness.

Participants were welcomed by Feldman Zsolt, Deputy State Secretary for Agricultural Economy at the Hungarian Ministry of Agriculture, Balázs Győrffy, President of NAK, and Vladimir Rakhmanin, FAO Regional Representative for Europe and Central Asia, whose presentation entitled *Sustainability and agriculture – FAO perspective* elaborated on the issues of sustainable development, particularly in the context of the UN 2030 Agenda.

Opening the first block of four specialist speakers, Guljahan Kurbanova from FAO presented the *Outlook for cereal markets in Europe, North Africa and the Middle East with a focus on protein content and mycotoxin contamination of feed stuffs*. A number of urgent and comprehensive measures should be taken to mitigate and eliminate safety risks in the feed supply chain with priorities on research, and control measures and adequate investments.

Nicolas Martin of the European Feed Manufacturers' Federation discussed *The importance of bio-industry co-products for the sustainability of the compound feed industry*. Many co-products from other sectors are already used as feed ingredients. To describe the resource efficiency of the industry, new indicators are required which go beyond the feed conversion rate and capture the nature of the resources used.

In his presentation entitled *Environmental sustainability of US soybean production*, Brent Babb of the U.S. Soybean Export Council introduced the U.S. Soy Sustainability Assurance Protocol (SSAP), a certified aggregate approach audited by third parties. The approach is quantifiable and results-driven with mass balance international certification available. Over 9 million tonnes of SSAP certified soy were shipped in this marketing year.

Elisabeth Bömcke of Fertilizers Europe spoke on *Nitrogen fertiliser management strategies*. In order to understand more clearly the challenge posed by environmental sustainability requirements and their influence on near-future market development, her presentation provided some insight on how the European regulations designed to mitigate the negative environmental impacts of the agricultural sector have affected the use of fertilisers in the EU-15.

The first speaker in the second block was Richard A. Brown from Gira, the international food research and consultancy firm. He provided an *Outlook for European meat value chains from the aspect of environmental sustainability*, in which he commented on the size, structure and growth outlook of meat production in the European Union (EU). Environmental sustainability is well articulated in the EU but is still a major challenge.

The rise of the Spanish pig sector: how can integrations contribute to environmental sustainability? was the question posed by Pablo Bernardos Hernández from the Spanish Ministry of Agriculture and Fisheries, Food and Environment. He reviewed the main challenges facing the Spanish pigmeat sector in the short and medium terms, with a particular focus on the environmental challenges.

From Wageningen University & Research, Roel Jongeneel described the *Regionalisation in EU milk production and its environmental implications*. Based on a market outlook analysis at EU Member State level, he provided insight into the main drivers behind the regionalisation process and assessed the environmental implications, as well as the impact policy may have in counteracting specialisation trends since milk quota abolition.

The topic covered by Nan-Dirk Mulder of Rabobank was *Dealing with global food supply challenge: precision farming and environmental sustainability*. With rapidly rising global food demand and limited resources, governments and industries need to invest in smarter farm and value chains systems such as precision farming. There will be more direct linkages between grain surplus meat exporters and grain deficit importers.

Fernando Cisneros of DSM Nutritional Products concluded block 2 with his presentation on *Sustainability and environmental impacts of feed additives*. DSM is developing sustainable science-based nutrition solutions for producers worldwide that enable the production of dairy, meat and fish protein products for a growing population.

Juhász Anikó, General Director of AKI, offered some closing remarks on the morning session. In the afternoon two parallel group discussions were held, on Environmental sustainability of crop production, and livestock production, respectively, in Hungary.

The conference presentations can be downloaded in pdf format from https://goo.gl/o9TW3e

Abstracts of AKI publications

The results of AKI's research work are presented in detail in a series of Hungarian language publications. English language abstracts are reproduced below. The publications may be downloaded from the AKI website (www.aki.gov.hu) or requested in printed form from aki@aki.gov.hu.

STUMMER Ildikó (ed.)

The market developments of the most important agricultural commodities in 2016

Agroeconomic Information, published 2017

This publication discusses the market developments of the most important agricultural commodities in 2016, mainly by presenting price trends. The material is based on the price information and data of the Market Price Information System of the Research Institute of Agricultural Economics, and of various Hungarian and international sources. The producer price of milling wheat decreased by 15 per cent to HUF 41.2 thousand/tonne in 2016, while it fell for feed wheat by 14 per cent to HUF 38.4 thousand/tonne. The producer price of feed maize remained almost unchanged at HUF 41.4 thousand/tonne in 2016. Sunflower seed was 3 per cent cheaper (HUF 104.6 thousand/tonne) in 2016 compared to 2015, while the producer price of rapeseed declined by 2.5 per cent to HUF 109.5 thousand/tonne. In Hungary, 1076 thousand tonnes sugar beet were harvested in 2016, an increase of 18 per cent over 2015. As in previous years, in 2016 Hungarian pork prices tracked the prices in the European Union. The pig producer price was HUF 453 per kilogramme warm carcass weight, 5.9 per cent higher than one year earlier. The producer prices of slaughter chickens increased by 3 per cent compared to the previous year, to HUF 254 per kilogramme in 2016. In Hungary, the cattle and lamb producer prices fell by 8 and 4.4 per cent respectively in 2016, while the raw milk price decreased by 8 per cent. The production of fruit and vegetables increased in 2016 compared to 2015, and the producer prices decreased by 15–17 per cent. The processors' sale prices of wines without geographical indication and wines with protected geographical indication (PGI) increased by 4 per cent in 2016 compared to the previous year.

KESZTHELYI Szilárd

Results of Hungarian FADN farms 2014

Agroeconomic Information, published 2016

The brochure presents the results generated from the data of 1,608 individual and 374 corporate sample farms. The selected sample farms are representative of the 110 thousand commodity producer agricultural holdings in Hungary according to farm type, economic size and legal form. At national level, the individual farms contributed 51.4 per cent of the overall net value added of the sector, while corporate farms accounted for 47.4 per cent. The shares in the previous year were very similar. The profitability of the agricultural sector increased significantly in 2014; the net value added at country level was 8 per cent higher than the previous year. The profit before taxes of individual farms grew by 3 percentage points (HUF 141.8 thousand per hectare), while for corporate farms the rate of growth reached 20 percentage points (HUF 93.24 thousand per hectare). The biggest increase in income was achieved by pig farming (90 percentage points), followed by poultry (25 percentage points), dairy (24 percentage points) and mixed farms (28 percentage points), but the profitability of arable crops and cattle and sheep rearing farms also witnessed strong growth (8 and 12 percentage points respectively). The vine growers suffered the biggest decrease in income (53 percentage points) followed by fruit producers (35 percentage points) and field vegetables growers (12 percentage points). Indoor vegetable farms experienced a much moderate decline in income (6 percentage points) compared to 2013.

KEMÉNY Gábor, LÁMFALUSI Ibolya and MOLNÁR András (eds)

Comparative study of precision arable crop production

Agroeconomic Book, published 2017

The use of precision technology among arable farms is still less widespread in Hungary but the increase in the number of producers using the technology has accelerated in the last two-three years. In this study, the incidence of precision and no tillage farming in Hungary and the level of used technology was examined among arable farms of the Hungarian Farm Accountancy Data Network (FADN) system by means of a questionnaire survey and in-depth interviews. From the results of the survey and the data available in the FADN system, comparative assessment was completed to explore the benefits / disadvantages of precision farming regarding attainable yield, input use, output, unit cost and income for the five most dominant arable crops in Hungary. The results confirmed that application of precision technology leads to increasing yields, output, per hectare profit and unit costs. In contrast to expectations, our investigations also showed an increase in input costs, which can be explained by the low initial level of input use, quite common among arable farms in Hungary. The change towards modern technology means that the intensity of input use needs to increase in order to achieve optimal economic performance, that is attainable with higher yields. With the available data, we carried out sector-level estimates of the macroeconomic effects, assuming farms with similar structural characteristics introduce precision farming. Finally, the cost-benefit of investment needed for the introduction of precision technology was assessed.

BÉLÁDI Katalin (ed.)

The cost and income situation of the major Hungarian agricultural products in 2013-2015

Agroeconomic Information, published 2017

This publication examines the cost and income situation of the major agricultural products in the period 2013-2015 on the basis of data from the farms of the Hungarian FADN system. The processed data concerns the so-called 'determinant producer farms' that provide the dominant part of domestic production. In addition to the mean data, the results of different farming groups are presented. The changes in the cost and income situation of arable crops, horticultural products (fruit and vegetables) and livestock products are analysed in separate chapters. The period under review was characterised by favourable weather conditions. In many cases, there were record yields in either 2014 or 2015. The changes in the amount of expenses were different, therefore the unit costs were also very different, especially in horticulture. Owing to subsidies, enterprises made a per-hectare profit in the case of all crops. This indicator presented different results for the livestock sectors. It is important to note that the profit of pig fattening constantly declined, counter to the situation with chicken fattening.

JANKUNÉ KÜRTHY Gyöngyi, SZÉKELYHIDI Katalin and Dudás GYULA (eds)

Examination of the factors influencing the agri- and food exports of Hungary

Agroeconomic Book, published 2017

Recent decades have been characterised by deepening trade connections and the elimination of trade barriers. There are more and more trade agreements among countries, and their integration is becoming deeper and deeper. Nowadays not only tariffs, but non-tariff barriers are essential parts of trade negotiations. This process is continuous as ongoing negotiations between countries and regional blocs proceed, for example between the European Union (EU) and third countries. Hungary's most important market is the EU, the destination for 85 per cent of its exports. These processes make it necessary to identify and examine those factors that influence foreign trade flows, especially for Hungary. In this study, we analysed almost 200 countries and organised them into separate regions based on their geographical location and political affiliation. Among others, we examined their macroeconomic environment, the importance of their food economies, foreign trade relations, trade agreements, tariff rates, SPS measures, and other non-tariff barriers of each region. We also used a gravity model to explain the foreign trade of Hungary's food economy. Our results suggest that distance, tariffs and non-tariff barriers are serious obstacles to trade. They seem to confirm many countries' efforts to establish deeper cooperation, not just to reduce tariffs but also non-tariff barriers, which often remain after tariffs are eliminated. The country analysis confirmed the results of the model. We also identified possible target markets and the barriers than could impede entry to them. In addition, we determined development areas for Hungary to improve its food exports.

BÉLÁDI Katalin

Cost and income data of the major products of Hungarian food industry 2014-2015

Agroeconomic Information, published 2017

This publication presents data about the production costs and sales income of the food industry's most important products in 2014 and 2015 compared to 2013. Firstly, the price changes of the major food product groups are briefly summarised and, secondly, tabulated data of individual food products are presented. These data show a general decrease in the production costs of meat products in 2015. It is the usual tendency that market prices followed trends in production costs in the case of almost all products. In the case of many meat industry products, the costs decreased more than the prices, so the profits were lower. In the poultry, dairy, milling and baking industries, as well as in the production of pasta products, there are decreasing raw material costs in different levels compared to the previous period, and the total production costs are also lower. In the milling industry, each observed product was profitable in 2015. The mildest degree of price and cost changes was in the baking industry, and the data of the products are still quite diverse.

KEMÉNY, Gábor and LÁMFALUSI, Ibolya (eds)

Evaluation of the operation of the agricultural risk management system, 2016

Agroeconomic Book, published 2017

This publication presents the achievements and the operation of the risk management system in 2016. In the first pillar, the number of farmers and the compensation contribution increased due to some recent, favourable changes in the risk management system's regulations. In the weather conditions of this year, drought was of no significance compared to 2015, but hail and spring freezing caused serious damage. In total, the area of damage and the amount of contribution benefit substantially increased in 2016 compared to the previous year. Small and medium-sized fruit farmers mostly received the benefit. The number of farmers with subsidised insurance in the second pillar, together with the fee-stock and the compensation, increased considerably. All three categories increased the fees by over 30.0 per cent. The penetration in land area improved for all crops. The insurance compensation and the loss rate significantly increased, mainly for arable crops and plantations where hail, spring freezing and storms caused the most damage. The insurance premium subsidy increased from HUF 3 billion to HUF 4 billion in 2016 and was temporarily financed by the budget of the Rural Development Programme 2014-2020. The claims for subsidies again exceeded HUF 4 billion, so in 2016 it was necessary to redistribute the compensation, just as in the previous two years

ILLÉS Ivett and KEMÉNYNÉ HORVÁTH Zsuzsanna

The financial situation of agriculture and the food industry, 2016

Agroeconomic Information, published 2017

In this study, we examined the financial situation of corporations in agriculture and the food industry with double-entry bookkeeping in 2016 compared to the previous year. The 9,712 agricultural corporations accounted for 4.2 per cent of the total economy and 4.5 per cent of the profitable companies in 2016. Food industry corporations had a 2.3 per cent share of the total number organisations and a 2.1 per cent share of the profitable companies. The profit before tax of agricultural corporations did not change significantly: it increased from HUF 103.4 billion to HUF 105.4 billion. The profit before tax of the food industry organisations increased from HUF 129.8 billion to HUF 149.4 billion. In the food industry sectors, the financial operations increased significantly, and thus changed from being negative to positive. The income situation of agricultural corporations was as favourable as in the previous year, as the returns on sales and equity remained around 5 per cent in 2016. The income situation and liquidity of the food industry continued to improve: the sectors' returns on sales rose by 0.5 percentage points. Owing to the structural changes in equity, as rising shareholders' equity and declining liabilities, the level of indebtedness of the sector decreased.

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