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Foreword

The year 2019 has been very busy and brought a wide range of changes in the life of Studies in Agricultural Economics. In line with the plans described in the foreword of the issue published a year ago, 120-3, changes in three areas have become apparent. First of all, the focus of the journal has been extended to Europe and Central Asia (ECA) from its former focus (Central and Eastern Europe). Second, we have modernised our website which is now in line with international standards. Third, the Editorial Board has also been reorganised together with the abolition of our Editorial Advisory Panel. We give special thanks for all the out-going members of the Editorial and Advisory Board for their work and continuous efforts in increasing the scientific value of Studies of Agricultural Economics. Based on the above, applications for obtaining a Thomson Reuters impact factor as well as a Scimago Q value have been submitted.

I think the last issue of 2019 well reflects the diversity of agricultural economics by offering papers and topics on a wide range of issues. The first paper, written by, Haas, Imami, Miftari, Ymerie and Grunert, analyses how Kosovar and Albanian consumers perceived food quality and safety in the dairy sector. Their surveys, targeting more than 600 consumers, suggest that despite the prevalent problems with food safety, Kosovars perceive domestic dairy products as significantly better than Albanians do in respect of imported food products. On the other hand, Albanian consumers use food safety and quality related information about cheese and milk more often. The most frequently used safety and quality cues for both samples are expiry date, domestic and local origin and brand reputation. Moreover, food safety certificates are more often used by Albanian than Kosovars, and international food standards such as ISO, HACCP or Global GAP are mostly unknown by both consumer groups.

The second paper, written by Cela, Zhllima, Skreli, Imami and Chan, also focuses on Albania and analyses the consumer preferences for goatkid meat in the country. A Conjoint Choice Experiment was utilized to design the survey and a Latent Class Analysis Model to analyse the results of a survey carried with 250 residents living in urban areas of Tirana. Origin was found to be the most important factor for all consumer classes and therefore the authors recommend the intensive use of labelling and other marketing tools to inform consumers of the products' origin.

The third paper, written by Bajrami, Wailes, Dixon, Musliu and Durand-Morat, investigates whether coupled subsidies increase milk productivity, land use, herd size and income in Kosovo. By using a Propensity Score Matching approach for data on 2013–2014 farming seasons, the authors show that a subsidy per head scheme was not effective in increasing land use, gross income and farm size, although it had a limited impact on improving milk productivity. The authors highlight the need to reformulate coupled subsidies and develop new, complementary strategies that address farmers' needs more efficiently.

The fourth paper in this issue, written by Galluzzo, provides an analysis of technical efficiency in Icelandic dairy and sheep farms through the use of the non-parametric approach of Data Envelopment Analysis. The research findings have highlighted the need for farmers to reduce certain inputs such as labour costs and general productive overheads, as well as to address their efforts to extensive forms of livestock farming, notably sheep rearing that is able to take advantage of the abundant and rich grasslands. In general, sheep farms have been found to be more technically efficient than dairy, while farms located in the capital region have been shown to have lower levels of technical efficiency overall.

The fifth paper, written by Sinha and Laha, investigates food price shocks and changing consumption expenditure patters in India by applying a difference-in-difference analysis. Results suggest that consumption expenditure differs in both spatial (rural and urban) and temporal (pre and post-2008) dimensions; specifically, the relative loss of consumption expenditure is significant in urban regions in comparison to rural regions in post-2008. Moreover, the authors found a declining trend in the availability of food grains in the post-reform period in India, which can be explained by the encouragement of the export of food grains due to comparative advantage of India vis-à-vis international market in the pricing of food grains.

The remaining two short communications, written by Urbancova and Balogh, analysed the working time organisation of senior workers in agricultural companies in the Czech Republic as well as the agriculture-specific determinants of carbon footprint, respectively. As to the former, survey results suggest that three factors were responsible for working time organisation in Czech agricultural companies: support of flexible employment forms, employee productivity and the use of specialists. The author suggested that right working time organisation of all age groups supported the cooperation of all employees and ensured knowledge continuity. As to the latter, Balogh employed a feasible generalized least squares estimator along with panel unit root tests on 1961-2013 data to explore what agriculture-specific factors influence the carbon footprint at a global level. Results show that carbon footprint is stimulated by economic development and agricultural production as well as agricultural export, while the growth of carbon footprint is negatively related to the higher share of rural population and agricultural development.

On the whole, I hope we succeed in our ambitious goals and that our work is respected by the international scientific community. I wish Merry Christmas and a Happy New Year to all of our readership.

Attila JÁMBOR
Budapest, December 2019

Rainer HAAS*, Drini IMAMI, Iliriana MIFTARI***, Prespa YMERIE*** and Klaus GRUNERT******

How do Kosovar and Albanian consumers perceive food quality and safety in the dairy sector?

Kosovo and Albania, in a manner similar to other Western Balkan countries, face serious challenges in relation to national food safety and control in terms of legislation, infrastructure, institutional capacity and private investments. Consequently, food safety is a major concern for consumers in this region. The objective of this study was to gain a better understanding of consumer perspectives on food safety and quality. Two surveys, one with consumers in Prishtina and one in Tirana, targeted more than 600 consumers. Despite the prevalent problems with food safety, Kosovars perceive domestic dairy products as significantly better than Albanians do when compared with imported food products. Conversely, Albanian consumers use food safety- and quality-related information about cheese and milk more frequently. The most frequently used safety and quality cues for both samples are expiry date, domestic and local origin and brand reputation. Food safety certificates are used by Albanians more often than by Kosovars, and international food standards such as ISO, HACCP or Global GAP are mostly unknown to both consumer groups.

Keywords: dairy sector, food safety, food quality, cheese, Albanian consumers, Kosovar consumers

JEL classification: Q13

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Introduction

The livestock sector, in a manner similar to other Western Balkan Countries, is the most important agri-food sector in Albania and Kosovo, representing up to half of the output value of agriculture. The dairy market is one of the fastest growing agri-food sectors in the region, while cheese making is the most prominent activity in the dairy industry. Cheese is one of the main food items of the local household's consumer basket, predominantly produced locally. The two main types of cheese consumed in Albania and Kosovo are white (feta-like) and Kashkaval (hard yellow cheese) (Imami *et al*., 2016a). The amount of international trade in cheese is very low in the region - imports, on the one hand, cover about 10% of the market, while exports, on the other hand, are of low importance due to high dairy production costs, lack of compliance with international safety standards and gaps in marketing, certification and branding. Consequently, the domestic market is and will remain the most important market for the local dairy industry (Imami *et al*., 2016a).

While cheese sold in supermarket chains is usually sourced from agroindustry, it is commonly found that cheese produced informally by farmers or small informal processors is sold in small neighbourhood shops or fresh markets. There have been claims about the undeclared use of powdered milk and the production and sales of contaminated milk in Albania, as is evident from Albanian daily newspapers (Imami *et al*, 2016b). Generally, cheese produced using fresh milk is considered superior, while there are concerns about the type/quality of powdered milk. However, there are serious problems regarding fresh raw milk production as well (e.g. microbiological contamination). Compliance with international standards, and especially EU standards, is becoming even more important when one considers the EU accession plans of the West Balkan Countries (WBCs).

Despite the importance of the livestock and specifically, the dairy sector within the agri-food sector and the significance of concerns relating to food safety standards, there is limited researcher understanding about consumer awareness and perceptions of food safety standards in the Western Balkans. This paper aims to fill in this gap by providing insight into consumer behaviour relating to food safety in the region, which might be of interest to policy-makers as well as private sector actors.

The paper is structured as follows. Section 2 provides a literature review on food safety with focus on WBCs, Section 3 describes the methods, Section 4 provides the results, whereas Section 5 consists of discussion and conclusions.

Literature review on food safety with focus on WBCs

Developing and transition countries face serious challenges relating to food safety arising from weak animal disease controls, in which have caused a higher prevalence of endemic infectious animal diseases. Another major concern in developing or transition economies are the high levels of mycotoxins or aflatoxins (among the most potent mutagenic and carcinogenic substances known); high temperatures, moisture and unseasonal rains during harvest, poor harvesting and storage conditions all contribute to higher levels of mycotoxins, which are transmitted to dairy products (Bhat and Vasanthi, 2003).

Western Balkan Countries (collectively, one of the poorest regions in Europe) face serious problems with their national food safety control systems in terms of legislation, infrastructure, institutional capacity and enforcement, and related private investments, the effects of which pose both real and perceived safety risks for consumers. The problems in the Agricultural Health and Food Safety System have been identified by several studies, especially in the meat (Imami *et al*., 2011) and dairy sectors (Gjeci *et al*., 2015; Zhllima *et al*., 2015; Haas *et al*., 2016, Udovicki *et al*., 2019). Brucellosis and aflatoxin production has been a major health concern for small dairy farmers (Gjeci *et al*., 2015), while similar concerns are being raised in Serbia (Udovicki *et al*., 2019). One of the reasons for this situation, in addition to weak law enforcement, is limited farmer awareness about animal diseases and food safety standards and their consequences in terms of health risks for farm households and end consumers (Gjeci *et al*., 2016).

The described food safety problems are not unknown to local consumers – indeed, food safety is a major concern for local consumers in the region (Zhllima *et al*., 2015). Origin and food safety certificates are among the most important attributes to guarantee food safety and quality according to Kosovo consumers, and for most of the consumers brands are an important means to communicate food safety (Haas *et al*., 2016).

In general, we know that consumers use quality cues, which often represent a bundle of information, to reduce the complexity of their food choice. Cues are used by people when forming beliefs about objects which, in turn, influence their behaviour with respect to those objects (Eroglu and Machleit, 1989). Quality cues can be communicated over labels, brand names, food certification standards or country of origin (Marchesini *et al*., 2007). Country of origin is a quality cue, which influences purchase decision even for low involvement food products (Ahmed *et al*., 2004). Some of these quality cues are experience attributes like taste, or freshness, which you can only verify after use, others are search attributes like price or brand name and often there are credence attributes like food certification standards where the consumer has to believe in the correctness of the auditing process (Srinivasan and Till, 2002). By default, food safety is hardly considered as an experience attribute but rather as a credence attribute – in developed countries with consolidated institutions, consumers may trust public institutions and/or supermarket chains to guarantee food safety.

In the case of countries with weak institutional framework, such as the Western Balkan Countries, the level of trust in public institutions to guarantee food safety may be lower. Imami *et al*. (2011) have found that consumers trust more in the retailer than in institutions for guaranteeing food safety, and that when possible, consumers prefer to buy food directly from producers as a strategy to ensure safety and quality (Imami *et al*., 2013). There is a competency gap between the generic knowledge for manufacturing food products and the specific knowledge necessary to implement food safety management systems in Serbian dairy industry, but increased customer confidence and working discipline of staff employed in food processing are important in the process of Hazard Analysis and Critical Control Points (HACCP) implementation (Tomasevic *et al*., 2016). On the other hand, the biggest knowledge gaps in the case of food handlers in Serbia relate to temperature control and source of food contamination (Smigic *et al*., 2016).

Perception of food safety is affected also by socio-demographic factors. Gender and education levels are expected to correlate to consumer food safety perceptions - female and educated consumers are expected to show a higher awareness of food safety issues in line with findings from previous research work (Nganje and Katibie, 2003; Zhllima *et al*., 2015).

Overall, there is a lack of research and understanding on consumer behaviour and perceptions in West Balkan countries regarding emerging concerns related to food safety and quality. Furthermore, previous studies focused generally on single WB countries – our study tends to address this weakness by providing research findings on a comparative basis for Albania and Kosovo. In this paper we use milk and cheese products as a representative product category, for which food safety is very sensitive, in order to measure the perception of consumers about quality and safety standards in the dairy sector.

Method, data and descriptive statistics of the sample

In order to gain a better understanding of consumer perspectives on food safety and quality issues, a quantitative, structured survey with consumers from Albania and Kosovo took place in spring 2019. The questionnaire included questions about consumers' consumption habits and attitudes towards the quality and safety of dairy products. For the structured survey, a questionnaire was designed based on literature review and expert interviews to gain insights on the level of food safety in the agri-food sector and about consumer knowledge and preferences concerning food safety and food quality.

In the questionnaire two important item batteries measured food safety and quality perception. The first one was a 5-point Likert scale for food safety and quality perception of domestic milk and cheese taken from Bruner (2011). The second item battery presented a list of quality and safety attributes and asked the consumers in case they want to know about safety of cheese, which of these attributes do the check. The answer measured the frequency from 1 = never to 5 = always.

Pre-test interviews of the questionnaire took place in Pristina and Tirana with randomly selected consumers. The interviews were carried out by experienced graduates/students with equal share of interviews. Interviewers were trained by the authors of this paper while they were assisted and supervised throughout the survey implementation. Distribution of the sample was based on a convenience sample technique without using quotas. The face-to-face interviews took place on public places and market squares in Prishtina (Kosovo) and Tirana (Albania) between April and May 2019. The foreseen sample size was 300 interviews for each country. Monovariate and multivariate techniques following

the approach of Wongprawmas *et al*. (2018) were applied for data analyses.

In total 642 valid questionnaires were collected from the interviews in Prishtina (299 interviews) and Tirana (343 interviews). At the beginning of the questionnaire four questions were asked to make sure that the respondent is responsible for food shopping, especially milk and cheese, and cooking. From these four questions we calculated a sum of the responses for each respondent and excluded respondents with a score less than 7. Seven consumers of the 649 were excluded from further analysis. On average, there were 38% male and 62% female consumers in the sample. This is in accordance with literature that more females than men are involved in food preparation.

Concerning age groups, Prishtina and Tirana had comparable frequencies, except Tirana had double the number of consumers over 65. The mean age for respondents from Prishtina was 42.4 and from Tirana 43.9 (Table 1).

Regarding education, there was a significantly higher share of consumers in the middle school category in Prishtina, while in Tirana, the number of consumers with high school and university degree was slightly higher. On average, half of the respondents had a university degree.

The distribution of household members shows typical characteristics of WBCs with fewer single households and a higher share of households with five or more people. In Austria, for example, there are only 6% of the households with more than five people compared to 65% in Prishtina, and 37% single households in Austria compares to 1% in Prishtina (Statistik Austria, 2018). Prishtina had in average 5.2 household members and Tirana 3.8.

Figure 1 shows the household income distribution of both samples. For further analysis we combined the groups of 150 to 800 Euro into the low income group, 801 to 1200 the middle income group and above 1200 Euro per month, we defined as high income groups. Concerning household income Tirana had almost double the share of low-income groups than Prishtina and a significantly lower share of middle- and high-income groups (Figure 1). On average, a household spent €299 for food per month, while 68% of respondents spent between €150 and €450 for food per month.

Table 1: Number and share of respondents by age group.

City	Age Groups				
	19-24	25-54	55-64	65>	Total
Prishtina	27	206	43	18	294
% within city	9.2%	70.1%	14.6%	6.1%	100.0%
Tirana	38	201	53	44	336
% within city	11.3%	59.8%	15.8%	13.1%	100.0%
Both cities	65	407	96	62	630
% within city	10%	65%	15%	10%	100%

Source: own composition

Table 2: Number and share of respondents by number of household members.

	Single	2 People	3 people	4 people	5 people or more	Total
Prishtina	3	11	23	64	194	295
% within city	1.0%	3.7%	7.8%	21.7%	65.8%	100.0%
Tirana	14	62	57	100	105	338
% within city	4.1%	18.3%	16.9%	29.6%	31.1%	100.0%
Total	17	73	80	164	299	633
% within city	3%	12%	13%	26%	47%	100%

Source: own composition

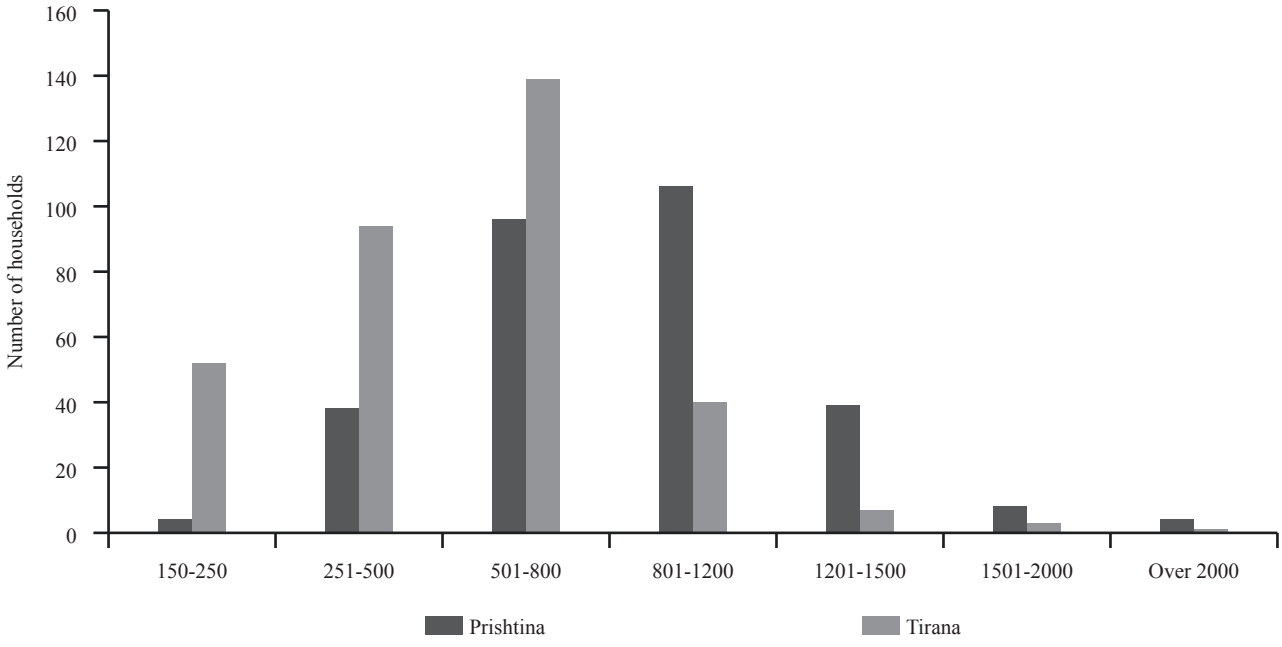

Figure 1: Household Income Groups for Prishtina and Tirana.
Source: own composition

Perception of domestic cheese and milk safety and quality

We ran a series of Analysis of Variance (ANOVA) tests with selected socio-demographic variables (gender, age and education, household income) and the safety and quality perception scale (Bruner, 2011). Before doing so, however, we applied a Principal Component Analysis (PCA) to the scale to see if all items were loading on the same factor. The PCA showed that all items loaded on one factor, the Kaiser-Meyer-Olkin (KMO) value was 0.8, which is an excellent value for the factor loading. The communalities were all high, indicating that the extracted factor represented the variables well. Due to the fact that all variables were loading on one factor, we calculated a mean value over all variables, which we also tested later for significant differences between socio-demographic variables.

Our underlying assumption was that there was a difference in the perception of domestic cheese and milk with respect to socio-demographic variables. In order to test this, ANOVA was applied combined with post-hoc tests for multiple comparisons. In case of homogeneous variances, the Hochberg GT2 test was used (because the number of cases in the sub-samples were different), while in the case of no homogeneity, we applied the non-parametric Tamhane test.

We found *no significant differences between male and female consumers and between age groups* concerning the domestic origin of food and its safety. Neither gender agrees or disagrees that buying milk from farmers is safer compared to milk from the factory. We measured education with four different categories, which we combined into two groups of consumers, one with lower (basic and middle school) and one with higher education (high school and university) for further analysis. *No statistical difference was found between lower and more highly educated consumers* concerning quality and safety of domestic cheese and milk. Both groups perceive domestic cheese and milk as safer and or of better quality when compared to imports. The only significant difference was for the statement "Imported cheese is of high quality" - lower educated consumers perceive imported cheese of inferior quality, whereas more highly educated consumers are indifferent about it. There is neither agreement nor disagreement that buying cheese from the farm is safer than buying cheese from the factory.

Concerning income, all income groups see domestic cheese and milk as safer and of higher quality than imported cheese and milk. The ANOVA analysis showed significant differences between lower income groups versus middle and higher income groups in respect to quality and safety of domestic cheese. Higher income groups perceive domestic cheese as safer and of better quality (Table 3). All three of the income groups are indifferent as to whether the quality of imported cheese is better, and believe that buying milk from the farmer is safer than buying milk produced at the factory.

As a next step, we tested for statistically significant differences between Kosovar and Albanian consumers and how they perceived the quality of domestic cheese and milk by using the safety and quality scale from Bruner (2011). Our underlying assumption was that Kosovar and Albanian consumers perceived the quality and safety of domestic versus imported cheese/milk different. ANOVA showed that all statements were significantly different except for "Imported cheese is of high quality" (Table 4).

The mean values between the two consumer groups from Prishtina and Tirana show that Kosovar consumers perceive domestic dairy products over all items (except imported cheese) as being both safer and of higher quality than Albanians do. The mean values with lower and upper bounds for Tirana show that Albanian consumers are either indifferent or slightly positive about the quality of domestic cheese and milk.

In order to gain additional information about the perception of cheese bought at the supermarket or the traditional local shop, respondents were asked to agree or disagree with several statements on a seven-point scale (from strongly disagree = 1 to strongly agree = 7). ANOVA showed that differences between Kosovars and Albanians are highly significant (Table 5).

Kosovar respondents see the quality of cheese bought in the supermarket as being more critical than Albanians do. When asked to indicate their agreement to the same statements in respect to a local traditional store, the results were the same. Kosovars perceive the safety and quality of cheese bought at the local store to be more inferior than Albanians do.

Table 3: Consumer perceptions on safety and quality of imported cheese.

Domestic cheese is safer than imported cheese				
Indicator	Income household 3 groups	N	Subset for alpha = 0.05	
			1	2
Hochberg[a,b]	Low Income	428	3.6355	
	Middle Income	148	3.8041	3.8041
	High Income	64		4.0313
Domestic cheese is of higher quality than imported cheese				
Indicator	Income household 3 groups	N	Subset for alpha = 0.05	
			1	2
Hochberg[a,b]	Low Income	428	3.6495	
	Middle Income	148		4.0338
	High Income	64		4.1875

Note: Means for groups in homogeneous subsets are displayed.
Source: own composition

Table 4: ANOVA results for differences between Kosovar and Albanian consumers.

Categories		Sum of Squares	df	Mean Square	F	Sig.
Mean domestic safety (all)	Between Groups	69.468	1	69.468	114.099	.000
	Within Groups	393.917	647	.609		
	Total	463.384	648			
I prefer to buy milk from farmer	Between Groups	56.323	1	56.323	25.417	.000
	Within Groups	1433.745	647	2.216		
	Total	1490.068	648			
Domestic cheese is safer than imported cheese	Between Groups	106.846	1	106.846	72.926	.000
	Within Groups	947.943	647	1.465		
	Total	1054.789	648			
Domestic milk is safer than imported milk	Between Groups	129.053	1	129.053	87.548	.000
	Within Groups	953.736	647	1.474		
	Total	1082.789	648			
Domestic cheese is of higher quality than imported	Between Groups	188.053	1	188.053	157.540	.000
	Within Groups	772.314	647	1.194		
	Total	960.367	648			
Domestic milk is of higher quality than imported	Between Groups	131.034	1	131.034	99.638	.000
	Within Groups	850.867	647	1.315		
	Total	981.901	648			
Imported cheese is of higher quality	Between Groups	.091	1	.091	.083	.773
	Within Groups	705.022	647	1.090		
	Total	705.112	648			
Buying milk from farmer is safer than buying milk produced in factory	Between Groups	18.335	1	18.335	9.734	.002
	Within Groups	1218.651	647	1.884		
	Total	1236.986	648			

Source: own composition

Table 5: ANOVA results on cheese bought at the supermarket.

Categories		Sum of Squares	df	Mean Square	F	Sig.
The cheese I have bought today is not safe	Between Groups	1348.657	1	1348.657	951.625	.000
	Within Groups	763.879	539	1.417		
	Total	2112.536	540			
The cheese I have bought today will have a bad taste	Between Groups	2413.821	1	2413.821	1967.890	.000
	Within Groups	659.913	538	1.227		
	Total	3073.733	539			
The cheese I have bought today is of bad quality	Between Groups	1952.203	1	1952.203	1560.138	.000
	Within Groups	674.452	539	1.251		
	Total	2626.654	540			
The cheese I have bought today is not healthy	Between Groups	1422.858	1	1422.858	936.939	.000
	Within Groups	815.502	537	1.519		
	Total	2238.360	538			
The cheese I have bought todayis not trustworthy	Between Groups	1280.770	1	1280.770	806.024	.000
	Within Groups	854.880	538	1.589		
	Total	2135.650	539			
The cheese I have bought today is too expensive	Between Groups	10.764	1	10.764	5.186	.023
	Within Groups	1118.825	539	2.076		
	Total	1129.590	540			

Source: own composition

The frequency of use of food quality and safety information of Kosovars and Albanians

In order to understand which safety and quality cues consumers use frequently, we asked the consumers the following question: “If you want to know about safety of cheese you buy, how often do you check the following characteristics?”. The 5 point semantic scale reached from 1 = never, 2 = occasionally (1-2 times per week), 3 frequently, 4 = often, to 5 = always. The underlying assumption is that a difference between Kosovar and Albanian consumers with respect to the use of food quality and safety information exists. ANOVA test showed significant differences for all items. Kosovars use food safety and quality cues less frequently then Albanians (see Figure 4).

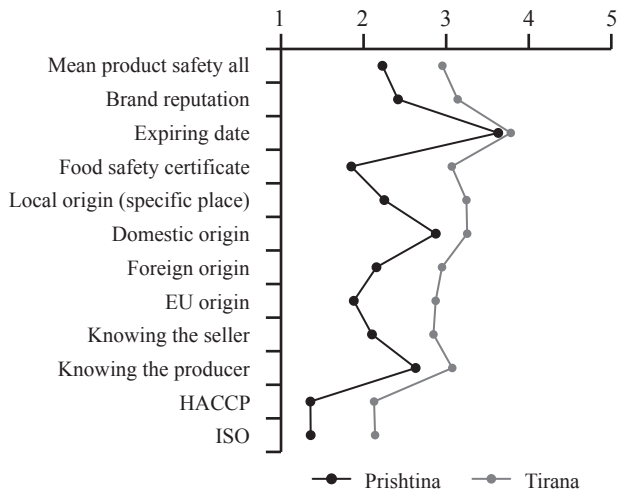

Figure 2: The frequency of use of food quality and safety information.

Source: own composition

Table 6: Ranking of attributes based on frequency of use.

	Prishtina	Tirana
1	Expiring date	Expiring date
2	Domestic origin	Domestic origin
3	Knowing the producer	Local origin (specific place)
4	Brand reputation	Brand reputation
5	Local origin (specific place)	Knowing the producer
6	Foreign origin	Food safety certificate
7	Knowing the seller	Foreign origin
8	EU origin	EU origin
9	Food safety certificate	Knowing the seller
10	ISO	ISO
11	HACCP	HACCP

Source: own composition

Table 7: Results of ANOVA about frequency of use of quality information.

Categories		Sum of Squares	df	Mean Square	F	Sig.
How often do you check in which country a foodstuff has been produced	Between Groups	134.009	1	134.009	77.511	.000
	Within Groups	1118.601	647	1.729		
	Total	1252.610	648			
How often do you check in which region within Kosovo (Albania) the foodstuff has been produced (for domestic products)	Between Groups	.248	1	.248	.109	.742
	Within Groups	1472.714	646	2.280		
	Total	1472.961	647			
How often do you check, if a foodstuff is organic	Between Groups	247.301	1	247.301	141.329	.000
	Within Groups	1132.135	647	1.750		
	Total	1379.436	648			
How often do you check the name of the grower/ manufacturer	Between Groups	5.890	1	5.890	2.447	.118
	Within Groups	1557.106	647	2.407		
	Total	1562.995	648			
How often do you check date of durability/ best before date	Between Groups	17.428	1	17.428	22.803	.000
	Within Groups	494.498	647	.764		
	Total	511.926	648			
How often do you check, if the package is damaged	Between Groups	38.857	1	38.857	40.935	.000
	Within Groups	614.142	647	.949		
	Total	652.998	648			
How often do you check the list of ingredients	Between Groups	16.824	1	16.824	7.941	.005
	Within Groups	1370.717	647	2.119		
	Total	1387.541	648			

Source: own composition

For both samples the expiry date and domestic origin were the most frequent used attribute. Table 6 shows the ranking of attributes, starting with the most frequent used on top. In the last position, both samples reported that they at least use ISO and HACCP standards.

In an additional series of questions, we asked respondents how often they checked food quality related information, when shopping for food (Table 7). An ANOVA with these questions showed significant differences between Kosovars and Albanians, except for "How often do you check in which region within Kosovo (or Albania) the foodstuff has been produced" and how often do you check the name of the grower/manufacturer".

We combined the respondents, who checked these attributes frequently (about half the times, or 3-4 times every week), often or always. It appears that Kosovars and Albanians check the best before date (date of durability) the most often, followed by damaged packaging. However, Kosovars check significantly more often in which country foodstuff has been produced. On the other hand, Albanians pay more attention to organic foodstuff (67% versus 24% of Kosovars). On the whole, more than two thirds of the respondents in both samples checked where their food came from (whether it was locally-produced or not).

We tested the same statements for differences between gender, age, education and income. Women check more

often than men the date of durability/best before date, if the package is damaged, if the foodstuff is organic and the list of ingredients (significant at all levels). Older (65+) consumers check less often in which country food has been produced, the name of the grower/manufacturer, if a package is damaged and the list of ingredients compared to the younger age groups. Higher educated consumers check more often all safety and quality information (except for organic foodstuff) than lower educated consumers. Low income groups check less often the country of origin, the region in which a product within Kosovo and Albania has been produced and the name of the grower/manufacturer.

We also asked respondents three additional questions. First, if they know about Global GAP (see Table 17) and if they know about the existence of the "Food and Veterinarian Agency (National Food Authority for Albania)". Third, if they buy food products labelled as PDO (Protected Denomination of Origin). The majority of respondents did not know about Global GAP (69% of Kosovars and 84% of Albanians didn't know about Global GAP). Chi-Square test for all three questions showed statistically significant differences. Knowledge about the Food and Veterinary Agency was more widespread: 78% of Kosovars and 86% of Albanians knew about the Food and Veterinary Agency. The vast majority of Kosovar consumers (96%) in Prishtina do not buy products labelled as PDO, compared to 77% of consumers in Tirana.

Discussion and conclusions

Previous studies reported that gender and education had an influence on the awareness and perception of food safety issues (Nganje and Katibie 2003; Zhllima *et al*., 2015). Female consumers and higher educated consumers pay more attention to food safety related information. Our study found similar results. Women and higher educated consumer groups check more often food safety and quality related information than men or lower educated groups. We found similar differences for younger versus older consumer groups and high versus low-income groups. Younger consumer groups and higher income groups use food safety and quality related information more often. This was observed for both cities in which the study took place.

Important quality cues mentioned in the literature are information on labels like expiry date, ingredients, brand names, food certificates and country of origin (Marchesini *et al*., 2007). In our study Kosovars use food safety and quality cues less frequent then Albanians. Albanians use food certificates more often than Kosovars, but neither of them pays attention to HACCP or ISO standards, which is not surprising because HACCP and ISO standards are primarily used for business-to-business communication and have not been communicated to consumers. A ranking of the frequency of use showed that information about expiry date, domestic origin/local origin, knowing the producer or the brand name are the most frequent used food safety and quality cues for Kosovars and Albanians. Kosovar respondents also use information about organic food way less often than Albanian respondents. This may be an indicator for either a lack of organic food supply in Kosovar supermarkets or an indicator for lower purchase power than in Albania, because organic food is generally more expensive than conventional food. There is also low awareness about GlobalGAP and food products with the EU label for Protected Denomination of Origin. In Kosovo, 95% of consumers are not buying PDO food products (versus 78% of Albanian respondents), which could be an indicator for that they don't know them. Despite this lack of knowledge about food safety standards and labels for geographical denomination, a majority of consumers in our samples knew about the Food and Veterinary Agency (76% of Kosovars and 86% of Albanians).

Several studies about WBCs report severe food safety problems in the food chains in Kosovo and Albania, especially in the dairy and meat sector (Gjeci *et al*., 2015; Haas *et al*., 2016; Imami et al., 2011; Udovicki et al., 2019; Zhllima *et al*., 2015). Zhllima *et al*. (2015) reported that food safety is a major concern for local consumers in the region. There is evidently a lower level of food safety in the food chains in Kosovo and Albania and consumers are concerned about it, so one would expect that consumers in Kosovo and Albania would perceive domestic food products such as milk and cheese as inferior compared to imported products. We didn't observe this in our study. There were no statistically significant differences between socio-demographic variables, except higher income groups check the quality of domestic milk and dairy more than lower income groups. However, we observed statistically significant differences between Kosovar and Albanian consumers. Kosovar consumers perceive the quality of domestic cheese and milk better than Albanian consumers. Albanian consumers are either indifferent only slightly positive about the quality of domestic dairy products. Regarding the quality of cheese bought at supermarkets or local traditional stores, Kosovars were more critical than Albanians. In other words, Kosovars show more consumer patriotism for domestic milk and cheese than Albanians but at the same time they are less satisfied with the safety and quality of cheese offered at supermarkets and local stores.

Imami *et al*. (2013) reported that consumers prefer to buy food directly from producers as a strategy to ensure safety and quality. In our study, consumers from Prishtina show a statistically significant higher preference to buy milk from farmers than Albanian consumers but when asked if milk from farmers is safer than milk from the factory both samples were indifferent about it.

Our results might be useful for policymakers and food companies for two main reasons. First, communication and advertising strategies about domestic food safety and quality in Kosovo and Albania, either from policymakers or companies, could specifically address female consumers, and better educated consumers/higher income consumers. Those consumers show higher awareness and more frequent use of food safety and quality related information. Second, stakeholders could focus especially on lower educated / lower income consumers to reduce their information deficits about food safety and quality related information.

The high awareness about the national Food and Veterinary Agency shows how important it is to establish national food safety and quality organisations. For example, in the case of Austria, during EU accession, the government decided to establish an agricultural organisation, independent from the

Ministry of Agriculture, to be focused on food safety, quality and food marketing, the so-called AMA (Agricultural Market Austria). AMA was responsible to harmonise the legal framework for food production, food safety and marketing. AMA coordinates more than 40,000 food safety controls per year in Austria. It developed a nationwide quality and origin certificate, the AMA quality seal, which is one of the best-known food certificates in Austria nowadays. The establishment of such an organisation demonstrates how important it is to combine activities related to food safety and food quality with food marketing. It would be highly advisable for Kosovo and Albania to establish a similar organisation, especially with respect to the existing EU accession plans.

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Consumer preferences for goatkid meat in Albania

The objective of this paper is to analyse consumer preferences for goat-kid meat attributable to the market potential of mountainous areas and the valorisation opportunities arising from the certification of origin. The study explores consumer preferences toward the main attributes of goat-kid meat such as origin, weight and quality-certification. A Conjoint Choice Experiment was utilised to design the survey and a Latent Class Analysis Model employed to analyse the results of a survey carried out with 250 residents living in urban areas of Tirana. Origin was found to be the most important factor for all three identified consumer classes. This result can be used to producers' advantage if labelling and other marketing tools are available to inform consumers of the products' origin. Implementation and enforcement of origin identification should be a priority for the government and other stakeholders.

Keywords: consumer preferences, goat-kid meat, Albania, conjoint choice experiment
JEL classification: Q13

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Introduction

Knowledge of consumer demand for niche products is crucial for market development. It is a significant theme of inquiry for businesses, and for decision-makers so as to be able to make strategic decisions. The patterns of consumer preferences for food products vary by income and country. In developing and transition countries, the increasing levels of income, degree of trade liberalisation and increasing urbanisation have enabled fast changes of consumer lifestyle and preferences. Within the wide range of agri-food products, demand for meat products has received growing attention from researchers due to food security, food safety, and health concerns and the impact on farmers' incomes, especially in remote and rural areas in developing countries (Guerrero *et al.*, 2013; Krystallis and Arvanitoyannis, 2006). Despite the growing importance of small ruminants in rural farming systems, particularly in mountainous areas, there is a dearth of information on consumer demand, perceptions, preferences for small ruminants' meat, especially for goat meat (Grunert *et al.*, 2004; Knight *et al.*, 2006; Van Loo *et al.*, 2014; Vukasovič, 2013).

The change in incomes and dietary habits of transitional countries like Albania has prioritised chicken, pork and beef over small ruminant meat (FAOSTAT, 2018). Moreover, small ruminants' meat seemingly is affected much more by income changes as is indicated by their subsequently larger share of the food budgetary expenditures. Consumer preference studies for meat in the developed countries have been extensively studied and it has been found that consumers are attaching more weight to extrinsic factors such as product origin, sustainable production practices, social and environmental values (Font i Furnols and Guerrero, 2014; Montossi *et al.*, 2013). However, there has been only limited research on consumers' purchasing behaviour and preferences in developing countries.

Also in the case of Albania, there is a lack of research and knowledge about consumer preferences for small ruminant meat, particularly goatkid meat. Related studies such as consumer preferences for lamb meat was explored by Imami *et al.* (2011), while consumer awareness and perceptions for food safety with focus on small ruminant meat was analysed by Zhllima *et al.* (2015). However, these studies have not investigated origin preferences and certification as a signal for ensuring meat quality.

The purpose of this paper is to analyse consumer preferences for the main quality attributes of goatkid meat such as local origin, size (weight) and food safety certification. The study also aims to group consumers according to their preferences for goatkid meat and provide more specific recommendations for effective marketing and policymaking purposes.

This study was organized in the framework of an action research conducted in partnership with the mountainous farmer association ADAD Malore under the auspices of the project funded by EFSIM (Empowering Smallholder Farmers in Markets). The questionnaire was developed after conducting extensive literature review, focus groups of goat shepherds of Kukes region, and the butchers in Kukes and Tirana region and semi-structured interviews with various stakeholders.

The recommendations from this study are crucial for policymakers to understand the potential opportunities for valorising smallholders' production in Albania by taking advantage of the perceived importance of Geographic Indication, based on consumer preferences and behaviours. Small ruminant meat is considered a priority subsector by the government of Albania (MARDWA, 2014). However, sector investments supporting this subsector (by government and donors) should have strong market research information to support any change in their market orientation. In this context, understanding consumer preferences for goatkid product attributes is instrumental to the design of efficient and sustainable intervention activities by any programme/organisation, and this includes both private entrepreneurs' and investors' strategies.

The paper is structured as follows. The following section consists of the overview of the small ruminant sector

in Albania, focusing on goats (kids), and is followed by a literature review, whereas Section 4 provides a description of the methodology. Section 5 consists of analysis of the results and the last section provides conclusions of the study.

Overview of the small ruminant sector in Albania

Albania has a long tradition of producing and consuming small ruminant meat. Small ruminants are an important source of income for smallholders in the mountainous areas, which are exposed to higher levels of poverty. The privatisation of the agricultural sector as part of the transition into a market economy, combined with increased consumer incomes, resulted in an increase in the production and consumption of meat (including small ruminant meat) during the 1990s and 2000s in Albania. The number of goats increased by 20% during the period 2005-2015, achieving an overall total of 932,000 heads (INSTAT, 2016). This increase is driven by the increase in local demand for both small ruminant meat and milk. In fact, Albanians consume almost twice the quantity compared to other Southern European consumers. On the other hand, there is also a strong consumer preference for goatkid milk which is mostly used for producing cheese (Imami *et al.*, 2016).

Most sheep and goat flock sizes are very small. An average sheep flock size is close to 30 milking sheep and the goat flock size is around 25 milking goats. There are about 40,000 farmers that have sheep, and 22,000 farmers that have goats (which is quite significant considering that the number of farms is around 300,000 in Albania). Many small ruminant flocks are mixed (combining both types, sheep and goat) and mixed activity (both milk and meat). In most cases, the production system is pasture-based. Sheep and goats depend nearly entirely on grazing in pastures in Albania, both in winter and summer (Skreli and Imami, 2019).

Slaughterhouses supply the domestic market for fresh meat (small ruminant meat is mostly sold fresh, but small amounts are also processed on-farm as dry meat). Restaurants or butchers (which are also the main outlets for small ruminant meat) often order live animals directly from slaughterhouses or slaughter points. Contracts between farmers and buyers are rare. Payment for live small ruminants and fresh meat sold to retailers is typically cash-based (Skreli and Imami, 2019).

Most small ruminants are sold and slaughtered when the animal is small, since for many farmers, milk production is the main activity. Consumers prefer small carcass meat weighing up to 10 kg (slaughtered weight) (Imami et al, 2011). The average consumption of goat meat in Albania is higher than world (and European) averages.

Literature review

Small ruminant meat consumers tend to consider certain factors as cues or proxies for quality. After price, origin is the most frequently reported attribute in studies of consumer preferences and frequently is cited to be related to feelings and emotions, including ethnocentricity (Pauselli *et al.*, 2009; Shimp and Sharma, 1987). Domestic small ruminants' meat is considered fresher and tastier by consumers in Albania (Imami *et al.*, 2011). Becker *et al.* (2000) conducted a consumer survey in Germany and found important extrinsic cues consumers used in judging the quality of fresh meat were country of origin and place of purchase, while flavour or smell were also important intrinsic cues. In some studies, more focus is given on the local origin as a credence attribute related to type of breed, production systems or relevant values given to certain regions (Pauselli *et al.*, 2009). Moreover, there is a stated preference about meat from mountainous areas compared to meat from flat areas, due to the perceived influence of feeding regime on meat flavour and odour (Imami *et al.*, 2011).

Information about extrinsic attributes related to a certain region, breed or production system has been in the focus of various studies. These attributes are valorised through the use of a brand or designation of origin schemes, which are more common in developed countries. In various studies such as Verbeke *et al.* (2009), guarantee of origin as a credence attribute has been included as a quality and safety indicator. Previous studies on Albania analysed consumer preferences for meat origin found a strong preference of the Albanian consumer towards Albanian-produced meat products (Imami *et al.*, 2011). However, there are no local territorial certification schemes in Albania.

Other attributes which are important to the quality of meat for small ruminant meat is carcass weight or size. A sensory analysis by Rodrigues and Teixeira (2009), Bernués *et al.* (2012) and other Spanish authors as cited by Guerrero *et al.* (2013) found that weight influenced fat and carcass yield, fat contents, meat colour, meat texture, odour and flavour intensities as well as juiciness and tenderness. Lighter weight carcasses were considered tenderer and with less flavour and odour intensity, lighter colour and juicier when compared to heavier carcasses. The relationship between carcass weight (size) and consumer perception on quality of meat has been identified by Imami *et al.* (2011). The authors found that Albanian consumers prefer smaller carcasses meat to bigger ones. Other factors of relevance for consumers include the type of rearing system (Alexandre *et al.*, 2008; Carlucci *et al.*, 1998) and halal certification (Ibrahim, 2011). The notion of feeding system (mountainous versus plain areas as stated by Font i Furnols *et al.* (2009)) may imply a preference for meat of small ruminant in mountainous areas.

Methodology

The conjoint analysis used in this study derives from the theoretical premise established by Lancaster (1966) according to which the utility of a product is based on the bundle of attributes it has. The Conjoint Choice Experiment (CCE) methodology was developed by Louviere and Woodworth (1983) and was originally used in the market research and transport literature. The utility of any good is derived from the characteristics of the good rather than the good itself (Lancaster, 1966). CCE is based on the idea that a good can

be described by its attributes or characteristics and by the levels of those attributes. There are five stages for developing a conjoint choice experiment, collecting data and conducting analysis (Cattin and Wittink, 1982; Green and Wind, 1975; Chan-Halbrend *et al.*, 2010). The stages for this study are shown in Table 1 below.

During the first and second stages of CCE, the attributes and their respective levels are determined. Different studies have used several techniques for determining the most relevant product attributes such as focus group interviews, in-depth interviews or means-end chain analysis (Krystallis and Ness, 2005). For this study we chose to determine the attributes through extensive literature review on choice criterion for observing consumer preferences (Gázquez Abad and Sánchez Pérez, 2009; Goering, 1985; Sandalidou *et al.*, 2002; Siskos *et al.*, 2001) and two focus groups of stakeholders with goat shepherds of Hasi Association of Goat Breeders and other stakeholders with experience related to the Kukes region, situated in northeast Albania. One group was composed of two marketing experts from RASP (Rural Association Support Programme), two veterinarians, one zootechnician and one agri-economist, three butchers as well as 12 shepherds originating from the Hasi region. The shepherds grow a local breed of goat known as the "Goat of Hasi". The other focus group was carried out with civil society representatives, local experts, municipality representatives and members of Association of ADAD Malore. In addition, semi-structured interviews were also conducted with important stakeholders of the small ruminants' meat in Albania. The focus groups and semi-structured interviews results combined with literature review served as a basis for the choice of attribute levels. Four attributes were chosen for goatkid meat: (1) weight, (2) origin, (3) guarantee indication and (4) price.

Weight was considered very important since it was related to the feeding scheme and the quality of meat as discussed in the previous section. Considering the focus group results and the characteristics of goatkid in Albania, a carcass weight of 5, 10 and 15 kg was determined as representative for the market. Bernués *et al.* (2012) as well as Imami *et al.* (2011) highlighted the importance of carcass weight in determining the quality of the meat – Albanian consumers prefer smaller size in the case of lamb meat (and we expect similar preferences for goatkids too). Rodrigues and Teixeira (2009), exploring sensory characteristics of Cabrito Transmontano Protected Origin Designation, found that lighter weight carcasses were considered more tender with less flavour and odour intensity than heavier carcasses.

Product origin was considered a principal attribute for the study. Following focus group discussions, there were definitive regions where rearing in mountainous areas were more common like in Laberia (regions of Gjirokaster and Vlore), Kukes and the rest of the mountainous areas of the country[1]. Kukes/Has is situated in the Northeast areas of the country. Gjirokaster and Vlore are part of the agro-climatic and socio-cultural region named Laberia and are positioned in southwest Albania. The regions are completely separated from each other and represent two different areas of Albania where the major similarities are their mountainous characteristics and the large number of farmers engaged in small ruminant's activities. Gjirokaster has by far the highest levels of meat production available per inhabitant for small ruminants with about 83 kg/capita followed by Vlore in the 2nd place. The region of Kukes has a production per capita of about 34 kg per capita which is quite high compared to the country average (INSTAT, 2016).

Table 1: Stages of a Conjoint Choice Experiment and Analysis carried for goatkid meat.

Stage	Description
1. Selection of attributes	Attributes were selected based on a focus group with stakeholders and an extensive literature review.
2. Assignment of attribute levels	Attribute levels were determined by literature reviews and by the focus group comprised of stakeholders in the value chain of small ruminants meat.
3. Construction of choice sets	The SSI Web program using the Random Method that incorporated orthogonal array was used to create the profiles in the survey.
4. Data collection	Survey was conducted via face-to-face interviews in different weekdays in several areas of urban Tirana.
5. Data analysis	Data is analysed with Conjoint Choice Model & LCA Approach using Sawtooth Software Latent Class.

Source: Own composition based on Chan-Halbrendt *et al*. (2010)

Geographic indication was deemed as relevant given that in Albania there are no certificates determining the origin of the meat. Therefore, in a manner similar to other studies such as Verbeke *et al.* (2009), the authors added the existence of a guarantee of origin as a credence attribute. Guarantee of origin is not yet popular in Albania; however, consumers are concerned with discovering trustworthy ways for determining origin. An attempt of Geographic Indication (GI) registration was made by the farmers of Hasi (Hasi Association of goat breeders) within the framework of the Biodiv Balkans project[2].

Price has been established as a key attribute as in many other studies exploring consumer preference. Price levels were determined based on market observations. Four price levels were chosen, equally distant starting from a minimum price of 750 ALL to 1050 ALL[3]. Other attributes such as animal sex (Rodrigues and Teixeira, 2009), age, aroma, tenderness, flavour (Webb *et al.*, 2005) rearing system, freshness (Alexandre *et al.*, 2008; Carlucci *et al.*, 1998), halal certification (Ibrahim, 2011) were not included in the study since they were not ranked as attributes of primary importance by the focus group members and the butchers during the semi-structured interviews.

In the third stage, the construction of choice sets were made. Sawtooth Software SSI Web 6.6 was used to design the survey and to prepare the data for analysis. The attributes and levels were combined into choice tasks composed of triplets of profiles (concepts) or alternatives, as in the example shown in Table 2.

[1] The production of small ruminant (sheep and goat) meat is concentrated in the regions of Vlore (16.8 percent), Fieri (14 percent), Korce (13.0 percent) and Gjirokaster (11.4 percent), which together account for 55 percent of the total production. Kukesi produces 5% percent of the sheep and goat meat in Albania.

[2] The BiodivBalkans project aimed to identify and protect agrobiodiversity as a driver for a sustainable agricultural development in Albanian mountainous regions. Among other activities it developed Geographical Indications (GI) of Hasi goat (endemic breed) and its kid goat meat in order to address the territorial dimension.

[3] During 2016, the average exchange rate was 1 EUR = 135 ALL, according to the Bank of Albania.

Table 2: Example of a goatkid meat choice sets.

Attributes	Levels		
Origin	Other mountainous areas	Laberia	Kukesi/Hasi
Carcass Weight (Kg)	5	10	15
Guarantee of origin	Without certificate of origin	Without certificate of origin	With certificate of origin
Price (ALL)	750	950	1050
	I would choose		
	↓	↓	↓
	□	□	□

Source: own composition

Table 3: Age structure of the sample and comparisons with overall Tirana population.

Structure of the sample			Census data on Tirana		
Age category	Frequency	Share	Age category	Frequency	Share
0-17	0	0%	0-14	290,837	19%
18-30	51	20%	15-29	370,948	25%
30-40	56	22%	30-39	181,557	12%
40-50	53	21%	40-49	207,496	14%
50-60	60	24%	50-59	202,490	14%
Over 60	30	12%	Over 60	245,180	16%
Total	250	100%	Total	1,498,508	100%

Source: Field survey and Albanian Census of Population and Housing, 2011

Table 4: Socio-economic indicators of the sample.

Education			Employment			Income (ALL)		
Categories	Obs.	%	Categories	Obs.	%	Categories	Obs.	%
Primary school	29	11.6	Unemployed	57	23	0-30,000	8	3.2
Secondary sch.	106	42.4	Student	17	6.8	30,001-60,000	85	34.0
University	115	46	Self-employed	40	16	60,001-90,000	86	34.4
			Employed	113	45	90,001-120,000	57	22.8
			Retiree	23	9.2	120,001-160,000	11	4.4
						160,001-200,000	3	1.2
Total	250	100	Total	250	100	Total	250	100

Source: Survey results

Goatkid meat product profiles are constructed by selecting one level from each attribute and combining across all attributes. In this study, there are four attributes, of which one has four levels (price), two has three levels and one has two levels. Thus, the numbers of possible profiles were $4\times3\times3\times2 = 72$ profiles. A complete factorial design would use all the 72 profiles, which is impractical for respondents to evaluate at one time. The most commonly used method of constructing a fractional factorial design in conjoint measurement is the orthogonal array (Green and Wind, 1975). The complete enumeration option of Sawtooth Software SSI Web 6.6 was used for generating the choice tasks. In complete enumeration, profiles are nearly as orthogonal as possible within respondents, and each two-way frequency of level combinations between attributes is equally balanced. Within choice tasks, attribute levels are duplicated as little as possible - a property called "minimal overlap" (Chrzan and Orme, 2000). Twelve choice tasks (profiles), each made of three concepts, were included in each questionnaire and respondents were asked to choose 12 concepts, one from each triplet concepts in a task. Seven questionnaire versions were generated and eighty-four different choice tasks were created for the seven versions, a design that is optimal and efficient ($p < 0.05$).

Questionnaires were developed based on literature review and focus groups and seven versions of the questionnaires were developed. For each of the seven versions of the questionnaires, there were two parts. The first part of the questionnaires consisted of 12 concepts (one for each choice sets with three product profiles) and the second part was composed of additional questions that include the socio-demographic details of each respondent and questions to obtain insight into consumer purchasing and consumption habits.

A sample of choice sets (profile) used is given in Table 2.

In the fourth stage of the research, a total of 250 face-to-face interviews were carried out in Tirana, the largest city in Albania using a random approach. Interviews were conducted by four well-trained interviewers (students and graduates) supervised by the authors of this paper. The focus group with stakeholders identified Tirana as the main driver of market demand for goat kid meat. Tirana, given its size of the population and higher average income, is the ideal place to conduct such a study. The interviews took place in various places of the capital city such as entrance to butcher stores and supermarkets, the entrance to the main green park of the city and the roads to main green market places. The interviews took place during November - December 2016. The main interviewee target was "food buyers" excluding minors (younger than 18 years).

Socio-demographic characteristics are deemed important for representativeness (Juma et al, 2010; Knight *et al.*, 2006), thus the questionnaire included socio-demographic indicators of the respondents. The sample was divided quite symmetrically by gender (51% are male). The vast majority (96 percent) of the respondents were from urban areas. Age distribution of the sample is reflected in Table 3. With the exception of the group of consumers below 18 years old who were not the target of the survey, the age groups compared well to the census of the population of Tirana.

The sample is dominated by well-educated respondents (Table 4). The low share of respondents with primary education is explained by the high accessibility and immigration flows in the inner part of Tirana agglomerations, while also only adult population was targeted in the survey. More than a fifth of the respondents are unemployed. The unemployment coefficient is within the range provided by the official data, which is 14 % according to the Labour Force Survey 2017 (INSTAT, 2018) and 30% according to the Census of Population and Housing 2011 (INSTAT, 2012). The share of

households with an income level between 30000 ALL per month and 90000 ALL per month is comparable with the Household Budget Survey of 2016 (INSTAT, 2017).

In the fifth stage, the conjoint choice method combined with Latent Class Analysis (LCA) was used to the traditional aggregated or one-class model. In latent class analysis, the different segments that have different utility preferences are accounted for and hence better market predictions can be made. Sawtooth software SSI was used to design the questionnaire and web Sawtooth Latent Class software was used to analyse the data.

The LCA is a random utility model. Building on the seminal work of McFadden (1973), consumer utility can be represented as follows:

$$U_{ijt} = \beta X_{ijt} + \varepsilon_{ijt}, \quad (1)$$

where i refers to individual i, j refers to concept j and t refers to choice set t. The utility level U_{ijt} is a linear function of the observable vector of attributes X_{ijt} and their coefficients to be estimated, β. ε_{ijt} is a random error term, which captures all unobservable attributes and factors that influence the choice process.

McFadden (1973) showed that the probability that concept j in choice set t is chosen by individual i is given as:

$$P_{ijt} = \frac{\exp(X_{ijt}\beta)}{\sum_{k=1}^{J} \exp(X_{ikt}\beta)}, \quad (2)$$

The numerator is the exponent of the observable utility of concept j in choice set t, and the denominator is simply a collection of observable utility from all available concepts.

In our study, only product attributes (weight, origin, guarantee of origin and price) have been considered; therefore, an individual's probability of choosing concept j was considered as a function of goat kid attributes. The socio-demographic variables have not been considered, due to software limitations, as mentioned above.

Results

The conjoint choice experiments/latent class analysis enables the segmentation of the consumers into separate classes. Out of the best replications, we chose the replication with three classes. Our decision was based on the relative change of the Consistent Akaike Info Criterion and the Chi-square statistics but also based on the development of the goatkid market in Albania.

Of the three classes, class 2 (with 65% of the sample) is the largest class (Table 5). For class 2, the most important attribute is the guarantee indication of origin, meaning that respondents in this class preferred goatkid meat having a certification of origin. This class also shows high preference for goatkid meat of smaller carcasses (5 and 10 kg) and from other mountainous areas (other than Kukes/Has or Laberia).

Table 5: Market segmentation for goatkid meat.

Segment Size	Class 1	Class 2	Class 3
	13.0%	65.0%	22.0%
Importance of attributes			
Origin	46.8%	26.4%	83.6%
Carcass weight	4.1%	29.3%	2.6%
Guarantee indication	0.7%	40.4%	6.9%
Price	48.3%	3.7%	6.7%
Part Worth Utilities for each attribute			
Origin			
Kukes/Has	-0.8856***	0.0521	3.5975***
Laberi	2.1840***	-0.3074***	-1.9868***
Other mountainous areas	-1.2984***	0.2554***	-1.6107***
Carcass weight			
5 kg	0.1432	0.2189***	-0.1137
10 kg	0.0168	0.1857***	0.0619
15 kg	-0.1600	-0.4046***	0.0518
Guarantee of origin			
With certificate of origin	0.0273	0.4297***	-0.2313
Without certificate of origin	-0.0273	-0.4297***	0.2313
Price			
Price	-1.1999***	0.0267	0.1498

Note: ***T absolute value higher than 2,6 Alpha 0.01
Source: Consumers preferences Survey results

We will label this group as "*guaranteed baby goatkid fans*".

Class 3, representing 22% of the sample, is the second largest class. For this class, the most important attribute is origin. This class strongly prefers meat from Kukes and Hasi region. This class can be named as "*Kukes goatkid fans*".

Class 1 with 13% of the sample is the smallest group. The most important attribute in this class is price, while the second most important attribute is origin – there is a strong preference for goatkid meat from Laberi (provided that it is available at reasonable prices (within the 750 – 1050 ALL/kg price range). Given the importance of price attribute and (negative) price associated sign, this class may be labelled as "*price sensitive consumers*".

A socio-demographic analysis has been carried for each selected class. The variables were not significant except in Class 3 which reveal a higher inclusion of consumers with relatively higher incomes. The analyses did not show significance in other variables such as age, education, gender and employment.

Conclusions

This paper provides the first in-depth consumer study on goatkid meat in Albania. The study throws light into various important aspects of urban consumer preferences for goatkid meat attributes including origin, price, weight and origin guarantee indication. The findings of the study are useful to capitalise the market opportunities of small ruminants' meat and for the policymakers engaged in empowering smallholder producers in mountainous areas.

Origin is one of the most important attributes for all the identified consumer classes, and the most important attribute for the largest class (Class 2 covering 65% of the sample). Consumers in Class 3 show a strong preference for goatkid meat coming from Kukes/Has, whereas consumers in Class 1 (which is a price-sensitive class) prefer meat from Laberi.

Thus, these classes represent clear market potentials. Interestingly, considering the wide belief and regional differences in terms of traditional ways of producing small ruminants, consumers in this biggest consumer class prefer goat-kid meat from different mountainous areas (other than Kukes/Has or Laberi). One additional explanation could be that most residents in Tirana were born or come from households originating from different areas in Albania, and thereby have preferences tied to their origin.

The study highlights the important aspects of development aid interventions and influence to policymakers. Following EU rural development policies, several initiatives to develop local markets and efficient food supply chains can be developed to benefit farmers, distributors or consumers. Active involvement in bottom-up mechanism for valorising local value chains are excellent aspects for territorial development. Initiatives should interrelate improvement and guarantee of the quality of agricultural products and products with territorial marketing. Adoption of a national legal framework for Geographical Indications compatible with the EU regulation, with the goal of enabling the registration of local food specialties in the EU, is necessary. Albanian policymakers have to identify viable instruments of support for the adoption of GI certification schemes for the local markets. Development of capacities related to GI (PDO/PGI) certification can strengthen sector competitiveness. The development of quality schemes may be supported in the context of EU integration given the importance of GI regulations in the EU.

Our results may also be useful for local breeders, small ruminants' meat processors, business associations and policymakers. Farmers can use this information to decide which would be the most profitable and preferred goatkid type of meat to sell and what is the best product attribute to promote. The preference for smaller carcasses versus larger ones which may be translated as a preference for goatkid (or lamb) baby meat is a well-known phenomenon in Albania (Imami *et al.*, 2011) – given consumer preferences, farmers slaughter animals at an early stage causes loss both in efficiency and meat quality. Other reason for doing so is also the shortage of feed during summer. Based on this state of affairs, public agents/development agencies may consider consumer education on meat quality and providing farmers incentives for keeping goatkids longer (also as a temporary separate activity) until they reach the optimal weight. The results are limited for creating market segmentation due to the lack of significant socio-demographic factors. Groups of producers or associations, such as the case of the Hasi goat breeders association can consider introducing their own marks based on the characteristics of their breeds, the interests and values of their members and the image of their area of production. Cooperation with butchers and other retailers is crucial for achieving mutual benefits in terms of sale sustainability and market diversification. Other types of meat by-products can be developed, except for carcass meat, which can be valorised considering these findings.

One of the limitations of this study is that it focuses only on urban consumers (although almost half of the population still live in rural areas), who may have a different consumption pattern. The conclusions provided for the urban residents of Tirana are still important because it is the most important market and thus is useful *per se*. Furthermore, it can also be useful information for other urban areas in Albania or nearby countries which, despite differences, have a high degree of similarity in terms of culture.

Research in the future may investigate other sectors for exploring and discovering niche markets for local smallholder producer. Further research may also consider assessing various dimensions of 'origin'. Indication of geographical origin is a very important clue for scrutinising the potentials for using guarantee as a sign of meat quality. Considering that credence attributes are not transferable due to scarce information, efforts made to reduce confusion and lower transaction costs by revealing to consumers the origin, may provide assurance to consumers for the needed information on safety and quality of meat as well as for authenticity originating from the rearing systems characterising the place of origin.

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Egzon BAJRAMI*, Eric J. WAILES, Bruce L. DIXON**, Arben MUSLIU*** and Alvaro DURAND-MORAT****

Do coupled subsidies increase milk productivity, land use, herd size and income? Evidence from Kosovo

This study assesses the effectiveness of the Subsidy per Head Scheme (SPHS) in increasing milk productivity, land use, herd size and income in dairy farms across the seven regions of Kosovo. SPHS represents one of the largest coupled subsidy programs in the agricultural sector of Kosovo in terms of farmer participation and budget allocation. We use a Propensity Score Matching approach to assess the impact of this program by comparing a group of participants with a group of non-participants during the 2013–2014 farming seasons. We test the robustness of the impact results using four different matching algorithms. Results reveal SPHS was not effective in increasing land use, gross income and farm size (number of cows), although SPHS had a limited impact on improving milk productivity. In addition, the study highlights the need to reformulate coupled subsidies and develop new, complementary strategies that address farmers' needs more efficiently.

Keywords: coupled subsidy, propensity score matching, impact evaluation, Kosovo

JEL classification: Q18

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Introduction

The agricultural sector in Kosovo is highly subsidised. The Ministry of Agriculture, Forestry and Rural Development (MAFRD) has been implementing the Direct Payments (DP) Program since 2009. This policy involves several direct payment schemes, such as a subsidy per head (referred to later as the Subsidy per Head Scheme (SPHS)) and subsidy per hectare of planted grains and subsidy on milk quality (MAFRD, 2010). All these subsidies are coupled and are intended to help Kosovo dairy farmers a) increase income, milk production and quality; b) intensify the use of currently unused land and pastures; c) improve input quality, food safety and food quality standards; and d) develop a management capacity compliant with European Union (EU) requirements. Over the past years, agricultural economists have been concerned with the effects of direct payments (Bajrami and Ostapchuk, 2019). A number of empirical studies have shown efforts to estimate their effect, predominantly on farm level outcomes, such as productivity (Guan and Oude Lansink 2006; Bezlepkina and Oude Lansink, 2006; McCloud and Kumbhakar, 2008; Henningsen *et al.*, 2009; Rizov *et al.* 2013), farm structure (Kim *et al.*, 2005; Ahearn *et al.*, 2006), and farm income (Dewbre and Mishra, 2007).

Empirical findings on subsidies` effects on these outcomes are mixed. Several studies have shown that subsidies positively affect farm productivity (Guan and Oude Lansink 2006; McCloud and Kumbhakar, 2008), while some other studies have found a negative relationship between subsidy and production (Bezlepkina and Oude Lansink, 2006; Henningsen *et al.*, 2009). In line with the productivity findings, a number of studies also agree that subsidies contribute to farm income (Pufahl and Weiss, 2009; Bojnec and Fertő, 2019).

Overall, there has been less research on the effects of coupled direct payments. This might be due to the decoupling of direct payments, which occurred in many countries, specifically across the EU. However, coupled direct payments are still applied, particularly across some pre-candidate and EU candidate countries. Their continued application might result in substantial disadvantages for farm development. Among the main drawbacks, the literature highlights that coupled payments might hinder further farm investments, disincentivize farm size growth, productivity improvement and diversification, and lessen support for small farms since most support is intended for large farms. There is considerable empirical evidence showing that coupled payments negatively affect productivity (Karagiannis and Sarris, 2005; Zhengfei and Oude Lansink, 2006; Rizov *et al.* 2013).

For example, Rizov *et al.* (2013) investigated the impact of the Common Agricultural Policy (CAP) on the total EU commercial farm productivity and found that subsidies negatively impacted farm productivity. Henningsen *et al.* (2009) showed that coupled subsidies have a considerable effect on input use and output level. In terms of farm size growth and structural transformation, Edmeades *et al.* (2019) has analysed the effects of coupled payments on the agricultural sector of Croatia. The report highlights that coupled payments have slowed down the structural transformation process of Croatian agriculture since large farms absorb the majority of support.

Although subsidies` effects have been studied by a plethora of authors, there is little evidence on the observable effects of coupled direct payments on the livestock sector. Furthermore, the literature gap is wider with regard to pre-candidate countries for the EU. In this paper, we examine empirically the actual effects of a coupled subsidy program. For this purpose, the livestock sector of a pre-candidate country - Kosovo - was chosen.

Over the years, Kosovo's livestock sector has been one of the key drivers of agricultural development. However, this sector suffered severe damage during the 1998–1999 war. More than half of the livestock were killed or stolen, and about 40% of infrastructure and machinery was destroyed (MAFRD, 2003). Nevertheless, during the post-war period,

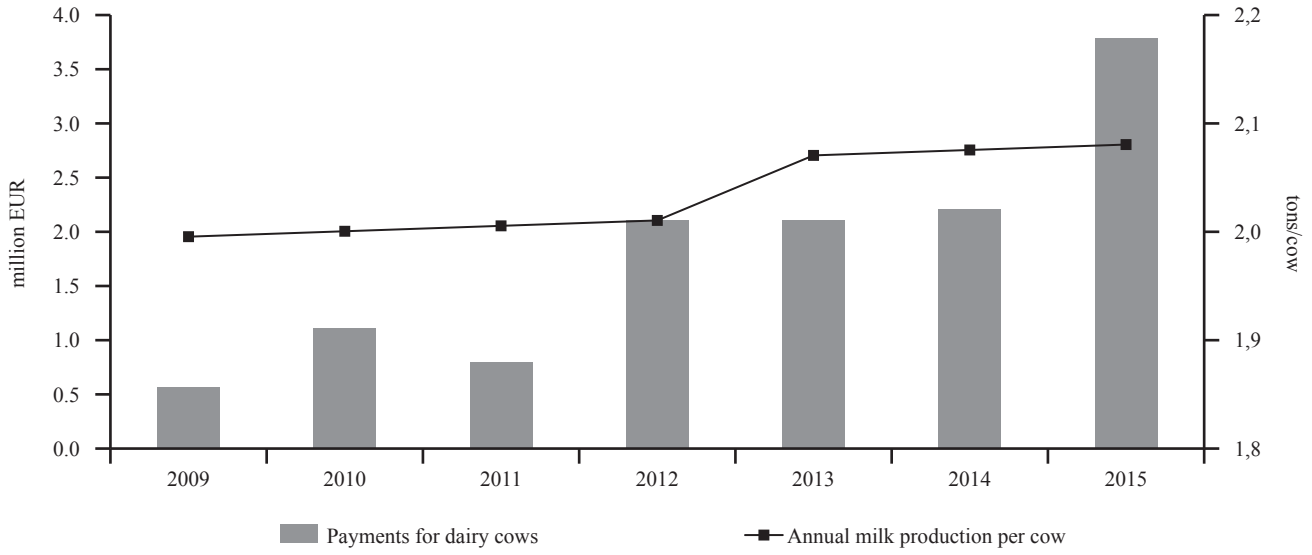

Figure 1: Budget allocation for SPHS (€) and annual milk productivity per cow (t).
Source: Constructed by authors using data retrieved from MAFRD (2016).

the livestock sector, specifically dairy, has emerged as one of the most important agricultural sectors, contributing about 10% to the total national GDP (Bytyqi *et al.*, 2014).

In 2015, there were over 258 thousand cattle in Kosovo, distributed across more than 63 thousand households, with an average herd size of four cows (MAFRD, 2016). Most of Kosovo`s dairy farms are characterized by low milk productivity, poor infrastructure and inefficient land use (Miftari *et al.*, 2014). Milk yields per cow are low compared to other European countries. In 2014, the estimated average milk yield per cow in Kosovo was 2,075 litres per year (MAFRD, 2015), while the EU-28 average was 6,727 litres (European Commission, 2015). Primary dairy products are produced predominantly by the large number of subsistence and semi-subsistence dairy farms in the country. During the post-war period, dairy farmers in Kosovo faced the challenges posed by small-scale dairy farms, characterized by low milk productivity, traditional breed genetics, poor feeding, poor hygiene and breeding conditions and fragmented land use. These challenges caused low efficiency (Bajrami *et al.*, 2017) even though the dairy sector was heavily subsidised from 2009 to 2016, mainly by direct payment schemes from the government (Figure 1).

One of the main objectives of the SPHS is to increase milk production. Although annual milk production per cow increased 0.7% a year in the period 2009–2015, Kosovo's cattle inventory decreased drastically over the same period. Dairy cow numbers declined by 5% annually, and total milk production declined by an annual average of 4.3%.

MAFRD spent over €50 million to implement all (crop and livestock) schemes of the DP program from 2009 to 2014. In addition, since 2009 MAFRD has been allocating a significant portion of its budget to implementing the SPHS, where over €3.7 million was allocated in 2015, a 71% budget increase for this scheme as compared to 2014 (Figure 1). Although significant budget has been allocated to SPHS, to date there has not been any systematic evaluation of this programs actual impact on the Kosovo dairy sector, particularly in terms of increasing land use, income, herd size and improving production.

The present study addresses this gap in the literature by investigating the effects resulting from the SPHS policy on Kosovo's dairy sector. We assess the impact of SPHS using survey data. Specifically, we use farm-level survey data collected from randomly selected dairy farmers (n = 327) to estimate the SPHS effects on its main three objectives (increasing milk production, intensifying land use, improving farm income) and the SPHS specific objective of increasing herd size (farm structure). The survey data are analysed using a Propensity Score Matching (PSM) model. We assess the robustness of the estimated results by employing four alternative matching algorithms.

Material and methods

A survey instrument was developed, pre-tested and administered to dairy farmers in Kosovo during a period of two months, specifically from mid-July to mid-September 2015. Primary data on farmer socio-economic characteristics (e.g., age, gender, education, farming experience, household size), their dairy activity (farm size, farm assets, milk production and quality, dairy product sales) and participation status in different governmental programs were collected from 327 randomly selected dairy households across all the seven regions of Kosovo.

In order to estimate the impact of SPHS on milk productivity, land use, farm structure and farm income, two groups of dairy farmers (participants and non-participants in the SPHS) were randomly selected for the study. In most of the reviewed studies using the PSM approach, the non-participants' groups are at least twice as large as the participants' group, mainly due to better chances to obtain more matched observations with members of the participant's group (Pufahl and Weiss, 2009; Becerril and Abdulai, 2010; Birol *et al.*, 2011; Kabunga, 2014). Therefore, for this study, a proportion

size of 1:3 (participants to non-participants) across the seven sampled regions was used to increase the chances of having more matched observations. Subsequently, the number of respondents per region was estimated using a weighting technique on the population list of participant farmers in the SPHS in 2014. All sampled farmers were listed on MAFRD records as having five[1] or more dairy cows in 2014, which is also the SPHS support eligibility criteria MAFRD applies. In contrast to the EU, where farmers receive subsidies non-exclusively linked to production (Takácsné-György and Takács, 2012), SPHS is a subsidy coupled to the number of dairy cows.

In order to isolate the effect of SPHS, only those observations that received support exclusively from SPHS were included. Ninety out of the 327 sampled dairy farmers were supported by more than one direct payment scheme and, therefore, were removed from the analysis. Eighty-eight observations were dropped due to missing data, leaving a total of 149 observations for further analysis, precisely 40 participants and 109 non-participants.

Specification of the PSM Impact Evaluation Model

Estimating the effect of participating in a specific program is the main goal of evaluation studies. A number of evaluation techniques can be utilized to estimate treatment effects. According to Pufahl and Weiss (2009), evaluation studies estimate the mean effect of participating in a program. Among a plethora of techniques, PSM is a widely used approach in evaluation studies. It can be used as a combination of methods; however, it is also commonly used as a single approach (see: Becerril and Abdulai, 2010; Birol *et al.*, 2011; Kabunga, 2014). Our PSM impact evaluation model estimates the mean effect (impact) of the SPHS on milk productivity, land use, farm structure and farm income. Following Kabunga (2014), this impact is estimated as the average treatment effect on the treated (ATT) participants in the SPHS program:

$$ATT = E[y_{1i} - y_{0i} | D_i = 1) = E[y_{1i} | D_i = 1) - \\ - E[y_{0i} | D_i = 1), \quad (1)$$

where E is the expectations operator, y_{1i} is the observed outcome of farmer i (participant), y_{0i} is the observed outcome of the same farmer i (non-participant) and $D_i = 1/0$ denotes whether the farmer participated in the SPHS or not.

Missing data in the counterfactual is a major issue in evaluation studies since we cannot observe the outcomes of participating farmers (treated) had they not been treated $(y_{1i} | D_i = 1)$. Therefore, the mean effect of program participation is estimated by constructing a control group similar to the treated group, which enables measuring the outcome that would have been observed for the treated group if they had not been treated. While a simple comparison of the mean outcomes between treated and non-treated groups seems intuitive, it can lead to biased results. One potential source of bias is that treated and non-treated farmers may differ in terms of observed characteristics (covariates) such as experience in milk production, formal education, age of the farm manager, corn planted area, whether the farmer uses grazing or not and whether they keep farm records. A second source of bias between these two groups might be the differences in unobserved characteristics such as motivation and managerial skills. Rosenbaum and Rubin (1983) introduced the PSM to control for the observed characteristics and subsequently estimate the mean outcomes of participants and non-participants, respectively.

A set of observable covariates must be chosen for the purposes of matching prior to applying the matching procedures and constructing comparison groups. Caliendo and Kopeinig (2008) emphasize that only covariates that simultaneously influence the participation decision and the outcome covariate should be included, while covariates that might be affected by the treatment should not be included. Economic theory and the previous knowledge of the researcher regarding the program and observed units should be used in specifying the model (Sianesi, 2004; Smith and Todd, 2005). Experience in milk production, corn planted area, formal years of education, farm manager age, a binary variable indicating if the farm manager keeps farm records or not and a binary variable for grazing or non-grazing production systems were used as observed covariates to conduct matching. It is assumed covariates simultaneously could affect the outcome and the participation decision.

Following Kabunga (2014), the observable impact of SPHS was measured in two stages. In the first stage, propensity scores $P(x_i)$ for each individual farmer were generated using a probit model. The propensity score indicates the probability of a dairy farmer joining the SPHS program given the observed covariates, x_i:

$$\Pr(P_1 = 1 | x_i) = p(x_i), \quad (2)$$

The control (non-participants) group was constructed by matching the participants with non-participant farmers based on their propensity score values. Observations without an appropriate match were dropped from further analysis.

Subsequently, prior to estimating the *ATT*, two conditions must be satisfied: the assumption of Conditional Independence and the assumption of Common Support. Following Rosenbaum and Rubin (1983), the Conditional Independence Assumption (CIA) can be specified as follows:

$$(y_1, y_0) \perp D | X, \quad (3)$$

stating that a given set of observable covariates X are not affected by treatment, and potential outcomes y are independent of treatment assignment D (Khandker *et al*., 2010). As noted in Khandker *et al.* (2010), Rosenbaum and Rubin (1983) called this assumption "un-confoundedness", implying that uptake of the program is based entirely on observed covariates. This assumption reduces bias when the untreated units are constructed.

Following Khandker *et al.* (2010), the Common Support assumption, which can be specified as

[1] Due to random selection, some of the visited farmers had fewer or more cows compared to the number of cows recorded on the list. Between the period that they were registered in the program and our visit, they decreased or increased their number of cows.

$$0 < P(D = 1|X) < 1, \quad (4)$$

allows that treatment observations have comparison observations "nearby" in the propensity score distribution (Heckman *et al.*, 1999). Basically, this assumption ensures that participants and non-participants have an equal chance of being either an adopter or non-adopter; therefore, participation in the treatment is not exclusively controlled by an unobservable variable(s) (covariate(s)). When these two assumptions are satisfied, the treatment assignment is said to be strongly ignorable (Rosenbaum and Rubin, 1983), allowing for unbiased mean comparisons.

In the second stage, the *ATT* of SPHS was estimated. We measure the impact of SPHS on four outcome variables: milk productivity per cow per day (y_1), land use (y_2), gross income (y_3) and farm size (number of cows (y_4)). The impact of SPHS was measured separately for each of these four outcome variables. Given that CIA and Common Support assumptions hold, following Kabunga (2014), the PSM estimator for *ATT* was measured as follows:

$$ATT^{psm} = E[y_{1i}|D_i = 1, p(x_i)] - \\ -E[y_{0i}|D_i = 0, p(x_i)], \quad (5)$$

where ATT^{psm} measures the mean difference of the outcome of interest (e.g., milk productivity per cow) between the participants and non-participant farmers with similar propensity scores, $p(x_i)$. The variable $p(x_i)$ denotes the estimated propensity score for farmer *i*. These observations are balanced on their propensity score and lie within the region of common support (Kabunga, 2014). In other words, the PSM estimator is simply the mean difference in outcomes over the common support, properly weighted by the propensity score distribution of participants (Caliendo and Kopeinig, 2008).

Before estimating the *ATT*, treated farmers must be matched with non-treated farmers (control). Treated units must be similar to non-treated units in terms of observed characteristics unaffected by participation. Therefore, some non-treated units might be dropped to ensure comparability (Khandker *et al.*, 2010).

Treated units were matched with non-treated units based on the estimated propensity scores, constructed by the selected observed covariates listed above. In total, four matching methods were used to match treated with non-treated farmers: the Nearest Neighbour Matching (NNM), Caliper or Radius Matching, Stratification and Interval Matching, and Kernel-based Matching method (KBM). The different matching methods were used to measure the robustness of the results to the matching method (Kabunga, 2014).

In NNM, each treatment unit is matched to a comparison unit with the closest propensity score. The number of matched units (n) is set up prior to matching (usually n = 5 is used). NNM can be conducted with or without replacement, where with replacement approach indicates that the same non-participants (non-treated farmers) can be used as a match for different participants (treated farmers). Following Khandker *et al.* (2010), NNM can be specified as follows:

$$|p_i - p_j| = \min_{k \in \{D=0\}} \{|p_i - p_k|\}, \quad (6)$$

where p_i denotes the propensity score of treated farmer *i*, and p_j denotes propensity score of the non-treated farmer. The difference in propensity scores for a participant and its closest non-participant neighbour may be very high with NNM. Therefore, this matching method may result in poor matches.

The Caliper or Radius Matching method addresses the issue of large differences in propensity scores between matches by imposing a threshold "tolerance" or caliper on the maximum propensity distance[2]. Therefore, caliper provides a certain range where treated units can be matched (with replacement) with non-treated units (Khandker *et al.*, 2010). Caliper or Radius Matching (*E*) can be specified as follows (Heinrich *et al.*, 2010):

$$E(\Delta Y) = \frac{1}{N}\sum_{i=1}^{N}[Y_{1i} - \bar{Y}_{0j(i)}], \quad (7)$$

where $\bar{Y}_{0j(i)}$ denotes the average outcome for all comparison units who are matched with case *i*, Y_{1i} is the outcome for case *i*, and *N* is the number of treated cases. Therefore, this approach does not limit the number of matches with a given participating dairy farmer, as long as the units are "close" enough (Heinrich *et al*., 2010).

Stratification and Interval Matching divide the common support of the propensity score into a set of intervals (strata) and afterwards, the mean outcome difference (impact) between treated and non-treated group within each interval is calculated. One of the main issues with this approach is selecting the number of strata to use. As cited in Caliendo and Kopeinig (2008), Cochran (1968) demonstrated that five subclasses are often enough to remove 95% of the bias associated with a given, single covariate. According to Aakvik (2001), one way to justify the number of strata used is to check the balance of the propensity score or the covariates within each stratum, implying that the estimated propensity score is appropriate only if it balances covariates.

Finally, the *KBM* method uses a weighted average of the propensity scores of all non-participants to construct the counterfactual match for each participant. *KBM* assigns weights to each non-participant farmer and subsequently, farmers are matched based on these weights. Following Khandker *et al.* (2010), KBM can be specified as follows:

$$\omega(i,j)_{KBM} = \frac{K\left(\frac{P_j - P_j}{a_n}\right)}{\Sigma_{k \in C} K\left(\frac{P_k - P_i}{a_n}\right)}, \quad (8)$$

where ω denotes the estimated weight, P_i denotes the propensity score for participant *i*, P_j is the propensity score for the non-participant *j*, *K* denotes the Kernel function and α_n denotes the bandwidth parameter.

These matching procedures need to be checked for balance within the distribution of the observed covariates in both treated and non-treated groups (Kabunga, 2014). Basically, this procedure compares the covariates that are used

[2] Caliper represents the maximum tolerance level or maximum propensity score distance by which a match can be made (Heinrich *et al.*, 2010). As noted by Smith and Todd (2005), a possible drawback of caliper matching is that it is difficult to know a priori what value for the tolerance level is reasonable.

for matching, before and after matching to check for any remaining differences after conditioning on the propensity score (Caliendo and Kopeinig, 2008). For example, formal education in years is compared prior to matching and after matching. Stata was utilized for estimation purposes.

Results and discussion

Table 1 reports the summary statistics for farm and household characteristics of sampled dairy farmers.

Estimated average daily milk production per cow is 11.88 litres per cow, amounting to 3,623 litres of annual production over 305 days of lactation. This average differs markedly from MAFRD (2015), where average annual milk production per cow in Kosovo in 2014 was estimated at 2,075 litres per cow. However, this difference is expected since the MAFRD estimate included all dairy farms in Kosovo, while our sample includes only the farms that are or potentially could be SPHS participants. These farms are considered to be commercial and semi-commercial, indicating their production levels might be higher due to market participation. Nushi and Selimi (2009) report milk yields in Kosovo vary from 1,500 to 6,000 litres per cow, depending on the farm and breed. A minimum of five dairy cows owned is a condition for participating in the SPHS program. Dairy farmers in the selected sample have an average of 7.06 dairy cows.[3] According to MAFRD (2015), the average number of cattle in agricultural households in Kosovo is four.

Dairy operations average €8,030 in annual gross income. This mean is very similar to the average annual gross income for all agricultural household types in Kosovo which MAFRD (2015) estimates at €8,466. In terms of experience, dairy farmers in this sample had an average of nine years of experience in dairy operations. Further, they averaged 11 years of formal education.

Table 1: Summary Statistics: Farm and Household characteristics.

Variable	Description	Mean	S.D.[1]
Nocows	Number of dairy cows per dairy farm	7.06	3.51
Mcowday	Daily milk production per cow (liters/cow)	11.88	1.98
Mcowyear	Annual milk production per cow (liters/cow)	3,623.97	604.90
Dailycons	Daily milk consumption per person (kg/person)	0.61	0.13
Grains	Area planted with grains (ha)	3.78	4.41
Wheat	Area planted with wheat (ha)	2.36	3.14
Corn	Area planted with corn (ha)	1.36	1.81
Landuse	Total land use (ha)	4.00	4.54
Dairyincome	Annual gross dairy income (€)	8,030.59	4,949.23
Experience	Experience in years in dairy operation	9.10	6.06
Education	Formal education in years	11.09	2.83
Age	Age in years	43.03	17.85
Household	Number of household members	9.10	4.84
Grazing	If the farmer uses grazing (yes=1)	0.87	0.33
Barn	If the farmer keeps cows tied in the barn (yes=1)	0.97	0.16
Frecords	If the farmer keeps farm records (yes=1)	0.40	0.49

N = 149.
[1]S.D. - Standard Deviation.
Source: authors

Table 2: Number of sampled participant and non-participant dairy farmers by region.

Region	Ferizaj	Gjakova	Gjilan	Mitrovica	Peja	Prishtina	Prizren	Total
Participants	1	3	1	2	14	12	7	40
Non-participants	2	4	15	8	24	34	22	109
Total	3	7	16	10	38	46	29	149

Source: authors

Results from Propensity Score Matching (PSM)

Since SPHS was implemented in both years 2013 and 2014, two groups of farmers (participants and non-participants) were formed. Participants were SPHS participants only in 2014, while non-participants could be from 2013 and/or 2014. Farmers were proportionally distributed among the seven regions based on the number of dairy farmers per region (Table 2).

Twenty-six per cent of these dairy farmers were participants, while the majority, more than 73%, were non-participants in SPHS. At the regional level, farmers from Prishtina and Peja constitute the highest share of the sample, while Ferizaj and Gjakova constitute the lowest participation numbers. From the total sample of 149 dairy farmers, a sample of 132 was used for matching purposes – since the 17 omitted observations (non-participants) did not satisfy the common support criteria.

This sample was selected based on several covariates (experience, education, age, corn planted area, farm records and grazing) that help to increase the balance between the two groups (participants and non-participants). After matching, there should be no statistical mean differences for the selected covariates between these groups. Therefore, to examine mean differences in observed characteristics between participants and non-participants, t-tests were performed (see Table 3).

Dairy farmers (SPHS participants and non-participants) differed in terms of number of dairy cows, land use, gross dairy income, experience, age and education (see Table 3). On average, participants had 15% more dairy cows, and 2.05 more planted hectares with grains compared to non-participants. In contrast, non-participants had on average 2.42 more years of experience in dairy operation and were on average 14 years older compared to participants. However, participant dairy farmers were better off in several other characteristics compared to non-participants. Specifically, participants had, on average, more years of education, higher annual gross dairy income, and most importantly, even for the four outcome variables (daily milk yield per cow, land use, gross income and number of dairy cows), SPHS participants were better off. Daily milk yield per cow for the participants (non-participants) group was estimated at 12.7 (11.4) litres on average, their farms averaged €8,185 (€6,568) annual gross income from the dairy operation, were using on average 3.6 ha (2.6 ha) for grains and other crops and had, on average, 7.1 (6.2) number of cows. Prior to matching, significant differences were found for daily milk yield per cow, corn planted area, total grains planted area, total land use, annual

[3] PSM sample was truncated at four cows per farm since MAFRD supported also farmers with four cows in 2014.

Table 3: Difference in mean for the matching and outcome variables for potential and selected participants and non-participants (controls).

Variable	Potential participants	Potential Controls[1]	Difference	Selected participants	Selected Controls[2]	Difference
No. of observations	40	109	/	40	92	/
Number of dairy cows (log)	1.96	1.82	0.14	1.96	1.84	0.12
Daily milk yield per cow in liters (log)	2.54	2.43	0.10***	2.54	2.43	0.11***
Wheat planted area (ha)	3.19	2.06	1.12	3.19	1.97	1.22
Corn planted area (ha)	2.02	1.12	0.90**	2.02	1.79	0.23
Area under grain cultivation (ha)	5.28	3.23	2.05*	5.28	3.84	1.44
Land use (log)	1.29	0.95	0.34*	1.29	1.19	0.10
Annual gross dairy income in euro (log)	9.01	8.79	0.21*	9.01	8.77	0.24
Years of experience in dairy operation	7.33	9.75	2.42*	7.33	7.73	0.40
Formal education in years	11.13	11.08	0.04	11.13	11.78	0.65
Age of the dairy farm manager	33.05	46.69	13.64***	33.05	35.95	2.90
Household size	8.65	9.27	0.62	8.65	7.78	0.88
Dummy for Grazing/ Non-grazing	0.93	0.85	0.07	0.93	0.95	0.02
Dummy for farm records	0.38	0.40	0.03	0.38	0.43	0.05

Significance levels: * p<0.05, ** p<0.01, *** p<0.001;
[1]Potential controls – Potential non-participants;
[2]Selected controls – Selected non-participants.
Source: authors

gross income, experience in dairy operation and age of the farm manager. In contrast, means of demographics such as education and household size did not differ significantly between potential participants and potential non-participants (see Table 3).

The initial differences between SPHS participants and non-participants are a potential source of biased estimates of program impact. Therefore, eliminating the initial statistical differences implies, for example, better-off farmers are not more likely to participate in the program; thus, all the dairy farmers in the selected sample have an equal chance of being an adopter or non-adopter relative to their propensity scores. As noted in Kabunga (2014), this suggests that there is no positive selection bias in adoption behaviour. The summary statistics from Table 3 suggest there is no statistical difference between selected participants and selected controls (non-participants) on selected covariates for matching.

Results from PSM for daily milk production, land use, number of cows and gross income

The selection of matching covariates was based on the previous studies in the dairy sector in Kosovo (Musliu *et al.*, 2009; Miftari *et al.*, 2010), previous studies of impact assessments using PSM in the dairy sector (Kirchweger and Kantelhardt, 2012; Kabunga, 2014; Rawlins *et al.*, 2014; Alemu and Adesina, 2015) and the relevant theory and institutional settings following Smith and Todd (2005). In addition, the selected variables were tested for correlation with the treatment variable (SPHS participation).

Propensity scores for each observation were generated by an estimated Probit model. The dependent variable is participation/non-participation coded as 1 for participants and 0 otherwise (see Equation 2). Estimated Probit coefficients are reported in Table 4.

This Probit model was used to measure the impact of the SPHS on the four outcomes discussed above. For the estimated Probit model, the pseudo-R2 is above 0.14, indicating a good model fit (Kabunga, 2014). Caliendo and Kopeinig (2008) argue that the pseudo-R2 indicates how well the regressors explain the participation probability and its value should be fairly low. Second, most variables included in the model have the expected signs. Farmers with more experience, more years of education, older farmers and those who keep farm records are less likely to join the SPHS program. In contrast, farmers using grazing and growing corn are more likely to participate in SPHS. Among these variables, age is highly significant ($p<0.01$). Corn is statistically significant ($p<0.05$), implying farmers planting more corn are more likely to join the program. There was no significant relationship between SPHS participation and experience, education, grazing and farm records.

Table 4: Probit coefficient estimates for the PSM.

Dependent variable is SPHS 1/0	Coefficient	S.E.[1]
Experience	-0.01	0.02
Corn	0.16*	0.08
Records	-0.22	0.25
Education	-0.02	0.04
Grazing	0.79	0.45
Age	-0.03**	0.01
Constant	-0.12	0.70
N	149	
LR $\chi 2$	24.95	
Pseudo-R^2	0.14	

Significance levels: * p<0.05, ** p<0.01, *** p<0.001.
[1]S.E. - Standard Error
Source: authors

King and Nielsen (2019) critique propensity score matching for producing biased estimates and being less efficient than other matching methods. Much of the cause for PSM inferiority results from "pruning", in other words discarding observations that do not match well with other observations. With this in mind, we note that after discarding the 17 observations that lack common support, the means of the independent variables in the Probit model show no statistically significant differences ($p<0.05$) which implies some balance between treated and control observations. King and Nielsen (2019) note that reducing imbalance leads to less biased estimates.We also note that two of the matching methods used - stratification matching and KBM - use all 132 observations, thus avoiding some of the bias induced by pruning.

Table 5: Average treatment effects of SPHS on treated (ATT) from three matching algorithms.

Nearest neighbour matching (NNM)				
Outcome	**ATT**	**t-value**	**Treated**	**Control**
Milk yield (log)	0.107	1.534	40	23
	(-0.07)			
Land use (log)	0.103	0.286	40	23
	(-0.3)			
Gross income (log)	0.236	1.003	40	23
	(-0.24)			
Farm size in cows (log)	0.120	0.656	40	23
	(-0.19)			
Stratification matching				
Milk yield (log)	0.116***	3.827	30	102
	(-0.03)			
Land use (log)	0.213	1.448	30	102
	(-0.14)			
Gross income (log)	0.096	1.019	30	102
	(-0.09)			
Farm size in cows (log)	0.030	0.362	30	102
	(-0.07)			
Kernel based matching (KBM)				
Milk yield (log)	0.114**	2.441	40	92
	(-0.05)			
Land use (log)	0.168	0.992	40	92
	(-0.17)			
Gross income (log)	0.202	1.513	40	92
	(-0.13)			
Farm size in cows (log)	0.15	1.178	40	92
	(-0.13)			

Standard errors are in parentheses.
Source: authors

The impact of the SPHS program on milk productivity per cow, land use, gross income and number of dairy cows was estimated subsequent to imposing the common support condition, i.e., matching participants with non-participants in the region of common support (Sianesi, 2004). The PSM framework matches participants with non-participants on a single dimension-propensity score. Similar propensity scores were generated from similar covariates. Balancing tests after the matching process indicated no statistical differences in the observed covariates between the two groups. As noted in Kabunga (2014), the overall matching quality before and after propensity score estimation is shown also by the relatively low pseudo-R2, implying that there are no systematic differences in the distribution of covariates.

After the matching procedures, the net impact (*ATT*) of the SPHS on daily milk productivity, land use, gross income and number of dairy cows is estimated using Equation 5. All the outcome variables were measured in logs to reflect percentage changes. The results of the estimations based on NNM, Stratification matching, and *KBM* are presented in Table 5[4].

The milk productivity outcome is the log of daily milk production per cow per farm and the other three dependent variables are also logged. Thus, the estimated *ATT* are continuous percentage change rates. Participation in SPHS results in increases in milk productivity of 10.7%, 11.6%, and 11.4% with NNM, Stratification, and *KBM* matching methods, respectively. The impact of SPHS is statistically significant under the stratification and *KBM* methods but not statistically different from zero with the NNM method.

One of the main objectives of the SPHS is to increase the use of currently unused land and pastures. Therefore, the land use outcome was measured as the land area used by the farmer for intensive crop production, including grains and other crops. All three matching algorithms (NNM, Stratification Matching, and *KBM*) revealed insignificant *ATT*, indicating that SPHS did not have any effect on increasing land use among the program participants.

Gross income of dairy farmers from the dairy operation was measured as the total annual gross income combined from different income sources of the dairy operation such as income received from milk sales, secondary dairy products sales such as cheese, cottage cheese, income from animal sales, and manure sales. All three matching algorithms displayed insignificant *ATT* (Table 5).

[4] We also estimated Radius Matching algorithm, however the method resulted in using only 24 observations, which is such a small size for a PSM study that we deemed the results irrelevant.

Increasing the average number of dairy cows is another objective of SPHS; therefore, the farm size outcome was measured as the total number of dairy cows in the barn. Similar to the results for land use, three of the matching algorithms showed insignificant impacts on increasing the number of dairy cows for the participant farms.

Discussion

Direct payments in the agricultural sector constitute a frequently used policy tool, especially across European countries. Subsequently, the evaluation of this policy scheme has been greatly emphasized over the last years. A special focus has been given to coupled direct payments, where their effects have been questionable in the literature. Therefore, our study contributes to the emerging literature by evaluating a coupled, direct payment program in Kosovo.

The results do not provide robust evidence for the first policy objective (milk production per cow) across matching algorithms. The findings from NNM are consistent with Bajrami *et al.* (2016) and GAP (2016), who concluded that the MAFRD subsidies did not show any positive effect on increasing production. However, results are robust for the other three objectives, revealing that SPHS did not increase land use, gross income and farm size (number of cows). The lack of statistically significant average treatment effects confirms results from previous studies (Bajrami *et al.*, 2016; GAP, 2016) that SPHS did not have any significant effect on increasing land use, farm size and gross income for dairy farmers who participated in the program.

For land use, these results might be expected, considering that the majority of farms are small, and they tend to use the same amount of land area over time. Similarly, Kastner International and AWI (2012) claimed that due to the application of thresholds being used as eligibility criteria for direct payments, small farms are motivated to continue farming and not release their land for use by bigger farms that could produce at a lower cost.

For gross income, GAP (2016) found that the SPHS increases farmer income in the short run. Contrary to the findings of GAP (2016), we did not find any effect on improving dairy farmers' income. Nevertheless, GAP (2016) also claimed that in the long run, this scheme prevents the development of the dairy sector, since it supports and keeps less productive farmers from terminating production.

Lastly, an important focus of policy analysis in agriculture is their effect on farm size. According to MAFRD (2015), small farms (1–9 cows) constitute 65% of cattle inventory in Kosovo. Therefore, we examined the effects of SPHS on farm size as the number of dairy cows. Results revealed that SPHS did not have any statistically significant effect on increasing farm size. Furthermore, one of the matching algorithms revealed negative effects, suggesting SPHS reduced the number of dairy cows on supported farms. Findings of GAP (2016) showed that this policy impacted the farm structure, with 94.2% being family farms (1–5 milking cows).

These findings are important. Since the SPHS program was initiated in 2009, MAFRD has spent over €8 million funding it. Furthermore, over the same period, MAFRD has increased its budget allocation for this program by an annual average of 47%. In 2014, over €2.2 million was expended by MAFRD to implement the SPHS. The results from this impact assessment suggest SPHS has not been effective in reaching its objectives. Four alternative matching algorithms tested the robustness of results; one of the first studies employing this technique to evaluate direct payment's effects.

Conclusions

Our findings suggest that SPHS has had a slightly positive impact on milk productivity and a generally insignificant impact on land use, gross income and farm size. Direct payments are considered inefficient measures for promoting growth, since their effect tends to diminish over many years (Kastner International and AWI, 2012). Likewise, our findings suggest the SPHS needs to be reformulated or replaced with a program that more effectively and efficiently achieves the objective of improving the competitiveness of the Kosovo's dairy sector. Perhaps budget could be reallocated to upgrading the genetic potential of dairy cows and improving research and extension services to enhance management skills.

Our use of a Propensity Score Matching approach with four matching algorithms is a more rigorous test of policy effectiveness than done in most similar past studies. The results of this study can be generalized beyond Kosovo by highlighting the ineffectiveness of coupled direct payments and the need to formulate new strategies that address farmers' needs more effectively.

This study shed light on the ineffectiveness of coupled direct payments to address the needs of small-scale farmers. One concern about the findings of this study is that assessment is based on recall observations for only two years, 2013 and 2014 (recall data). However, some dairy programs tend to have long-term objectives; therefore, an ideal dataset would have had a longitude of five years (2009–2014). Nevertheless, research with a larger sample over a longer period would be desirable particularly if data were collected from producers after each year. Additionally, the number of observations used in the PSM models is small, so results must be evaluated with this caveat in mind. However, we generally find no persuasive evidence of SPHS effectiveness, which is more defensible than if the results had led to statistically significant findings.

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Nicola GALLUZZO*

An analysis of technical efficiency in Icelandic dairy and sheep farms

Usable agricultural land in Iceland is predominantly represented by permanent grasslands and pasture used for livestock grazing, while the cultivation of arable crops such as cereals and potatoes has a very modest incidence on the total agricultural surface area. The main purpose of this research, therefore, was to assess the technical efficiency of dairy and sheep farming across Iceland's regions using annual census data for the years 2008 and 2017. The assessment of the technical efficiency of farms – one that is able to analyse multi-input/output production functions – has been estimated through the use of the non-parametric approach of Data Envelopment Analysis (DEA). The research findings have highlighted the need for farmers to reduce certain inputs such as labour costs and general productive overheads, as well as to address their efforts to extensive forms of livestock farming, notably sheep rearing, which is able to take advantage of the abundant and rich grasslands. In general, sheep farms have been found to be technically more efficient than dairy, while farms located in the capital region have been shown to have lower levels of technical efficiency overall.

Keywords: Data Envelopment Analysis, rural areas, labour, dairy farms, sheep farms, Iceland.
JEL classification: Q12

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Introduction

In sharp contrast to fishing and related industries, agriculture in Iceland is not a primary economic sector, and its contribution to the country's total export revenue and gross domestic product is relatively minor (Agnarsson, 2000; Jóhannesson, 2010). Nevertheless, agriculture is of crucial importance due to its role in protecting the Icelandic environment and safeguarding its landscape (Agnarsson, 2000).

Soil characteristics and climate have strongly influenced the country's agricultural activities, with dairy and sheep farming representing the most important and widespread enterprises within this sector. Consequently, Iceland is largely self-sufficient in the production of lamb and beef, and of milk, butter, and other processed dairy products (Helgadóttir *et al.*, 2013). According to Helgadóttir and other authors, grassland represents one of the predominant and fundamental crops for animal feed, while the diffusion of arable crop cultivation is very modest, and has seen significant changes in recent times. The economic crisis that struck Europe from 2008, as investigated in relation to other economic sectors by various authors, has also had a notable impact on farms and their level of technical efficiency (Oh *et al.*, 2009). These researchers have assessed technical efficiency in certain productive processes in the primary and secondary economic sectors, noting that Icelandic enterprises have for a long time had lower levels of technical efficiency than other European countries, and that this gap has actually been increasing due to various inherent socio-economic factors at play in Iceland (Oh *et al.*, 2009). They argue that the low level of innovation, skills and competence, and labour investments directly and negatively affect technical efficiency in many Icelandic enterprises.

Meanwhile, Tor Jóhannesson argues that a low population density in small rural villages has also had significant effects on the primary sector (Jóhannesson, 2010). He argues that these socio-demographic constraints in the primary sector have had direct implications for the growth of agri-food enterprises, technical services available to farmers, and the development of the farming industry in general. As a consequence of the small dimension of villages, rural depopulation, the low level of specialised crop cultivation, and the prevailing climatic conditions, agricultural production is predominantly addressed towards small local markets. Furthermore, farms are not as competitive as retail firms, with relatively few farms reaching levels of technical and allocative efficiency due to the fact that they are not able to implement competitive management strategies owing to their small size and the low level of investment in costly labour- and time-saving innovative technologies (Seyfrit *et al.*, 2010). In order to reduce the skills and knowledge gap in rural areas, various on-line courses have been proposed by different universities with the core purpose of increasing skills and competence and, conversely, reducing the levels of permanent emigration from, and poverty in, rural villages (Bjarnason and Edvardsson, 2017; Seyfrit *et al.*, 2010).

The most recent FAO statistical data reported in literature show that more than 70% of Iceland's land area is unproductive, and only around 4,000 people are engaged full-time in farming (Bjarnason and Edvardsson, 2017), although there are many who are part-time farmers, working predominantly in other economic sectors.

Summing up, greater job opportunities elsewhere are the main drivers influencing the rural emigration of the younger generations, while specific investments aimed at increasing technical efficiency in Icelandic farms that would lead to a coherent and cohesive rural development are crucial to reducing the socio-economic marginalisation of rural areas (Seyfrit *et al.*, 2010).

A review of the available literature reveals that many studies have adopted a non-parametric approach to estimate the technical efficiency of farms in various European coun-

tries, comparing the impact of financial subsidies with the levels of technical efficiency found in different countries (Laurinavičius and Rimkuvienė, 2017; Galluzzo, 2013; 2015; Latruffe *et al.*, 2017; Gorton *et al.*, 2008; Bojnec and Latruffe, 2008). At the same time, various authors have focused their research on assessing the levels of crop specialisation (Gorton *et al.*, 2008; Galluzzo, 2015; 2017; Latruffe *et al.*, 2017; Bojnec and Latruffe, 2008). In many European countries, technical efficiency in farms has been assessed using non-parametric and deterministic methods such as the DEA, but it seems that studies of technical efficiency in farms in Iceland using a non-parametric approach for comparing two different types of livestock farming are not so common in the literature. This paper, therefore, represents an innovative study, introducing the assessment of technical efficiency in Icelandic farms and, in particular, in relation to farms specialised in sheep rearing and dairy production, highlighting the inputs that should be minimised in the productive process, taking into account the fact that Icelandic farms do not receive any payments or subsidies disbursed by national authorities which might have the potential to influence the technical efficiency in farms, as many studies for other countries have argued (Laurinavičius and Rimkuvienė, 2017; Galluzzo, 2013; 2015; Latruffe *et al.*, 2017; Gorton *et al.*, 2008; Bojnec and Latruffe, 2008).

The core purpose of this research was to assess the technical efficiency in a sample of Icelandic farms specialised in typical and fundamental agricultural productions such as dairy farming and sheep rearing through a quantitative approach, using data for dairy and sheep farms in the various Icelandic regions gathered by the National Institute of Statistics from 2008 to 2017 and published in its income statements and balance sheets. The novelty of the research is in relation to the economic framework of farming in Iceland, where technical efficiency has previously been estimated predominately for the secondary sector but not the primary sector, in order to identify which types of livestock farming are more technically efficient, while also taking into consideration the effect that the ending of quotas in 1992 has had on farming in Iceland (Bjarnason and Edvardsson, 2017).

The farms have been grouped in two clusters, in function of their productive specialisation as sheep and dairy farms, in all Icelandic regions (Appendix 1). Through the application of a quantitative non-parametric model to a multi-input oriented technical efficiency model, it has been possible to assess the technical efficiency in farms over the period 2008 to 2017, comparing the data in terms of constant prices for the 2017 year.

The investigated variables for output were operating income and owner's equity. Operating income is able to express profit after subtracting operating expenses and other daily costs of running the business. The investigated variables for input were operating expenses, comprising costs correlated to productive activity in farm, the cost of goods and raw materials or, rather, costs to buy seeds, fertilizers, forage, labour costs, other expenses, liabilities, and costs for assets, by means of which it is possible to estimate the level of investments in farms.

Methodology

Technical efficiency can be estimated through two different approaches: a parametric or stochastic modelling using Stochastic Frontier Analysis (SFA), and a non-parametric modelling using Data Envelopment Analysis, or DEA (Farrell, 1957; Lovell, 1993; Coelli *et al.*, 2005; Battese and Coelli, 1992). The assessment of technical efficiency in a parametric approach using Stochastic Frontier Analysis requires a specific and well-defined function such as the Cobb-Douglas or other typologies of function (Coelli *et al.*, 2005; Lovell, 1993). Using DEA, on the other hand, it is possible to assess multiple inputs and multiple outputs through a linear programming methodology without using *a priori* defined functions of production such as the Cobb-Douglas or a Translog (Coelli *et al.*, 2005; Bravo-Ureta and Pinheiro, 1993).

In general, the Stochastic Frontier Approach (SFA) can be used where there is a consolidated functional form and *a priori* knowledge of the productive function. This is not the case in this paper, hence the DEA, which is more flexible and deterministic, is more suitable since it fits well to the aim of this research that is focused on investigating the level of inputs used in an assessment of technical efficiency in farms, based on a modest sample size.

The non-parametric approach can be input- or output-oriented in function of the target of the frontier in terms of the minimising of inputs or the maximising of outputs (Coelli *et al.*, 2005; Farrell, 1957). This paper has used an input-oriented model with the aim of assessing which input variables could be minimised by farmers, in terms of both constant returns to scale (CRS) and variable returns to scale (VRS) that are able to measure the efficiency in each Decision Making Unit (DMU) of observation (Galluzzo, 2013; 2015; Chavas and Aliber, 1993), which in this research are represented by farms specialised in dairy farming or in sheep breeding in each Icelandic region.

In this study, each DMU represents the different Icelandic regions investigated over the period of study, clustered according to the function of its own productive specialisation, be it dairy or sheep farming. The sample size for both the 2008 and 2017 years of investigation involved almost 2,500 farms.

The optimal level of efficiency is represented by all the DMUs placed on the frontier of technical efficiency, while all the DMUs placed under this frontier can be considered as inefficient, having a value lower than the optimal threshold that is equal to 1 (Coelli *et al.*, 2005; Galluzzo, 2013; 2015; Chavas and Aliber, 1993; Bravo-Ureta and Pinheiro, 1993). As proposed by Charnes *et al.* (1978), and by Banker *et al.* (1984), the DEA model assumes that there are n DMUs which produce a quantity s of output y in such a way that $y \in RS^{+}$ by using m inputs in multiple arrangement and in combination of $x \in R^{+}$. The technical efficiency of a DMU k, under the assumption proposed by Charnes *et al.* (1978), can be evaluated by solving a linear programming problem minimising the level of input used in the production process (Charnes *et al.*, 1978, Banker *et al.*, 1984; Coelli *et al.*, 2005; Bravo-Ureta and Pinheiro, 1993; Battese and Coelli, 1992):

$$\min \theta - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right), \quad (1)$$

s.t.

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = \theta\, x_{ik}, \quad i = 1, 2 \ldots, m, \quad (2)$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} + s_i^+ = y_{rk}, \quad r = 1, 2 \ldots, s, \quad (3)$$

$$\theta, \lambda_j, s_i^-, s_r^+ \geq 0, \quad (4)$$

$$\sum_{j=1}^{n} \lambda_j = 1, \quad (5)$$

The formulas 2 and 3 describe the main constraints in the minimisation assessment of the input-oriented function.

The aim of the DMU is to assess the value of θ, which is the optimal level of technical efficiency equal to 1; ε is a non-Archimedean infinitesimal value, proposed by Charnes *et al.* (1978), aimed at overcoming some difficulties linked to testing multi-optimum solutions; and λ is a convex coefficient in the input x in each DMU j producing a level of output y in the farms j (Oh *et al.*, 2009). S_r^+ and S_r^- are non-negative output and input slacks or rather an excess in input or an output shortfall. Thus, if θ is equal to 1 and all input and output slacks are equal to zero, the DMU is operating on the CRS frontier and, therefore, is technically efficient (Charnes *et al.*, 1978, Banker *et al.*, 1984; Coelli *et al.*, 2005; Bravo-Ureta and Pinheiro, 1993; Battese and Coelli, 1992). On the contrary, if θ is not equal to 1 and all input and output slacks are different to zero, there is an improper or inefficient use of resources in the enterprise, with the consequent need for the entrepreneur to eliminate inefficiencies.

Variable returns to scale (VRS) in the DEA model can be used for measuring the pure technical efficiency (PE) and also the scale efficiency (Banker *et al.*, 1984; Banker, 1984; Zhu, 2000) which, as argued by these latter authors, is the ratio of the technical efficiency under the constant returns to scale assumptions to the technical efficiency under the variable returns to scale assumptions. If the scale efficiency is equal to 1, the firm or DMU is efficient. Furthermore, the increasing returns to scale (IRS) and the decreasing returns to scale (DRS) are assessed with the aim of analysing the primary cause of scale efficiency; in fact, if the CRS technical efficiency score is higher than the VRS technical efficiency value there is an increasing returns to scale (IRS), otherwise there is a decreasing returns to scale (DRS).

For the purposes of this analysis, a cross-section of data has been used in order to assess the change in technical efficiency over the two years of investigation, 2008 and 2017, without considering environmental variables, such as the quality of the land, that could have a direct impact on technical efficiency.

Results and discussion

According to the statistical data of the most recent census in Iceland, published in 2010, the highest concentration of farms is in the South and Northwest regions. In contrast, the lowest concentration of farms is to be found in the capital area and in the Southwest region, where less than 100 enterprises were detected operating in the primary sector. Focusing attention on the main types of animals reared, the data published by the National Institute of Statistics have underlined that sheep, cows, and horses predominate in Icelandic animal husbandry. Poultry farming is primarily concentrated in the Capital region, in the Southwest, and in the South Peninsula, which is the region with the greatest concentration of animal rearing in general, while in the northern Icelandic regions there is a significant concentration, in particular, of sheep breeding. Dairy farming is predominantly concentrated in the South and Northeast regions, even if other regions also have scattered small-scale dairy farming enterprises with a modest endowment of animals.

The percentage of Icelanders employed in agriculture is 3.56%, with a total of 12,000 people actively engaged in agriculture on a full-time basis. The total output in the primary sector for the 2017 year in constant prices equals 59,023 million Icelandic króna (ISK). The labour costs have been calculated considering the cost of each unit of labour for each Icelandic region in terms of average values. The leasing costs represent those expenses that farmers have borne in order to be able to access goods and/or activities not otherwise found in farms, also assessed in constant prices.

The findings of technical efficiency estimated in all Icelandic regions for 2008 have revealed that the highest results close to the optimal threshold of 1, both in Constant Returns to Scale (CRS) and also in Variable Returns to Scale (VRS), were found in dairy farms in the North-West, Southern, and Westfjords regions (Table 1). In sheep farms, the highest levels of technical efficiency were found in the Capital

Table 1: Values of technical efficiency in constant returns to scale (CRS) and variable returns to scale (VRS) assessed in Icelandic regions in 2008.

Region	Dairy CRS	Dairy VRS	Sheep CRS	Sheep VRS
Capital and Southern Peninsula	0.31	0.31	1.00	1.00
Eastern	0.82	0.85	1.00	1.00
North-eastern	0.85	1.00	0.82	0.83
North-western	1.00	1.00	0.87	1.00
Southern	1.00	1.00	1.00	1.00
Western	0.80	0.81	0.77	0.78
Westfjords	1.00	1.00	1.00	1.00

Source: own calculations based on Statistics Iceland (2019) data

Table 2: Values of technical efficiency in constant returns to scale (CRS) and variable returns to scale (VRS) assessed in Icelandic regions in 2017.

Region	Dairy CRS	Dairy VRS	Sheep CRS	Sheep VRS
Capital and Southern Peninsula	0.62	0.64	0.42	1.00
Eastern	0.75	1.00	1.00	1.00
North-eastern	0.63	1.00	0.88	0.94
North-western	0.68	0.93	0.95	1.00
Southern	0.79	1.00	0.82	1.00
Western	0.91	1.00	0.83	0.90
Westfjords	1.00	1.00	1.00	1.00

Source: own calculations based on Statistics Iceland (2019) data

and Southern Peninsula, Eastern, Southern, and Westfjords regions. In contrast, the lowest values of technical efficiency were found in the Capital and Southern Peninsula region in dairy farms, and in the Western region for sheep farms.

In 2017, the technical efficiency, in terms of both CRS and VRS, in the investigated dairy farms showed the best results in the Westfjords region, while the worst results were found in the Capital and Southern Peninsula region (Table 2). Sheep farms have shown the highest levels of technical efficiency in the Westfjords and Eastern regions of Iceland.

The differences in technical efficiency among Icelandic regions are due, in large part, to differences in their orographic and pedological features, considering that many parts of Iceland have soils that are created by magmatic processes and are more or less unproductive. In fact, in some regions there are permanent pastures that can be used during the spring and the summer months to rear animals in the wild and provide forage without the need to buy feed. The age or gender of the farmer are not the only variables able to act on technical efficiency, since more farms have tried to diversify their activities through the introduction of agritourism or other types of agricultural activities. Furthermore, in many cases, agriculture is linked to fishing, which is the main primary sector activity in Iceland.

In Icelandic sheep farms, findings for the gain in inputs reveal that only the 5 out of 7 regions have seen zero change and they need to increase or reduce the allocated input (Table 3); in contrast, the worst results in terms of the reduction of inputs have been found in the North-eastern and Western regions, where farms must reduce their labour capital, assets and liabilities in 2008. In 2017, the sheep farms located in the North-eastern region have to reduce labour input, assets and liability.

As regards Icelandic dairy farms, only 4 regions out of 7 in 2008 have achieved the optimal level of input, while the Capital, Western and Eastern regions reveal the worst results in terms of needing to decrease all inputs and in particular labour, assets and liabilities (Table 4). In 2017 the Capital of Iceland and North-western regions have pointed out a significant decrease in labour input, assets and liability.

In general, it is important to focus attention on the difference in technical efficiency between the two types of livestock farming. In fact, sheep farms show the best results in terms of technical efficiency, due both to their greater ability to convert modest-quality feed into meat, and to a lower level of inputs such as labour and leasing costs compared to dairy farms, owing to the fact that the animals are predominantly reared in the wild. This is clearly not the case in dairy farms, and this has an influence on their level of technical efficiency. Furthermore, the fact that dairy farms received a different level of quotas and state subsidies in the past could have had an effect in reducing their level of technical efficiency.

The metafrontier analysis, crucial to estimating and comparing different clusters of DMUs in Iceland, has corroborated the observation that, when measuring input-oriented variable returns to scale for both types of specialised farming studied in Iceland, namely dairy and sheep, a higher level of technical efficiency can be found in sheep than dairy farms. In fact, the average values of CRS, VRS, and Scale Efficiency in dairy farms were equal to 0.881, 0.946 and 0.932 respectively, while in sheep farms the values were equal to 0.949, 0.974 and 0.974.

Conclusions

A brief review of the available literature has highlighted that studies and research aimed at estimating the technical efficiency in specialised farms in Iceland using a non-parametric approach are not so common.

The findings of this study have revealed that lower levels of technical efficiency have been detected in dairy farms

Table 3: Gains, in percentage, in some investigated inputs in Icelandic sheep farms in 2008 and in 2017.

year 2008					
Region	**Operating expenses**	**Goods and raw material**	**Labour costs**	**Assets**	**Liabilities**
Capital and Southern Peninsula	0	0	0	0	0
Western	-14.26	-8.33	-12.37	-21.37	-36.31
Eastern	0	0	0	0	0
North-eastern	-8.83	-3.54	-13.26	-16.53	-19.54
North-western	0	0	0	0	0
Southern	0	0	0	0	0
Westfjords	0	0	0	0	0
year 2017					
Region	**Operating expenses**	**Goods and raw material**	**Labour costs**	**Assets**	**Liabilities**
Capital and Southern Peninsula	0	0	0	0	0
Western	2.21	3.96	2.08	-9.95	-9.95
Eastern	0	0	0	0	0
North-eastern	5.23	0.39	-1.44	-7.96	-5.11
North-western	0	0	0	0	0
Southern	0	0	0	0	0
Westfjords	0	0	0	0	0

Source: own calculations based on Statistics Iceland (2019) data

Table 4: Gains, in percentage, in investigated inputs in Icelandic dairy farms in 2008 and 2017.

year 2008					
Region	**Operating expenses**	**Goods and raw material**	**Labour costs**	**Assets**	**Liabilities**
Capital and Southern Peninsula	-30.64	-19	6.07	-86.8	-68.69
Western	-5.96	-15.94	-7.07	-20.67	-19.14
Eastern	-0.43	-8.77	2.72	-14.41	-14.41
North-eastern	0	0	0	0	0
North-western	0	0	0	0	0
Southern	0	0	0	0	0
Westfjords	0	0	0	0	0
year 2017					
Region	**Operating expenses**	**Goods and raw material**	**Labour costs**	**Assets**	**Liabilities**
Capital and Southern Peninsula	7.73	5.54	-0.6	-41.26	-35.51
Western	0	0	0	0	0
Eastern	0	0	0	0	0
North-eastern	0	0	0	0	0
North-western	-2.34	0.24	-6.09	-6.54	-20.7
Southern	0	0	0	0	0
Westfjords	0	0	0	0	0

Source: own calculations based on Statistics Iceland (2019) data

compared to sheep farms, largely due to a greater use of inputs such as labour, suggesting that labour-saving techniques should be introduced in dairy farms, in particular with regard to milking activities. In fact, in dairy farms, it is not so common to find the livestock left in the wild, and the main activities are predominately located in stalls; in contrast, sheep farms rear animals in wild pastures, with farmers generally leaving sheep to roam freely from the Spring to the end of the Summer. The main result of this are consequently higher costs for managing herds in terms of labour, feed, and management inputs for dairy farms compared to sheep farms. In dairy farms, the introduction of greater automation, particularly in the milking process, could be useful for reducing labour costs, although the modest size of herds often means that it is not economically viable to introduce innovative technologies that are capable of significantly minimising the level of inputs.

Summing up, it is important to underline that it is crucial to reduce certain inputs such as labour and other costs directly related to the rearing of animals. In fact, considering the prevailing climatic conditions and the typology of soils, the production of pasture represents one of the main cost items for Icelandic farms, and proper and efficient management strategies to reduce this cost input is essential in order to improve the technical efficiency in farms. At the same time, an increase of new innovative labour-saving technologies, in particular in dairy farms, represents a good opportunity for increasing technical efficiency. Furthermore, a reduction of steps in the supply chain, even if it not directly correlated to technical efficiency, is crucial to increasing the level of income in farms without necessarily raising the level of output, consequently reducing the buyer power of the specialised firms downstream of the farms by mainstreaming Icelandic food production from small localised markets to a broader domestic one. In general, small farms in Iceland have had a lower level of output price compared to larger farms, and have had a more limited ability to diversify their productions and activities in order to supplement their incomes. If small farms are able to sell their productions in the local market, they will be able to increase the prices and therefore their level of income. This is becoming a greater possibility for small Icelandic farms, particularly in the wake of increasing touristic flows and the consequently growing demand, both for the supply of local foods and for the provision of in situ venues (such as agritourisms) in which to eat it.

Comparing the findings for technical efficiency in this study to those carried out in other European countries, the estimation of technical efficiency in sheep farms that has been made using a different approach to the Stochastic Frontier Analysis has pinpointed which inputs have acted on the inefficiency of farms (Theodoridis *et al.*, 2014). The findings from this research have shown very similar levels of technical efficiency found in other specialised zootechnical farms, corroborating the view that the variable labour represents one of the main inputs that must be minimised in order to maximise technical efficiency in livestock farming (Bojnec and Latruffe, 2009). Furthermore, comparing this research to other studies carried out in many countries belonging to the European Union, it has not been possible to assess what the direct impact of a public policy to support dairy and sheep farming would have in Iceland, as some authors have argued in relation to other EU countries (Zhu *et al.*, 2012). In fact, dairy farms in Iceland have shown broadly the same levels of technical efficiency as those assessed in similar studies of other European countries during the phases of enlargement of the European Union for farms characterised by equally modest levels of land capital, numbers of sheep and cows, and a relatively small economic dimension (Bojnec and Latruffe, 2008).

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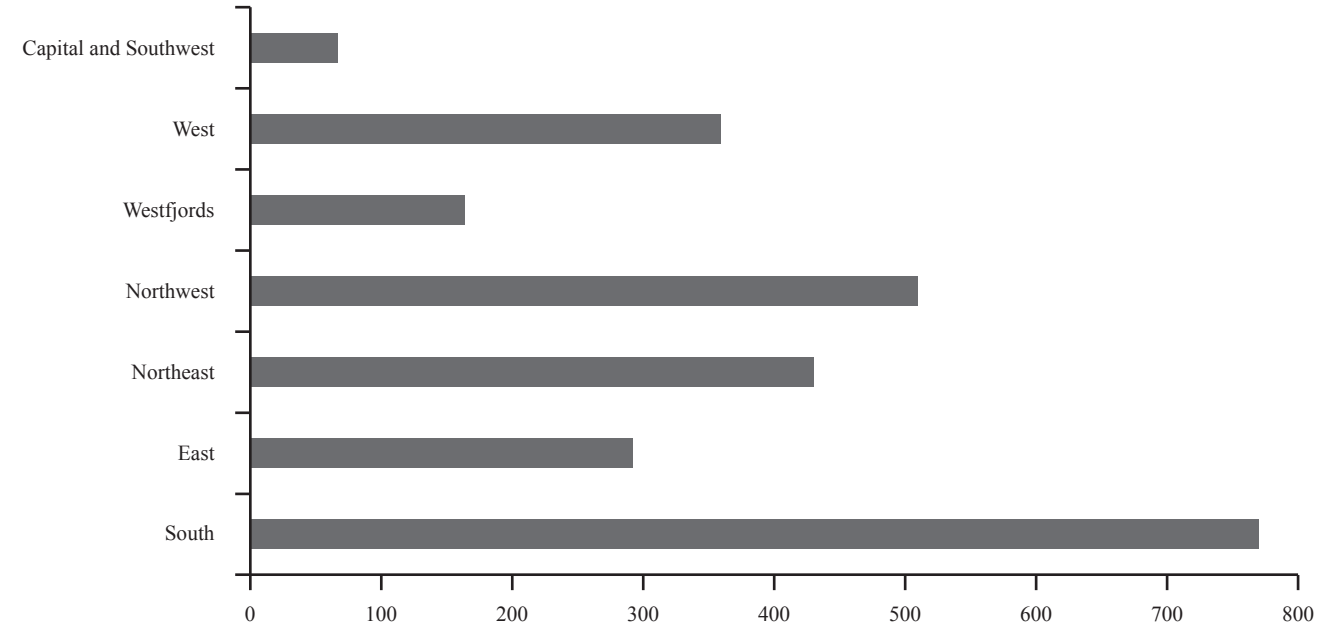
Appendix

Appendix 1: Main Icelandic regions investigated from 2008 to 2017

Source: GoogleMaps (2019)

Appendix 2: Number of farms in Iceland in 2010



Source: own calculations based on Statistics Iceland (2019) data

Subhra SINHA* and Arindam LAHA*

Food Price Shocks and the Changing Pattern of Consumption Expenditure across Decile Classes in Rural and Urban India: A Difference-in-Difference Analysis

Against the backdrop of liberalised trade in agricultural commodities in the twenty-first century, world food prices have risen at a faster pace since 2007. Food price volatility is inextricably connected with the problems of food security due to its implications for the availability of food, household incomes and purchasing power, malnutrition, per capita consumption expenditure and the changing patterns of consumption on the part of poor people. In India's case, a declining trend in the availability of food grains in the post-reform period can be explained by the encouragement given to the export of food grains due to India's comparative advantage vis-à-vis the international market in relation to the pricing of food grains. However, the mere availability of food in the country is obviously not sufficient to ensure access to food for all households. In this context, our main objective in this paper is to evaluate the implications of food price volatility on access to food across decile classes in India. Empirical results reveal that consumption expenditure differs in both spatial (rural and urban) and temporal (pre- and post-2008) dimensions; specifically, the relative loss of consumption expenditure is significant in urban regions in comparison to rural regions in post-2008. In fact, difference-in-difference regression results also reinforced our earlier findings that differences in consumption expenditure can be explained by the spatial effect.

Keywords: access to food, availability of food, consumption expenditure, decile classes, food price volatility
JEL classification: Q11, Q18

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Introduction

Since the post-independence, the top priority of Indian policymakers has been to sustain and improve food and nutrition security through food self-sufficiency. Their multi-pronged strategy has helped India to raise levels of food grain production substantially, maintaining a stock of food grains, and increasing the per capita availability of food grains. In fact, the attainment of self-sufficiency in food grains is one of the greatest achievements of the Indian economy in the post-independence period. After remaining a food deficit country for about two decades after independence, India has not only become self-sufficient in food grains but now has a surplus of food grains to export on the world market. The change in per capita net availability of cereals, pulses and food grains[1] since the seventies is presented in Table 1. It is evident that India's policy commitment to ensuring aggregate availability, indicated by the emphasis on food grain production from the 1950s and self-sufficiency from the late 1960s, did lead to per capita net availability of food grain increasing steadily, with some fluctuations, through the period from 1950s to mid-1990s, with the role of imports declining from the late 1960s (Athreya *et al.*, 2008). The decade from 1951 to 1960 saw a rise in food grain availability largely due to various policies of the Government of India, which focused on raising agricultural productivity and thus domestic production of food grains. There was also a significant increase in the area of land under food grains cultivation (Krishnaji and Krishnan, 2003). There were variations in the extent of net availability of food grains per day throughout the seventies and eighties. However, the origin of the emerging crisis in the availability of food grains can be traced back to the second half of the nineties. The per capita availability of food grains was observed to have declined from a peak of 481.92 grams per capita per day in 1991-1995 to 441.04 grams per capita per day in 2006-2010, and to 472.74 grams per capita per day in 2011-15.

Table 1: Per capita Net Availability of Cereals, Pulses and food grains in India (grams per capita per day), 1971-2015.

Year	Cereals		Pulses		Foodgrains (Cereals + Pulses)	
	Average	Percentage change	Average	Percentage change	Average	Percentage change
1971-1975	392.68	-	43.96	-	442.64	-
1976-1980	398.78	1.55	42.98	-2.23	441.76	-0.20
1981-1985	416.82	4.52	39.30	-8.56	456.12	3.25
1986-1990	433.86	4.09	40.00	1.78	473.86	3.89
1991-1995	444.50	2.45	37.42	-6.45	481.92	1.70
1996-2000	434.92	-2.16	34.18	-8.66	469.08	-2.66
2001-2005	414.24	-4.75	32.36	-5.32	446.60	-4.79
2006-2010	404.62	-2.32	36.44	12.61	441.04	-1.24
2011-2015	423.34	4.63	43.64	19.76	472.74	7.19

Source: Authors calculation based on Economic Survey (various years)

The declining trend in the availability of food grains in the post-reform period can be explained by the encouragement by policymakers of the export of food grains due to India's comparative advantage vis-à-vis the international market in the pricing of food grains (i.e. the relative price of food grains[2], as shown by the secondary vertical axis in

[1] Net availability of cereals (or pulses or foodgrains) is a sum total of net production, net imports, and change in government stocks.

[2] Price relatives is estimated by the ratio of international price (FAO food price index) to domestic price (Indian WPI) indicators.

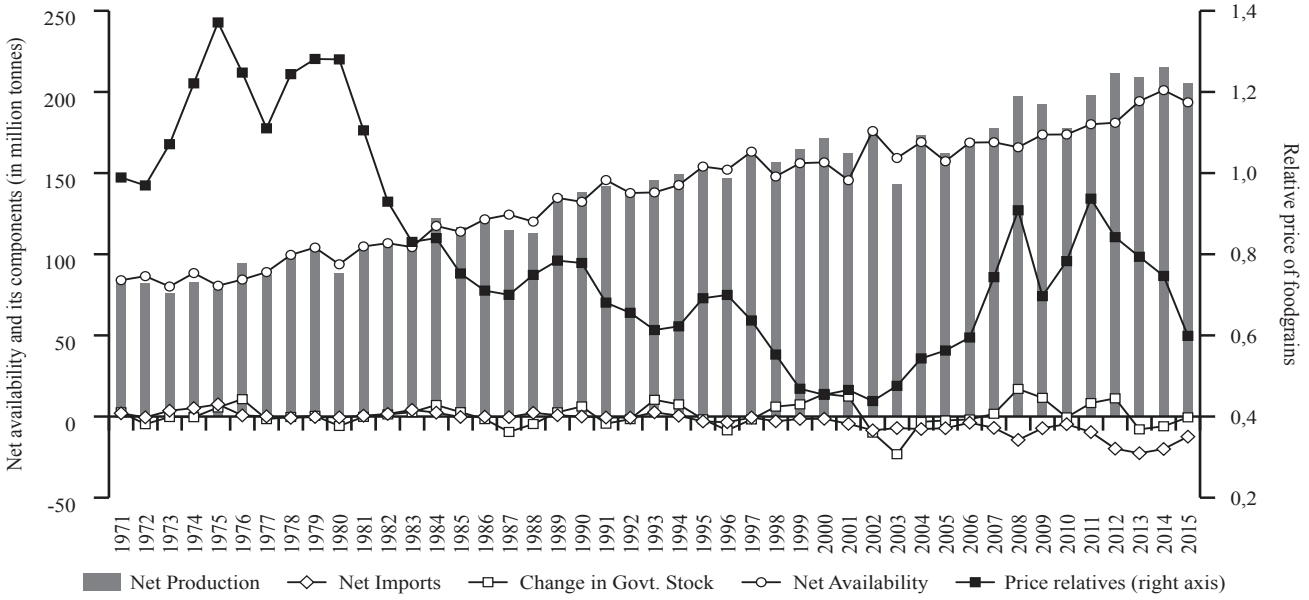

Figure 1: Trend of food price relatives and net availability of foodgrains (& its components).
Source: Authors calculation based on Economic Survey (various years)

Figure 1). It is evident that in the first half of the seventies[3], huge imports of cereals resulted in a higher volume of net availability of cereals in comparison to its net production. The dependence on imports of cereals has reduced significantly over a successive period of time, and India has become a net exporter of cereals since 1995. Thereafter, the production of cereals witnessed a decelerating trend, which ultimately resulted in a declining trend in the per capita availability of cereals. Even though there was substantial progress in the production of cereals during 2006-2010, the declining trend in the availability of cereals exhibits no reversal trend. This is mainly attributable due to the large volume of exports of cereals from India as the domestic price was below international prices. Inappropriate management of the procurement and buffer stock policy of the government is meanwhile considered as another factor explaining the declining availability of cereals for Indian households.

However, the mere availability of food in the country is obviously not sufficient to ensure access to food for all households. In fact, economic access to adequate food depends on the purchasing power of the individual. In this context, the increasing purchasing power of Indian households is reflected in rising monthly per capita consumption over the last 18 years. However, the difference in purchasing power between rural and urban India is reflected in the differential increase in the monthly per capita consumption for rural and urban India. For rural India, real MPCE[4] is seen to have grown from Rs.159.89 in 1993-94 to Rs.220.51 in 2011-12 (i.e. an increase of about 38% over 18 years). In urban India, there has been a substantially higher growth in real MPCE from Rs.264.76 in 1993-94 to Rs.400.54 in 2011-12 (i.e. an increase of 51%). However, in spite of the upward trend of monthly consumption expenditure of households, expenditure on food items reveals a decelerating trend over time. In fact, the share of household consumption expenditure allocated to food can be seen to have declined by nearly 15 percentage points to 48.6% in the rural sector and by about 16 percentage points to 38.5% in the urban sector over an 18-year period. Specifically, cereals have registered the largest decline in share among all the item groups – from 24% to 12% in rural India and from 14% to 7% in urban India over the last 18-year period (NSSO, 2013). The declining demand for food grain (specifically cereals items) reflects the loss of purchasing power on the part of the poor largely due to their deteriorating livelihood security. This view[5] is consistent with the view that declining demand for food grain is due to rising food grain prices arising from the adoption of Structural Adjustment Policies (SAPs) which involved deflationary macroeconomic policies and the opening up of the agricultural sector (Athreya, 2008). Except for 'beverages, etc.', none of the food groups show any noticeable increase in their share of household consumption expenditure, and some of them show a distinct fall (Table 2). The "miscellaneous goods and services" category (including education and medical care) is the group which has grown the most – from 17% of total expenditure in 1993-94 to 26% in 2011-12 in rural India and from 27.5% to nearly 40% in urban India (NSSO, 2013).

Literature Review

Price volatility of agricultural commodities has an important implications for resource allocation as well as consumer and producer welfare (Committee on World Food Security, 2011). However, the implications may not be the same for a producer or a consumer; and while downward price movement may have a negative impact on farm revenue of the

[3] The period from 1961 to 1970 saw a decline in food grain availability, which was partly due to severe droughts in the mid-1960s, leading to wheat imports from the USA under Public Law 480 (Athreya *et al.*, 2008).

[4] Monthly per capita consumption expenditure is measured using a price deflator with 1987-88 as base.

[5] An alternative view argued that declining demand for cereals is due to dietary diversification.

Table 2: Trends in MPCE and Share of Cereals, Food and Non-food in Total Expenditure since 1993-94.

	Rural					Urban				
	1993-94	**1999-00**	**2004-05**	**2009-10**	**2011-12**	**1993-94**	**1999-00**	**2004-05**	**2009-10**	**2011-12**
	Growth of MPCE at 1987-88 prices									
$MPCE_{URP}$	159.89	-	175.17	187.79	220.51	264.76	-	311.35	355.03	400.54
$MPCE_{MRP}$	162.56	179.39	181.56	192.93	221.93	268.38	306.42	326.8	368.99	413.53
$MPCE_{MMRP}$	-	-	-	213.17	246.54	-	-	-	394.52	439.01
	Share of total consumption expenditure in									
Cereals	24.20	22.20	18.00	15.60	12.00	14.00	12.40	10.10	9.10	7.30
Food total	63.20	59.40	55.00	53.60	48.60	54.70	48.10	42.50	40.70	38.50
Non-food total	36.80	40.60	45.00	46.40	51.40	45.30	51.90	57.50	59.30	61.50

Source: Report of the Key Indicators of Household Consumption Expenditure in India, 2011-12 (NSSO, 68th Round)

producers, it has some favourable impact on food expenditures of the consumers. On a macroeconomic level, price volatility has far-reaching implications for growth and poverty (ADB, 2008; Lustig, 2008; Bidi et al, 2009; Ivanic and Will, 2008; Robles *et al.*, 2010; Martin and Ivanic, 2016; Headey and Martin, 2016), economic crisis (Acemoglu et al, 2003; Aizenman and Pinto, 2005), riots (Van Weezel, 2016); the marketing of agricultural produce, and food security (Rapsomanikis, 2009; Kalkuhl et al, 2016). The risk of food price volatility ultimately damages food security in the form of access to food by the poor. In this context, government policies can mitigate the risk of price volatility through the management of food price stability and thereby insulate their population from the harmful effects of food price variability (Saini and Gulati, 2016; Gouel *et al.*, 2016; Global Panel, 2016).

In fact, price volatility is inextricably connected with the problems of food security via implications on household incomes and purchasing power (Rapsomanikis, 2009; Headey, 2011), malnutrition (Devereux, 2009; Bibi *et al.*, 2009; Action Centre la Faim, 2009; Compton *et al.*, 2010). In most of the studies on the implications of price volatility on food security, simulations exercises are employed to assess the impact in terms of reductions in per capita consumption (Rapsomanikis, 2009), increases in the number of poor people (ADB, 2008; Headey, 2011) and changing patterns of consumption on the part of poor people (ADB, 2008; Bibi *et al.*, 2009). However, the data generation procedure involved in such simulations exercises have been criticised in some studies (Headey, 2011). In marked contrast to some other studies, Headey (ibid.) argued that the number of food-insecure people actually decreased during the period of price volatility, 2005-08. The result was explained by the positive impact of rapid economic growth in emerging countries and the existence of price stabilisation policies. Inadequate social safety nets in some countries can explain the varying impact of the food price shocks on poverty. Ivanic and Will (2008) estimated that at least 105 million people in LDC became poor because of high food price inflation since 2005. The poor people face the worst situation as they spend a larger percentage of their income on food as compared with richer income groups.

Several studies examined the implications of rising world food prices in the nutritional level of the people. In a cross-section study, Devereux (2009) revealed the linkages between maize prices and child nutrition in Malawi. Acute malnutrition increased during 2004-05 due to doubled prices of maize, and started decreasing thereafter when the price stabilized. The prevalence of being underweight and wasting in young children in Bangladesh, Cambodia and Mauritania was explained by the rising food price in those countries. It also led to a widespread reduction in the dietary diversification of the region (Compton *et al.*, 2010). However, literature relating to the differential impact of rising food prices on gender and different social groups is relatively scanty in nature. Nevertheless, approaching the topic from this perspective, Hossain and Green (2011) have argued that small-scale farmers and small traders have been the worst affected, whereas commodity producers and workers in export sectors have improved their situation. Meanwhile, rising food prices in Mali led to a reduction in non-food consumption to absorb the shock of price volatility (Bibi *et al.*, 2009). Finally, in the Philippines and Bangladesh, poorer people depend mainly on a single major staple of their food consumption due to lower possibility of substitution in the event of food prices soaring (ADB, 2008).

Against such a backdrop of existing literature, this study addresses the existing research gap on the following two grounds. Firstly, this study presents a disaggregated analysis on the changing pattern of consumption behaviour of the decile classes of the population in India to address the differential impact of rising food prices on different social groups. Secondly, given the known limitations of the data generation procedure involving the use of a simulation exercise, the study employs a 'quasi-experiments with constructed controls' design. The design basically involves comparing the consumption behaviour between households within a decile group to that of the median group of households across decile classes. This framework is also applicable in comparing change in the consumption expenditure of rural India vis-à-vis urban India. Among the different types of quasi-experimental designs that can be used to assess food price impacts, a 'differences-in-differences' (DID) method is used in this study. Thus, the study tries objectively to examine the changing pattern of consumption expenditure across decile classes of the population in India. Changes in consumption expenditure can be explained by spatial differences (rural vis-à-vis urban) and temporal dynamics (before price shock vis-à-vis after price shock). The extent to which spatial-temporal dynamics can explain the consumption expenditure of households is tested within a difference-in-difference framework.

Table 3: NSSO Methodology of Consumption Estimation at Different Reference Periods.

Category	Item Group	Schedule type I		Schedule type II	
		Method	Reference period	Method	Reference period
I	Clothing, bedding, footwear, education, medical (institutional), durable goods	URP	Last 30 days	MMRP	Last 365 days
		MRP	Last 365 days		
II	Edible oil; egg, fish & meat; vegetables, fruits, spices, beverages and processed foods; pan, tobacco & intoxicants	URP	Last 30 days	MMRP	Last 7 days
		MRP	Last 30 days		
III	All other food, fuel and light, miscellaneous goods and services including non-institutional medical; rents and taxes	URP	Last 30 days	MMRP	Last 30 days
		MRP	Last 30 days		

Source: Author's modification on the original table as found in Key Indicators of Household Consumer Expenditure in India, 2011-12.

Data and Methods

Data on consumption expenditure on different reference period or recall period (URP, MRP, MMRP) has been collected from different rounds of NSS covering the period 1993-94 to 2011-12. Data on consumption expenditure are collected from two types of schedules of NSS enquiry: schedule 1.0 type 1 and schedule 1.0 type 2 (Table 3). Different estimates on consumption expenditure actually depend on the reference period or recall period for reporting consumption: Uniform reference period (URP), Mixed reference period (MRP), and Modified mixed reference period (MMRP).

In a disaggregated analysis, the study examines the changing pattern of consumption expenditure across fractile[6] classes of population in rural and urban India. NSS reports data on consumption expenditure across decile classes: the first decile class comprises the bottom 10% of the population in terms of MPCE and the top (10^{th}) decile class comprises the top 10 percent of the population.

To compare the level of consumption expenditure for different segments of the population in the pre- and post-crisis scenario (or rural-urban division), pairwise t-test is employed in this paper. Test of equality of consumption expenditure determines whether the mean consumption expenditure is statistically different in spatial dimension (rural and urban India) in a given temporal setting or whether the mean consumption expenditure is statistically different in temporal dimension (pre and post-2008) in a given region. For example, in the second case, the hypothesis is given by H_0: CE_1=CE_2, where CE_1 and CE_2 are the means of the consumption expenditure for say, period 1 and 2 respectively. The t-test statistic can be written as:

$$t = \frac{CE_1 - CE_2}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}} \approx t_{n_1+n_2-2}, \tag{1}$$

where S_1 and S_2 are the standard deviation of the respective periods. Comparing the calculated and tabulated values of the t statistic necessary conclusions can be made.

Difference-in-difference technique (DID) is used in the study to examine the changing scenario of consumption expenditure in spatial (rural-urban divide) and temporal (pre and post food price inflation) dynamics. DID technique is used in the study to calculate the effect of a food price surge in 2008 (i.e. treatment) on consumption expenditure (i.e. outcome) by comparing the average change in consumption expenditure for rural India (i.e. treatment group), compared to the average change over time for the urban India (i.e. control group). In addition, the change in consumption expenditure of a decile class (i.e. treatment group) is compared with the median class (i.e. control group). In other words, in a panel data structure framework of consumption expenditures across decile classes over time, the study measures the differences, between the treatment and control group, of the changes in the outcome variable that occur over time.

It is to be noted that DID estimator can be numerically calculated by using table 4. In this table the lower right cell itself represents the estimator.

The DID regression technique can provide us the same estimator along with the significance level (Gertler *et al.*, 2010). The empirical specification of the regression can be written as follows:

$$y = \alpha + \beta T + \gamma I + \delta (T.I) + \varepsilon, \tag{2}$$

where T is a time dummy variable (t = 1 for post 2008, t = 0 for pre 2008), and I is a regional variable (i = 1 for rural and i = 0 for urban). The interaction effect (or the composite variable) $T.I$ is a dummy variable ($t = i$ =1 for rural consumption in post 2008).

The estimates in this regression specification can be derived as follows:

$$\begin{aligned}
&\alpha = (yIT = 0, I = 0) = y_{00} \\
&\beta = (yIT = 1, I = 0) - (yIT = 0, I = 0) = y_{10} - y_{00} \\
&\gamma = (yIT = 0, I = 1) - (yIT = 0, I = 0) = y_{01} - y_{00} \\
&\delta = [(yIT = 1, I = 1) - (yIT = 0, I = 1)] - \\
&-[(yIT = 1, I = 0) - (yIT = 0, I = 0)] = \\
&= [(y_{11} - y_{01}) - (y_{10} - y_{00})],
\end{aligned} \tag{3}$$

It is to be noted that the regression technique provides us the same DID estimator.

[6] Fractile is that point below which a stated fraction (or decimal equivalence) of the values lie.

Table 4: Calculation of DID estimator.

y_{it}	i = 1 (say Rural)	i = 0 (say Urban)	Difference
t = 1 (say post 2008)	y_{11}	y_{10}	$y_{10} - y_{11}$
t = 0 (say pre 2008)	y_{01}	y_{00}	$y_{00} - y_{01}$
Change	$y_{01} - y_{11}$	$y_{00} - y_{10}$	DID = $(y_{00} - y_{01}) - (y_{10} - y_{11})$

Source: Author's calculation

Table 5: Calculation of DID estimator by using regression coefficients.

y_{it}	i = 1 (say Rural)	i = 0 (say Urban)	Difference
t = 1 (say post 2008)	$\alpha+\beta+\gamma+\delta$	$\alpha+\beta$	$\gamma+\delta$
t = 0 (say pre 2008)	$\alpha+\gamma$	α	γ
Change	$\beta+\delta$	β	$\Delta\Delta y = \delta$

Source: Author's calculation

Table 6: Decile Group Wise Comparison of Average MPCE at Constant (1993-94) Prices in 61st and 66th round.

Percentile group of population	Rural				Urban			
	61st 2004-05 (U30)	61st 2004-05 (M)	66th 2009-10 (U30)	66th 2009-10 (M)	61st 2004-05 (U30)	61st 2004-05 (M)	66th 2009-10 (U30)	66th 2009-10 (M)
10%-20%	169.00	193.00	143.37	153.84	223.00	248.00	177.32	188.67
20%-30%	195.00	220.00	188.52	200.00	269.00	294.00	245.68	260.46
30%-40%	221.00	245.00	218.89	230.84	316.00	342.00	295.79	313.97
40%-50%	246.00	271.00	246.86	259.30	368.00	396.00	349.64	370.12
50%-60%	275.00	299.00	275.29	289.05	433.00	461.00	410.78	435.14
60%-70%	310.00	333.00	307.35	321.78	512.00	545.00	483.02	511.50
70%-80%	359.00	380.00	346.06	361.66	619.00	657.00	574.06	609.45
80%-90%	442.00	455.00	400.49	415.52	804.00	854.00	697.77	744.55
90%-95%	570.00	569.00	490.03	505.52	1,088.00	1,144.00	911.74	971.76
95%-100%	1,116.00	938.00	910.52	886.16	2,137.00	1,985.00	1,929.65	1,907.55
All	**319.00**	**331.00**	**352.74**	**362.38**	**531.00**	**555.00**	**607.42**	**631.30**
Median	**292.50**	**316.00**	**291.32**	**305.41**	**472.50**	**503.00**	**446.90**	**473.32**

Source: Data on 61st round has been collected from Report on Consumption Expenditure, 2004-05 (p.19), and data on 66th round has been deflated by using suitable price indices.

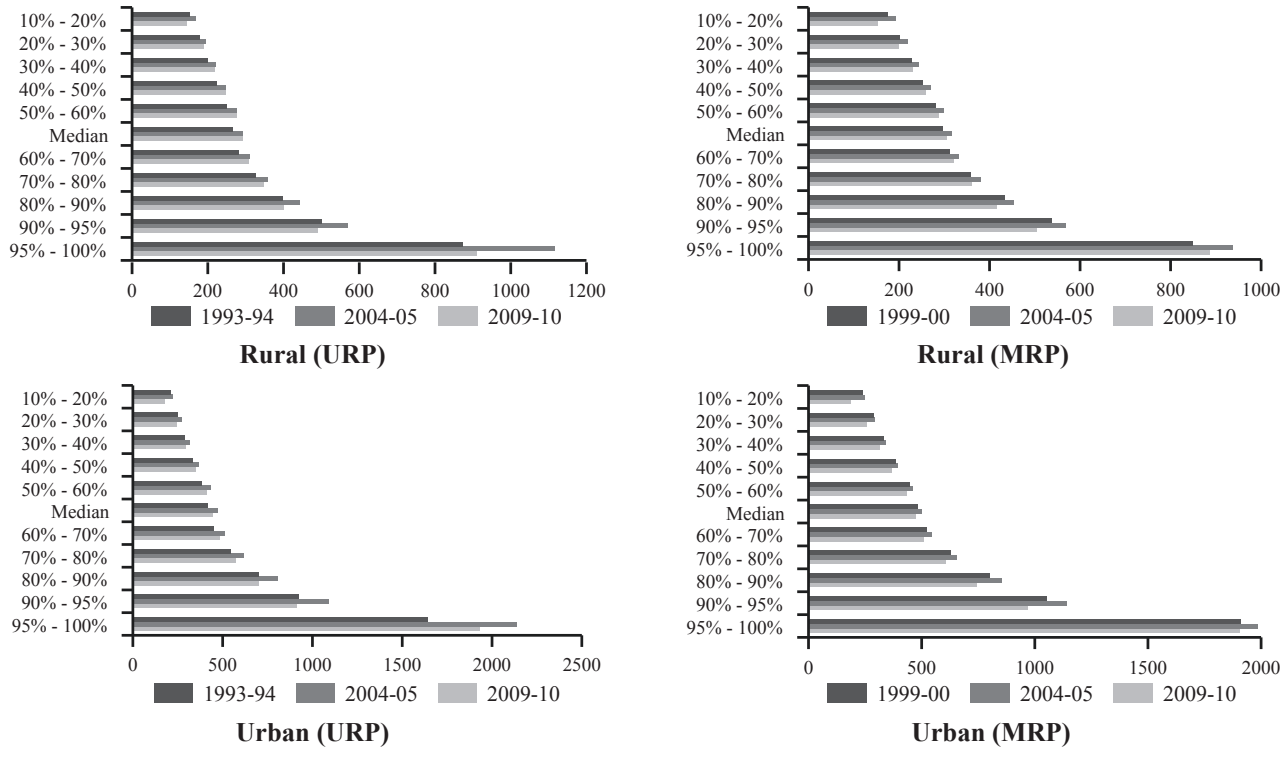

Figure 2: Change in MPCE across Decile Classes.

Source: own calculations

Table 7: Tests of Equality of Mean Consumption Expenditure in Rural and Urban India.

Time	Method	Mean CE_Rural	Mean CE_Urban	t-statistic	P-value at two-tail test
2004-05	URP	390.30	676.90	-3.066	0.013
2009-10	MRP	352.74	607.54	-2.741	0.022
2004-05	URP	390.30	692.60	-3.104	0.012
2009-10	MRP	362.37	631.32	-2.873	0.018
Region	**Method**	**Mean CE_Pre 2008**	**Mean CE_Post 2008**	**t-statistic**	**P-value at two-tail test**
Rural	URP	390.3	352.74	1.849	0.097
Rural	MRP	390.3	362.37	4.608	0.001
Urban	URP	676.9	607.54	3.137	0.011
Urban	MRP	692.6	631.32	4.086	0.002

Source: own calculations

Table 8: Decile Class wise difference-in-difference estimates of MPCE before and after 2008 in Rural India (URP & MRP).

Decile class	Rural		Change	Rural		Change
	2004-05 (U30)	2009-10 (U30)		2004-05 (M)	2009-10 (M)	
10% -20%	169.00	143.37	-25.63	193.00	153.84	-39.16
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	-123.50	-147.95	-24.45	-123.00	-151.57	-28.57
20%-30%	195.00	188.52	-6.48	220.00	200.00	-20.00
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	-97.50	-102.80	-5.30	-96.00	-105.41	-9.41
30%-40%	221.00	218.89	-2.11	245.00	230.84	-14.16
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	-71.50	-72.43	-0.93	-71.00	-74.57	-3.57
40%-50%	246.00	246.86	0.86	271.00	259.30	-11.70
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	-46.50	-44.46	2.04	-45.00	-46.11	-1.11
50%-60%	275.00	275.29	0.29	299.00	289.05	-9.95
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	-17.50	-16.03	1.47	-17.00	-16.37	0.63
60%-70%	310.00	307.35	-2.65	333.00	321.78	-11.22
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	17.50	16.03	-1.47	17.00	16.37	-0.63
70%-80%	359.00	346.06	-12.94	380.00	361.66	-18.34
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	66.50	54.74	-11.76	64.00	56.25	-7.75
80%-90%	442.00	400.49	-41.51	455.00	415.52	-39.48
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	149.50	109.17	-40.33	139.00	110.10	-28.90
90%-95%	570.00	490.03	-79.97	569.00	505.52	-63.48
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	277.50	198.71	-78.79	253.00	200.10	-52.90
95%-100%	1,116.00	910.52	-205.48	938.00	886.16	-51.84
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	823.50	619.19	-204.31	622.00	580.75	-41.25

Source: own calculations

Changing Pattern of Consumption Expenditure across Decile Classes

To have a deeper insight into the trend in consumption expenditure for the different segments of population, this paper utilises secondary data on MPCE (measured in uniform and mixed reference periods) for different percentile groups of population in rural and urban India from 50th (1993-94) to 66th (2009-10) rounds of consumption expenditure surveys. In presenting the trend of consumption expenditure behavior, estimates of MPCE is deflated by suitable price indices (CPI-AL price indices for rural and the CPI-UNME for urban sector) and expressed at 1993-94 prices. In general, consumption expenditure across decile classes' at first exhibited an upward trend during the 1990's and then decelerated in the post-2008 scenario (Figure 2). Table 6 presents the MPCE data on 61st and 66th rounds of consumption expenditure surveys to explore the change in consumption expenditure in the pre and post food crisis scenario across percentile groups of the population.

Empirical results from the mean equality test suggest that mean levels of consumption expenditure in rural and urban differ significantly at a 5 per cent level of significance

Table 9: Decile Class wise difference-in-difference estimates of MPCE before and after 2008 in Urban India (URP & MRP).

Decile class	Urban		Change	Urban		Change
	2004-05 (U30)	2009-10 (U30)		2004-05 (M)	2009-10 (M)	
10% -20%	223.00	177.32	-45.68	248.00	188.67	-59.33
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	-249.50	-269.58	-20.08	-255.00	-284.65	-29.65
20%-30%	269.00	245.68	-23.32	294.00	260.46	-33.54
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	-203.50	-201.21	2.29	-209.00	-212.86	-3.86
30%-40%	316.00	295.79	-20.21	342.00	313.97	-28.03
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	-156.50	-151.11	5.39	-161.00	-159.35	1.65
40%-50%	368.00	349.64	-18.36	396.00	370.12	-25.88
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	-104.50	-97.26	7.24	-107.00	-103.20	3.80
50%-60%	433.00	410.78	-22.22	461.00	435.14	-25.86
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	-39.50	-36.12	3.38	-42.00	-38.18	3.82
60%-70%	512.00	483.02	-28.98	545.00	511.50	-33.50
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	39.50	36.12	-3.38	42.00	38.18	-3.82
70%-80%	619.00	574.06	-44.94	657.00	609.45	-47.55
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	146.50	127.16	-19.34	154.00	136.13	-17.87
80%-90%	804.00	697.77	-106.23	854.00	744.55	-109.45
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	331.50	250.87	-80.63	351.00	271.23	-79.77
90%-95%	1088.00	911.74	-176.26	1144.00	971.76	-172.24
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	615.50	464.84	-150.66	641.00	498.44	-142.56
95%-100%	2,137.00	1,929.65	-207.35	1,985.00	1,907.55	-77.45
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	1,664.50	1,482.75	-181.75	1,482.00	1,434.23	-47.77

Source: own calculations

(Table 7). A negative estimate of t-statistic suggests that rural consumption expenditure is lower than the urban region, while positive estimates of t-statistic suggest that consumption expenditure in the second period (i.e. post-2008), in fact, declines in comparison to the first period. Spatial variation in consumption expenditure is also statistically significant in a particular time period. The findings remain the same irrespective of the measures of consumption expenditure (uniform or mixed reference period) used.

Spatial-temporal Difference in Consumption Expenditure: Difference-in-difference

Table 8 summarises the change in MPCE across decile classes in the pre- and post-2008 scenario. Differences in the average consumption expenditures are also noted across decile classes by considering the median class as the control group of the population. A general trend of declining consumption expenditure across decile classes is noticeable after the rise in food prices in 2008. Change in consumption expenditure of a particular decile class (e.g. expenditure decline by Rs. 25.63 for 10%-20% class) is compared with the change in consumption expenditure of the median class (e.g. expenditure decline by only Rs. 1.18 for median class) by calculating the difference-in-difference estimator. The relative loss (the difference-in-difference of the changes in consumption expenditure) is Rs. 24.45. Inspection of the relative changes across decile classes indicates that the food price surge in 2008 had far-reaching implications on the consumption expenditure of most of the classes (especially higher decile class from 70%-80% and lowest decile class) in comparison to the median class. Middle decile classes (e.g. 40%-50% and 50%-60%) do not exhibit the same trend. The relative change in MPCE measured by using URP is seen as more prominent for the lower-income group (10%-20% to 50%-60%) than considering MRP as the measurement reference. For the higher-income class (from 60%-70%), MRP measurement provides larger relative change than URP.

The overall conclusion remains the same for urban India: the higher decile classes (from 80%-90%) and the lowest ones (10%-20%) are worse affected than the median class of the population. However, the magnitude of relative loss is lower in urban areas than in their rural counterparts. As with rural India, measurement of relative change by using a

Table 10: Decile class and region-wise difference-in-difference estimates of MPCE before and after 2008.

Decile class	Region	2004-05 (U30)	2009-10 (U30)	Change	2004-05 (M)	2009-10 (M)	Change
10%-20%	Rural	169.00	143.37	-25.63	193.00	153.84	-39.16
	Urban	223.00	177.32	-45.68	248.00	188.67	-59.33
	Difference	-54.00	-33.95	20.05	-55.00	-34.83	20.17
20%-30%	Rural	195.00	188.52	-6.48	220.00	200.00	-20.00
	Urban	269.00	245.68	-23.32	294.00	260.46	-33.54
	Difference	-74.00	-57.16	16.84	-74.00	-60.46	13.54
30%-40%	Rural	221.00	218.89	-2.11	245.00	230.84	-14.16
	Urban	316.00	295.79	-20.21	342.00	313.97	-28.03
	Difference	-95.00	-76.90	18.10	-97.00	-83.13	13.87
40%-50%	Rural	246.00	246.86	0.86	271.00	259.30	-11.70
	Urban	368.00	349.64	-18.36	396.00	370.12	-25.88
	Difference	-122.00	-102.77	19.23	-125.00	-110.81	14.19
50%-60%	Rural	275.00	275.29	0.29	299.00	289.05	-9.95
	Urban	433.00	410.78	-22.22	461.00	435.14	-25.86
	Difference	-158.00	-135.49	22.51	-162.00	-146.09	15.91
60%-70%	Rural	310.00	307.35	-2.65	333.00	321.78	-11.22
	Urban	512.00	483.02	-28.98	545.00	511.50	-33.50
	Difference	-202.00	-175.66	26.34	-212.00	-189.72	22.28
70%-80%	Rural	359.00	346.06	-12.94	380.00	361.66	-18.34
	Urban	619.00	574.06	-44.94	657.00	609.45	-47.55
	Difference	-260.00	-228.00	32.00	-277.00	-247.79	29.21
80%-90%	Rural	442.00	400.49	-41.51	455.00	415.52	-39.48
	Urban	804.00	697.77	-106.23	854.00	744.55	-109.45
	Difference	-362.00	-297.28	64.72	-399.00	-329.03	69.97
90%-95%	Rural	570.00	490.03	-79.97	569.00	505.52	-63.48
	Urban	1088.00	911.74	-176.26	1144.00	971.76	-172.24
	Difference	-518.00	-421.71	96.29	-575.00	-466.24	108.76
95%-100%	Rural	1,116.00	910.52	-205.48	938.00	886.16	-51.84
	Urban	2,137.00	1,929.65	-207.35	1,985.00	1,907.55	-77.45
	Difference	-1,021.00	-1,019.13	1.87	-1,047.00	-1,021.38	25.62

Source: own calculations

particular referencing period (URP or MRP) provides similar findings also in the context of urban India (Table 9).

Considering the urban region as the control group, the change in consumption expenditure of the rural region (i.e. treatment group) is also examined. Overall, it has been seen that change in consumption expenditure post-2008 is distinctly marked in comparison to the expenditure in urban area in change in rural areas. It has been reflected by the positive DID estimator in all cases. The findings suggest that urban area faces challenges in the wake of food price inflation in 2008 due to their dependence on non-wage goods (especially food grains) from rural areas (Table 10).

In the specification of DID regression, we have included a treatment effect (*i*, for rural or urban area), time effect (t, for pre and post-2008) and the interaction effect of time and treatment (*ti*). The coefficient of the treatment effect (δ) indicates the estimated average treatment effect. All coefficients have their expected signs. Time effects suggest that mean consumption expenditure is, in fact, declines in post 2008. However, the result is not found to be significant. Treatment effects suggest that mean consumption expenditure in rural is lower than urban region, and the result is found significant. In other words, significant coefficients of treatment effect in both the regressions (URP or MRP) imply the influence of spatial effect in determining the average MPCE across decile classes of the population. This supports our earlier findings of significant differences in mean MPCE in rural-urban differences in consumption expenditure (Table 11).

Sophisticated statistical software also reports average MPCE levels in urban and rural India in pre and post 2008 (table 12). The difference-in-difference coefficients (31.6 in URP and 33.4 in MRP) as shown in table 12 is similar to the coefficients of interaction effects in difference-in-difference regressions (Table 11).

Conclusions and Policy Implications

The main objective of this paper was to examine the implications of food price volatility on the changing pattern of consumption expenditure across decile classes in India. The background of the study suggests that the declining trend in the availability of food grains in the post-reform period can be explained by the encouragement of the export of food grains due to the comparative advantage of India vis-à-vis the international market in the pricing of food grains.

Consumption expenditure differs in both spatial (rural and urban) and temporal (pre- and post-2008) dimensions. Empirical results reveal that the relative loss of consumption expenditure (or difference-in-difference of the changes

Table 11: Results of difference-in-difference regression (URP and MRP).

	Uniform Reference Period		Mixed Reference Period	
	Coefficients	**t Stat**	**Coefficients**	**t Stat**
Constant	676.9	5.01***	692.6	5.49***
t	-69.3	-0.36	-61.2	-0.34
i	-286.6	-1.50*	-302.3	-1.69**
ti	31.7	0.11	33.3	0.13
	Observations: 40 Unadjusted R-squared = 0.367207, Adjusted R-squared = 0.333002		Observations: 40 Unadjusted R-squared = 0.104473, Adjusted R-squared = 0.0298452	

Note: ***, **, * implies significant at 1%, 10% and 15% level
Source: Author's calculation

Table 12: Results of Average MPCE (URP and MRP).

	Uniform Reference Period			Mixed Reference Period		
	i = 1 (Rural)	**i = 0 (Urban)**	**Difference**	**i = 1 (Rural)**	**i = 0 (Urban)**	**Difference**
t = 1 (post2008)	352.7	607.7	255.0	362.4	631.3	268.9
t = 0 (pre 2008)	390.3	676.9	286.6	390.3	692.6	302.3
Change	37.6	69.2	DID = 31.6	27.9	61.3	DID = 33.4

Source: Author's calculation

in consumption expenditure) in the urban regions is higher in comparison to the expenditure change in rural areas after the food price shock of 2008. Also, difference-in-difference regression has reinforced our earlier findings that differences in consumption expenditure can be explained by the interplay of spatial and temporal factors and the effects of their interaction.

In the backdrop of the relative loss of consumption expenditure in urban regions than rural regions after 2008, there is a need for a provision of social safety nets in urban India. The implementation of targeted promotional social protection policies through a combination of buffer stock operations and a public distribution system is expected simultaneously to address both the problem of access to food and the stabilisation of food prices.

As a limitation, the study considers only one dimension of food security (i.e. access to food as measured by the estimates of consumption expenditure). Any sweeping generalisation on the basis of this dimension may not capture the overall impact on nutrition food security. Adequate attention needs to be given to dietary diversification away from cereals and increasing consumption of horticulture and livestock products, which may compensate for calorie and protein losses arising from the declining per capita availability of cereal consumption. Macro evidence should be supplemented by micro empirical observations to provide a holistic overview of the impact of food price volatility on nutrition security.

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Short communication

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Working time organisation of senior workers in agricultural companies with a focus on age management

The current situation on European agricultural labour markets and the expected demographic development emphasise the need to address the issues of work and working time organisation in order to attract a young generation to agriculture. The aim of this paper is to evaluate the use of modern individual methods of working time organisation within agricultural companies. Data was collected through a quantitative survey consisting of 259 active agricultural companies in the Czech Republic. Results suggest that three factors were responsible for working time organisation in agricultural companies: support of flexible employment forms, employee productivity and the use of specialists. The right working time organisation of all age groups supports the cooperation of all employees and ensures knowledge continuity.

Keywords: age management, agricultural companies, human resource management, competence development
JEL classifications: J24, M54, D83

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Introduction

Employees, their knowledge (explicit and tacit), experience and innovations are the most valuable assets for any company nowadays (Wikstrom *et al.*, 2018). Knowledge sharing among all generations of employees is a key aspect of age management (Urbancová and Hudáková, 2017) in companies because ageing of the population has a negative impact on the labour market and future employment in companies (Kosir and Soba, 2016), primarily so in agriculture. With regard to the competitive environment and high costs incurred by organisations in relation to creating new jobs and adapting to the requirements of employees, a continuous emphasis on their education and development is needed (Lambert, 2018; Bjerke, 2016). It is necessary for farms and agricultural companies to focus on the organisation of working time (Askenazy, 2013), including flexible forms of employment as well as flexible forms of working time organisation (Stirple *et al.*, 2018; Urbancová and Navrátilová, 2016).

Besides posing serious social challenges, changes in the age structure of the population should also be analysed from an age management perspective: how to organise the working time and work conditions of the elder generations for the company to be more efficient? The management of age diversity of employees is also essential for knowledge continuity management (Urbancová and Hudáková, 2017) as well as it helps to keep agricultural values, objectives, past management decisions and future intentions in agricultural companies (Brown *et al.*, 2019).

In the Czech Republic, the agricultural sector is characterised by a less favourable age structure when compared to the national economy. The age 50+ generation is significantly over-represented in agriculture, causing labour markets to be rigid, inflexible and unproductive (Wikstrom *et al.* 2018, Kosir and Soba, 2016).

At the same time, the Regional Economic Strategy of Europe suggests that the percentage of part-time employment contracts in Europe will increase faster than the number of full-time employment contracts (increase approx. by 2 %). Therefore, the agricultural labour market environment must apply new trends in human resources activities that will help to maintain the knowledge base in agriculture companies thanks to inter-generational cooperation of employees. This can either be achieved through suitable working time organisation or through proper age management.

Based on the above, the aim of the paper is to evaluate the use of modern methods of working time organisation within agricultural companies in the Czech Republic.

Literature review

Nowadays, there exists many flexible forms of employment, including shorter working times, overtime work, uneven work schedule, flexible working times, job rotation, job sharing, temporary career interruption, company scholarships and purchased leave, flexitime or freelancing (hiring specialists for short-term cooperation as private service providers). However, it is important to note that the use of individual forms of working time organisation and employment depends on the organisational conditions, personal characteristics and the nature of work (Ilmarinen, 2011). As confirmed by many studies (Galea *et al.*, 2014; Askenazy, 2013; Mohrenweiser and Zwick, 2009), the agricultural sector is no exception in this regard. Although the use of flexible working time organisation is also influenced by the type of a job, a wide range of flexible working time organisations makes it possible to use them in agriculture, especially for different age groups (Principi and Fabbietti, 2015; Ciutiene and Railaite, 2015; Froehlich *et al.*, 2015; Urbancová and Hudáková, 2017).

A higher involvement of specific groups of employees (i.e. individuals around retirement age, students, young mothers with children) in the labour market in the Czech Republic is especially hindered by the insufficient offering of part-time employment opportunities. The Czech employees aged 45+ in agriculture (including hunting and forestry) represented 52.7% of the workforce in 2016, whereas in the national economy it was 42.4 %. In agriculture, the 45-59 age group represented 40.8% of the workforce, whereas in the national economy it was 34.7%. Regarding the oldest age group (aged 60+), agriculture also employed more of such workers (11.6 %) than the national economy (7.7 %). The proportion of the eldest generation has been growing moderately recently, caused not only by retirement age growth but also by the transition from the numerous age group of 45-59.

It should also be noted that employees aged 50+ need specific working conditions. They have specific physical strains, less motivation and different personal goals. According to the literature (Lorga and Dobre, 2018; Urbancová and Navrátilová, 2016; Moshchenko *et al.*, 2018), the main indicators affecting age and working time management in Czech agricultural companies are the size of the company (number of employees), the level of training of the company management, the age of the head of the company, the family structure of a firm and the ownership of agricultural companies (domestic or foreign).

Searching for the tools to enhance motivation/stimulation is particularly important these days as the unemployment in the Czech Republic declined in 2017 to its lowest level for the past 19 years and showed the lowest rate in EU-28. Thus, the Czech Republic is probably at its natural unemployment rate and the problem of its economy is not unemployment but a lack of workforce. The lack of qualified employees is already clearly visible in agriculture.

As evident from the above, the current situation in the Czech agricultural labour market is unfavourable in many respects. The lack of young farmer generations and the lack of skilled workforce lead to the need of farm managers to use flexible working time organisation and management. Despite the importance of the topic, a relatively low number of research has been dedicated to the scientific analysis of age and working time management in the Czech agriculture, especially regarding senior workers – a gap to be filled by this paper.

Data and method

In order to determine how working time organisation is used in agricultural companies in the Czech Republic, a questionnaire consisting of 23 questions on age management and 7 identification questions was used. The questionnaire was divided into four parts (conditions of age management application; benefits and limits of age management application, costs of age management, use of working time organisation and knowledge continuity) and this paper concentrates on the "use of working time organisation and knowledge continuity".

Primary data was gathered by using online questionnaires. The research was conducted in 2017 by quota-based selection among agricultural companies active in the Czech Republic (n=259). In total, 860 e-mails to owners or management of agricultural companies were sent out, out of which 259 were returned, resulting in a response rate of 30.11%. The sample was based on the Albertina database of organisations. Albertina is a unique database that contains important data of more than 2,700,000 organisations registered in the Czech Republic. The questionnaire was completed by middle or higher management of the addressed companies and in the case of smaller companies, by the owner itself. Half of the respondents worked for small companies (49.8% were from companies with 1–49 employees), a quarter for medium-sized companies (26.3% were from companies with 50–249 employees) and another quarter worked for large companies (23.9% were associated with companies with 250 employees or more). The vast majority of the companies (84.2%) were under Czech ownership, while 15.8% of the companies were owned by foreigners. Table 1 shows the share of senior employees (50+) in the 259 companies.

Table 1: The share and number of senior workers in the sample.

Share of senior workers	Number of companies
0-5%	69
6-10%	44
11-15%	35
16-20%	38
21-30%	36
31-40%	15
41-50%	13
51-100%	9
Total	259

Source: own composition

First, descriptive statistics were used to evaluate the results. As a second step, factor analysis was run and as recommended by Anderson (2013), the Varimax method and the Kaiser-Guttman rule (i.e. the dispersion value of substantial factors is higher than 1) were used to select the most important factors. Values above 0.3 (Anderson, 2013) are considered as key values in social science, and primarily in the HR management. In our case, factor analysis was used to identify factors that put behaviour of respondents (owners/managers of the agricultural company) into meaningful groups. The statistical software IBM SPSS Statistics 24 was used to evaluate the results.

Results and discussion

As evident from Table 2, two thirds of agricultural companies in the Czech Republic used part-time and flexitime forms of employment in agriculture. Teleworking was also relatively popular, while the use of other forms like company scholarships or purchased leave was limited.

It is also observable from our sample that agricultural companies in the Czech Republic used flexible working forms mostly for younger employees and for women with children and less for the 50+ age group. However, better use of flexible forms of employment would allow employers to better adapt to workforce demand fluctuations and demographic changes, increase employee loyalty, save costs,

Table 2: Working time organisation in the 50+ age group.

Working time organisation/form of employment	Number of companies	Share (%)
Flexitime The employees choose the beginning and/or the end of their working time by themselves, they are present at their working place during the working hours fixed by the employer and work fixed number of hours per day, week or month.	39	20.2
Part-time employment The employer and employee agree upon a working time shorter than a fixed 40-hour working time per week, in the employment contract.	39	20.2
Special part-time Agreement to complete a job and agreement to perform work under Sec. 75/Sec. 76 of the Czech Labour Code (20 hours/week, small-scale employment up to CZK 2000)	50	25.9
Job sharing One job is shared by two people: they work part-time in mutual synergy.	5	2.6
Teleworking, home working An employee carries out his/her tasks from distant location through the use of phone, e-mail, Skype, ICQ and similar contemporary communication technologies. The tasks can also be performed at home (home working).	18	9.3
Compressed work week Uneven distribution of working time = an employee makes up full 40 hours-per-week in less than five days. Work days are longer, but a work week is shorter. The employee earns one extra free day in a week.	5	2.6
Temporary career interruption An employer may grant unpaid leave for a certain period, which may be used by the employee, e.g. for study, traineeship abroad.	10	5.2
Company scholarship (for studying employees)	0	0.0
Purchased leave This option is for the employees who need extra leave weeks: they "purchase" the extra time – with their monthly salary proportionally reduced. Such leave is not handled by laws; it is upon agreement of both parties.	2	1.0
Flexitime work year An equivalent to flexitime, related to calendar year. During such year, an employee works more in certain months (overtime) and less in other months (he/she takes compensatory leave).	12	6.3
Freelancing Hiring specialists for short-term cooperation as private service providers.	13	6.7
Total	193	100

Note: The respondents can state more answers. If organizations do not allow flexible forms in selected agricultural companies, respondents did not respond.
Source: own composition

Table 3: Company classification based on working time organisation.

Variables	Flexible work-minded	Productivity-minded	Specialist-minded
Flexitime	**0.705**	0.233	0.059
Short-time employment	**0.746**	0.190	0.089
Part-time employment	**0.602**	0.323	-0.212
Job sharing	0.154	**0.681**	-0.048
Teleworking, homeworking	**0.736**	-0.144	0.052
Compressed work week	0.133	0.504	**0.582**
Temporary career interruption	**0.512**	0.085	0.157
Company scholarships	-0.058	0.052	**0.811**
Purchased leave	0.023	**0.671**	-0.001
Flexitime work year	0.234	**0.522**	0.322
Freelancing	0.420	-0.326	**0.559**
Variance explained	27.330%	12.985%	12.097%

Source: own survey

recruit or dismiss an employee more quickly in reaction to changing market situations and create a better company brand.

The results were further processed by using Varimax-based factor analysis (Table 3). This technique has identified three important types of companies, explaining 52% of the total variance of the sample: flexible work-minded, productivity-minded and specialist-minded companies.

As to flexible-minded companies, it is evident they support flexible working time, short-and part-time employment, teleworking and temporary career interruption. Values of coefficients vary from 0.5 to 0.7 which can be considered significant and it is traditional agricultural family farms (companies) who chose these forms of working time organisation.

The second factor is created from job sharing, purchased leave and flexitime work year with relatively high coefficients. This factor can be named "Productivity-minded", referring to the fact that such agricultural companies in the Czech Republic focus rather on the stable productivity of their employees. On the contrary, the third type of companies consists of "Specialist-minded" organisations preferring

compressed work weeks, freelancing and company scholarships, working with higher rates of highly specialised work. Although it seems that traditional forms of working time organisation in agriculture are still most often used, some signs appear that companies also use less frequent forms of working time organisation, which are highly needed, especially in agriculture.

Results are mainly in line with the literature. The importance of age management for all age groups, regardless of the sector, is documented by Principi *et al.* (2015) and Riva *et al.* (2014). It is, therefore, necessary to focus on the examined issue of age management also in agricultural companies. Results have shown the necessity for the addressed companies to support flexible working arrangements, employee productivity and the use of specialists, which is in accordance with Angeloni and Brogonovi (2016) and Ciutiené and Railaité (2015). Age management in agriculture can also help to ensure the knowledge continuity process and to effectively use the internal and external knowledge to increase the performance of agriculture organisations, which is confirmed by the research of Bjerke (2016). Increasing the agricultural managers´ knowledge by educating them can increase labour productivity, which is confirmed by Nowak and Kijek (2016).

In order to eliminate the negative consequences of a rigid labour market, ageism, non-used working time and insufficient knowledge continuity, agricultural companies can use the Hogan Development Survey (HDS). This survey focuses on assessing potential obstacles to personal and professional development of each employee, helps identifying the motives and values of an individual in achieving goals in its personal and work life as well as tests personality features in their interpersonal relations and personal lives and thus affect their work performance.

Moreover, poor health is probably the main reason why the employees leave the company and labour market before they reach the official retirement age (Collien *et al.*, 2016; Riva *et al.*, 2014; Štorová, 2012). However, timely intervention in terms of re-organisation of working procedures, using flexible working time and improving lifestyle may lower the probability of early retirement. Medical guidance can also help those with lowered physical performance above 50 to improve their labour market situation. Moreover, according to McKinsey & Company (2019), positive work-life balance policies, resulting from company culture, increase work performance of 50+ employees and enhance their productivity and competitiveness.

Conclusions

This paper analysed the level and structure of working time organisation in Czech agricultural companies, especially considering employees above 50 ages. Results suggest that the majority of Czech agricultural companies uses traditional forms of working time organisation in agriculture, though some signs appear that companies also use less frequent forms of working time organisation, which are highly needed, especially in agriculture. By using factor analysis, the paper has identified three important types of Czech agricultural companies in terms of age management: flexible work-minded, productivity-minded and specialist-minded companies.

Given the above, it can be summarised that it is precisely the use of flexible forms of working time organisation and flexible forms of employment, which is an important part of age management. The limitation of the research lies in the sample and method characteristics. Future research might focus on other countries and sectors as well as the determinants and impacts of proper age management.

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Short communication

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Agriculture-specific determinants of carbon footprint

The global food system, from fertiliser production to food packaging, is responsible for approximately one-third of all human-caused greenhouse gas emissions. The ecological footprint captures the ecological assets that a population needs to produce, the natural resources it consumes, and to absorb its waste. The carbon footprint as the main component represents more than 50% of the total ecological footprint. Carbon footprint is said to be a widely accepted indicator of GHG intensity, originating from different economic activities. Due to its important role in raising awareness of global warming, scientists and policymakers also use it as a management tool for estimating environmental pollution. In contrast, the application of carbon footprint on the agricultural sector is still limited in the literature. The paper aims to explore what agriculture-specific factors influence the carbon footprint at a global level based on 1961-2013 data. The study employs feasible generalized least squares estimator along with panel unit root tests. Results show that carbon footprint is stimulated by economic development and agricultural production (arable land, agricultural machinery, fertilizer use), and in addition, agricultural exporting has a positive impact on the carbon footprint. By contrast, the growth of carbon footprint is negatively related to the higher share of rural population and agricultural development.

Keywords: carbon footprint, agriculture, determinants, trade

JEL classification: Q15

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Introduction

According to environmental scientists, agriculture is one of the major contributors to climate change. Approximately one-third of the greenhouse gas emissions (GHG) come from agriculture (Gilbert, 2012). It is already well known that agricultural GHG emissions are mainly composed of methane and nitrous oxide. Furthermore, agriculture uses approximately 11 per cent of the Earth's land surface for crop production and makes use of 70 per cent of all water surface (FAO, 2003; FAO, 2011). The global food system, ranging from fertiliser manufacture to food storage and packaging, is responsible for up to one-third of all human-caused GHG emissions (Gilbert, 2012).

Environmental pollution is generally captured at a national level by measuring ecological and carbon footprints in environmental economics. Ecological footprint measures a country's use of cropland, forests, grazing land and fishing grounds for providing resources and absorbing carbon dioxide from burning fossil fuels (Global Footprint Network, 2018). The carbon footprint represents more than 50% of the total ecological footprint in many countries of the world. Furthermore, the carbon footprint is supposed to be a widely accepted indicator of GHG intensity, originating from different economic activities. Due to its increasing importance, scientists and policymakers also use it as a management tool.

Investigating the determinants of carbon footprint on the agricultural sector at product level has already been addressed by the literature, though analyses at the country level are still limited in the empirical literature, especially from a global perspective. Therefore, the paper analyses the determinants of carbon footprint on a global sample, focusing on the role of economic development, agricultural production, agricultural development and agricultural trade (export) between 1961 and 2013.

The paper is structured as follows: the subsequent section discusses the theoretical framework of the study. Section 3 presents the methodology and econometric specification. Section 4 illustrates the development of the ecological and carbon footprint, followed by the results. The final section concludes.

Theoretical framework

Two main approaches exit on estimating GHG emission: the consumption-based and the production-based approach (Mózner, 2013). The domestic emission inventories are based on a production-based approach, while the consumption-based approach claims that countries are responsible for emissions generated elsewhere due to its consumption (Peters and Hertwich, 2008; Mózner, 2013).

Several scientific studies have been published on the measurement of GHG emissions at the macro level. In recent years, many income and non-income factors were identified as key drivers of emission (IPCC, 2014), such as population growth, trends in demographic structure (urbanisation), consumption expenditure, transport infrastructure, production methods, waste management and energy systems. Various non-income factors can be also mentioned such as geography, diet, and lifestyle, which also affect per capita emission of carbon footprints (GAIA, 2012; Corsten *et al.*, 2013).

The literature presents contradicting results relating to whether population growth in rich or poor countries contributes more to increasing GHG emissions. Poumanyvong and Kaneko (2010) measured elasticities ranging from 1.12 (high-

income), 1.23 (middle-income) to 1.75 (low-income) countries, while Jorgenson and Clark (2010) find a value of 1.65 for developed countries and 1.27 for developing countries.

In the previous decades, the calculation and use of carbon footprint has become more widespread. The carbon footprint is often used for determining the amount of carbon being emitted by economic activity. The carbon footprint is also an important component of the ecological footprint since it is a competing demand for biologically productive space (Global Footprint Network, 2018). Due to its important role in raising awareness of environmental degradation, scientists and policymakers also use it as a management tool for measuring the environmental effect of different countries.

However, it should be noticed that the carbon footprint is strongly correlated with consumption expenditure. The consumption-based emissions are more closely associated with GDP than with territorial emissions (IPCC, 2014). The consumption-based framework assigns the emissions released through the supply chain of goods and services consumed within a nation, irrespective of their territorial origin. The difference in inventories calculated based on the different frameworks are also the emissions embodied in trade (Peters and Hertwich, 2008; Bows and Barrett, 2010).

Different countries and agricultural sectors have diverse carbon footprints. Country size, the importance of agriculture and agricultural production, technology, population, etc. might influence carbon footprints of the economies in different ways. China with its highest population and production level is one of the major contributors to the global carbon footprint and climate change. In China, the carbon footprint of crop production represents 8% of the nation's total emissions and two-thirds of the agricultural footprint are of agrochemical origin. Moreover, irrigation and energy consumption contributes to 22% on average, whereas plastic film and machinery management contributes less than 10% of the total carbon footprint in crop production (Muthu, 2014).

Most of the carbon footprint studies are focusing on certain geographical area and product-level data. Muthu (2014) revealed that among the three main Chinese crops, rice has the biggest carbon footprint, followed by wheat and maize sectors. According to a study conducted on livestock of pig meat in Flanders by the carbon footprint method, 1 kg of pig meat creates a carbon footprint of 5.7 kg CO2 equivalent. At the farm level, fodders were responsible for more than two-thirds of the carbon footprint (Muthu, 2014).

Comparing carbon footprints between different animal meat productions, beef has the biggest carbon footprint, followed by pork (Dyer *et al.*, 2008, Desjardins *et al.*, 2014). In dairy production, Desjardins *et al.* (2014) demonstrated that powders have the largest carbon footprint among dairy products, followed by butter and cheese.

Hypotheses and econometric specifications

On the consumption side, developed, high income, and populated countries might have a larger demand for food products (consume more meat and processed food product) that might generate a larger carbon footprint. Ang (2007) revealed a positive relationship between per capita GDP and per capita CO2 emission. Kuznets (1955) supposed that the distribution of income becomes more unequal at the early stages of a country's income growth, then the distribution ultimately moves back toward greater equality as economic growth continues. The further developed curve called Environmental Kuznets curve (EKC) suggests that as development and industrialization progress, environmental damage increases due to greater use of natural resources, later, in the post-industrial stage, cleaner technologies appear with the willingness to enhance environmental quality (Munasinghe, 1999). The inverted U-shaped association between economic growth and environmental degradation is known as the Kuznets curve. The first hypothesis attempt to tests the EKC on carbon footprint:

H1: An inverted U-shaped relationship exists between economic growth and the development of countries' carbon footprint at a global level.

A higher scale of agricultural production needs more arable land and agricultural equipment; it also uses more fertilizer. This certainly increases environmental degradation (Foley *et al.*, 2011; Baccini *et al.*, 2012; Grace *et al.*, 2014; Henders *et al.*, 2015) and in turn, stimulates a country's carbon footprint.

H2: A higher scale of agricultural production (agricultural machinery, fertilizer use, arable land) leads to reductions in the carbon footprint.

Agricultural development is supposed to decrease agricultural CO_2 emissions by using environmentally friendly technologies, in line with Balogh and Jámbor (2017). Thus, the carbon footprint is also expected to decline in line with the progress of agricultural development at the global level.

H3: Agricultural development (agriculture value-added) via technological efficiency encourages the reduction of carbon footprint.

Globalization has considerably enhanced the trade in animal feed and processed meat products (Kearney, 2010), reducing the environmental burden (Balogh and Jámbor 2017) and decreasing countries' carbon footprint via technological advance.

H4: Agricultural export has a positive impact on the carbon footprint by stimulating food production and transport.

There is a significant trade-off between resource use and the consumption habits of the rural and urban population. Sethi (2017) suggest that a country's degree of urbanization also influences its carbon emissions and that cities and their spatial development contribute significantly to global warming through higher GHG emission. Thus, a country with a higher proportion of rural population (and thus, a lower urban population) might indicate a more limited carbon footprint compared to a country that is more urban in make-up.

H5: The higher the rural population (expressed as a percentage of the total population) is, the lower the carbon footprint is.

The applied econometric model aims to estimate the main determinants of carbon footprint in agriculture in the world. Data are derived from the Global Footprint Network (2018), the World Bank (2018a) WITS and World Bank (2018b) World Development Indicator databases. The sample includes a panel dataset of 133 countries and 52 years' period (1961-2013) representing the world economy. Descriptive statistics are available in the Appendix. In this study, the following equation is estimated for modelling carbon footprint:

$$\ln\_Carbonfootprint_{it} = \beta_0 + \beta_1 \ln\_GDPPC_{it} + \\ + \beta_2 \ln\_(GDPPC)^2_{it} + \beta_3 \ln\_Tractors_{it} + \beta_4 Arableland_{it} + \\ + \beta_5 Agrvadded_{it} + \beta_6 \ln\_Agrexportq_{it} + \beta_7 Ruralpop_{it} + \\ + \beta_8 \ln\_Fertilizer_{it} + \varepsilon_{it} \quad (1)$$

where *i* denotes the country *t* the given time.

In equation (1), the carbon footprint as a dependent variable is expressed in global hectares in logarithm form. The economic development is represented by GDP per capita, in PPP at current international US dollars (ln_*GDPPC*) and its squared term (ln_(*GDPPC*)^2. Agricultural development is measured by agriculture value-added in percentage of GDP (Agrvadded). Fertilizer consumption (kilograms per hectare of arable land), arable land area in the share of total land area (Arableland), and agricultural machinery (tractors per 100 square km of arable land) denote agricultural productivity. The rural population is expressed as the share of the total population (in per cent). Finally, agricultural trade is expressed as agricultural export in quantity (in kilograms).

A feasible generalized least squares estimator (xtgls) is applied to the sample to estimate the panel regression, along with panel unit root tests (Table 1). To avoid multicollinearity, different models were estimated with different composition of explanatory variables. Panel unit root tests suggested by Maddala and Wu (1999) and Pesaran (2007) were used to check the stationarity of applied variables. The test results indicate that dependent variables are stationary (rejection of the hypothesis of non-stationarity), i.e. variable does not have unit-roots. Descriptive statistics of the variables used are summarised in Table 2.

Table 1: Results of panel unit root tests.

Maddala and Wu (1999) Panel Unit Root test (MW)					
Specification without trend			**Specification with trend**		
Variable	lags	p-value	Variable	lags	p-value
ln_*Carbonfootprint*	0	0.000	ln_*Carbonfootprint*	0	0.000
ln_*Carbonfootprint*	1	0.000	ln_*Carbonfootprint*	1	0.021
ln_*Carbonfootprint*	2	0.000	ln_*Carbonfootprint*	2	0.322
Pesaran (2007) Panel Unit Root Test (CIPS)					
Specification without trend			**Specification with trend**		
Variable	lags	p-value	Variable	lags	p-value
ln_*Carbonfootprint*	0	0.000	ln_*Carbonfootprint*	0	0.000
ln_*Carbonfootprint*	1	0.000	ln_*Carbonfootprint*	1	0.624
ln_*Carbonfootprint*	2	0.008	ln_*Carbonfootprint*	2	1.000

Source: own calculations based on sample data.

Table 2: Descriptive statistics of variables.

Variable	Observations	Mean	Standard Deviation	Min	Max
ln_*Carbon*	6,429	15.28	2.41	4.93	21.98
ln_*GDPPC*	2,928	24.90	2.08	19.21	30.45
ln_(*GDPPC*)^2	2,928	49.80	4.15	38.41	60.90
ln_*Tractors*	4,191	3.88	2.43	-5.44	8.79
Arableland	628	16.52	14.25	0.55	73.39
Agrvadded	4,327	19.68	15.69	0.04	74.27
ln_*Agrexport*	2,308	21.23	2.41	6.79	27.67
Ruralpop	6,356	52.85	23.63	0.00	97.35
ln_*Fertilizer*	1,445	4.01	1.89	-7.76	9.71

Source: own calculations

Results

In all estimated models (1-4), explanatory variables are significant at 1% (Table 3). The regression results indicate that carbon footprint is stimulated by countries' income in the developing period of economic growth (GDP per capita), but then begins to decrease in the developed phase, confirming H1 (the EKC hypothesis). Furthermore, agricultural production variables (agricultural machinery, fertilizer use) are positively associated with a carbon footprint in line with the H2 hypothesis (production-based emission approach).

An inverse effect is revealed between agricultural development and carbon footprint, hence H3 has to be also accepted. This result confirms that agricultural development reduces footprint by providing better technology, thereby helping to reduce resource use and environmental pollution via environment-friendly technologies at a global level.

Agricultural trade (represented by agricultural export quantity) have a positive impact on carbon footprint, proving H4 in line with the findings of Ang (2009), Chebbi *et al.* (2011) and Balogh and Jambor (2017).

By contrast, the carbon footprint is negatively related to the higher share of the rural population in the total population (H5).

These results confirm the positive and significant effects of agricultural components on the carbon footprint. Last but not least, besides measuring and calculating the determinants of carbon footprint, it is necessary to have explanations on how to reduce the carbon footprint in agriculture. Thus, relevant knowledge should be shared on new agricultural practices, and sustainable innovations, as well as the financial access to new sustainable technologies, should be enhanced (Thornton, 2012). It is an especially important duty for the least developed countries in Asia and Africa.

After highlighting the different factors of carbon footprint in agriculture, the protection and maintenance of forest cover, good management practice of rangelands, fodders grasses and pastoral systems have to be developed and improved (FAO, 2011) in every country and region.

Furthermore, it will be necessary to do the same for agricultural practices such as the installation of crop rotations,

Table 3: Regression results.

VARIABLES	(1)	(2)	(3)	(4)
	ln_Carbonfootprint	ln_Carbonfootprint	ln_Carbonfootprint	ln_Carbonfootprint
ln*GDPPC*	0.9150***	0.9160***	0.9120***	0.9060***
	(0.0110)	(0.0116)	(0.0114)	(0.0101)
ln(*GDPPC*)^2	-0.1730***	-0.0484***	-0.0946***	0.0282***
	(0.0164)	(0.0132)	(0.0154)	(0.0076)
ln_*Tractors*	0.1100***	0.1170***	0.1190***	
	(0.0125)	(0.0123)	(0.0121)	
Arableland	0.0130***	0.0117***	0.0117***	0.0078***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
Agrvadded	-0.0277***			
	(0.0028)			
ln_*Agrexport*	0.0723***	0.0919***	0.0868***	0.0501***
	(0.0094)	(0.0096)	(0.0095)	(0.0086)
Ruralpop			-0.0069***	
			(0.0012)	
ln_*Fertilizer*				0.0338***
				(0.0095)
Constant	-5.629***	-8.650***	-7.331***	-8.5790***
	(0.330)	(0.214)	(0.318)	(0.1710)
Observations	843	917	917	1,309
Number of countries	82	90	90	117

Note: Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: own calculations.

intercropping and cover cropping or integration of agroforestry and other perennial species (FAO, 2017). Extensive agriculture uses more environmentally friendly technologies and produces less carbon footprint.

The two key components of GHG emissions in livestock farming are for fodders production and manure usage. Within farms, its changes could be realised and have real impacts on GHG decrease. Hortenhuber *et al.* (2011) revealed that in European dairy cattle farms, the substitution of 50% of soy meal by local products would have created a diminution of 26% of GHG emissions. It emphasises the importance of short supply chain in reducing environmental pollution.

Concerning the emission of nitrogen origin, legumes implementation, such as fava beans, chickpeas, and lentils, a solution can be to revitalize the soil and to use fewer fertilizers. These species have nitrogen-fixing properties, therefore, the atmospheric nitrogen becomes usable for these crops (Thornton, 2012).

Conclusion

The study analysed the determinants of carbon footprint in the agricultural sector employing panel econometrics at a global level for a period of 1961 and 2013. The results revealed that carbon footprint was highly associated with economic development in the earlier phase of development, than later, after a turning point, it tended to decrease (confirming the EKC hypothesis). Moreover, agricultural production is positively associated with an increase in carbon footprint, in line with the production-based emission approach.

Agricultural export has a positive impact on carbon footprint, by stimulating the production and transport of goods as well as by fostering the growth of carbon footprint. Finally, the carbon footprint is negatively related to the higher share of the rural population as well as the higher level of agricultural development at the world level.

On the other hand, it is also important to provide policy implications for decision-makers on how to reduce the carbon footprint in agriculture. Such solutions could be: relevant knowledge sharing on sustainable innovations and agricultural practices. Furthermore, the protection and maintenance of forest cover, the better management of rangelands, fodders grasses and pastoral systems can also play a key role in reducing carbon footprint. Shifting plants to nitrogen-fixing properties such as fava beans, chickpeas and lentils can be a tool to revitalise the soil.

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