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Foreword

Another year has come to an end and 2021 will surely be a memorable year for us. Our everyday life has significantly changed due to the persistent virus situation and this year was challenging for most of us, including the agricultural economics profession. However, 2021 will be memorable for our journal, Studies in Agricultural Economics, as our previous issues got backlisted by Scopus and we have received a Citescore of 1.2 for the first time in the life of the journal! Our challenge now is to increase this score and make Studies in Agricultural Economics even more recognised globally.

We have six papers in this issue. The first paper, written by Miftari, Cerjak, Tomic, Imami and Prenaj, examines the mediation effect of attitudes on the relationship between consumer ethnocentrism and intention to buy domestic wine in transition countries. The survey was conducted on a heterogeneous sample of 372 wine buyers from Albania and Kosovo during 2020, in the middle of the COVID-19 pandemic. Structural Equation Modelling by Partial Least Squares was used to analyse the collected data. The main results of this study show that the theoretical model from the theory of planned behaviour is valid in the case of buying behaviour of domestic wine in Kosovo, while in Albania, the subjective norm has no significant influence on the intention to buy domestic wine and perceived behavioural control has no significant influence on consumer behaviour.

The second paper, written by Bereżnicka and Wicki, aims to determine the direction and strength of the relationship between several factors influencing labour productivity, including the subsidy rate index and labour productivity in Polish farms. The study was carried out at the farm level, divided into quartile groups defined in terms of labour productivity. The panel data regression method was used to analyse data from Farm Accountancy Data Network for the years 2010-2018. It was found that the factors positively influencing labour productivity in agriculture were capital per employee and utilised agricultural area per employee, while labour productivity was negatively affected by the subsidy rate. In smaller farms where low labour productivity is observed, subsidies for operational activity are an important source of income generation and consumption financing.

The third paper, written by Zubor-Nemes, describes the interrelationship between crop insurance take-up, technical efficiency and investment in Hungarian farming using a system of simultaneous equations. The empirical analysis is based on farm accountancy data for the period 2001-2019. Results suggest that both technical efficiency and investment have positive and significant effects on insurance take-up. Accordingly, higher technical efficiency and a higher investment rate both lead to increased insurance usage. In terms of its relationship with efficiency, insurance has a positive and significant coefficient, but investment does not have a significant influence on technical efficiency. Where investment is concerned, insurance usage has a positive and significant effect, but the role of technical efficiency is insignificant. Results suggest that policy interventions that stimulate any of the three factors can potentially have additional positive impacts through spill-over effects on other factors.

The fourth paper, written by Kumar and Babu, analyses consumers' preferences for orange juice in India during COVID-19. Using data collected through online surveys, this paper applies both conjoint and market simulation analysis to study consumers' preferences when purchasing orange juice. Nine important product attributes as well as different levels for each attribute are considered for the analysis. Among the selected attributes, relatively respondents gave more importance to the 'method of production' of orange, followed by 'brand', 'pulp concentration', 'sweeteners', and 'preservatives.' The market simulation analysis showed that a new product with the desired levels (high mean utility values) across the selected attributes would stand to enjoy a market share of around 32 percent. These findings support product differentiation as a strategy by firms in the food processing sector under conditions of intense competition.

The fifth paper, written by Nguyen and Pham, examines the impact of non-farm activities on agricultural investment in Vietnam using the Vietnam Household Living Standards Survey. Results suggest that although income from non-farm activities contributes to relaxing credit constraints among farmers, such alleviation does not necessarily allow farmers to increase their on-farm investments. The authors found that in the developed regions where farmers participate and earn more from non-farm activities, despite there being a low level of credit constraints, their investment in agriculture is still limited due to the labour constraints of the farm household. In contrast, in the less developed regions, where farmers have less access to non-farm income sources, they tend to invest their non-farm income in on-farm activities.

The sixth paper, which is a short communication, written by Gonzalez-Martinez, Jongeneel, Salamon, Zezza, De Maria and Potori, investigates the effects of three different simulated post-COVID-19 recovery GDP growth rates during 2021-2023 on agricultural markets in four selected EU Member States (the Netherlands, Germany, Italy, and Hungary) compared to a pre-COVID-19 projection by using the AGMEMOD model. The country level analysis confirms that the agriculture sector in the EU has been quite resilient during the pandemic. The simulated impacts of the different GDP shocks on the agri-food sector are limited, which also conforms to reality, but changes in consumer behaviour could lead to longer lasting impacts on specific sectors.

Overall, I hope this issue once again reflects well the diversity of topics relevant for ECA agriculture and food systems. I wish Merry Christmas and a Happy New Year to all our readership, and hope that everyone stays healthy and keeps safe during these challenging times.

Attila JÁMBOR

Budapest, December 2021

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Consumer ethnocentrism and preference for domestic wine in times of COVID-19

Based on the theory of planned behaviour, this study examines the mediation effect of attitudes on the relationship between consumer ethnocentrism and intention to buy domestic wine in transition countries. The survey was conducted on a heterogeneous sample of 372 wine buyers from Albania and Kosovo during 2020, in the middle of the COVID-19 pandemic. Structural Equation Modelling by Partial Least Squares was used to analyse the collected data. The main results of this study show that the theoretical model from the theory of planned behaviour is valid in the case of buying behaviour of domestic wine in Kosovo, while in Albania, the subjective norm has no significant influence on the intention to buy domestic wine and perceived behavioural control has no significant influence on consumer behaviour. Consumer ethnocentrism has a positive influence on attitudes towards buying domestic wine and there is a partial mediating effect of attitudes on the relationship between consumer ethnocentrism and the intention to buy domestic wine. Intention to buy domestic wine shows a very strong and positive correlation with behaviour in both countries. The results of the study provide valuable information for food marketers who should develop an appropriate marketing strategy if they wish to increase the purchase of domestic food, especially wine.

Keywords: consumer preferences, consumers theory of planned behaviour, structural equation modelling

JEL classification: Q13

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Introduction

Consumers' decisions relating to wine purchasing are considered to be challenging to analyse due to the high number of wine brands, varieties, origin, taste, and price, factors which make the process of selecting wine more complex in comparison to other food products. In general, consumer preferences for foreign or domestic products are dependent on product categories and socio-demographic factors (Balabanis and Diamantopoulos, 2004; Zhllima *et al.,* 2012). The wine industry is undergoing major structural changes due to increasing international competition in the global marketplace (Morrison and Rabellotti, 2017). However, the origin of wine remains an important factor that influences consumer preferences and decisions to purchase wine (Jaeger *et al.,* 2013).

The domestic wine market in Kosovo and Albania is important for the local industry. Despite that Kosovo wine industry having had a strong export orientation in the past, the local market is and will remain crucial as increasing competition in the export market prevails (Zhllima *et al.,* 2020). In the case of Albania, the local market is the main channel for domestic wine, while exports have a small share of the local market (AGT-DSA, 2021).

The liberalisation of political and economic systems has led to elimination of tariff and non-tariff barriers throughout the world. Indeed, Albania and Kosovo, like other Western Balkan countries, have free trade agreements with several countries in the region, which means that both exports to and imports from these countries face no (major) trade barriers. One of the most serious effects of World Trade Organization (WTO) membership and free trade agreements is the lowered external protection/barriers (e.g. tariffs) which has resulted in higher competition in internal markets (Mizik, 2012). However, one of the most enduring forms of non-tariff barriers is that of consumer ethnocentrism (Shimp and Sharma, 1987).

Consumer ethnocentrism is defined as "the beliefs held by consumers about the appropriateness, indeed morality of purchasing a foreign-made product and the loyalty of consumers to the products manufactured in their home country" (Shimp and Sharma, 1987). Some studies on consumer ethnocentrism have shown that consumers of developed countries tend to be less ethnocentric when compared to consumers of developing countries (Reardon *et al.,* 2005). However, others suggest that consumers from the developing countries prefer to buy products from developed countries as well as reputable brands (Chung *et al.,* 2017).

Both Kosovar and Albanian consumers show a positive bias towards domestic food products. A recent study on Albanian and Kosovar consumers has revealed that consumers judge domestic food to be safer and of higher quality (Haas *et al.,* 2021). Thus, origin is perceived to be strongly related to quality and safety and it may be expected that, in the context of COVID-19 and its impact on health concern, this relationship may be more pronounced.

Indeed, "the pandemic has made consumers more concerned about their own food safety" (Palouj, *et al.,* 2021). Moreover, the disruption of the global supply chain both forced and encouraged consumers to buy domestic/locally produced products (Ben Hassen *et al.,* 2020). On the other hand, the COVID-19 pandemic has caused an increase in nationalist sentiments relating to consumer behaviour and consumer ethnocentrism (He and Harris, 2020). Research conducted in Norway revealed that COVID-19 made

consumers more sceptical towards imported products and increased a level of Norwegian consumer ethnocentrism (Lunderberg and Overa, 2020).

There is a rich literature on wine consumer preferences, especially in the case of traditional wine consumption and wine production countries. However, according to Wang and Chen (2004), limited research has investigated the variables that interact with, and can be used to predict, the intention to buy domestic products, especially in developing or transition countries. Indeed few consumer studies have been carried out in developing markets or transition economies, such as Western Balkans countries. Some of the studies are focused on consumer preferences for basic wine attributes (Zhllima *et al.,* 2020; Zhllima *et al.,* 2012), or instead explore preferences, motives, and attitudes when consumers are buying wine (Radovanović *et al.,* 2017).

The research on consumer ethnocentrism and wine purchase intention and behaviour is relatively scarce. Tomić Maksan *et al.* (2019) explored the influence of the consumer ethnocentrism of Croatian consumers on their intention to buy domestic wine; they revealed that consumer ethnocentrism has a strong effect on attitudes relating to the regular purchase of domestic wine, as well as that attitudes have a partial mediating effect on the relationship between consumer ethnocentrism and the intention to buy domestic wine. Tetla and Grybś-Kabocik (2019) conducted research with Polish young consumers to examine the level of consumer ethnocentrism within the alcoholic beverages market, including wine. The Polish Y generation showed moderate consumer ethnocentrism, and their preferences as to whether to opt for a domestic or an imported product were shown to depend strongly on the specific type of alcoholic beverage. Polish young consumers perceive imported wine as better than domestic grape wine.

Giacomarra *et al.* (2020) noted that ethnocentric tendencies, which affect preferences for domestic wines, influence consumers' perception of wine quality, with higher consumer ethnocentrism leading to a higher perception of local wine quality. Bernabéu *et al.* (2013) explored ethnocentric tendencies and identified wine preferences of consumers from Madrid and Barcelona. The research showed that consumers from Madrid and Barcelona have no ethnocentric behaviour, indicating good opportunities for wines from other regions in this particular market.

As highlighted above, COVID-19 can affect consumer behaviour including ethnocentrism. However, obviously, there is lack of, or only limited, research on this topic in general, and in conjunction to wine for obvious reasons. Thus, this paper contributes to the interest of the readers by analysing consumer ethnocentrism in times of COVID-19. More specifically, the objective of this paper is to assess the effect of consumer ethnocentrism on domestic choice over imported wine in Albania and Kosovo, two transition countries and emerging markets where wine consumption is concerned. Moreover, the study investigates the mediating effect of consumer attitudes on the intention to buy domestic wine, at the height of the COVID-19 pandemic.

The paper is structured as follows. The following section consists of the theoretical background, followed by methods, empirical analysis results and finally, a discussion of the results and conclusions are presented.

Literature review

Theoretical background

The Theory of Planned Behaviour (TPB) has shown that people's behaviour in most situations can be explained and predicted by intentions and Perceived Behavioural Control (PBC), while intention can be explained by attitudes, subjective norms, and PBC. Intention is defined as motivational factor that influences behaviour; it is an indication of how much people are willing to try, how much effort they want to put to perform the behaviour (Ajzen, 1991). PBC plays an important role part in the theory of planned behaviour because behavioural intention can only be expressed when the behaviour in question is under volitional control, if the person can decide to perform or not perform the behaviour (Ajzen, 1991). Thus, PBC is the perceived ease or difficulty of performing the behaviour. Attitude can be defined as the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question, while subjective norm refers to the perceived social pressure to perform or not perform the behaviour (Ajzen, 1991).

TPB has been used in many food-related studies covering various research areas and products, and it has also been applied to the consumption of wine (Caliskan *et al.,* 2020). However, there is a particular lack of research using the TPB model within the consumer ethnocentrism research area. Vabø and Hansen (2016) used TPB to investigate consumer intentions to purchase domestic food in Norway and found that consumer ethnocentrism has a positive direct effect on purchase intentions. Results from China have shown that consumer ethnocentrism has a significant effect on consumer purchase intentions of domestic products, while product attitude has a mediator effect between them (Wu *et al.,* 2010).

The level of consumer ethnocentrism is used as a factor to predict consumer attitudes, purchasing intention, and purchasing behaviour towards imported and foreign products (Schnettler *et al.,* 2011; Shimp and Sharma, 1987). It affects both foreign and domestic markets, but its effect is greater in the domestic market (Chung *et al.,* 2017). Studies have revealed that consumer ethnocentrism is a driver for domestic consumption (Kavak and Gumusluoglu, 2007; Vida and Reardon, 2008), and it affects evaluation of domestic food products (Chung *et al.,* 2017). Ethnocentricity indirectly affects the development of superior local brands based on their perceived originality value; consequently, it is important for local producers to understand the nature and extent of consumers' ethnocentricity orientation and in that context address effectively the wider question of consumer preferences.

Albania and Kosovo wine sector background

Grape and wine production in Kosovo has a history of thousands of years. Numerous topographies and archaeological discoveries provide evidence of an ancient Illyrian-Albanian tradition of grape and wine production (Gjonbalaj *et al.,* 2009). Suitable agro-ecological conditions combined with the tradition of winemaking have contributed to the

sector's growth. After achieving a production peak in the 1980s, namely 100 million litres of wine per year when there was also a strong export orientation, the sector experienced a strong decline in the following decade. During the late 1990s conflict, many vineyards were destroyed, and the production of grapes and wine dropped drastically. After the Kosovo conflict, the sector experienced growth due to the increase of interest by private businesses, government, and donors for the agriculture sector in general and vineyard and wine specifically. The government has been supporting the sector through different schemes. Vine growing and winemaking continue to provide a significant contribution to the Kosovo economy (MAFRD, 2020; FAO, 2016). In 2019, the total area cultivated with grapes was 3,367 ha, of which 2,489 belonged to wine grape varieties. There are altogether 26 registered companies producing 5,754,000 litres of wine (MAFRD, 2020). In addition, many farmers process grapes on their farms, typically informally, producing rakia, and to a lesser extent, also wine (FAO, 2016).

Kosovo's wine industry has had a strong export orientation. Domestic average wine consumption is less than 2 litres per capita per year according to the official estimates, which is very low compared to neighbouring Balkan Countries and much lower when compared to Western Europe – in addition to cultural and religious factors, low family income and the employment status of family members also affect wine consumption (Gjonbalaj *et al.,* 2009; FAO, 2016). With increasing incomes (Gjonbalaj *et al.,* 2009) as well as changing lifestyles, rapid urbanisation might be an important driver of the increase in wine consumption. Imports are strongly present, primarily in the upper-end market segments. National wine companies currently export a large share of production, but they are keen to increase their domestic market share as part of a market diversification and risk reduction strategy (FAO, 2016).

Similarly in Albania, there is a strong tradition for grape and wine production dating back thousands of years. On the other hand, it is an important sector from agriculture and rural development prospective. About 35,000 farmers (more than one in ten farmers) have vineyards. Since 2000, the production of grapes has increased drastically, namely more than doubled. Despite positive development at vineyard farming, wine production in Albania is relatively small compared to its potentials, and after experiencing growth during the past decade, stagnation is observed in the past years. Although stagnation seems to be the trend in wine production, upward trend is observed for wineries producing high and medium quality wine (AGT-DSA, 2021).

Albania has a strong trade deficit in wine. Imports have been growing over time from 2,549 tons in 2010 to 4,934 tons in 2019. Exports are modest and fluctuate between 5 and 28 tons. Thus, the local market is the main driver behind the industry growth, and there is a potential to substitute imports (there is unmet and even growing demand for quality wine in Albania). The growing income and the growing preference for wine (shifting away from rakia, the main traditional alcohol drink in the past, to wine) implies that there is space/potential that the domestic consumption (demand) may increase in the coming years. Moreover, the increasing tourism trend is expected to further contribute to the increase production and consumption of wine in Albania. Local producers can benefit from the growing tourism market, if quality and efficiency improvements were to be pursued at farm/grape production level and processing level (AGT-DSA, 2021).

Methods and procedures

Data collection

This study was conducted during September-October 2020 in Kosovo and Albania simultaneously, targeting population of Pristina and Tirana. Pristina and Tirana are the biggest cities in Kosovo and Albania in terms of population. They are also the largest economic, administrative, educational, and cultural centres of these two countries and in addition, remain the strongest central spots for businesses, media, students' life, and the international community. Lastly, purchasing power is concentrated in these two cities which represent the most attractive markets for local industry.

Initially, the study was designed to be carried out through face-to-face interviewing, but this was not possible due to COVID-19 pandemic. Hence, the study was administered online - two consumer surveys were completed for both countries (using a common framework). Although face-to-face interviews have been common in the past and the main form of surveys in the region, in recent years, online studies related to wine consumer behaviour have become more common (Mueller *et al.,* 2011). Naturally, during COVID-19, it has been the most (or the only) feasible alternative.

In the study, only those respondents who stated that they buy wine were included. In total 372 valid questionnaires were selected, out of which 248 came from respondents in Kosovo and 124 from respondents in Albania. To take account of the legal age for buying and drinking alcohol in Kosovo and Albania, only wine consumers over the age of 18 were involved in the survey. The response rate was higher in Kosovo (92%) compared to Albania (74%). To ensure that the data was of good quality, each submitted questionnaire was checked for completeness. Questionnaires that missed responses more than 2% were removed from the data set. Demographic characteristics of the two samples are presented in Table 1. As regards the gender of respondents in both countries, there is quite a balanced ratio between male and female.

In both countries, the sample is dominated by young age. This is not a surprise, for at least two reasons. First, both Albania and Kosovo are among the countries with the youngest population in Europe – for example in Kosovo, over 50% of its population is under the age of 25, while in Pristina the average age is estimated to be 28. On the other hand, the dominance of the younger age group is also related to the mode of survey implementation. There is a tendency to obtain higher response rates from younger participants in an online survey as compared with a face-to-face survey (Yetter and Capaccioli, 2010).

The majority of the respondents from both countries belong to the medium income category. Most respondents

have a university education – since the questionnaire was administered online, it is natural that educated people would be more likely to access or respond to online questionnaires.

The conceptual model for regular purchase of domestic wine is based on the measures of all constructs included in the TPB. The addressed questions for measuring the constructs of TPB were formulated based on the questionnaire developed by Ajzen (2013). The performed TPB model for regular purchase of domestic wine includes constructs of attitudes, subjective norm, perceived behavioural control, intention, and behaviour. In addition to these constructs, a construct of consumer ethnocentrism is introduced in our model based on the model assessed by Tomić *et al.* (2019) and instrument developed by Shimp and Sharma (1987) to measure a Consumer Ethnocentric Tendencies Scale (CETSCALE). All variables of the constructs were measured using a LIKERT scale of 5 points; where 1 is used for the responses when respondents were completely disagreed with the statement to 5 absolutely agree. The consumer ethnocentrism scale has been used and validated by numerous studies (Fernández-Ferrín *et al.,* 2015).

Shimp and Sharma (1987) developed a CETSCALE with 17 items, but in our study, we used a shortened version of CETSCALE with 10-item scale, along similar lines to Tasurru and Salehudin (2014). Five positive items were used to measure the attitudes of consumers towards domestic wine purchase similarly to Tomić *et al.* (2019) and Tomić and Alfnes (2018). The subjective norm was measured with six positive items adapted from Tomić *et al.* (2019) and Ajzen (2013), while the perceived behavioural control consists of three positive items. Consumers' intention and behaviour were measured with three item scale adapted by Tomić *et al.* (2019). Higher values of the items in all constructs indicate greater consumer ethnocentrism, higher levels of attitudes, subjective norm, perceived behavioural control towards intention and behaviour to buy domestic wine.

Methods & Hypotheses

According to Luque-Martinez *et al.* (2000), consumer ethnocentrism is a predictor of consumer attitudes. Wu *et al.* (2010) argued that higher consumer ethnocentrism meant more positive attitudes towards domestic and local products. Similarly, Salman and Naeem (2015) found that consumer ethnocentrism clearly had a strong influence on attitudes towards local versus foreign products. On the other hand, Batra *et al.* (2000) indicated that ethnocentric consumers had negative attitudes towards foreign products. Recent research by Tomić *et al.* (2019) provided evidence that consumer ethnocentrism influenced attitudes towards buying domestic wine. Based on the literature discussed above, the following hypotheses are constructed and tested.

H1: Consumer ethnocentrism has a positive impact on attitudes about domestic wine purchase

TPB has been successfully applied in numerous studies to explain and predict broad categories of food-related behaviours (Pandey *et al.,* 2021; Menozzi *et al.,* 2017). Previous studies have found that attitudes towards domestic products have a significant influence on intention to choose domestic products (Chung and Pysarchik, 2000; Vabø and Hansen, 2016). According to previous studies, subjective norms have had positive significant effects on consumers' intention to buy domestic food (Wu *et al.,* 2010). In addition,

Table 1: Demographic frequency distribution of samples.

Indicator		Kosovo (%)	Albania (%)
Gender	Female	44.9	50.4
	Male	55.1	49.6
Age (in years)	18-29	23.9	54.5
	30-45	58.3	31.7
	46-60	15.8	12.2
	>60	2.0	1.6
Household size	1	2.1	0.0
	2	8.2	12.2
	3-5	67.6	74.8
	>5	22.1	13.0
Income	Very low	0.4	0.8
	Low	2.5	0.8
	Medium	75.7	87.0
	High	19.0	10.6
	Very high	2.4	0.8
Employment	Employed	82.6	75.6
	Retired	1.6	1.6
	Student	5.7	15.4
	Unemployed	10.1	7.3

Source: Own calculations

Vabø and Hansen (2016) found that perceived behavioural control (PBC) had an influence on consumer intention to buy domestic food. The importance of perceived behavioural control was confirmed in a study by Watson and Wright (2000), which indicated that when domestic products are not available, consumers must purchase foreign products. Intention has a positive and significant impact on the actual purchase of local food.

H2: Attitudes, subjective norm, and perceived behavioural control have a positive impact on intention to purchase domestic wine, and intention and perceived behavioural control have a positive impact on behaviour (domestic wine purchase).

H3: The effect of consumer ethnocentrism on intention to purchase domestic wine is mediated by attitudes.

Previous studies in the food domain conclude that attitudes are often a mediating variable (Olsen, 2003; Garg and Joshi, 2018). A study by Wu *et al.* (2010) showed that attitude towards domestic products had a significant mediating effect between consumer ethnocentrism and intention to purchase domestic products, while Tomić *et al.* (2019) found that a consumer's attitude towards purchasing domestic wine had a significant mediating effect between consumer ethnocentrism and the intention to purchase domestic wine. Therefore, we propose that the positive relationship between consumer ethnocentrism and intention to purchase domestic wine is mediated by attitudes.

Descriptive statistics were calculated to provide an overview of the distribution, central tendency and standard deviation of the constructs comprising the estimated model. The small sample size is an issue when conducting SEM, however several researchers proved that simple SEM models could be tested even if sample size is small (n=100-150) (Tabachnick and Fidell, 2001; Ding *et al.,* 1995). Internal consistency and reliability analysis for LIKERT scale variables was performed using Cronbach's Alpha coefficient. According to Nunnally (1978), the variables in each scale have high degree of reliability and are positively related to each other if the Chronbach's Alpha is at least 0.7. Partial Least Square Structural Equation Modelling (PLS-SEM) with SmartPLS 3 is used to further explore, analyse, and predict research model. At first, Confirmatory Factor Analysis (CFA) was performed to evaluate the convergent and discriminant validity. Inspection of convergent validity was tested with Composite Reliability (CR) and the Average Variance Extracted (AVE). The values for the latent constructs need to be at acceptable level and greater than the thresholds of CFA > 0.7, CR > 0.7, and AVE > 0.5 (Hair *et al.,* 2017). Discriminant validity was tested with Heterotrait-Monotrait (HTMT) matrix, the values of which should be below 0.90 (Hair *et al.,* 2017). In the second stage, we assessed the research model by calculating the sum of variance on intention to buy domestic wine and behaviour (regular purchase of domestic wine) explained by consumer ethnocentrism, attitudes, subjective norm, and perceived behavioural control. The model fit was assessed with the Standardised Root Mean Square Residual (SRMR), whereby values below 0.10 are considered acceptable for model validation (Henseler *et al.,* 2014). In addition, we estimated mediation effect of the consumer attitudes between consumer ethnocentrism and intention to buy domestic wine. The level of mediation effect was assessed with the variance accounted for (VAF), whereby value higher than 80% indicates full mediation; a value in the range of interval 20-80% indicates partial mediation, and a value smaller than 20% shows that there is no mediation effect (Hair *et al.,* 2014).

Results and Discussion

Each construct in the model has Cronbach's Alpha greater than the minimum threshold 0.7, which according to Nunnally (1978) can be considered reliable. The construct of behaviour for both countries has the highest value of Cronbach's Alpha, as Table 2 shows. Means for the constructs of two samples can be seen in Table 3. There is a significant difference between the two countries in all constructs; Kosovo respondents in general showed higher consumer ethnocentrism, attitudes, subjective norm, perceived behavioural control, intention, and behaviour to purchase domestic wine.

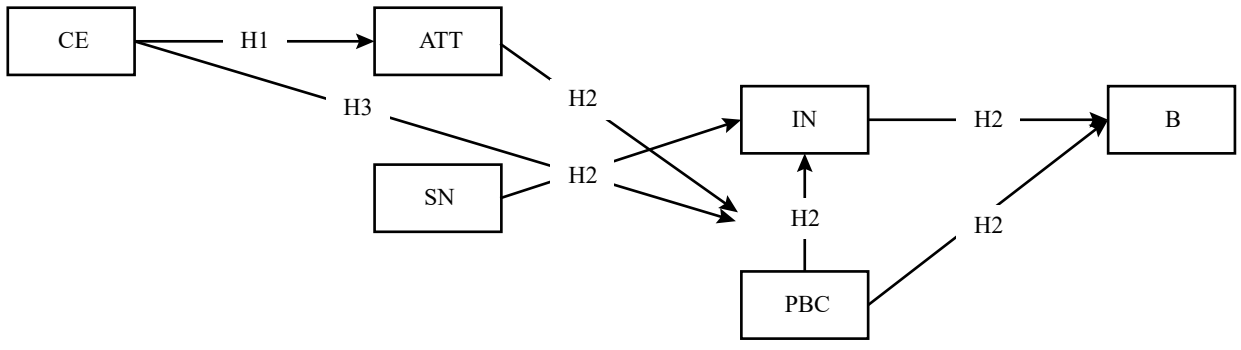

Figure 1: Research model for prediction of regular purchase of domestic wine.
Source: Own composition

Table 2: Reliability analysis of the constructs.

			Cronbach α Kosovo	Cronbach α Albania
Attitudes (ATT)	ATT1	Buying wine of local origin is very important to me	0.85	0.88
	ATT3	Buying wine of local origin is a pleasure for me		
	ATT4	For me, buying wine of local origin is a whole ritual		
	ATT5	Buying wine of local origin is fun		
	ATT6	Buying wine of local origin evokes positive emotions to me		
Behaviour (B)	B1	I regularly buy wine of local origin	0.91	0.91
	B2	In my shopping basket regularly is found wine of local origin		
	B3	When buying wine, I usually choose the one of local origin		
Consumer Ethnocentrism (CE)	CE1	Albanian/Kosovo citizens should always buy local products instead of imported ones	0.91	0.89
	CE2	Albanian/Kosovo products, first, last, and foremost		
	CE4	It is not okay to buy foreign products because it leaves Albanian/Kosovo citizens without a job		
	CE5	A true citizen of Albania/Kosovo should always buy local products		
	CE6	We need to buy products made in Albania/Kosovo and thus not allow others to get rich on us		
	CE7	It is always better to purchase Albanian/Kosovo products		
	CE8	Buying foreign products should be reduced to the most essential		
	CE9	I prefer buying Albanian/Kosovo products even though they are sometimes more expensive		
Intention (IN)	IN1	I intend to buy wine of Albania/Kosovo origin on a regular basis	0.89	0.87
	IN2	I plan to buy wine of Albania/Kosovo origin on a regular basis		
	IN3	I will probably buy wine of Albania/Kosovo origin on a regular basis		
Perceived Behaviour Control (PBC)	PBC1	For me, regular buying of wine of Albania/Kosovo origin is easy	0.70	0.74
	PBC3	If I wanted to, I believe I could buy wine of Albania/Kosovo origin on a regular basis		
	PBC4	I expect to be able to regularly buy wine of Albania/Kosovo origin		
Subjective Norm (SN)	SN1	My family members approve my regular purchase of wine of Albanian/Kosovo origin	0.88	0.90
	SN2	My close friends approve my regular purchase of wine of Albanian/Kosovo origin		
	SN3	My colleagues approve my regular purchase of wine of Albanian/Kosovo origin		
	SN4	My family members regularly buy wine of Albanian/Kosovo origin		
	SN5	My close friends regularly buy wine of Albanian/Kosovo origin		
	SN6	My colleagues regularly buy wines of Albanian/Kosovo origin		

Note: in the case of CE construct for Kosovo items like CE1, CE2, CE4, CE5, CE6, CE7 and CE9 were included except item CE8
Source: Own composition

Based on the results presented in Table 3, respondents in Albania generally have neutral ethnocentrism (mean 3.00), attitudes (mean 3.01) and subjective norm (3.10) about domestic wine purchase. While for Kosovo consumers, study results indicate that consumers' ethnocentrism (mean 3.75) and perceived behavioural control (mean 3.92) about domestic wine purchase is moderate. Person correlation coefficients presented in Table 4 confirm that there is positive statistically significant correlation among all constructs $p < 0.001$.

In the confirmatory factor analysis, the indicator loadings show good indicator reliability, as all loadings were larger than the threshold of 0.7 (Hair *et al.,* 2017). Composite reliability (CR) for each construct is higher than 0.7 which is in line with (Hair *et al.,* 2017). The AVE values are all above 0.5 (Fornell and Larcker, 1981) with intention and behaviour having the highest AVE value (Hair *et al.,* 2017). The model was also proved to be valid in terms of discriminant validity

Table 3: Mean of constructs in the two countries.

	Mean (Standard Deviation)		
	Albania	**Kosovo**	**P**
Attitudes	3.01 (0.86)	3.58 (0.95)	0.000
Behaviour	2.91 (0.99)	3.38 (1.12)	0.000
Consumer Ethnocentrism	3.00 (0.77)	3.75 (0.96)	0.000
Intention	2.77 (0.90)	3.55 (1.19)	0.000
Perceived Behaviour Control	3.38 (0.80)	3.92 (0.85)	0.000
Subjective Norm	3.10 (0.79)	3.47 (0.90)	0.000
	n (124)	n (248)	

Source: Own composition

Table 4: Correlation matrix of the constructs.

Indicator	Kosovo					Albania				
	ATT	B	CE	IN	PBC	ATT	B	CE	IN	PBC
B	0.771**					0.785**				
CE	0.585**	0.528**				0.457**	0.421**			
IN	0.689**	0.712**	0.625**			0.641**	0.571**	0.481**		
PBC	0.480**	0.423**	0.432**	0.490**		0.384**	0.328**	0.361**	0.422**	
SN	0.693**	0.678**	0.553**	0.710**	0.532**	0.643**	0.554**	0.413**	0.516**	0.475**

Notes: ATT = attitudes, B = behaviour, CE = consumer ethnocentrism, IN = intention, PBC = perceived behavioural control, SN = subjective norm; **p < 0.01.
Source: Own composition

Table 5: Convergent validity.

Construct	CR (Kosovo)	CR (Albania)	AVE (Kosovo)	AVE (Albania)
ATT	0.894	0.914	0.630	0.682
B	0.946	0.943	0.854	0.848
CE	0.932	0.917	0.634	0.580
IN	0.934	0.920	0.826	0.794
PBC	0.828	0.835	0.616	0.628
SN	0.912	0.929	0.633	0.687

Notes: ATT = attitudes, B = behaviour, CE = consumer ethnocentrism, IN = intention, PBC = perceived behavioural control, SN = subjective norm.
Source: Own composition

Table 6: Heterotrait-Monotrait (HTMT) matrix for Kosovo and Albania.

Indicator	Kosovo					Albania				
	ATT	B	CE	IN	PBC	ATT	B	CE	IN	PBC
B	0.870					0.872				
CE	0.666	0.580				0.512	0.467			
IN	0.787	0.787	0.694			0.741	0.649	0.552		
PBC	0.766	0.673	0.633	0.794		0.482	0.412	0.440	0.535	
SN	0.793	0.750	0.619	0.797	0.817	0.718	0.605	0.463	0.588	0.594

Notes: ATT = attitudes, B = behaviour, CE = consumer ethnocentrism, IN = intention, PBC = perceived behavioural control, SN = subjective norm.
Source: Own composition

as all values of the HTMT matrix for the latent constructs were below the threshold of 0.90.

Model for consumers' purchase of domestic wine in Kosovo and Albania

Consumer ethnocentrism (CE) in Kosovo has very strong and positive impact on attitudes (ATT) towards domestic wine purchase ($\beta_{CE\text{-}ATT} = 0.608$; $t = 15.56$; $p < 0.001$). The effect of consumer ethnocentrism on attitudes about domestic wine purchase is smaller for Albanian consumers' ($\beta_{CE\text{-}ATT} = 0.493$; $t = 7.056$; $p < 0.001$). Both these results confirm *H1*, stating that consumer ethnocentrism has a positive impact on attitudes towards domestic wine purchase. Attitudes are significantly and positively impacting Kosovo consumers' intention to buy domestic wine ($\beta_{ATT\text{-}IN} = 0.249$; $t = 3.903$; $p < 0.001$). The impact of attitudes on intention to buy domestic wine is greater in Albania ($\beta_{ATT\text{-}IN} = 0.446$; $t = 43.909$; $p < 0.001$), confirming *H2*. Subjective norm was positively impacting intention of Kosovo consumers to buy domestic wine ($\beta_{SN\text{-}IN} = 0.291$; $t = 4.574$; $p < 0.001$), confirming *H3*. This was not proved to be significant for Albanian consumers ($\beta_{SN\text{-}IN} = 0.037$; $t = 0.359$; $p < 0.720$). Perceived behavioural control has positive and significant impact on intention and behaviour of Kosovo consumers of purchasing domestic wine, but it has lower impact compared to the attitudes and subjective norm ($\beta_{PBC\text{-}IN} = 0.187$; $t = 3.438$; $p < 0.001$), ($\beta_{PBC\text{-}B} = 0.159$; $t = 2.366$; $p < 0.05$), confirming *H2*. In Albania, perceived behavioural control was positively impacting consumers' intention to purchase domestic wine ($\beta_{PBC\text{-}IN} = 0.184$; $t = 2.368$; $p < 0.05$), but this was not proved to be significant for behaviour ($\beta_{PBC\text{-}B} = 0.138$; $t = 1.380$; $p > 0.05$). In both countries intention has positive impact on consumers' behaviour of buying domestic wine (Kosovo: $\beta_{IN\text{-}B} = 0.616$; $t = 10.802$; $p < 0.001$), (Albania: $\beta_{IN\text{-}B} = 0.519$; $t = 5.763$; $p < 0.001$), confirming *H3*.

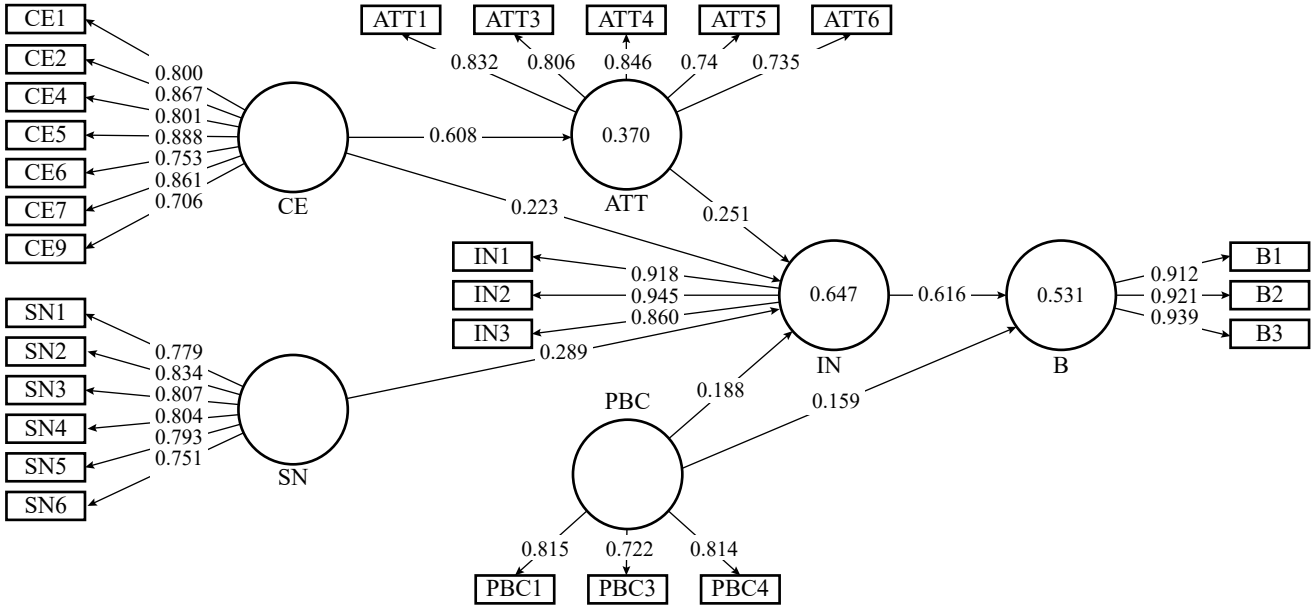

Figure 2: TPB exploratory model of regular purchase of domestic wine in Kosovo.
Source: Own composition

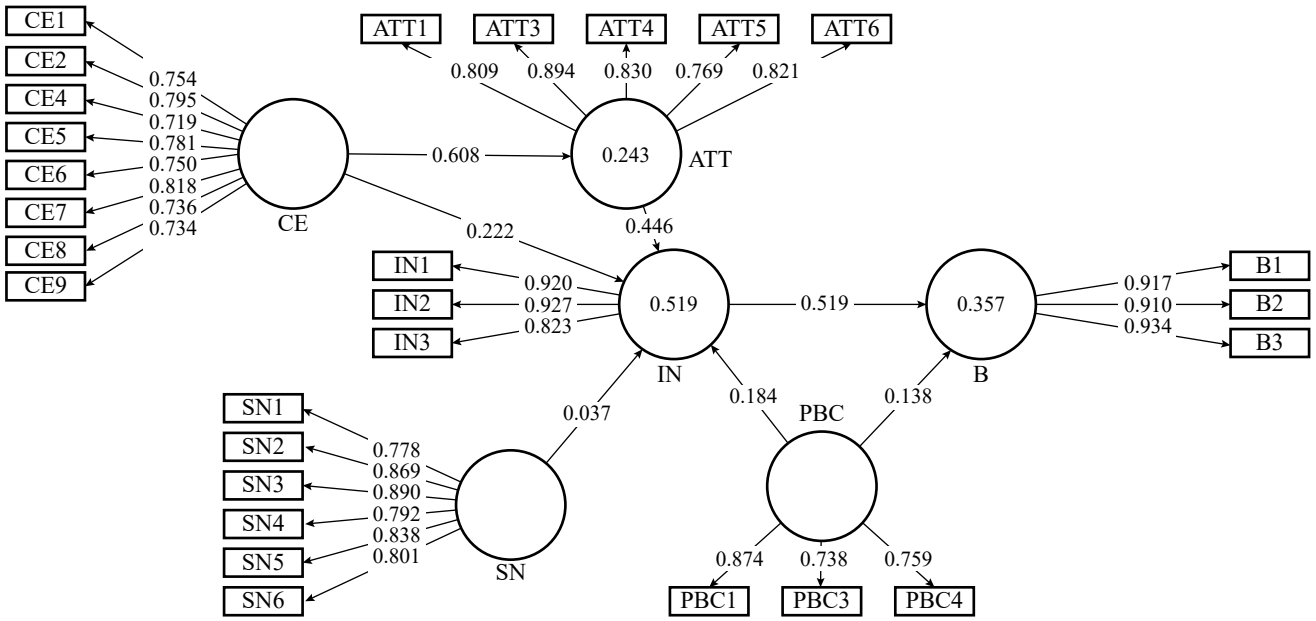

Figure 3: TPB exploratory model of regular purchase of domestic wine in Albania.
Source: Own composition

According to (Hair *et al.*, 2014), consumer attitudes is partially mediating intention to buy domestic wine. The VAF for both countries falls within the range 20-80%. Another approach for testing a mediation effect is the one proposed by Hair *et al.* (2017). Three types of mediation effect were identified by the authors: 1) complementary mediation effect occurs when the indirect and the direct effects are significant and both coefficients are in the same direction; 2) competitive mediation effect the indirect and the direct effects are significant but the coefficients in opposite direction and 3) indirect mediation where only the indirect effect is significant but not the direct effect. Based on this classification, consumers' attitudes in the two countries have complementary mediation effect on intention to purchase domestic wine, both the indirect and the direct effects are significant and have the same direction.

Based on the estimated models, consumer ethnocentrism explained 37% (Kosovo) and 24.3% (Albania) of the variance in attitudes towards domestic wine purchase (Figure 2&3). Consumer ethnocentrism, attitudes, subjective norm, and perceived behavioural control explained 64.7% (Kosovo) and 51.9% (Albania) of the variance in intention to buy domestic wine. While perceived behavioural control and intention explained 53.1% (Kosovo) and 35.7% (Albania) of the total variance in behaviour of regular purchase of domestic wine.

Table 7: Mediation effect of consumer attitudes on intention to buy domestic wine in Kosovo.

Effects	Path	Path coefficient	Indirect effect	Total effect	VAF	t-value	p-value
Mediator	CE→ATT	0.608	Not applicable				
	ATT→IN	0.251	Not applicable				
	CE→IN	0.223	0.153	0.376	40.69%	3.825	0.000

Notes: Variance accounted for (VAF) = indirect effect/total effect × 100; VAF = (0.153/0.376) ×100 = 40.69%. t-value = indirect effect/standard deviation = 0.153/0.04 = 3.825.
Source: Own composition

Table 8: Mediation effect of consumer attitudes on intention to buy domestic wine in Albania.

Effects	Path	Path coefficient	Indirect effect	Total effect	VAF	t-value	p-value
Mediator	CE→ATT	0.493	Not applicable				
	ATT→IN	0.446	Not applicable				
	CE→IN	0.222	0.220	0.441	49.88%	3.825	0.004

Notes: Variance accounted for (VAF) = indirect effect/total effect × 100; VAF = (0.220/0.441) ×100 = 40.69%. t-value = indirect effect/standard deviation = 0.220/0.075 = 2.933.
Source: Own composition

The model's overall quality was assessed with SRMR as proposed by Hair *et al*. (2014), in both models for Kosovo and Albania the value of the SRMR was not higher than the threshold 0.10.

Conclusions

In both countries, openness to foreign markets due to international free trade agreements has increased consumers' exposure to wine coming from different countries. Some studies on consumer ethnocentrism have shown that consumers of developed countries have a tendency to be less ethnocentric compared to consumers of developing countries (Reardon *et al.,* 2005; Lindquist *et al.,* 2001). It has been assumed that consumers of developing countries are more prone to buy foreign products (Ranjbarian *et al.,* 2010); however, such research is less present and still lacking where developing countries are concerned (Makanyeza, 2017). Csatáriné (2015) argues that consumers in developed countries should be less ethnocentric compared to those in developing countries, as their economy is strong enough to withstand competition from the foreign products. In this sense, consumers of developing countries may usefully urge producers to improve the quality of products made at home and thus, make their own economy less vulnerable to foreign competition. In addition, consumers' ethnocentrism can directly or indirectly impact the improvement of employment figures in the developing countries.

Consumers' ethnocentrism may vary from one country to another. In our study, consumers' ethnocentrism in two European (Kosovo and Albania) less developed countries had a significant positive impact on attitudes towards purchasing domestic wine. This study confirms the results found in other developing or transition countries (Silili and Karunaratna, 2014; Al Ganideh and Al Taee, 2012). However, the level of ethnocentrism appears to be less pronounced in Albania (when compared to Kosovo), which was somehow expected due to their historical differences even though both countries are culturally similar. Kosovo experienced an ethnic conflict in the late 1990s, thus it might be natural to expect that the "patriotic" sentiment in Kosovo is higher when compared to Albania. On the other hand, in Albania there is traditionally a deep sympathy and affection towards Italy which dominates the segment of imported wines.

For emerging wine markets such as those in Kosovo and Albania, both the ethnocentrism concept and its integration into the strategic development of this industry is relevant. Wine producers of both countries targeting ethnocentric consumers must compete with other wine producers; this means that they should develop different marketing strategy for domestic costumers. The high level of consumer ethnocentrism revealed in this study may indicate that consumers tend to be willing to purchase domestic over imported wine. This can be considered a useful concept for marketing managers in the wine industry, that is helpful for understanding decision making during wine purchases. It is important to further research to note that certain consumer market segments do prefer domestic wine over the imported alternatives.

Is it shown that highly ethnocentric consumers choose domestic products regardless of their quality, and brand image is less important to them than to less ethnocentric consumers (Chung *et al.,* 2017). However, their purchase intentions to buy a product depend on a domestic product possessing a positive quality image when compared to other domestic products. Consumers buying decisions are influenced by a brand's image; however, the level of that influence is expected to be lower for ethnocentric consumers.

The study results demonstrate that consumer ethnocentrism strongly affects consumers' attitudes towards domestic wine purchases in both countries. Consumers' attitudes partially mediate the relationship between consumer ethnocentrism and the intention to buy domestic wine, while ethnocentrism has been proved to be a significant predictor of consumers' intention to purchase domestic wine. A subjective norm was shown to significantly impact Kosovar consumers' intention to buy domestic wine; however, it did not prove to be significant for Albanian consumers. Perceived

behavioural control had significant impact on Kosovar consumers' intention to purchase domestic wine, but this was not the case for Albanian consumers. Perceived behavioural control also had a positive significant impact only on Kosovar consumers' behaviour towards domestic wine purchase, while intention was shown to have a significant impact on both consumers' behaviour relating to domestic wine purchases in both countries.

The study has several limitations. One of the major limitations results from the fact that it was administered online due to COVID-19 situation. As such, it was natural that educated and young people would be more likely to access or respond to online questionnaires, and as a result, the sample cannot be considered representative for the whole population in both countries. Future research should consider using a more representative sample, which can be achieved by face-to-face interviews (after COVID-19 threat/constraint is removed).

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Joanna BEREŻNICKA* and Ludwik WICKI*

Do operating subsidies increase labour productivity in Polish farms?

In the agricultural economics literature, there is a lack of consistent results concerning the relationship between operational subsidies and labour productivity. This premise lay behind the research outlined in this paper, which aims to determine the direction and strength of the relationship between several factors influencing labour productivity, including the subsidy rate index and labour productivity in Polish farms. Special attention has been paid to quantitative evaluation of the effects of subsidies on operational activity. The study was carried out at the farm level, divided into quartile groups defined in terms of labour productivity. The panel data regression method was used to analyse data from Farm Accountancy Data Network for the years 2010-2018. It was found that the factors positively influencing labour productivity in agriculture were capital per employee and utilised agricultural area per employee, while labour productivity was negatively affected by the subsidy rate. In smaller farms where low labour productivity is observed, subsidies for operational activity are an important source of income generation and consumption financing. The financial surplus in such farms is not high enough to finance farm development. In such cases, subsidies become a factor slowing down processes of farm structural change because farmers are not interested in occupation change.

Keywords: agriculture, factor productivity, panel regression, subsidies in agriculture, labour efficiency

JEL classification: Q12, Q18

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Introduction

Directing financial support to agriculture causes the emergence of critical voices in society. Some people find that money they receive "for free" does not improve agricultural productivity (including labour productivity). One Polish agricultural economist, Wojciech Józwiak has concluded that subsidies make farmers "lazy". However, research shows that labour productivity in agriculture is much lower than in non-agricultural sectors, and its endogenous growth may be difficult to achieve due to low profitability and difficulties in accumulating capital and financing progress in agriculture (Giannakis and Bruggeman, 2018). These restrictions in the functioning of farms were one of the reasons for supporting European agriculture in the form of the EU Common Agricultural Policy (CAP), to increase both the productivity of factors of production and farmers' income. Subsidies in agriculture have been the subject of research to determine their impact on productivity, taking farm equipment, size, and production direction into consideration. However, the issue of the impact of subsidies on labour productivity in farms is rarely considered and there is a knowledge gap in this regard. McCloud and Kumbhakar (2008) even argue that there has been insufficient empirical assessment of the relationship between subsidies and labour productivity on farms. This is also confirmed by Hloušková and Lekešová (2020), who claim that there are only single studies that investigate direct relationships between subsidy levels and labour productivity. Additionally, most studies consider the nominal level of subsidies in the whole agriculture as a factor influencing income or labour productivity. There are no studies that aim to define how productivity changes, taking into account the relative level of subsidies (e.g. per employee or in relation to the amount of surplus). This means that there is a research gap in this area. We therefore aim to check whether the level of subsidy is related to labour productivity and whether the statement of the quoted W. Józwiak about the low impact of subsidies on the modernisation of agriculture can be regarded as true. Consequently, the aim of this paper is to determine the direction and strength of the relationship between the factors influencing labour productivity mentioned usually in the literature, supplemented with the subsidy rate index (SR) and labour productivity in Polish farms. This research can help to better understand the effects of farm subsidies in terms of their impact on the level of labour productivity. It has been hypothesised that observed higher labour productivity is mainly the result of a higher subsidy rate, which would mean that farmers receive budget funds and use them adequately to achieve better results from their production activities.

This paper is divided into three sections. First, we aim to bring the research on the relationship between subsidies and productivity in agriculture closer to the reader and indicate that the research results so far are varied and that they concerned the overall productivity of the farm, without focusing on labour productivity. The next part presents the methodology of work and the characteristics of the researched groups of farms. In the third part, the obtained results and conclusions are discussed.

Literature review

In global agriculture, there has been a slowdown in the overall rate of productivity growth after 2000, especially in developed countries, but the increase in labour and land productivity continues (Fuglie, 2018). If resource productivity sees little increase, this means agriculture loses competitiveness in relation to other sectors and this can result in

the abandonment of production on farms (Dorward, 2013; Giannakis and Bruggeman, 2018; Kavoosi-Kalashami and Motamed, 2020). Consequently, changes in agriculture that are conducive to an increase in productivity usually win support.

The increase in agricultural labour productivity is a condition for achieving higher income per person. This has a twofold effect: firstly, the standard of living of farmers increases and it is possible to invest surpluses in the development of farms, and secondly, given the constant volume of agricultural production, labour resources are elevated to other sectors of the economy. Hornowski *et al.* (2020) stated that work outside agriculture was the primary source of income in 82% of the Polish farms with an area of up to 15 ha. This is due to the low work efficiency of such farms, but also results in farmers not being interested in the development of their farms.

Higher labour productivity in agriculture is usually achieved by introducing progress embodied in fixed assets, which requires investment outlays or increasing the scale of production. Substitution of labour with capital, where possible, also results from the high share of labour costs in total costs (Ejimakor *et al.,* 2017). For example, in the conditions of highly fragmented agriculture in Poland, an increase in the capital to labour ratio determined as much as 60% of an increase in labour productivity (Gołaś, 2019; Kusz and Misiak, 2017; Niezgoda *et al.,* 2018; Nowak and Kijek, 2016). Unfortunately, the processes of concentration of capital and land are very slow and even over a period of 15 years, they are not clearly visible in the research (Kata, 2018). Increasing the ratio of land to labour is similarly beneficial for other countries like the Baltic states where a rapid increase in labour productivity was observed, resulting from both an increase in the ratio of land and capital to labour (Wicki, 2021), justifying support for expanding the area of farms in countries where small farms dominate (Wójcik and Nowak, 2012).

In the countries of Central and Eastern Europe, the productivity of agriculture is still much lower than in the EU-15 countries and the non-agricultural sectors (Wicki, 2018). Therefore, opportunities are being sought to design subsidies in agriculture to overcome these weaknesses. In Poland, under the second pillar of the CAP, subsidies are granted for the purchase of equipment and construction of buildings. However, such support is not available to everyone. The limitation is the small scale of production and low income, as even 60% of investments should be financed from farmers' own resources. In such cases, support for development processes results from the availability of funds from subsidies for operating activities.

The literature on the relationship between subsidies and on-farm productivity is extensive. It is pointed out that depending on how they are targeted and what their scale is, subsidies may have a positive but sometimes also negative impact on the pace of agricultural modernisation, the volume of agricultural production and the productivity of factors (Ackrill, 2000; Fulginiti and Perris, 1993; Kostlivý and Fuksová, 2019; Rizov *et al.,* 2013). The negative impact of the subsidies is related to the preservation of the agrarian structure and the demotivation of farmers to introduce changes as they had the opportunity to make a living on the received subsidies.

Many authors argue that subsidies have a noticeably positive impact on the development of farms and an increase in the overall productivity of agriculture by increasing investment opportunities, leading to an increase in the scale of production and enabling the replacement of more expensive factors of production with cheaper ones (Blancard *et al.,* 2006; Cechura *et al.,* 2015; Hlavsa *et al.,* 2017; Kirchweger *et al.,* 2015; Zsarnóczai and Zéman, 2018). Such a relationship was also confirmed for Polish farms (Kusz, 2018). The introduction of decoupled subsidies had a positive effect on overall agricultural productivity in the EU (Kazukauskas *et al.,* 2014; Mary, 2013; Rizov *et al.,* 2013), including labour productivity (Garrone *et al.,* 2019). By decoupling support, farmers can individually select production activities with higher added value, and allocation inefficiency is reduced (Dewbre *et al.,* 2001; Guyomard *et al.,* 2004). However, with decoupled subsidies, the goals related to obtaining an increase in the size of farms or the level of income were usually not achieved (Hubbard *et al.,* 2014).

It is also observed that the impact of subsidies on farm productivity depends on the country or region (Minviel and Latruffe, 2017). There differences between the old and the new EU members (countries that joined the EU in 2004 and later) are especially noteworthy. Some studies have shown that subsidies have a positive effect on productivity only on economically large farms (Staniszewski and Borychowski, 2020; Kostlivý and Fuksová, 2019). With an increase in the scale of production, an increase in labour productivity is achieved first, and followed by land and capital growth (Du *et al.,* 2018; Wicki, 2018). Consequently, along with the increase in the size of farms, the impact of the subsidy on their further development may be positive, as the per capita income is higher, which is sufficient not only to support the family, but also to invest. Other conclusions are presented in the study by Gołaś (2019) who found that the main factors leading to an increase in labour productivity in agriculture in the EU were high production intensity and farm size growth, while farm subsidies turned out to be insignificant in this aspect. In this approach, it is assumed that the relationship between subsidies and development may be small, and subsidies only have a social function in maintaining the level of income achieved.

It was also observed that the effects of subsidies are visible only after several years of support (Jitea and Pocol, 2014), implying that research results based on short-term data may yield inconclusive results. For individual countries, it was also found that the first increase was achieved in the size of the activity for which support could be obtained, but no increase in productivity, including labour productivity, was achieved (Skreli *et al.,* 2015), or that this increase was lower than expected (Bajrami *et al.,* 2019). This may be explained by the ineffective use of inputs, so that increasing them does not lead to an increase in production (Jitea and Pocol, 2014). For agricultural subsidies and support to bring the intended results, support should be directed towards overcoming barriers to the development of farms that have been identified in a particular country (Yanwen *et al.,* 2013).

Another issue is the development-oriented investment support of farms. It is shown that in the conditions of low-developed agriculture, the lack of support for investments leads to a slowdown in development and can even worsen the economic results of farms (Hlavsa *et al.,* 2017; Kirchweger *et al.,* 2015), while subsidies themselves contribute to an increase in resource productivity (Hubbard *et al.,* 2014). In this paper, however, we focus on the influence of decoupled subsidies.

Data and Methods

The data used in the paper came from the FADN.PL database. We obtain individual annual data for 3457 farms for the period 2010-2018. The collected data was used to build a balanced data panel, which included 31,113 objects. In the next stage, farms were divided into quartiles according to the criterion of labour efficiency per one employee obtained in 2018 (such a procedure allowed to avoid the migration of objects between quartiles). The year 2010 was taken as the year of the beginning of the analysis, as it was the first year in which the economic size of farms was established, based on the standard production volume.

The EU countries are characterised by a large diversity of agricultural structures and farming conditions, hence the adoption of data on farms from one country for the analysis allows for a more precise explanation of the relationship. Additionally, it was possible to obtain individual data from the same farms for several consecutive years. Such an approach allows to avoid difficulties in creating a credible model resulting from the large diversification of agriculture between countries, and at the same time provides the basis for presenting specific recommendations for a given country.

Panel modelling with fixed-effect estimators (FEM) was used to construct the models. The choice of the fixed effect model (FEM) was preceded by the Hausman test (at $p < 0.05$) and the Breusch-Pagan test. The FEM model is considered more reliable than the random effect model (Hausman, 1978; Hausman and Taylor, 1981; Greene 2008). The general model of panel data is presented in equation 1.

$$y_{it} = m_i + \sum b x_{it} + e_{it}, \quad (1)$$

where b stands for the vector of structural parameter expressing the influence of the independent variable x, x_{it} - realisation of the independent variable for the i-th item in t-time, e_{it} is the rest, meeting the classic assumption $E(e_{it}) = 0$ and $\mathrm{Var}(e_{it}) = S_e^2$. In the fixed effect model (FEM), m_i is decomposed into fixed expressions for individual groups, separately. Therefore, the model looks as follows:

$$\begin{aligned} y_{it} &= a_1 d_{1it} + a_2 d_{2it} + \cdots + a_k d_{kit} + b x_{it} + e_{it} = \\ &= a_i + b x_{it} + e_{it} \end{aligned}, \quad (2)$$

where: a_i stands for specific fixed expressions, while d_i is for zero-one variables, with the value 1 for i-th object and 0 otherwise.

Based on the data on the results of farms, after creating a division into quartiles reflecting levels of labour productivity on a farm, models were constructed for the entire group of farms as well as for individual quartile groups.

When deciding on the choice of factors for the model, the ones that were most often identified as having an impact on work efficiency were selected. Authors dealing with this subject indicated the following indices: the size of farms (Giannakis and Bruggeman 2018; MacDonald *et al.,* 2020; Parzonko and Bórawski, 2020), land resources per employee (Galluzzo, 2016; Giannakis and Bruggeman, 2018), capital per employee (Kusz and Misiak, 2017) and the intensity of production (Fuglie *et al.,* 2017; Gołaś, 2019; Hayami, 1970; Yamada and Ruttan, 1980). Hence, the presentation of the level of operating subsidies in relation to the value added generated on the farm in the set of analysed factors will – as mentioned in the introduction – complement the knowledge about the mechanisms of increasing labour productivity, and will also allow to verify to what extent operating subsidies are an important factor in achieving higher labour productivity.

The study assumed the measurement of labour productivity (LP) as a relation of net added value (NVA) to labour resources expressed in AWU (SE415/SE010). Following Hloušková and Lekešová (2020), the net value added (NVA) indicator is a synthetic indicator of standard production in EU FADN, expressing general production effects, outlays, and operational subsidies. Thus, per employee, it is one of the most important indicators of labour productivity. It measures productivity with regards to the value input of human capital in relation to external material costs. In this paper, variables with the level of human capital were not included separately due to the lack of relevant data. The subsidy rate (SR) was adopted as a measure of the level of support, which is the ratio of the value of subsidies to operating activities to the NVA. Subsidies are included in the NVA and shape them, and therefore may have an impact on labour productivity.

Additionally, variables that appeared in various studies in the field of labour productivity were taken into account, such as capital value per working person (C_AWU), measured by the value of total assets per one unit of labour; agricultural land area per working person (A_AWU), production intensity (In_A), which was the relation of costs to agricultural land area; livestock density (LU_A) and farm size (SE005), measured by standard output.

Results

Farm characteristics

Farms included in the research were characterised by different potentials resulting from the resources held, affecting labour productivity. Table 1 summarises the data characterising the examined Polish farms, broken down into quartiles, for which separate models have been developed.

The data presented in Table 1 confirm the differentiation of the analysed quartile groups, especially between Q1 and Q4. It is interesting that an average farm in Q4 has an

Table 1: Selected characteristics of Polish farms (averages per farm).

Specification	All farms	Averages for farms by quartile			
		Q1	Q2	Q3	Q4
Land [ha]	40.71	20.52	28.82	39.04	63.31
Annual work unit (AWU)	2.00	1.80	2.00	2.07	2.00
Total assets [thousand PLN]	1,421.77 (761.34)	702.32 (390.71)	986.45 (551.39)	1,372.33 (716.38)	2,232.36 (1,170.89)
Farm income [thousand PLN]	90.61	27.42	53.20	86.78	159.78
Subsidies [thousand PLN]	50.50	26.20	37.70	50.55	76.26

Note: land values are in parentheses.
Source: Own calculations based on FADN.PL data

Table 2: Descriptive statistics of variables – Polish farms panel

Variable	Statistics	Poland	Q1	Q2	Q3	Q4
LP [thousand PLN]	Avg	57.89	24.75	38.65	59.25	108.85
	Min	0.01	0.01	0.02	0.09	0.31
	Max	490.10	267.41	341.91	473.12	490.10
	SD	53.07	22.53	27.10	36.93	68.01
SR [%]	Avg	50.43	63.02	52.94	45.71	40.05
	Min	0.00	0.00	0.00	0.00	0.00
	Max	100.00	100.00	100.00	100.00	100.00
	SD	30.05	30.85	29.98	28.09	26.08
C_AWU [thousand PLN/AWU]	Avg	316.12	175.71	223.08	326.48	538.97
	Min	5.26	11.34	9.22	5.26	30.03
	Max	2,159.81	1,764.85	2,058.83	2,040.15	2,159.81
	SD	266.06	156.46	173.21	216.55	323.40
A_AWU [ha/AWU]	Avg	20.53	12.03	15.55	20.60	33.94
	Min	0.27	0.40	0.27	0.39	0.54
	Max	280.40	94.94	118.58	280.40	222.58
	SD	17.72	9.46	11.16	14.49	23.71
In_A [thousand PLN/ha]	Avg	7.00	6.14	6.96	7.24	7.68
	Min	0.43	1.09	0.86	0.43	0.68
	Max	220.73	99.76	220.73	188.40	197.70
	SD	8.31	5.48	10.33	7.88	9.29
LU_A [LU/100 ha]	Avg	7.03	9.30	7.99	6.14	4.71
	Min	0.00	0.00	0.00	0.00	0.00
	Max	1,718.00	746.00	324.60	1,718.00	194.70
	SD	18.04	21.40	16.79	30.30	9.98
SE005 [thousand PLN]	Avg	46.40	24.57	35.29	49.83	75.86
	Min	4.01	4.01	4.10	4.09	4.71
	Max	3,433.98	460.97	462.30	3,433.98	467.82
	SD	51.06	25.89	31.90	66.60	53.75

Source: Own calculations based on FADN.PL data

area 3 times larger than that of a farm in Q1, but at the same time the difference in the amount of capital is more than four times. This determines the income achieved (the difference between Q4 and Q1 is almost 6 times to the disadvantage to the latter). It is worth emphasising that despite differences in acreage of utilised agricultural area (UAA) and the value of capital, the amount of employment on farms did not differ between quartiles. This may mean that some farms do not fully use their labour force.

In individual quartiles, the level of received subsidies for agricultural activity also varied. There are almost 3-fold differences in the level of received payments between groups Q1 and Q4, which is not surprising as it is a consequence of the size of the farm. However, there is a clear difference between the value of income and subsidies – in Q1, these values are almost equal, in Q4, there is a clear difference between these amounts. This proves that these smaller farms are very dependent on budget support, but at the same time it is a small amount. Combined with a small amount of capital and land, it limits the possibilities of increasing agricultural production and overall productivity on farms from quartiles 1 and 2.

From Table 2, it can be observed that there are significant and systematic differences in labour, capital, and production intensity as well as in farm size between quartile groups as well as inside these groups, which is visible in the high values of standard deviation. In Q4, labour productivity is almost two-fold higher than the mean for the country and four-fold higher in comparison with Q1. Similarly, other

variables indicate that labour productivity primarily depends on farm size and technical equipment rather than production intensity. The SR level decreases in the successive groups from Q1 to Q4. It can, therefore, be stated that the value of subsidies has a relatively lower significance for the level of income in the Q4 group of farms. In farms from this quartile, a bigger part of NVA was obtained due to agricultural activity, not subsidies, even when NVA in this group was much higher than in other quartiles.

Factors determining the increase in labour productivity

In Table 3, the correlation matrix for variables used in the analysis is presented.

Agricultural land area per working person (A_AWU), capital value per working person (C_AWU) and farm size (SE005) are most significantly and positively correlated with the LP variable. The subsidy rate (SR) is negatively correlated with LP. It is worth noting that SR is also negatively correlated with every other variable, which implies that subsidies are more important in small, low-intensity and less equipped farms. The dependencies presented in Table 3 confirms the results from the farm description according to quartile groups.

Table 4 presents the parameters of the panel regression model for the assessment of the influence of selected factors on labour productivity in groups of Polish farms.

The obtained results indicate that three independent variables (regardless of whether the model concerns the whole set or quartile groups) have an impact on the level of labour productivity. These variables are: C_AWU, A_AWU and SR. In the models, SE005 has a significant positive impact on three groups. This means that the primary factor influencing the increase in labour productivity on Polish farms is farm size and better equipment of labour with capital. The obtained result indicates that, from the perspective of labour productivity, land and capital concentration and investment in labour substitution by capital can be a developmental path for Polish farms in the future.

Similar results, indicating the main role of capital in achieving higher productivity, were established for Poland for the period before 2010 by Wójcik and Nowak (2012) and for other countries by Zsarnóczai and Zéman (2019) and Salimova *et al.* (2019). The results of our research are also consistent with the findings of Niezgoda *et al.* (2018), who stated that on larger farms, the effectiveness of the substitution of labour with capital is much higher, implying that the small scale of production is still a strong limitation. With

Table 3: Variable correlation matrix – Polish farms panel.

Variable	LP	SR	C_AWU	A_AWU	In_A	LU_A	SE005
LP	1						
SR	-0.299	1					
C_AWU	0.651	-0.082	1				
A_AWU	0.649	-0.128	0.631	1			
In_A	0.042	-0.252	0.099	-0.188	1		
LU_A	-0.126	-0.029	-0.111	-0.194	0.005	1	
SE005	0.496	-0.173	0.557	0.379	0.213	-0.055	1

Note: Critical value (for two-sided 5% critical area) = 0.0111, for n = 31,113.
Source: Own calculations based on FADN.PL

Table 4: Estimation of fixed effects for the LP variable – Polish farms panel and quartile groups.

Variable	Poland	Q1	Q2	Q3	Q4
Constant	28.17***	24.40***	21.897***	34.384***	36.621***
	(11.780)	(4.77)	(6.246)	(10.54)	(7.557)
SR	-0.419***	-0.243***	-0.305***	-0.406***	-0.831***
	(-36.57)	(-19.36)	(-17.28)	(-19.90)	(-22.81)
C_AWU	0.070***	0.030***	0.046***	0.065***	0.082***
	(14.66)	(2.799)	(3.591)	(7.470)	(12.51)
A_AWU	1.254***	0.776***	1.150***	1.236***	1.270***
	(14.11)	(3.456)	(6.289)	(7.300)	(10.46)
In_A	-0.222**	-0.520	-0.188	-0.538***	-0.165
	(-2.34)	(-1.130)	(-1.040)	(-4.662)	(-1.254)
LU_A	-0.020**	0.008	0.03*	-0.011***	-0.142*
	(-2.247)	(0.876)	(1.693)	(-2.638)	(-1.916)
SE005		0.171***	0.161***		0.264***
		(2.781)	(2.953)		(5.752)
R^2 (within R^2)	0.761	0.619	0.593	0.602	0.665
	(0.731)	(0.571)	(0.541)	(0.552)	(0.623)
Durbin-Watson test	1.75	1.96	1.96	1.89	1.74
Sample size	31,113	7,777	7,778	7,778	7,777

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$
Source: Own calculations based on FADN.PL

a small scale of production, the significance of operating subsidies for inducing productivity growth is small. However, Gołaś (2019) stated that the most important factor in increasing labour productivity was the increase in UAA per employee. Both our research and that of others indicate that operating subsidies are not the main driver of labour productivity growth in agriculture.

In research on agriculture across the whole EU, the most important factor leading to an increase in labour productivity was the increase in the capital-labour relationship, while the increase in farm size and production scale did not have a significant influence on labour productivity. Subsidies per worker had negative impact on labour productivity (Bereżnicka and Wicki, 2021). The situation is different in Poland, our research shows that even in the group of farms with the highest labour productivity, there is still a significant positive relationship between labour productivity and the size of farms. This means that in Polish agriculture, compared to EU agriculture, the main limiting factors are small land and capital resources on farms. In Polish farms, which are still highly scattered, subsidies are not a key factor in increasing labour productivity. As the size of farms grows, the increase in land and capital resources is more important, and the importance of subsidies in creating added value decreases.

In each of the separate quartile, the subsidy ratio had a negative relationship with labour productivity. This means that the higher level of subsidies was not conducive to the growth of labour productivity, and seems to perpetuate its relatively low level, resulting from the fact that the negative impact of this variable is three times higher in the Q4 group compared to the Q1 group. It also means that achieving higher labour productivity does not depend on the level of operating subsidies in Poland, but on other factors included in the model like the capital-labour, land-labour relations, and in some groups also the economic size. Giannakis and Brugemann (2018) suggest that farmers' pluriactivity and low level of new technology familiarity may also be the cause of low productivity. It can be pointed out that increasing the size of farms and their equipment allows them to become more independent from operating subsidies. Similar results were obtained by Jitea and Pocol (2014) for agriculture in Romania. Hornowski *et al.* (2020) indicates that operating subsidies in small farms in Poland make it possible to maintain the level of personal income of farmers at an acceptable level, and to a lesser extent have a pro-development function. To stimulate development, the use of subsidies that directly support investment is needed. Galuzzo (2016) reached similar conclusions on small farms in Italy. However, such subsidies are mainly used by large farms, as in smaller ones it is not possible to generate a surplus for co-financing investments (Kostlivý and Fuksová, 2019). The obtained results may also be the basis for confirming that the high level of subsidies to operating activities leads to a slowdown in farm structural change and an increase in labour productivity in agriculture (which indicates an ineffective allocation of budget support). However, it was also confirmed that regardless of the level of labour productivity and the size of farms, increasing the area and accumulation of capital supporting work contribute to achieving higher and higher productivity.

Conclusions

The paper analysed the relationship between subsidies and farm level labour productivity in Poland and showed a significant negative dependency between the subsidy rate and labour productivity in Polish farms. This was proven not only for the general whole model, but also for models of quartile groups distinguished in terms of labour productivity. The negative correlation between subsidy rate and labour productivity was stronger in groups characterised by a high level of labour productivity. However, the conducted research confirmed that the factors traditionally taken into consideration, such as an increase in the scale of production, an increase in the capital-labour ratio, and an increase in land per worker, still have a significant positive impact on labour productivity. The significance of these factors is greater in farm quartiles with an observed high level of productivity, a finding which provides a justification for productivity development, even where more productive and bigger farms are concerned. This would mean that the current progress of farms relating to labour productivity and income level per person will continue, and diversification in this scope will continue to grow. The process may end in a small percentage of farms with high productivity and economic independence, and a high percentage of small farms that will not constitute the basis of the farmers' livelihood. Results also suggest that in Polish agriculture, it is the case that the factors limiting the growth of labour productivity are small resources of land and capital on farms, and that these barriers to growth should therefore be removed.

The income of farms with the lowest labour productivity is more strongly dependent on subsidies than in farms with high productivity, where the increase in labour productivity was dependent on the subsidy level for operational activity to a lesser extent. This may mean that in farms where low labour productivity is observed, subsidies for operational activity are an important source of income generation and form of consumption financing, which may not be enough to generate a surplus that could be allotted to financing the development of the farm. In such cases, subsidies become a bottleneck for farm structure change that would lead to an increase in labour productivity. The hypothesis set in the study that a higher subsidy rate is associated with higher labour productivity on farms was negatively verified.

The limitation in the conducted research is the inability to eliminate the influence of factors not included in the model, which may strongly modify the efficiency (for example the production direction and its structure). The extent to which other objectives, such as environmental protection, emission levels or animal welfare, are achieved, have also not been taken into consideration. The implementation of such goals on farms may lead to a reduction in productivity. The new challenges facing agriculture justify further research on the productivity of factors of production, including labour, with a view to modifying the principles of agricultural support.

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The relationship between crop insurance take-up, technical efficiency, and investment in Hungarian farming

Climate change is putting increasing pressure on agriculture, which might be reduced by paying more attention to risk management, production efficiency and farm investment. This paper describes the interrelationship between crop insurance take-up, technical efficiency and investment in Hungarian farming using a system of simultaneous equations. The empirical analysis is based on farm accountancy data for the period 2001-2019. Results suggest that both technical efficiency and investment have positive and significant effects on insurance take-up. Accordingly, higher technical efficiency and a higher investment rate both lead to increased insurance usage. In terms of its relationship with efficiency, insurance has a positive and significant coefficient, but investment does not have a significant influence on technical efficiency. Where investment is concerned, insurance usage has a positive and significant effect, but the role of technical efficiency is insignificant. Results suggest that policy interventions that stimulate any of the three factors can potentially have additional positive impacts through spill-over effects on other factors. These effects could be further enhanced if, for instance, interventions focusing primarily on insurance take-up also pay attention to investment by differentiating insurance premium subsidies, depending on whether there is an ongoing (or operating) investment that can be linked to weather-related risk management.

Keywords: risk management, farm performance, system of simultaneous equations, Data Envelopment Analysis.
JEL classifications: G22, L25, Q12

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Introduction

The crop production sector represents about 60 percent of total agricultural output in Hungary (Eurostat, 2020). There are more than 234,000 farms and, based on their main activity, two thirds of them are mainly engaged in crop production (KSH, 2020). The major specialisation is arable crop production, and the dominant arable crops are wheat, maize, barley, sunflower and rapeseed. The area of arable land is about 4 million hectares, representing 4 percent of the EU-27 arable land (Eurostat, 2020). Hungarian crop farming is mainly characterised by many small farms and a few very large farms in terms of size in hectares (KSH, 2020).

Hungarian agriculture is heavily exposed to the impact of extreme weather events and climate change due to the preponderance of crop production. Extreme weather events have become much more common in recent years. For example, in the Carpathian Region in the period 1961-2010, heatwaves became not only more frequent, but also longer, more severe and intense, in particular in summer in the Hungarian Great Plain (Spinoni *et al.*, 2015). In certain parts of Hungary, the number of heatwave days has increased by more than two weeks since 1981 (OMSZ, 2015). Similarly, the frequency of heatwaves has increased across much of Europe (IPCC, 2014).

Changes in precipitation patterns are also observable in Hungary. Annual precipitation has decreased by 5.6 percent between 1901 and 2014, and the reduced precipitation falls in a more intensive pattern which decreases its potential utilisation and increases the frequency of extreme rainfall events. The annual number of rainy days has decreased by 15 days since 1901 (OMSZ, 2015). The increasing number of heatwave days and decreasing number of rainy days raise the likelihood of longer drought periods.

Drought and hail are the most frequent types of crop damage in Hungary and can pose even greater risks to agricultural production in the future. Thus, strategies for adapting to increased weather and climatic risk and for mitigating the potential financial implications are becoming increasingly important. To help alleviate the financial risk related to increased weather and climatic risk, a damage mitigation system (DMS) has been provided by the Hungarian government since 2007 (Kemény and Varga, 2010).

Assessment of the possible impacts of extreme weather events is an important part of farmers' risk management strategies. Farmers can use several methods to deal with increased weather risk. Firstly, crop insurance can play an important role in mitigating the financial impacts of climate change (Falco *et al.*, 2014). Secondly, improving technical efficiency to make more efficient use of natural resources can contribute to adaptation to climate change. Improving technical efficiency is important because of the limited availability of natural resources, such as water and land. Thirdly, investment in agricultural production can also contribute to dealing with the challenges posed by climate change. According to Collier *et al.* (2009), farmers' risk assessments can identify adaptation strategies which can be managed through investments, such as irrigation and modified cropping systems.

Although all three factors can mitigate climate related impacts on crop production, to the author's knowledge, the interrelationships between crop insurance take-up, technical efficiency and farm investment have not been studied to date. Baráth *et al.* (2017) investigated the relationship between crop insurance demand and economic performance measured by farm profit margin and total factor productivity. However, no study to date has, to the author's knowledge, evaluated the effect of technical efficiency on insurance demand. Furthermore, the effects of insurance usage and technical efficiency on farm investment also have not been examined to date.

The main objective of this paper is therefore to investigate the interrelationships between crop insurance usage, technical efficiency and investments in Hungary over a period of nearly twenty years (between 2001 and 2019). By studying the determining factors of farmers' behaviour, policy recommendations on how the crop insurance market can be improved can be made. In addition, such interrelationships may mean that policy interventions also lead to increased technical efficiency and encourage investment.

The paper is structured as follows. The next section presents a literature review, followed by a description of the methodology and data. The results are then presented, followed by the exploration of the new insights gained from the analysis. Finally, these insights are used to formulate some policy recommendations and draw some general conclusions.

Literature review

In order to examine the interrelationships between the three factors in farmers' risk management strategies properly, other drivers of farmers' behaviour towards these factors also need to be considered. Therefore, an overview of the determining factors follows.

Crop insurance take-up

Several studies show that larger farms are more likely to insure their crops (Baráth *et al.*, 2017; Enjolras and Sentis, 2011; Sherrick *et al.*, 2004). According to Sherrick *et al.* (2004) and Finger and Lehmann (2012), insurance users tend to be older, more experienced and better educated. Crop diversification has an impact on insurance demand, although there are mixed arguments concerning the effect of diversification (non-concentration). On the one hand, Falco *et al.* (2014) and Goodwin (1993) found that crop diversification could be a substitute for crop insurance. On the other hand, Mishra *et al.* (2004) suggested that a risk-averse farmer diversifying his/her production also took out insurance to reduce risk.

The intensity of direct input use (seeds, fertilisers, pesticides, etc.) is a proxy for production intensity, which also may affect insurance usage. Serra *et al.* (2003) found that the application of chemical inputs reduced the expected return from crop insurance, consequently the farmer is less likely to take out crop insurance. This is in line with the result of Smith and Goodwin (1996) showing that producers who purchase crop insurance use fewer agrochemicals. In contrast, Möhring *et al.* (2020) found a positive relationship between crop insurance and pesticide use in European agriculture.

Finger and Lehmann (2012) and Goodwin and Smith (2013) found evidence of the effect of subsidies on insurance use. While there are targeted incentives to adopt crop insurance, such as insurance premium support, direct payments may also influence insurance usage. Finger and Lehmann (2012) found that direct payments reduce farmers' insurance take-up. They pointed out that this relationship between premium support and direct payments highlighted contradictory influences of agricultural policy measures. Therefore, this current study examines the effect of total amount of subsidy (except investment subsidy), taking also account other financial support.

Among other determining factors, intuitively, insurance history can be a good proxy of willingness to pay for insurance and the average of the previous three years of insurance usage can be used as the measure of willingness to adopt crop insurance. Lefebvre *et al.* (2014) found that the farmers intending to invest are more likely to have positive attitudes towards innovation and to follow good farm management practices, such as having agricultural insurance. Baráth *et al.* (2017) provided empirical evidence that economic performance, measured by farm profit margin (PM) and total factor productivity (TFP), had a positive impact on farm insurance demand.

Technical efficiency

Latruffe *et al.* (2004) and Bojnec and Fertő (2013) showed that larger farms are more technically efficient than smaller ones. Dessale (2019) and Nowak *et al.* (2016) found that the age of farm managers had a positive effect on technical efficiency, which they said could be explained by older farmers possessing greater farming experience. According to Dessale (2019), technical efficiency is positively correlated with education, because more educated farmers have the ability to use information from various sources more effectively and are able to apply new farming technologies that would increase outputs.

In terms of production diversification, a more specialised (concentrated) farm may be more efficient as there is no competition for land between activities and farmers can focus their management efforts (Bojnec and Latruffe, 2009). However, Lazíková *et al.* (2019) found that production diversity positively affected technical efficiency.

Subsidies can increase technical efficiency if they provide the necessary financial means to keep technologies up to date or to invest in efficiency improvement (Zhu and Lansink, 2010). On the other hand, subsidies can serve to reduce farmers' effort and consequently reduce their technical efficiency (Bojnec and Latruffe, 2009). Bojnec and Latruffe (2009) and Zhu and Lansink (2010) also found that total subsidies had a negative impact on technical efficiency. According to Pawłowski *et al*. (2021), investments are a basic way to increase efficiency. However, they emphasised that not every investment leads to increased efficiency, owing to the phenomenon of overinvestment.

Investment

The extent of investment is influenced by several factors. Investment history affects the subsequent investments, namely, farmers who invested recently are more likely to intend to invest again (Lefebvre *et al.*, 2014). Larger farms are also more likely to invest (Lefebvre *et al.*, 2014; Niavis *et al.*, 2020). Farmers' characteristics, such as age and education can also have an impact on investment decisions. The results of Niavis *et al.* (2020) suggested that the relationship between farmers' age and their investment behaviour was not linear, instead one may observe phases in the life of farmer with different rates of investment. According to Wieliczko *et al.* (2019), education can have a negative impact on investment due to the non-agricultural work undertaken by these farmers which discourages agricultural investment.

Fertő *et al.* (2017) identified a positive association between investment and investment subsidies. Direct payments also contributed to increasing investment activity in agriculture, although this represents income support and not investment support (Fogarasi *et al.*, 2014).

Methods and data

The empirical analysis uses micro data of Hungarian farms available from the national farm accountancy data network (FADN) collected by the Research Institute of Agricultural Economics (AKI) in Budapest. The FADN observes the assets-, financial- and income-based situations of a representative sample according to three categories: region, economic size and type of farming. The sample consists of nearly 2000 agricultural holdings from year to year (Keszthelyi and Kis Csatári, 2020). Data from about 1000 crop specialised farms for the period 2001-2019 are used in this study. To investigate the relationship between insurance demand, technical efficiency and farm investment, it is firstly necessary to determine the technical efficiency scores. The efficiency scores are estimated using Data Envelopment Analysis (DEA). Secondly, a system of simultaneous equations is applied to examine the relationship between insurance take-up, technical efficiency and farm investment, also considering other factors, such as farm size, concentration, production intensity, subsidies and information on farmers' characteristics.

The empirical analysis takes account of the three distinct phases of the Hungarian DMS. Initially, the DMS offered only very low compensation for losses (Kemény and Varga, 2010). To help increase the compensation capacity of the DMS, a two-scheme risk management system was introduced in 2012. The first scheme is damage mitigation, in which participation is compulsory for all farms above a certain size in hectares (Lámfalusi and Péter, 2020). The second scheme consists of crop insurance premium support for three types of insurance ('A', 'B', 'C'), in which participation is voluntary. Under this scheme, the premium support cannot exceed 65 percent[1] of the premium paid. Between 2012 and 2015, there was no lower limit for premium support, this was introduced only in 2016 ('A' type – 41.25 percent, 'B' and 'C' type – 30 percent). The various types of subsidised insurance cover different combinations of crops and natural hazards (currently specified in the legislation). The 'A' type (also referred as 'all-risk') insurance covers all the most important weather risks for the major arable and fruit crops. The 'B' type insurance addresses the major vegetable crops, minor fruit crops and some major arable crops, and covers only certain major risks. The 'C' type insurance is available for all relevant crops for any damage not covered by insurance types 'A' and 'B' (Lámfalusi and Péter, 2020). Since 2012, farmers have had the option to cover weather risk by taking up subsidised or traditional (non-subsidised) crop insurance.

Estimation of efficiency scores

The two principal methods used for efficiency analysis are Stochastic Frontier Analysis (SFA) which uses parametric econometric techniques and DEA which is based on nonparametric mathematical programming techniques to construct a frontier over the data. Efficiency measures are calculated relative to this frontier (Coelli *et al.*, 2005). The main advantage of using DEA over SFA for efficiency measurement is that it does not require any assumption about the functional form and about the distribution of the error terms (Charnes *et al.*, 1994). However, the DEA method is data sensitive. The frontier is highly subject to the errors in the data because this method uses only the extreme observation to identify the 'best-practice frontier' (Timmer, 1971).

The statistical estimators of the frontier are obtained from a finite sample; consequently, the related measures of efficiency are sensitive to the sampling variations of the obtained frontier (Simar and Wilson, 1998). Simar and Wilson (1998) provided a general methodology of bootstrapping to analyse the sensitivity of nonparametric efficiency scores to sampling variations. The present study employs output oriented constant returns to scale DEA model with bootstrap method to estimate the technical efficiency scores. The estimation of efficiency scores is based on one output (gross production value without subsidies) and four inputs (land, labour, capital, intermediate consumption).

System of simultaneous equations

To investigate the relationship between insurance use, technical efficiency and investment, a system of simultaneous equations is used. The model is defined by the following equations (Amemiya, 1979; Maddala, 1983):

$$\mathbf{y}_1^* = \gamma_{11}\mathbf{y}_2 + \gamma_{12}\mathbf{y}_3 + \mathbf{X}_1\boldsymbol{\beta}_1 + \mathbf{u}_1, \quad (1)$$

$$\mathbf{y}_2 = \gamma_{21}\mathbf{y}_1^* + \gamma_{22}\mathbf{y}_3 + \mathbf{X}_2\boldsymbol{\beta}_2 + \mathbf{u}_2, \quad (2)$$

$$\mathbf{y}_3 = \gamma_{31}\mathbf{y}_1^* + \gamma_{32}\mathbf{y}_2 + \mathbf{X}_3\boldsymbol{\beta}_3 + \mathbf{u}_3, \quad (3)$$

where $\mathbf{y}_1^*$, $\mathbf{y}_2$, $\mathbf{y}_3$ are $N \times 1$ vectors, γ_{11}, γ_{12}, γ_{21}, γ_{22}, γ_{31}, γ_{32} are scalars, $\mathbf{X}_1$ is $N \times M_1$ matrix, $\mathbf{X}_2$ is $N \times M_2$ matrix, $\mathbf{X}_3$ is $N \times M_3$ matrix, $\boldsymbol{\beta}_1$ is $M_1 \times 1$ vector, $\boldsymbol{\beta}_2$ is $M_2 \times 1$ vector, $\boldsymbol{\beta}_3$ is $M_3 \times 1$ vector and $\mathbf{u}_1$, $\mathbf{u}_2$, $\mathbf{u}_3$ are $N \times 1$ error terms. The number of farms is indicated by N. The number of exogenous variables in the corresponding equations is denoted by M_1, M_2 and M_3.

Equation (1) refers to the crop insurance demand model. The dependent variable $\mathbf{y}_1^*$ indicates the farmer's decision on whether to take out crop insurance or not and is observed as a binary variable so that $\mathbf{y}_1 = \mathbf{y}_1^*$ if $\mathbf{y}_1^* > 0$, otherwise $\mathbf{y}_1 = 0$. Equation (2) describes the efficiency model, where the dependent variable $\mathbf{y}_2$ indicates the technical efficiency scores which are estimated with the DEA method, as a result, these are bounded above by 1 and below by 0. Equation (3) corresponds to the investment model. The dependent variable $\mathbf{y}_3$ denotes the amount of net investment and is observed.

[1] In 2020, the limit of financial support was raised to 70 percent.

The model can be estimated equation-by-equation with the two-stage approach proposed by Amemiya (1979) and Maddala (1983). In the first stage the following reduced-form model is estimated.

$$\mathbf{y}_1^* = \mathbf{X}\boldsymbol{\Pi}_1 + \mathbf{v}_1, \quad (4)$$

$$\mathbf{y}_2 = \mathbf{X}\boldsymbol{\Pi}_2 + \mathbf{v}_2, \quad (5)$$

$$\mathbf{y}_3 = \mathbf{X}\boldsymbol{\Pi}_3 + \mathbf{v}_3, \quad (6)$$

where X is $N \times M$ vector consisting of all exogenous regressors from all equations, $\boldsymbol{\Pi}_1$, $\boldsymbol{\Pi}_2$, $\boldsymbol{\Pi}_3$ are the $M \times 1$ coefficients, and $\mathbf{v}_1$, $\mathbf{v}_2$, $\mathbf{v}_3$ are the $N \times 1$ error terms of the reduced model. The number of distinct exogenous vectors is denoted by M.

The coefficients of Equation (4) with the binary dependent variable are estimated with the Probit model. The dependent variable of Equation (5) is technical efficiency estimated using the DEA method. When regressing that variable, it is to be considered that the efficiency scores are serially correlated and the error terms are derived from a truncated distribution (Simar and Wilson, 2007). To deal with this issue, the empirical analysis follows Simar and Wilson (2007) and uses truncated regression with double bootstrap to estimate Equation (5). Equation (6) with continuous dependent variable can be estimated using ordinary least squares (OLS). The first stage predicted values are $\hat{\mathbf{y}}_1 = \mathbf{X}\hat{\boldsymbol{\Pi}}_1$, $\hat{\mathbf{y}}_2 = \mathbf{X}\hat{\boldsymbol{\Pi}}_2$ and $\hat{\mathbf{y}}_3 = \mathbf{X}\hat{\boldsymbol{\Pi}}_3$.

In the second stage, these fitted values are used as instruments for the endogenous regressors to estimate Equation (1), Equation (2) and Equation (3) following Newey's two step procedure (Newey, 1987). The first step generates residuals from a linear probability regression of the endogenous variables on regressors and instruments. The second step fits the Probit, Simar-Wilson and linear regression models on regressors including the first step residuals (Cameron and Trivedi, 2009). The z statistics for the coefficients of first step residuals provides the basis of the Durbin-Wu-Hausman test for endogeneity. If some of the coefficients are significantly different from 0, then the second step estimator needs to be adjusted by using the bootstrap method following Cameron and Trivedi (2009).

The list of variables used in the empirical analysis and their description is provided in Table 1. Monetary indicators have been deflated to the year 2001 using price indices provided by the Hungarian Central Statistical Office. The related descriptive statistics are presented in Table 2.

Table 1: Description of variables used in the empirical analysis.

Variable	Description
Age of manager	Age of the farm manager
Training of manager	Agricultural training of the manager (0: no, 1: yes)
Utilised Agricultural Area	Size indicator, utilised agricultural area (ha)
Insurance	Whether the farm has crop insurance in a given year (0: no, 1: yes)
Insurance history	The average insurance use of the last three years. Proxy variable for willingness to take out crop insurance.
Investment	Net investment per 1 hectare of land (HUF 1,000/ha)
Investment history	The average net investment of the last three years (HUF 1,000/ha). Proxy variable for willingness to invest.
Output	Gross production value without subsidies (HUF 1,000)
Labour	Annual working unit (AWU) (sum of worked hours/2,200)
Capital	Tangible assets (HUF 1,000)
Intermediate consumption	Material expenses (HUF 1,000)
Technical efficiency	Technical efficiency (TE), CRS efficiency
Concentration	Concentration of crop production calculated as the share of two major crops in the arable area
Intensity	Cost of seeds, fertilisers and pesticides and other direct material costs (HUF 1,000/ha)
Investment subsidies	Investment subsidies (HUF 1,000/ha)
Subsidies	Total amount of subsidies excluding investment subsidies (HUF 1,000/ha)
2007-2011 period	Dummy: 1 for 2007-2011, 0 otherwise
2012-2015 period	Dummy: 1 for 2012-2015, 0 otherwise
2016-2019 period	Dummy: 1 for 2016-2019, 0 otherwise

Source: Own compilation

Table 2: Descriptive statistics of the variables.

Variable	Mean	Standard deviation	Minimum	Maximum
Age of manager	55.84	11.15	20.00	99.00
Training of manager	0.69	0.46	0.00	1.00
Utilised Agricultural Area	227.41	390.14	3.38	5,256.00
Insurance	0.42	0.49	0.00	1.00
Investment	7.79	55.07	-545.23	1488.51
Insurance history	0.40	0.40	0.00	1.00
Investment history	9.07	38.33	-255.75	697.31
Output	42,482.16	87,703.48	102.29	1,776,742.00
Labour	3.63	7.69	0.01	139.24
Capital	56,178.20	78,428.38	2.57	1,265,346.00
Intermediate consumption	27,066.55	60,489.82	304.95	818,440.20
Technical efficiency	0.52	0.17	0.02	0.96
Concentration	0.74	0.17	0.27	1.00
Intensity	42.95	23.96	0.00	547.68
Investment subsidies	1.63	11.07	0.00	343.97
Subsidies	48.34	24.93	0.00	920.75

N=11,362
Source: Author's calculations based on FADN data

Results

The results of the system of simultaneous equations employed in the study are presented in Tables 3, 4 and 5. The endogeneity test based on the significance of first step residuals indicates that technical efficiency and investment are endogenous for insurance take-up, and insurance is endogenous for technical efficiency. Therefore, the second step estimator is adjusted by using the bootstrap method as required.

Results of the insurance take-up model

In addition to technical efficiency and investment, insurance history was found to have a positive and significant effect on insurance take-up (Table 3). The farmer's age positively influences insurance usage, but the contribution of education is not significant. The coefficient of farm size is insignificant. Concentration and intensity significantly decrease insurance take-up. The total amount of subsidies (excluding investment subsidies) affects insurance demand positively. This variable also consists of the premium support which is targeted to increase crop insurance usage. The period 2007-2011 does not have a significant effect on insurance use but in the periods 2012-2015 and 2016-2019, insurance take-up increased significantly. The most recent period has the highest impact.

Results of the technical efficiency model

Insurance usage has a positive and significant effect on technical efficiency (Table 4). However, investment is statistically insignificant for the efficiency model. The age of the farmer negatively influences technical efficiency, but the contribution of education is positive and significant. Farm size also impacts technical efficiency positively. Both concentration and intensity have a positive and significant influence on technical efficiency. By contrast, subsidies significantly decrease efficiency.

Results of the investment model

Insurance take-up has a positive and significant impact on investment (Table 5). However, technical efficiency does

Table 3: Estimated parameters of the insurance take-up model

	Coefficient	Standard error	z	P>|z|	Lower 95% CI	Upper 95% CI
Insurance						
Technical efficiency	4.6762***	0.6929	6.7500	0.0000	3.3180	6.0343
Investment	0.0031***	0.0011	2.8800	0.0040	0.0010	0.0052
Insurance history	1.8345***	0.0433	42.4100	0.0000	1.7497	1.9192
Age of manager	0.0045***	0.0016	2.9000	0.0040	0.0015	0.0076
Training of manager	0.0156	0.0346	0.4500	0.6530	-0.0522	0.0833
Utilised Agricultural Area	0.0001	0.0001	0.6400	0.5200	-0.0001	0.0002
Concentration	-0.8332***	0.1002	-8.3200	0.0000	-1.0295	-0.6368
Intensity	-0.0087***	0.0016	-5.4600	0.0000	-0.0118	-0.0055
Subsidies	0.0067***	0.0012	5.6100	0.0000	0.0043	0.0090
2007-2011 period	0.0199	0.0541	0.3700	0.7120	-0.0861	0.1260
2012-2015 period	0.1022*	0.0576	1.7700	0.0760	-0.0107	0.2151
2016-2019 period	0.1643***	0.0580	2.8300	0.0050	0.0506	0.2779
Technical efficiency residual	-4.5291***	0.7004	-6.4700	0.0000	-5.9019	-3.1563
Investment residual	-0.0024**	0.0011	-2.1800	0.0290	-0.0046	-0.0002
Constant	-3.1069***	0.3538	-8.7800	0.0000	-3.8004	-2.4135

Notes: *p < 0.1; **p < 0.05; ***p < 0.01.
Source: Author's calculations based on FADN data

Table 4: Estimated parameters of the technical efficiency model.

	Coefficient	Standard error	z	P>|z|	Lower 95% CI	Upper 95% CI
Technical efficiency						
Insurance	0.0318***	0.0061	5.2400	0.0000	0.0199	0.0437
Investment	0.0000	0.0001	0.3600	0.7160	-0.0001	0.0002
Age of manager	-0.0009***	0.0001	-6.1800	0.0000	-0.0011	-0.0006
Training of manager	0.0132***	0.0033	4.0100	0.0000	0.0067	0.0196
Utilised Agricultural Area	0.0001***	0.0000	20.6300	0.0000	0.0001	0.0001
Concentration	0.0249**	0.0106	2.3600	0.0180	0.0043	0.0456
Intensity	0.0024***	0.0001	22.1200	0.0000	0.0021	0.0026
Subsidies	-0.0009***	0.0001	-8.9700	0.0000	-0.0011	-0.0007
Insurance residual	-0.0259***	0.0073	-3.5500	0.0000	-0.0402	-0.0116
Investment residual	0.0000	0.0001	0.2700	0.7830	-0.0002	0.0002
Constant	0.4488***	0.0130	34.4000	0.0000	0.4232	0.4744

Notes: *p < 0.1; **p < 0.05; ***p < 0.01
Source: Author's calculations based on FADN data

Table 5: Estimated parameters of the investment model.

	Coefficient	Standard error	z	P>|z|	Lower 95% CI	Upper 95% CI
Investment						
Insurance	3.8928*	2.0774	1.8700	0.0610	-0.1792	7.9648
Technical efficiency	35.5100	21.7268	1.6400	0.1020	-7.0374	78.1393
Investment history	0.0853***	0.0130	6.5400	0.0000	0.0597	0.1109
Age of manager	0.0002	0.0481	0.0000	0.9960	-0.0941	0.0945
Training of manager	0.6342	1.1045	0.5700	0.5660	-1.5307	2.7992
Utilised Agricultural Area	-0.0031	0.0023	-1.3700	0.1710	-0.0077	0.0014
Concentration	-15.8671***	3.2624	-4.8600	0.0000	-22.2619	-9.4723
Intensity	-0.0800	0.0488	-1.6400	0.1010	-0.1757	0.0157
Investment subsidies	1.5280***	0.0445	34.3100	0.0000	1.4407	1.6153
Subsidies	0.0455*	0.0265	1.7200	0.0860	-0.0064	0.0975
Technical efficiency residual	-0.4926	2.4273	-0.2000	0.8390	-5.2505	4.2653
Investment residual	-29.2752	21.9509	-1.3300	0.1820	-72.3028	13.7524
Constant	-2.2911	10.6342	-0.2200	0.8290	-23.1361	18.5538

Notes: *p<0.1; **p<0.05; ***p<0.01.
Source: Author's calculations based on FADN data

not influence investment significantly. Investment history also has a positive and significant effect on investment. The impact of the farmer's age and education are insignificant. The role of farm size is insignificant in the case of investment decision. Concentration influences investment negatively and significantly, but production intensity has no significant effect on investment. Total subsidies (excluding investment subsidies) and investment subsidies also have a positive sign; both are statistically significant, but the impact of investment subsidies is higher.

Discussion

This study examined the interrelationship between crop insurance take-up, technical efficiency and investment among Hungarian FADN crop specialised farms. All three factors can all play a role in improving these farms' resilience to the impacts of extreme weather events and climate change and the empirical results show that each of them is influenced by several drivers.

Insurance take-up

Insurance take-up is influenced by insurance history, age of manager, concentration, intensity and subsidies but not by training of the manager and the farm size. The positive effect of manager's age on insurance take-up, as also shown by Sherrick *et al.* (2004) and Finger and Lehmann (2012), suggests that older farmers are more risk averse. Concentration influences insurance take-up negatively, which is in line with the findings of Mishra *et al.* (2004). This result suggests that a farmer with a diversified crop production structure may also take out crop insurance to further reduce weather risk. The negative role of intensity is in line with findings of Smith and Goodwin (1996) and Serra *et al.* (2003) and confirms that intensification can substitute for insurance usage. Subsidy influences positively crop insurance demand, as also shown by Baráth *et al.* (2017), who argued that subsidies may increase demand for crop insurance by relaxing farm budget constraints. In addition, total subsidy includes insurance premium support, which specifically encourages crop insurance growth.

Differences in research methodology may explain why, unlike Enjolras and Sentis (2011), Sherrick *et al.* (2004) and Zubor-Nemes *et al.* (2018), no significant effect of farm size on insurance demand was detected. The first study applied logistic regression, the second used multinomial logit model and the third applied Probit models. The present study investigated the reciprocal effects and the relationship between the three dependent variables may eliminate the direct impact of farm size on insurance demand. Similarly, Baráth *et al.* (2017) applied a system of simultaneous equations and found that the effect of farm size is not significant for TFP specification, only for the PM specification.

The absence of any significant impact of education, in contrast to the finding of Sherrick *et al.* (2004) and Finger and Lehmann (2012), may also be caused by differences in research methodology. The effect of education on insurance demand can be eliminated by using a system of simultaneous equations.

Technical efficiency

Technical efficiency is determined by manager age and training, farm size, concentration, intensity and subsidies. Farm size positively affects technical efficiency, in line with the findings of Bojnec and Fertő (2013) and Latruffe *et al.* (2004). More educated farmers are more efficient, as shown by Dessale (2019). This implies that these farmers are willing to apply new technology to increase technical efficiency. Concentration positively affects technical efficiency, as shown by Bojnec and Latruffe (2009), suggesting that farmers who can focus their management efforts are more efficient than farmers with more diversified cropping structures.

Intensity also increases technical efficiency. Kemény *et al*. (2019) modelled the effects of climate change on the yield of winter wheat and maize for the period 2020-2100 and showed that, in the case of maize, the application of the correct amount of nitrogen can reduce yield loss caused by climate change. The negative role of subsidies, as also shown by Bojnec and Latruffe (2009) and Zhu and Lansink

(2010), suggests that subsidies can reduce farmers' effort and therefore decrease technical efficiency.

The negative impact of farmers' age on technical efficiency, in contrast to the findings of Nowak *et al.* (2016) and Dessale (2019), suggests that younger Hungarian farmers may adapt much more easily to new technologies, such as digital technologies, than their older counterparts.

Investment

Investment is affected by investment history, investment subsidies and concentration but not by age of manager, training of manager, farm size or intensity. The positive role of investment history is in line with the findings of Lefebvre *et al.* (2014) and confirms that investment history is a good proxy for willingness to invest. Investment subsidies and total subsidies (excluding investment subsidies) also increase investment, as shown by Fertő *et al.* (2017) and Fogarasi *et al.* (2014). It may be that credit market imperfections and the resulting liquidity constraints have an impact on investment decisions of farmers (Bakucs *et al.*, 2009). According to Fogarasi *et al.* (2014), credit market imperfections are slightly compensated by investment support with facilitating the financing of agricultural activity. In addition, they argue that direct payments can also increase investment activity. Concentration has a negative effect on investment. One reason could be that growing fewer types of crops might require less equipment with lower maintenance costs.

The absence of any significant impact of farmer age and education on investment, in contrast to the findings of Niavis *et al.* (2020), suggests that younger and older farmers invest similarly in Hungary. Similarly, the finding that agricultural education does not have a significant effect on investment among Hungarian farmers is not consistent with the findings of Wieliczko *et al.* (2019) in Poland. The current research investigates only the impact of agricultural training and could be extended to include non-agricultural education to get a deeper understanding of the impact of education.

Differences in research methodology may also explain why, unlike Lefebvre *et al.* (2014) and Niavis *et al.* (2020), this study detected no effect of farm size on investment. The former treated the investment variable as a dummy variable and the latter investigated the number of investments. The present study used net investment per hectare, and it follows that investments of equal value appear to be smaller for larger farms, which may obscure differences by size.

One reason why intensity has no significant effect on investment may be that the quantitative changes of fertiliser or pesticide use do not influence significantly the equipment needed if the farmers already use these chemicals. In future work, it would be useful to investigate the partial effect of the changes on each input separately to see that the aggregation of these inputs is the causes the insignificant result.

Interrelationships between the three factors

Crop insurance usage impacts positively on technical efficiency. Crop insurance provides a safety net – consequently, the producer also receives income in the case of natural damage. This safety might also contribute to developing the technology and improving technical efficiency. Another explanation might be that crop insurance has a premium cost which can put pressure on the farmer to improve their technical efficiency to generate additional income to compensate. As regards the positive and significant impact of technical efficiency on insurance usage, Baráth *et al.* (2017) obtained similar results when investigating the effect of economic performance (measured by farm profit margin and TFP) on insurance demand. This result suggests that managers of farms with higher technical efficiency also consider carefully other aspects of production. They are more likely to subscribe to crop insurance to control risk than managers of farms with lower technical efficiency.

Insurance take-up affects investment positively. The reason may be that the safety net provided by the insurance provides an opportunity for further development. Investment also encourages insurance demand. Lefebvre *et al.* (2014) similarly found a positive relationship between farmers intentions to invest and other good farm management practices, such as having agricultural insurance. However, some producers use credit to finance investment and insurance subscription is a precondition of contracting credits from financial institutions.

Although investments are a basic way to increase efficiency (Pawłowski *et al.*, 2021), the present study, which investigates the simultaneous effects of insurance take-up, technical efficiency and investment, does not reveal any significant interaction between technical efficiency and investment. It may be concluded that since investment has a long-term effect, the current year's investment improves the technical efficiency only in the following years. Similarly, the effect of technical efficiency on investment is not significant. This implies that the less efficient and more efficient farms equally willing to invest, especially with appropriate financial support.

Conclusions and recommendations

Climate change and extreme weather events are putting increasing pressure on agriculture in Hungary as elsewhere. The empirical results of this study show that encouraging insurance take-up by Hungarian crop specialised farms has a positive effect both on their technical efficiency and investment. Simultaneously, development of technical efficiency and investment increase insurance usage.

The model also reveals that significant differences in the insurance demand of farms have already occurred over time. With the introduction of two-scheme risk management system in 2012, insurance usage increased significantly. In 2016, the establishment of lower limit of premium support was even more stimulating. Since Hungarian crop insurance policy has evidently become more effective following revision on several occasions, there may be scope for its further development. Future policy interventions concerning insurance usage may, by taking account of the drivers of farmers' behaviour, potentially have additional positive impacts through spill-over effects on technical efficiency and investments.

Owing to the positive and significant impact of crop insurance take-up on investment, policy interventions focusing on insurance use might also pay attention to investment,

for example, differentiating insurance premium subsidies depending on whether there is an ongoing (or operating) investment that can be linked to weather-risk management.

In view of the different effects of managers' age on insurance take-up and technical efficiency, it may be that the usage of crop insurance should be more forcefully targeted at older farmers. This approach might have a 'knock on' effect on technical efficiency and serve to make farms managed by older farmers more resilient to weather-related impacts.

Since insurance history significantly increases insurance take-up, the insurance companies might focus on farmers who have not purchased crop insurance recently to expand the range of insured. Similarly, since investment history is closely related to current investment, policy concerning investment initiatives might be more forcefully targeted at the farmers who have not invested recently.

Subsidies have a significant role for all three variables. But it seems that in the context of crop insurance, technical efficiency and investment, the targeted financial support is more effective than total subsidies including direct payments. Total subsidies decrease technical efficiency. In contrast, targeted subsidies, i.e., premium support, encourage crop insurance demand and investment subsidies stimulate investment significantly. This finding can help decision makers to further develop agricultural support schemes, for example through the refinement of direct support schemes.

Further research is needed to investigate the dynamic relationship between insurance take-up, technical efficiency and farm investment. This study does not examine the possible lagged effect of dependent variables; only average historical values are considered as proxy variables for the willingness to insure and the willingness to invest. A deeper insight into the causality effects between these variables may be achieved by applying a dynamic panel model.

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An analysis of consumers' preferences for orange juice in India during COVID-19

Boosting the immune system's response through better nutrition has been suggested as a coping strategy to help fight COVID-19. Among other food products, orange juice, a rich source of Vitamin C, has been in huge demand in India since the outbreak of COVID-19. Panic buying has further added to this increased demand for orange juice. Using data collected through online surveys, this paper applies both conjoint and market simulation analysis to study consumers' preferences when purchasing orange juice. Nine important product attributes (flavour, preservatives, sweetener, brand, taste, pulp concentration, container, production method of orange and price) as well as different levels for each attribute are considered for the analysis. Among the selected attributes, relatively respondents gave more importance to the 'method of production' of orange, followed by 'brand', 'pulp concentration', 'sweeteners', and 'preservatives.' The market simulation analysis showed that a new product with the desired levels (high mean utility values) across the selected attributes would stand to enjoy a market share of around 32 percent. These findings support product differentiation as a strategy by firms in the food processing sector under conditions of intense competition.

Keywords: COVID-19, nutrition, orange juice, consumer preference, conjoint analysis, market simulation

JEL classifications: M21, M31, M37

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Introduction

Currently, the COVID-19 pandemic is a critical challenge across the globe. Prior to vaccines becoming available, the world has been in crisis due to the lack of a definitive medicine or a method to cure the disease. In this situation, one contentious recommended method has been to maintain a good nutritional status to fight against the virus. "Immune boosting" is also a trending topic correlated with the COVID-19 pandemic, appearing alongside numerous speculative cures, treatments, and preventative strategies. Also, there is no current evidence that any product or practice will provide enhanced "immune-boosting" protection against COVID-19. However, the public health experts continue to advise that the individual's immune system will need to adapt unaided to COVID-19 as it is the body's multi-level defence network against potentially harmful bacteria, viruses, and other organisms (Coelho-Ravagnani *et al*., 2021). Hence, this COVID-19 pandemic has indirectly turned the world's attention towards boosting the immune system as a defensive force against disease-causing bacteria, viruses, and other organisms (Ferrarezi *et al*., 2013).

The nutritional status of individuals has been suggested as a possible bulwark, capable of destabilising the COVID-19 pandemic. As many doctors have pointed out, vitamin C possesses antioxidants and other properties that protect the cells from substances that damage the body (Aman and Masood, 2020). A deficiency of vitamin C can lead to delayed wound healing, an inability to properly fight infections and an impaired immune response. Fortunately, orange juice and citrus juice contains more than enough of the recommended daily intake of vitamin C. Orange juice is the most consumed fruit juice world-wide and in India is no exception to this trend. It is obtained from the endocarp of the Mandarin orange (*Citrus reticulate*) fruit.

The mandarin orange is most common among citrus fruits grown in India. It occupies nearly 43 percent of the total area under citrus cultivation in India (2017-18). The area under orange cultivation in India has increased drastically from 0.12 million hectares in 1991-92 to 1 million hectares in 2017-18 and the production rose from 0.11 to 1.26 million tonnes (MA, 2018). Oranges are predominantly produced in the States of Andhra Pradesh, Maharashtra, Madhya Pradesh, Telangana, Tamil Nadu, and Punjab. Andhra Pradesh leads other states, accounting for 45 of India's orange cultivation and 61 percent of orange juice production (MA, 2018). Several varieties of oranges are cultivated in India to make orange juice. The orange juice contains substantial amounts of several micronutrients such as vitamin C, folate and polyphenols (e.g. hesperidin, which is a flavanone) and may contribute significantly to boosting the immune system.

With an increasing number of COVID-19 positive cases both in India in general and in Andhra Pradesh in particular, the demand for consumption of orange juice is on the rise. Currently, the unforeseen and significant increase in the demand for orange juice has exceeded the available supply in the Indian market. This spike in orange juice consumption can be attributed to consumers seeking out immunity-boosting food and drinks, like vitamin C-rich citrus, during the pandemic. Differences in social status, culture, environmental influences, purchasing power, motivation, and lifestyle give rise to different consumer behaviour in relation to orange juice consumption. These conditions simultaneously create opportunities for producers and processors to market a wide variety of orange juices with different attributes like flavour, brand, taste, pulp, and price, according to the needs and desires of consumers as well as the market segments targeted by traders. The consumption of orange juice has been the focus of increased public attention in times of COVID-19 due to its perceived capacity to boost the immune system.

Thus, it is vitally important to analyse consumers' preferences for different attributes and concentrations of orange juice, as well as to highlight how orange juice can be promoted in respect of the product attributes that matter most to consumers. Consequently, conjoint analysis and market simulation analysis have been employed in this study with a view to sustaining the marketability of new products.

Review of literature

Many studies have been conducted on consumer preference for food products; here, an attempt has been made to present a critical review of the literature relating to orange juice. Ferrarezi *et al.* (2013) analysed the impact of label information on the consumer intent to purchase ready-to-drink orange juice and nectar by applying conjoint analysis to data from Brazil. A convenience sample of 149 consumers and a factorial design featuring four characteristics, price, brand, information about the product and kind of beverage, were used. Three levels were established for brand and product information, and two for price and kind of beverage. Findings of the study revealed that low price, product information and the market leading brand had a positive impact on buying intentions. 'No preservatives/natural' was the information that most influenced consumer's purchase intent. The authors also suggested that these results could be useful for the strategic planning of consumer education and might also have important implications for Brazilian orange juice manufactures.

Sriratana and Limsombunchai (2010) analysed the factors influencing the pure orange juice purchasing decisions of consumers in the Bangkok Metropolitan area by employing both descriptive analysis techniques and conjoint analysis. Their survey, which was conducted among 400 sample consumers, revealed that being able to see a certificate of standard and quality assurance was the most important factor influencing the pure orange juice purchasing decisions of consumers, followed afterwards by nutrition and price factors, respectively. Types of oranges and packaging were found to be relatively insignificant factors by comparison.

Luckow and Delahunty (2004) analysed the consumer acceptance of orange juice containing functional ingredients, performing a descriptive sensory analysis on four functional orange juices and seven conventional orange juices. The survey conducted on 100 consumers revealed that they generally preferred the sensory characteristics of conventional juices. The study also revealed the existence of a small consumer segment (11%) that significantly preferred the sensory attributes of functional juices. Annunziata and Vecchio (2013) applied conjoint analysis to explore consumers' evaluation of four attributes of probiotic functional foods: base product (yoghurt, orange juice and biscuits), health claim (generic, psychological and prevention), price (high, regular and low) and brand (familiar and unfamiliar). Their analysis revealed that consumers considered the base product as the most important attribute in selecting a probiotic functional food, followed afterwards by the prevention claim. Further, customer groups differ significantly in their evaluation of the perceived healthiness of functional foods and in the importance that they attach to price and brand.

Windhita *et al.* (2017) analysed the quality attributes and factors that influence consumers' preferences for local oranges and imported oranges in Indonesia. Conjoint analysis revealed that the taste of local oranges is the most important attribute, followed by colour and size; meanwhile, for imported oranges colour and size are the major attributes. In terms of flavour, local oranges were considered superior to imported oranges. However, where colour and size attributes were concerned, imported oranges were viewed as being superior to local oranges. Consequently, the researchers concluded that consumers prefer local oranges to imported oranges on account of their flavour and taste.

Methodology

Food choice and consumption are complex phenomena, influenced by various psychological and sensory-categorical factors associated with marketing. The initial product evaluation and satisfaction after use are the factors that consumers generally consider when selecting a food product. The quality of the product, which can be considered to be an important factor in this context, can be perceived in various forms such as flavour, preservatives, sweeteners, taste and so on (intrinsic cues). When it is difficult to assess a product from its intrinsic cues, consumers often rely on extrinsic cues such as price, brand name, container, or method of production to infer the quality of the product indirectly (Sethuraman and Cole, 1999; DelVecchio, 2001). The qualities or attributes can contribute to a market-oriented approach in developing new products since it is a broad concept and is well recognised in terms of marketing and consumer behaviour (Ophuis and van Trijp, 1995).

Literature research and in-depth interviews with sector experts were carried out to determine the definitions of important orange juice attributes to be included in this study. Research attributes and attribute levels were limited based on the information obtained and accordingly, nine attributes and 27 levels (3 levels/attribute) were identified to study their effects on the purchase of orange juice for conjoint measurement (Table 1). Conjoint analysis has been widely used to assess the consumer's preference for and purchase intention towards various food products (see e.g. Asioli *et al*., 2014; Ferrarezi *et al*., 2013; Mann *et al*., 2012; Ares *et al*., 2008; Haddad *et al*., 2007; Helgesen *et al*., 1998; Gil and Sanchez, 1997). It is a multivariate technique that models the purchase decision-making process by analysing consumer trade-offs among hypothetical multi-attribute products. Thus, in a conjoint analysis, a product can be described as a combination of a set of attribute levels, where a utility is estimated for each level to quantify the value that an individual gives it. The utility values contributed by each attribute level determine purchasers' total utility or overall judgment of a product (Green and Srinivasan, 1978). Consequently, in this study, the conjoint analysis was deemed appropriate to measure the consumers' preferences of orange juice. This research was intended to describe and analyse the consumers' socio-economic profile, consumers' preferences for the combination of desirable orange juice attributes as well as to provide a market simulation analysis for introducing a new product

with the desired levels of attributes based on the higher average utility values. A discrete conjoint model was selected for this study, and no assumptions were made regarding the relationships between attributes and product scores.

The research was conducted in East Godavari, West Godavari, Chittoor, Guntur and Ananthapuramu districts of Andhra Pradesh purposively as the number of COVID-19 cases had begun to increase alarmingly in these districts since March 2020. The sample required to collect the requisite data was drawn in accordance with the formula proposed by Yamane (1967):

$$n = \frac{Z^2 P(1-P)}{e^2} = \frac{(1.96)^2 0.5(1-0.5)}{0.05^2} = 384.16 \quad (1)$$

Accordingly, 500 sample respondents (100 respondents from each district) were selected through the convenience sampling method (in view of COVID-19 pandemic) for getting the requisite data. The respondents visiting 'more' supermarkets in each district to purchase orange juice (on the dates of data collection) were interviewed with the help of a pre-tested schedule. The selected respondents were the end consumers who decided to buy orange juice. They were found in a condition of preferring to buy orange juice to boost their immunity against COVID-19.

The primary data considered in this study were collected from sample respondents through online questionnaires. The first online questionnaire was employed to identify the attributes and attribute levels desired by respondents. The next questionnaire involved choosing a combination of attributes from the popular attributes (Table 1) selected in the first questionnaire. Therefore, by employing the orthogonal procedure, 20 combinations (profiles) of attributes and levels were obtained. This methodology was followed because although a full factorial design (3^9= 19683 profiles) in conjoint analysis would provide all the effects that can be obtained from the parameters corresponding to the main effects, such a huge amount of information might overload the interviewee or cause them to lose interest, adversely affecting the quality of their answers.

Table 1: Attributes and levels used in conjoint analysis.

Attributes	Levels
Flavour	• Similar to fresh orange • Stronger than fresh orange • Weaker than fresh orange
Preservatives	• Sodium Benzoate (SB) or Potassium Sorbate (PS), or Citric Acid (CA) in 500 PPM • SB or PS or CA in 750 PPM • SB or PS or CA in 1000 PPM
Sweeteners	• Low calories, Natural sweetener • No calories, Artificial sweetener • High calories, Sugar/Honey
Brand	• B Natural • Patanjali • Tropicana
Taste	• More sour than sweet • More sweet than sour • Balanced sweet and sour
Pulp	• More pulp • Medium pulp • No pulp
Container	• Plastic Bottle with screw cap • Plastic Pouch with screw cap • Paper Pouch with Straw
Method of Production of Orange	• Fully Organic • Conventional use of PPC • Reduced use of PPC
Price (Rs/litre)	• >100 • 75-100 • <75

Source: Own composition

For this reason, researchers often use fractional factorial designs that are less than full factorial designs (Wehmeyer and Lankenau, 2005). To help obtain reliable data, two basic principles of orthogonality and equilibrium have been applied. By employing the orthogonal design, participants' fatigue can be reduced to a minimum; thereby, 19683 combinations are reduced to 20. The rule of thumb is the minimum number of choice sets should be equal to [(1 + Total number of attribute levels) – Number of attributes] = [(1 + 27) – 9] = 19. With the orthogonal design, the number of combinations of attributes and attribute levels is simplified to 20 (Appendix 1) to make it easier for the consumers to describe their orange juice preferences. The resultant combinations were again offered back to the respondents by means of the second online questionnaire, whose purpose was to measure the likelihood of buying orange juice. The respondent's task was to assess product attributes on a twenty-point scale, where 1 is "would definitely not purchase" and 20 is "would definitely purchase". Consumer appraisal (intention to buy) represents the dependent variable and attribute levels represent independent variables in conjoint analysis.

Utility is a conceptual basis for measuring value in a conjoint analysis, which is an assessment of subjective preferences that are unique for each respondent. The conjoint analysis's main output is a series of utility values for each level of the attributes considered above. Each attribute that enjoys higher utility value will have a higher preference and a higher chance of being selected and *vice versa*. The predicted preference for each level of selected attributes of orange juice would be obtained from the merging of these utilities across the respondents. This is given by:

$$Y = X_1 + X_2 + X_3 + \ldots\ldots\ldots + X_n + Constant \quad (2)$$

where the independent variables on the RHS are the attributes of orange juice. These independent variables are non-metric (ranked) data for different profiles of the orange juice, considering different levels across the selected attributes. While the dependent variable, Y is the overall or total utility preference of the respondent to different levels across different attributes. This dependent variable also includes consumer ratings of the importance of levels across the attributes of a product. Thus, in this study,

$$\begin{aligned}\text{Total utility} = {} & \text{Utility } X_1 \text{ (attribute level 1 to } i) + \\ & + \text{Utility } X_2 \text{ (attribute level 2 to } i) + \\ & + \text{Utility } X_3 \text{ (attribute level 3 to } i) + \\ & + \text{Utility } X_4 \text{ (attribute level 4 to } i) + \\ & + \text{Utility } X_5 \text{ (attribute level 5 to } i) + \\ & + \text{Utility } X_6 \text{ (attribute level 6 to } i) + \\ & + \text{Utility } X_7 \text{ (attribute level 7 to } i) +\end{aligned}$$

$$+ \text{Utility } X_8 \text{ (attribute level 8 to } i) +$$
$$+ \text{Utility } X_9 \text{ (attribute level 9 to } i) + \textit{Constant}$$

where, Y = total utility, X_1 to X_9 = Predicted utility values of (nine) selected attributes and *Constant* = the constant value in the analysis. The mean utility values across all the selected profiles serve as the analysis summary. They are used to derive the importance and relative importance of an attribute. Attribute importance is the difference between the highest and lowest utility levels of the attribute. The relative importance of an attribute is essentially its share of importance. If the distance between the utility levels of an attribute is large (i.e. the difference between highest and lowest utility levels of the attribute), then that attribute will have a larger bearing on the respondents' choice of product than another attribute, where the distance is not as large. The distance, therefore, reflects the importance of the attribute in determining consumer preferences.

As this study aims at concerning the consumers' preferences for different levels across selected attributes of orange juice consumption in selected districts of Andhra Pradesh, it will provide a clear picture for designing an effective marketing strategy for this product in tune with the consumers' preferences. The knowledge about various attributes' relative importance can help analyse marketing simulation (and even advertising decisions). Thus, a market simulation analysis is also carried out to make it possible for firms to direct attention and resources for improving the product towards the attributes and desired attribute levels that are of greatest importance to target consumers.

Results

Table 2 summarises the respondents' demographic profile. Out of the total sample, 65 percent are male, and the remaining 35 percent are female. Around 38 percent of the participants are of ages 21 – 35 years, 26 percent are of ages 36 – 50 and about 20 percent are aged over 50 years. Most of the participants are educated to at least graduate level (85%), and only four percent of the selected respondents are illiterate. Around 54 percent of the respondents are engaged in the service industry, and they enjoy a monthly income in excess of Rs. 25000 (appr. $330). It seems that the tendency to consume orange juice remained biased towards this higher income group. A further classification was also made in to consider the effect of residential locality on orange juice consumption. It was noticed that almost three quarters of the sample respondents (74%) were urban consumers. Thus, in contrast to consumers from rural areas, urban consumers were well represented in this study.

Table 2: Socio-economic profile of orange juice preferring selected respondents (n = 500).

Consumer's Features	Frequency	%
Gender:		
Male	325	65
Female	175	35
Age:		
Under 20	83	16.6
21–35	192	38.4
36–50	128	25.6
>50	97	19.4
Educational Background:		
Illiterate	21	4.2
High School	52	10.4
Graduate	352	70.4
Post-graduate	75	15
Monthly income (Rs):		
<10,000	73	14.6
10,001 to 25000	206	31.2
25001 to 50,000	142	38.4
>50,000	79	15.8
Place of living:		
Rural	128	25.6
Urban	372	74.4

Source: Own composition

Table 3: Utility value of each attribute level (consumers in general).

Attributes	Levels	Mean Utilities	SE
Flavour	Similar to Fresh Orange	0.061**	0.025
	Stronger than fresh orange	0.024	0.100
	Weaker than fresh orange	-0.085*	0.101
Preservatives	SB or PS or CA in 1000 PPM	-0.147*	0.101
	SB or PS or CA in 500 PPM	0.064	0.092
	SB or PS or CA in 750 PPM	0.083**	0.094
Sweeteners	High calories, Sugar/ Honey	-0.137*	0.086
	Low calories, Natural sweetener	0.125**	0.095
	No calories, Artificial sweetener	0.012	0.103
Brand	B Natural	-0.162*	0.098
	Patanjali	0.172**	0.089
	Tropicana	-0.01	0.097
Taste	Balanced sweet and sour	0.094**	0.095
	More sour than sweet	-0.097*	0.098
	More sweet than sour	0.003	0.095
Pulp	Medium pulp	0.147**	0.100
	More Pulp	0.032	0.100
	No pulp	-0.179*	0.101
Container	Plastic bottle with screw cap	-0.024*	0.105
	Plastic pouch with screw cap	-0.02	0.092
	Paper pouch with straw	0.044**	0.099
Method of Production of Orange	Conventional use of PPC	-0.007	0.091
	Fully Organic	0.184**	0.088
	Reduced use of PPC	-0.177*	0.100
Price (Rs/litre)	<75	0.017	0.105
	>100	-0.052*	0.095
	75-100	0.035**	0.108
Constant		10.508	0.025

** The highest utility values represent more value from the consumer's perspective.
* The lowest utility values represent less value from the consumer's perspective.
Source: Own composition

Where utility estimates are concerned, the greatest positive value from the consumer's preferences indicates the most preferred attribute level by the consumer, whereas the smallest negative value indicates the least favourable attribute level by the consumer. Meanwhile, the total value of utility with the largest positive value shows the most preferred combination of attributes.

From Table 3 and Figure 1 shows that in general, the most preferred attribute level is 'fully organic' (0.184) from the 'method of production of orange' attribute, and the least favoured level is 'no pulp' (-0.179) which is in the 'pulp' attribute. The 'fully organic' level concerning the 'method of production' of orange attribute recorded the highest (positive) utility value whereas by contrast, the remaining two levels 'conventional use of PPC' and 'reduced use of PPC' recorded negative utility values of -0.007 and -0.177, respectively.

For 'brand', the consumers preferred 'Patanjali' (0.172), while the least popular one is 'B Natural' with a utility value of -0.162. The consumers preferred the Patanjali brand because of the strong perception that the product is 'organic' (close to the nature); that is, 'pesticides/chemical-free' and 'without adulteration'. Further, in view of the ongoing slowdown of the Indian economy amid the COVID-19 crisis, consumers now prefer Swadeshi products as they wish to revive it. This company has limited advertising expenses (only through regional newspapers, some digital advertising, etc.) and consequently, offer a quality product at lower prices. The firm is also offering this product through its website where the customers can order it and can take advantage of free delivery if the order value exceeds Rs. 499 (around $7). Interestingly, other companies that also sell orange juice online do not offer such discounts.

For the 'pulp' attribute, the 'medium pulp' level is preferred to 'no pulp' by the consumers with the highest utility value of 0.147. For the attribute, 'sweeteners', the consumers preferred 'low calories, natural sweetener' with the highest utility value of 0.125 against 'high calories, sugar/honey'. Reasons for this include increasing concerns surrounding health and nutrition, enhance palatability, high stability in food and a significant expansion in sucralose availability in India since 2002 (Allison and Kristina, 2016).

For 'taste' and 'preservatives' attributes, the consumers preferred 'balanced sweet and sour (0.094)' and 'SB, PS and CA each in 750 PPM (0.083)' levels, respectively. The survey highlighted that the consumers blame carbohydrates, and specifically sugar, for weight gain. This is because (artificial) sugars continue to be the most cited cause of weight gain. Hence, they preferred natural sweeteners in the orange juice, but not at the expense of the great taste of 'balanced sugar and sour' in the orange juice, as taste is, and will remain, one of the biggest drivers of purchase intent. Nowadays, the preservation of fruit juice has become a business activity of great significance, especially in COVID-19. This is because the demand for orange juice is currently rising sharply and outstrips its supply, meaning that if producers wish to make the product available to the consumers even during the off-season without suffering from microbial spoilage during storage, the use of preservative chemicals is inevitable. However, though the consumers are largely uninformed about the selected preservatives' chemical properties, they prefer to have them in medium concentration in the orange juice.

Even among the different levels of flavour attribute, the consumers preferred 'similar to fresh orange' with the highest utility value of 0.061 compared to the other two levels, stronger than 'fresh orange' and 'weaker than fresh orange'. This implies that they prefer natural flavours and are against adding artificial (non-natural) ingredients in the orange juice. It is also interesting to observe that the consumers showed interest in paper pouch containers (with a utility value of 0.044) instead of plastic pouch containers for orange juice given environmental health and safety factors. Further, this paper pouch (aseptic package) provides excellent protection for the ready to serve fruit juices. They

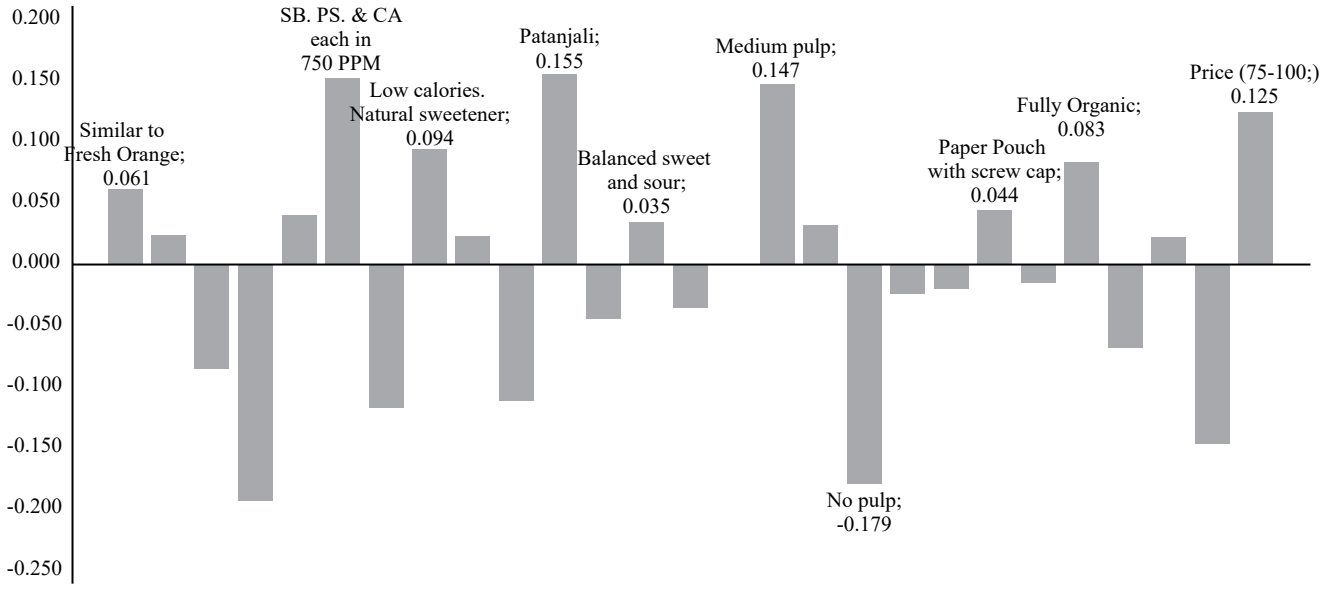

Figure 1: Mean utility values of each attribute level.
Source: Own composition

are made by combining thermoplastic with paperboard and aluminium foil. Their multi-layered construction enables the carton to protect the contents from various factors responsible for spoilage. The aluminium foil layer is a strong barrier for O2 and light. The inner plastic layer made of polyethylene makes it possible to seal through the liquid. The outer paper layer provides stiffness making it possible for the cartons in a brick shape, thus, enabling maximum utilisation of available storage and transportation space. Excellent graphics may also lead to good display and shelf appeal and may also permit the printing of technical ingredient details on the container.

It is important to note that because of inelastic demand for the orange juice during the post-COVID regime, the levels of the 'price' attribute recorded very low utility values. Though the 'price' of the product is a crucial topic in marketing literature, it seems that this attribute has limited importance in the orange juice purchasing decision, especially during the post-COVID regime, given the persistent increase in demand for this product market. Even the reputed online stores are displaying non-availability of orange juice on their respective websites due to a sharp increase in demand. Interestingly, from a marketing perspective, the orange juice with less fresh orange flavour, very high level (1000 PPM) of preservatives, higher doses of sweeteners (honey), plastic containers, the total absence of pulp, reduced use of PPCs in the method of production of the orange and higher market price are negatively perceived by the consumers. Thus, personal health benefits and the opportunity to purchase a brand (Swadeshi) that manufactures orange juice from organically produced oranges are given more weight and assigned higher utility values by consumers.

The above findings are quite different to the results of earlier studies conducted by Luckow and Delahunty (2004) and Anisa *et al.* (2017), as the current study indicates consumers' preferences for orange juice in the light of COVID-19 pandemic. It has been shown that, in the Indian context during the pandemic, consumers are exhibiting increased quality consciousness focusing first on the 'method of production of the produce' (organic production) followed afterwards by the 'Brand' producing the orange juice (close to the nature), and the presence of medium fruit pulp, with low calories and natural sweeteners. Consequently, the attributes relevant to the health consciousness of the consumers outweighed other attributes like flavour, preservatives, price, taste and shape of the container. However, the present findings are in tune with the study conducted by Ferrarezi *et al.* (2013), where the consumers (selected through Convenience sampling method) preferred 'natural' product of orange juice.

It therefore becomes apparent that the choice of attribute levels has a critical bearing on perceived attribute importance, and this highlights why both the highest and the lowest prevalent levels should preferably be included in the research design to get unbiased estimates of the importance of attributes. If the range of levels within an attribute is stretched beyond the market's prevailing levels, its importance will be inflated. Since it may not always be desirable or feasible to cover a realistic range of levels within attributes, the correct interpretation should be in terms of the relative importance of the selected attributes. The findings are shown in Table 4.

It was observed that for the average consumer, given the attribute properties tested in terms of relative importance, 'method of production' has the strongest influence with 19.91 per cent on the decision-making, followed by brand, pulp, sweeteners, taste, preservatives, flavour, container, and price. This shows that consumers are aware of the benefits of organic food that contribute to better health through reduced pesticide residues and increased nutritional quality. Accordingly, the consumers considered 'Brand' as the next important attribute for the firm that market orange juice manufactured from organically produced oranges. The other attributes like pulp, sweetener, preservatives, taste, flavour, price, and container are followed in the order of preference. Contrary to the expectations, 'price' was accorded less priority in choosing the product, as the respondents' health consciousness outweighed the expenditure incurred on it implying that there is inelastic demand for the product in the market in view of the COVID-19 pandemic. This knowledge concerning the relative importance among various attributes as perceived by the consumers can assist the firms in planning marketing and advertising decisions of the product. Consequently, other factors being equal, one would devote greater attention and resources to improving a product in respect of attributes that are of greatest importance to target consumers.

Product developers are always faced with trade-offs. For instance, using lesser sugar and honey in the orange juice would result in a decline in its price. Whether this could increase demand for the product in the market could be gauged by examining the trade-offs that consumers are willing to make.

Figure 2 illustrates trade-off analysis across the two attributes, pulp, and sweeteners. Assume the firm that currently produces orange juice with medium pulp and sweeteners comprising high calories, sugar/honey is considering switching to medium pulp with low calories, natural sweeteners, or going for more pulp with no calories, artificial sweeteners. The utility improves by + 0.262 (= 0.272 – 0.01) if the firm maintains medium pulp but switches to low calories and natural sweeteners. Likewise, the utility improves by + 0.034 (= 0.044 – 0.01) if the firm uses more pulp along

Table 4: Relative Importance among selected attributes.

Source	Importance	Relative Importance (%)
Flavour	0.15	8.05
Preservatives	0.23	12.69
Sweeteners	0.26	14.45
Brand	0.33	18.42
Taste	0.19	10.54
Pulp	0.33	17.98
Container	0.07	3.75
Method of production of orange	0.36	19.91
Price	0.09	4.80

Source: Own composition

with no calories and artificial sweeteners in the orange juice. Comparing these, the firm can deduce that an average consumer will prefer the increase in natural sweeteners in the orange juice over the increase in pulp quantity.

Similarly, assume the firm currently produces orange juice with medium pulp and sweeteners comprising high calories, sugar/honey is considering whether to retain with medium pulp, but with no calories, artificial sweeteners, or going for more pulp with low calories, natural sweeteners. The utility improves by + 0.149 (= 0.159 – 0.01) if the firm maintains medium pulp but with no calories, artificial sweeteners. Likewise, the utility improves by + 0.147 (= 0.157 – 0.01) if the firm uses more pulp with low calories, natural sweeteners in the orange juice. Comparing these, the firm can deduce that an average consumer will prefer the increase in artificial sweeteners in the medium pulp orange juice over the increase in pulp quantity and use of low calories, natural sweeteners. Thus, the firm can apply the trade-off analysis to make important product design and marketing decisions to boost the product's demand.

In analysing the issue further, the main advantage of conjoint analysis is that it allows one to simulate a market even if the consumers have not tested the product(s). In this case, the market for orange juice concerning different profiles is analysed. This helps one to compare the market shares associated with the new (desired) product (named Product 4 with all desired levels across selected attributes, as concluded in Appendix 1) with the existing products in the market. Thus, on running the market simulation model (Appendix 2), the new Product 4 enjoys the highest market share of around 32 percent compared to other products. This result seems satisfactory to launch this Product 4 in the market with the levels preferred across the respondents' attributes. The firms are even further interested in eliciting the consumers' preferences for another new Product 5 with different intrinsic cues (taste, pulp, preservatives, sweeteners) and extrinsic cues (method of production of orange, price, and brand). Regarding Simulation 2, the market share of new Product 5 to be introduced into the market with changed intrinsic and extrinsic cues enjoy a lower share (27.50) than Product 4 (32.00) of Simulation 1. Consequently, it would be better to include the attributes and attribute levels of orange juice as desired by the consumers (i.e. Product 4).

Conclusions

With the onset of the COVID-19 pandemic, there is increasing awareness among the public to consume orange juice to boost their immune against the COVID-19 pandemic. This study investigated consumers' preferences relating to orange juice purchasing decisions (through employing conjoint analysis) and further provided a simulation of the market for a new product to be released with the attributes and attribute levels desired by them. The findings revealed that the 'method of production of orange' is the most important attribute followed by the 'brand' being available in the market, and the presence of medium fruit pulp, with low calories and natural sweeteners. It is interesting that the priority where the brand is concerned is methods of producing the orange juice that are close to the nature (using natural sweeteners in the final product). This result could be perceived as an expected one because, consumers have become more health conscious in the light of COVID-19 pandemic.

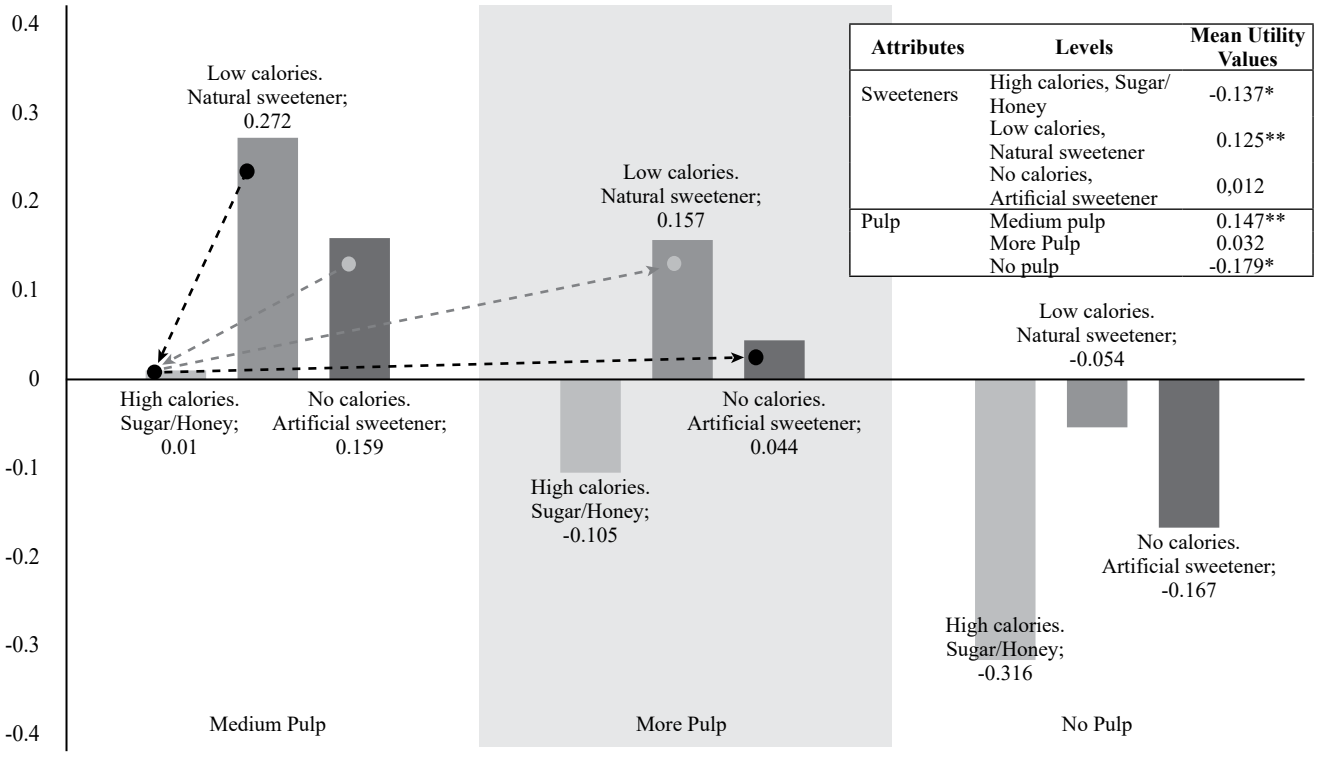

Figure 2: Trade-off analysis across the levels of Pulp and Sweeteners Attributes of orange juice.
Source: Own composition

However, and contrary to expectations, the product's 'price' was assigned lesser importance by the consumers, as there is inelastic demand for orange juice in the market. In contrast to earlier studies, attributes pertaining to health consciousness (like method of production of orange, a 'brand' producing orange juice using methods that are close to the nature, medium fruit pulp, with low calories and natural sweeteners) outweighed other attributes like flavour, preservatives, price, taste, and shape of the container in the light of COVID-19 pandemic.

Market simulation analysis revealed that the proposed new product (Product 4) with the desired attributes and attribute levels perceived by the respondents might expect to enjoy a market share of around 32 percent, and this is encouraging for the firms to launch such a product into the market. These results could also be useful for strategic planning of consumer instruction and have important implications for orange juice manufactures in the study area (Ferrarezi *et al*., 2013). However, this research suffers from few limitations, such as the limited number of product attributes and attribute levels, while the survey respondents were selected through convenience sampling method and were also frequently contacted through emails and mobile phones (to cross-check the data supplemented by them) because of the COVID-19 pandemic. Furthermore, the effects of demographic factors were not analysed with respect to demand and orange juice attributes. Hence, there is scope for further research that takes into account more attributes and attribute levels and is applied to a wider geography.

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Appendix

Appendix 1: Profiles used to evaluate the buying preferences of orange juice.

Profile	Flavour	Preservatives	Sweeteners	Brand	Taste	Pulp	Container	Mehod of Production	Price (Rs/litre)
Profile 1	Weaker than fresh orange	SB or PS or CA in 1000 PPM	No calories, Artificial sweetener	B Natural	More sour than sweet	More Pulp	Paper Pouch with Straw	Reduced use of PPC	>100
Profile 2	Stronger than fresh orange	SB or PS or CA in 500 PPM	Low calories, Natural sweetener	B Natural	More sweet than sour	Medium pulp	Paper Pouch with Straw	Conventional use of PPC	75-100
Profile 3	Similar to Fresh Orange	SB or PS or CA in 500 PPM	High calories, Sugar/Honey	Patanjali	Balanced sweet and sour	Medium pulp	Paper Pouch with Straw	Conventional use of PPC	>100
Profile 4	Similar to Fresh Orange	SB or PS or CA in 500 PPM	No calories, Artificial sweetener	Patanjali	More sour than sweet	More Pulp	Plastic bottle with screw cap	Conventional use of PPC	75-100
Profile 5	Stronger than fresh orange	SB or PS or CA in 1000 PPM	Low calories, Natural sweetener	Patanjali	Balanced sweet and sour	No pulp	Plastic bottle with screw cap	Reduced use of PPC	>100
Profile 6	Weaker than fresh orange	SB or PS or CA in 500 PPM	High calories, Sugar/Honey	B Natural	More sour than sweet	Medium pulp	Plastic Pouch with screw cap	Fully Organic	<75
Profile 7	Stronger than fresh orange	SB or PS or CA in 500 PPM	No calories, Artificial sweetener	B Natural	More sweet than sour	No pulp	Plastic bottle with screw cap	Reduced use of PPC	<75
Profile 8	Stronger than fresh orange	SB or PS or CA in 750 PPM	High calories, Sugar/Honey	Tropicana	More sweet than sour	More Pulp	Plastic Pouch with screw cap	Conventional use of PPC	>100
Profile 9	Weaker than fresh orange	SB or PS or CA in 750 PPM	High calories, Sugar/Honey	Patanjali	More sweet than sour	More Pulp	Plastic bottle with screw cap	Reduced use of PPC	75-100
Profile 10	Stronger than fresh orange	SB or PS or CA in 1000 PPM	No calories, Artificial sweetener	Patanjali	More sour than sweet	Medium pulp	Plastic Pouch with screw cap	Fully Organic	75-100
Profile 11	Weaker than fresh orange	SB or PS or CA in 1000 PPM	No calories, Artificial sweetener	Tropicana	More sweet than sour	Medium pulp	Plastic bottle with screw cap	Conventional use of PPC	<75
Profile 12	Similar to Fresh Orange	SB or PS or CA in 1000 PPM	Low calories, Natural sweetener	B Natural	Balanced sweet and sour	More Pulp	Plastic Pouch with screw cap	Conventional use of PPC	<75
Profile 13	Stronger than fresh orange	SB or PS or CA in 750 PPM	High calories, Sugar/Honey	B Natural	More sour than sweet	No pulp	Plastic bottle with screw cap	Conventional use of PPC	75-100
Profile 14	Stronger than fresh orange	SB or PS or CA in 750 PPM	Low calories, Natural sweetener	Tropicana	More sour than sweet	No pulp	Paper Pouch with Straw	Reduced use of PPC	<75
Profile 15	Similar to Fresh Orange	SB or PS or CA in 1000 PPM	High calories, Sugar/Honey	Tropicana	More sweet than sour	No pulp	Paper Pouch with Straw	Fully Organic	75-100
Profile 16	Weaker than fresh orange	SB or PS or CA in 500 PPM	Low calories, Natural sweetener	Patanjali	More sour than sweet	No pulp	Plastic Pouch with screw cap	Conventional use of PPC	>100
Profile 17	Similar to Fresh Orange	SB or PS or CA in 750 PPM	No calories, Artificial sweetener	B Natural	Balanced sweet and sour	Medium pulp	Plastic Pouch with screw cap	Reduced use of PPC	75-100
Profile 18	Weaker than fresh orange	SB or PS or CA in 500 PPM	No calories, Artificial sweetener	Tropicana	Balanced sweet and sour	More Pulp	Plastic bottle with screw cap	Fully Organic	75-100
Profile 19	Weaker than fresh orange	SB or PS or CA in 750 PPM	No calories, Artificial sweetener	Patanjali	Balanced sweet and sour	No pulp	Paper Pouch with Straw	Fully Organic	<75
Profile 20	Similar to Fresh Orange	SB or PS or CA in 750 PPM	Low calories, Natural sweetener	B Natural	More sweet than sour	Medium pulp	Plastic bottle with screw cap	Fully Organic	>100

Source: Own composition.

Appendix 2: Simulation of market and shares of products.

Product ID	Flavour	Preservatives	Sweeteners	Brand	Taste	Pulp	Container	Method of Production of orange	Price (Rs/lit)	Market Share (%) (Simulation 1)	Market Share (%) (Simulation 2)
Product 1	Similar to Fresh Orange	SB, PS, & CA each in 500 PPM	Low calories, Natural sweetener	B Natural	Balanced sweet and sour	More Pulp	Plastic bottle with screw cap	Fully Organic	>100	29.00 (0.29)	26.50 (0.265)
Product 2	Stronger than fresh orange	SB, PS, & CA each in 750 PPM	No calories, Artificial sweetener	Patanjali	More sweet than sour	Medium pulp	Plastic Pouch with screw cap	Conventional use of PPC	75-100	25.00 (0.25)	24.00 (0.240)
Product 3	Weaker than fresh orange	SB, PS, & CA each in 1000 PPM	High calories, Sugar/ Honey	Tropicana	More sour than sweet	No pulp	Paper Pouch with Straw	Reduced use of PPC	<75	14.00 (0.14)	22.00 (0.220)
Product 4	Similar to Fresh Orange	SB, PS, & CA each in 500 PPM	Low calories, Natural sweetener	Patanjali	Balanced sweet and sour	Medium Pulp	Paper Pouch with Straw	Fully Organic	Rs.75-100/lit	32.00 (0.32)	--
Product 5	Similar to Fresh Orange	SB, PS, & CA each in 1000 PPM	High calories, Sugar/ Honey	Tropicana	More sweet than sour	More pulp	Paper Pouch with Straw	Reduced use of PPC	>100	--	27.50 (0.275)

Note: Figures in parentheses indicate utility values.
Source: Own composition

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The impact of non-farm activities on agricultural investment in Vietnam: the difference made by credit constraints levels

This paper examines the impacts of non-farm activities on farm inputs investment decisions across six regions in Vietnam using the Vietnam Household Living Standards Survey. Results suggest that although income from non-farm activities contributes to relaxing credit constraints among farmers, such alleviation does not necessarily allow farmers to increase their on-farm investments. We found that in the developed regions where farmers participate and earn more from non-farm activities, despite there being a low level of credit constraints, their investment in agriculture is still limited due to the labour constraints of the farm household. In contrast, in the less developed regions, where farmers have less access to non-farm income sources, they tend to invest their non-farm income in on-farm activities. The article contributes to the literature by showing that differences in credit constraints levels lead to variations in farm households' decisions on whether or not to direct non-farm income towards investment in agricultural production.

Keywords: non-farm activities, agricultural inputs investment, regions, credit/liquidity constraints, Vietnam.
JEL classification: Q14

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Introduction

Credit is a necessary and important factor in the agricultural production process in many poor countries. Credit access can considerably increase the financial ability of farm households for agricultural inputs and productive investments in both the short-run and long run (Lin *et al.*, 2019). Indeed, credit has been considered as one efficient way to improve agricultural productivity and reduce poverty. In developing countries, particularly in rural areas where the credit markets are imperfect, farmers cannot easily access credit sources. With constrained credit, rural households have difficulties in making agricultural inputs investment and consequently must limit their production and smoothing consumption (Oseni and Winters, 2009). Some empirical literature has found that in rural areas of developing countries, credit constraints have significant adverse effects on agricultural productivity (Guirkinger and Boucher, 2008; Dong *et al.*, 2012) and farm investment (Carter and Olinto, 2003).

One way farmers used to overcome the constraints and imperfections of the credit market is by diversifying their livelihoods into non-farm activities (Oseni and Winters, 2009). The literature indicated that the income source obtained from non-farm activities could help farm households for improving their household income (Ferreira and Lanjouw, 2001; Nnadi *et al.*, 2020; Kumar *et al.*, 2020), smoothing consumption (Seng, 2015; Mishra *et al.*, 2015; Abdurezak and Ahmed, 2020), and reducing poverty (Haggblade *et al.*, 2010; Hoang *et al.*, 2014; Bui and Hoang, 2020). Sometimes, farm income is not sufficient to supply a sufficient livelihood (Minot *et al.*, 2006), which can be a push factor driving rural households to seek opportunities for employment outside farm activities. In farming activity, farm households always face many risks or limited risk-bearing capacity, inducing household members to engage in non-farm activities to reduce risk and reduce consumption uncertainties (Reardon, 1997; Barrett *et al.*, 2001; Oseni and Winters, 2009). In addition, the non-farm income can be used in agricultural production when farmers do not have enough financial capacity to pay for farm inputs. Thus, participation in the non-farm market could help farm household to relax the liquidity constraints they face when credit is not available (Pfeiffer *et al.*, 2009).

Both the loss of family labour in the shift from farm activity to non-farm activities and access to non-farm income can influence agricultural production in direct and indirect ways. Besides the labour-lost effect, the earnings from non-farm employment can provide cash for farmers to make investments in agricultural production to enhance productivity. These investments could be for the short term such as the purchase of fertilisers, feed, herbicide, pesticide, and other inputs, or for the long term such as investments in machinery or irrigation or the adoption of new technologies (high yielding seed or improved seed) (Pfeiffer *et al.*, 2009).

There are numerous studies showing the relationship between non-farm activities and agricultural inputs investment/expenses in several developing countries. The findings reveal this effect can be positive, negative, or nil (equal to zero), depending on the context. The positive relationship between non-farm participation and the purchasing of productive agricultural assets has been explored in many countries, including Bulgaria, Nigeria, Mexico, Philippines, and Ghana (Hertz, 2009; Oseni and Winters, 2009; Pfeiffer *et al.*, 2009; Takahashi and Otsuka, 2009; Anríquez and Daidone, 2010). These studies all concluded that the income from non-farm activities could loosen the credit constraints for farm households who were now able to pay more for inputs in agricultural production. However, in Albania, Kenya and China, non-farm employment had been found to have a negative impact or no impact (Albania: Kilic *et al*., 2009; Kenya: Mathenge *et al*., 2015; China: Huang *et al*., 2009) on agricultural input expenditures. Ahituv and Kimhi (2002) analysed farm households' off-farm labour and farm capital investment decisions and found a strong negative associa-

tion between off-farm work and farm capital accumulation in Israel. In the case of Vietnam, Stampini and Davis (2009) found a positive relationship between non-agricultural labour activities and the use of inputs in farming production.

Based on the above studies, we wonder why there exists a difference in the empirical results of the impact of non-farm income on the farmers' investment decisions when the markets are imperfect in all studied countries? What is the factor affecting these different results? In the cases of Albania and China – where negative, or no effects were found – Davis *et al.* (2009) supposed that non-farm employment is considered clearly an alternative to the intensification of farming and makes farmers access to credit easier. In all cases, the articles posited that this was driven mainly by farm credit constraints (Davis *et al.,* 2009). Thus, our research question is how will the effect of non-farm activities on farm inputs investment decisions look like if the farmer's capacity to access credit sources or the level of credit constraints farm households are subject to is different?

In order to answer this research question, our paper attempts to examine the effect of non-farm activities on agricultural inputs investment among the regions in Vietnam. We suppose that each region has dissimilarities in agricultural production activities due to geographical characteristics. In addition, the opportunities to engage non-farm employment are considered dissimilarities among regions where the centre and developed regions have higher participation chances than the far and less developed regions. The territory of Vietnam is divided into six main regions, namely Red River Delta, Midland and Northern Mountainous, Northern and Coastal Central, Central Highland, South Eastern Area and Mekong River Delta. The income per capita also varies from region to region, out of which Red River Delta and South Eastern Area belong to high-income regions or developed regions, while the remainder are lower-income regions or less developed regions. The dissimilarity in opportunities to engage in the non-farm sector, or to put it another way, the dissimilarity in the capacity to access credit sources could bring different impact results in these two groups of regions. In addition, the influence of participation in non-farm employment on the decision to purchase or invest inputs into agricultural production depends on the context of the credit constraint of farm households. The level of restriction credit or the level of access to credit sources could be different among regions, especially between developed and less developed regions. Therefore, to examine the effect of non-farm activities on agricultural inputs investment/expenditure in the cases of the dissimilarity of capacity to access non-farm income sources, we focus on the analysis of this effect among regions in Vietnam. The article contributes to the literature by providing evidence on the difference in farm investment behaviour influenced by credit constraints level differences.

The remainder of this paper is organised as follows. Section 2 describes the background of rural non-farm activities in the different regions of Vietnam. Section 3 presents the material and method of the paper, including the data sources, the research methodology and descriptive statistics of variables used in this paper. In section 4 and 5, we present the estimation results and conclusion.

Conceptual framework

The relationship between farm and non-farm sectors in rural economy is shown in the household model of Singh *et al.* (1986) and Pfeiffer *et al.* (2009). If all markets are perfect and farm households are not constrained, a separable model is applicable because the production decisions that households make are independent of consumption and labour allocation decisions. In the presence of market imperfection, this household model is called non-separable because the household's decisions regarding production, consumption, and labour allocation are interacting with each other. The production decisions of households such as use of inputs, choice of activities, and desired production levels are affected by their characteristics as consumers or their socio-economic status (Oseni and Winters, 2009).

If the credit market is complete, farm households can borrow enough to meet their production needs, which means that they are not constrained. In this case, the production decisions of households can be made separately from their consumption decisions. However, in the presence of credit market imperfection, farm households cannot borrow to optimise production or alternatively, they are constrained by limited credit, thus the farm households make their production and consumption decisions jointly (Oseni and Winters, 2009). According to Pfeiffer *et al.* (2009), if credit is not available, a farm household's expenditures on inputs for agricultural production (including hired labour) cannot exceed its own exogenous income and savings plus income received from off-farm work. The liquidity constraint becomes linked to consumption decisions and the household's leisure time is linked to off-farm activities (Oseni and Winters, 2009). Thus, when facing credit constraints, households make decisions that can lessen their constraint, and their decisions in relation to agricultural production or purchasing inputs are related to the household's off-farm income.

To overcome the liquidity constraints, one possible way is to engage in non-farm activities to earn an alternative income. Singh *et al.* (1986) supposed that an increase in the off-farm income can influence the production and consumption of the household facing credit constraints. With the relaxation for credit-constrained, an important concern is how participation in non-farm activities affects farm households' investment in inputs of agricultural production. Oseni and Winters (2009) reasoned that participating in non-farm activities could increase the overall household's income, thereby making the decision easier to purchase agricultural inputs. According to Pfeiffer *et al.* (2009), if a household is constrained by limited liquidity or credit, the income from working outside of farming can be used to purchase inputs for agricultural production. The paper of Hertz (2009) also indicated that this is consistent with the presence of farm credit constraints that induce farmers to fund farm expenditures with non-farm income.

On the other hand, when family members engage in non-farm activities, this induces a shift of family labour from on-farm activity to non-farm activities, thus potentially reducing family labour in agricultural production. The increase in non-farm income creates an incentive to substitute some of

the cheap inputs for family labour (Pfeiffer *et al.*, 2009). The analysis in the conceptual framework of Pfeiffer *et al.* (2009) concluded that a credit-constrained household could send family members to participate in non-farm activities, and in turn, these income sources could help farmers not only purchase agricultural inputs but also hire labour to compensate for the family labour lost.

The decision to purchase or invest farm inputs depends on the context of household and the asset position of the household including natural capital, human capital, social capital, and financial capital (Ellis, 2000; Oseni and Winters, 2009). Mathenge *et al.* (2014) developed a theoretical model for inputs purchased by farms, which is dependent on factors such as household characteristics or human capital, non-farm income, as well as some factors related to the agro-ecological conditions for crop production and market conditions. Thus, to examine the relationship between agricultural inputs, investment, and non-farm income, it is necessary to control these factors. According to Evans and Ngau (1991) and Oseni and Winters (2009), land or farm size represents natural capital, and it is hypothesised that farm households with a larger farm size tend to use more agricultural inputs for production. The human capital or household characteristics are the factors which affect the decision in purchased inputs including education level, age, household size and family labour (Oseni and Winters, 2009; Mathenge *et al.*, 2014). It is hypothesised that when a household possesses a higher level of schooling, this leads to increased expenditure on farm inputs. Social capital refers to one's membership of social networks that offer a household the opportunity to gain important benefits. Ellis (2000) has further indicated that aspects of one's social identity such as gender and ethnicity should be regarded as social capital. Financial capital refers the financial capacity or credit access ability of farm households. In this paper, non-farm income is considered to represent financial capital and it is the factor that we would like to focus on. Moreover, the non-farm income variable is an endogenous variable which correlates with the other independent variables in the model. Several studies have applied instrumental variables to address the endogeneity problem of non-farm income variables (Pfeiffer *et al.*, 2009; Oseni and Winters, 2009; Kilic *et al.*, 2009; Hertz, 2009).

Background of rural non-farm activities by regions in Vietnam

With the introduction of the reform policy or *Doi Moi* policy in 1986, the structural changes occurred not only within the agriculture sector but also in the entire rural economy of Vietnam. The rural non-farm sector was expanded and developed gradually following the opening of the economy. As a result, household businesses have become the most important source of job creation in the rural economy. Based on the calculation from data of Vietnam Household Living Standard Survey of 2012, Table 1 displays the farm income, non-farm income and non-farm participation rate of rural households by region. The share of non-farm income was relatively high (65.48%), while the non-farm participation rate of rural households was quite high (73.96%).

Among the regions, the earnings from non-farm activities are largest in the Red River Delta and South Eastern Area, at 67.06 million Vietnam Dongs (VND) and 76.40 million VND, respectively. Those two regions – where the two biggest cities (Hanoi and Ho Chi Minh) are located – are the most developed regions, and each has a high population. The opportunities to seek income from other activities outside farm production are high in these regions as compared to other regions far from the centre. The Central Highland, Midland and Northern Mountainous regions are located far from the major developed regions where the earnings from non-farm employment are quite small (only 28.29 million VND and 31.68 million VND, respectively). If we examine the share of non-farm income in total household income, the percentages for the Red River Delta region, Northern and Coastal Central region and South Eastern Area are the highest among the regions, at 79.67%, 69.75% and 67.21%, respectively. The main production activity in the Central Highland region is agricultural production; thus, farm income is the main income source of farm households here (61.15%). In the Midland and Northern Mountainous region and Mekong River Delta, non-farm income also plays an important role with its share extending beyond half of the total farm household's income. The participation rate in non-farm activities of the head or/and spouse household was found to be a little

Table 1: Farm income, non-farm income and non-farm participation rate of rural households in Vietnam by regions.

	RRD	MNM	NCC	CHL	SEA	MRD	Whole country
Farm income (million VND)	17.11	25.37	19.99	44.53	37.27	31.69	26.11
Non-farm income (million VND)	67.06	31.68	46.10	28.29	76.40	48.20	49.52
Total income (million VND)	84.17	57.05	66.09	72.82	113.67	79.89	75.63
Farm income share (%)	20.33	44.47	30.25	61.15	32.79	39.67	34.52
Non-farm income share (%)	79.67	55.53	69.75	38.85	67.21	60.33	65.48
Non-farm participation rate of head or/ and spouse (%)	80.51	63.77	71.57	74.17	86.07	74.47	73.96

Notes: RRD: Red River Delta, MNM: Midland and Northern Mountainous, NCC: Northern and Coastal Central, CHL: Central Highland, SEA: South Eastern Area, MRD: Mekong River Delta.
VND is Vietnam's currency (Vietnamese Dong).
Source: Vietnam Household Living Standards Survey (VHLSS), 2012

different between regions. Naturally, the two most developed regions (Red River Delta and South Eastern Area) have a high non-farm participation rate (80.51% and 86.07%), while this rate remains lower in other regions.

There are many ways to define non-farm income. Specifically, Reardon (1997) defined non-farm income as consisting of different types of activities such as non-farm wage, self-employment, and migration remittances. Oseni *et al*. (2009) indicated that non-farm income is the total income of three income sources: wage employment, self-employment, and transfers. On the other hand, Pfeiffer *et al*. (2009) identified off-farm income including non-agricultural wage work and remittances. Based on previous definitions and the Vietnam Household Living Standard Survey dataset, we define non-farm income as income earned from non-farm wages, self-employment income, and other income. In Vietnam rural households, earnings from wages is a major component of non-farm activities (Figure 1). In fact, it is the largest component of non-farm income in all households across the six regions. This is especially so in the South Eastern Area, where this non-farm wage income source accounts for 67.65% of total non-farm income. For other regions, this income source constitutes over half of the total non-farm income of households. In addition, it can be seen that earnings from self-employment represent an important source of non-farm income for Vietnamese rural households.

Data and Methodology

Data sources

Our empirical analysis is based on a data set from the Vietnam Household Living Standards Survey (VHLSS). This survey of the household living standard was conducted by the General Statistics Office of Vietnam and collaborated with the World Bank within the framework of Living Standard Measurement Surveys (LSMS). This survey provides detailed data on socio-demographic characteristics, employment, production, income sources, assets, and other information from a representative sample of urban and rural households in Vietnam. However, this article only focuses on the rural farm households that participate in all agricultural, forestry and aquaculture activities. We aggregate the three primary sectors (agriculture, forestry, and aquaculture) and not only on a specific sector to investigate the relationship between non-farm activities and production inputs cost. The commune survey of the VHLSS is also used in this paper for instrumental variables (IVs) to deal with the endogenous variable. This survey investigated the socio-economic characteristics of the communes to facilitate the choice of IVs. However, some communes have missing values or were not investigated, a situation which has led us to reduce the number of observations. Finally, the number of households in our analysis is 4,823.

Methodology

The purpose of our empirical analysis is to investigate the difference in the impact of non-farm activities on agricultural input investment in the short run among regions. Here we focus on all three primary activities – agriculture, forestry, and aquaculture – of farm households. Thus, we aggregate the cost of all inputs of farm production for all agriculture, forestry, and aquaculture activities.

The value of input expenses/investment can sometimes be equal to zero because some farm households use self-supplied inputs, do not use some of inputs in production such as herbicide, pesticide, or/and do not hire machines and labour. Hence, some observations take a value equal to zero with a positive probability, but the dependent variable is a continuous random variable with strictly positive values (Wooldridge, 2013). To deal with zeros in dependent variables, we

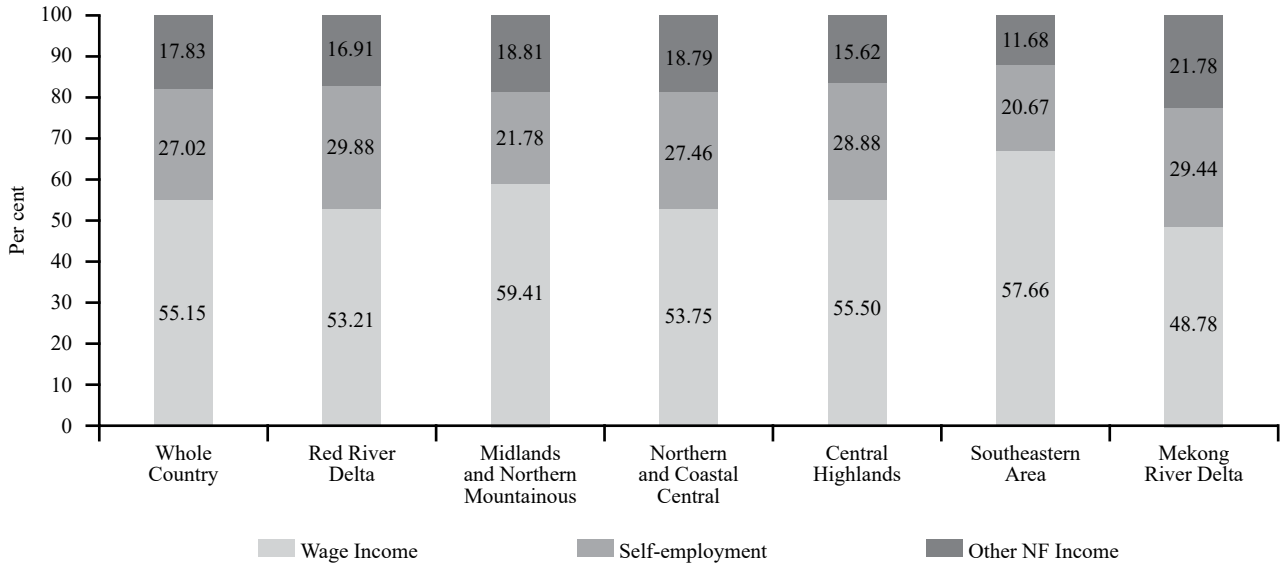

Figure 1: Source of non-farm income by region.
Source: Own composition based on VHLSS (2012)

applied the Tobit model for a corner solution response. The structural equation of the Tobit model is presented as follows:

$$y_i^* = \beta X_i + \varepsilon_i, \quad (1)$$

where, $\varepsilon_i \sim N(0, \sigma^2)$, and y^* is a latent variable that is observed for values greater than zero. The observed y_i is defined as:

$$y_i \begin{cases} y^* if\ y^* > 0, \\ 0\ if\ y^* \leq 0. \end{cases}$$

Based on the conceptual framework, the decision to purchase/invest agricultural inputs depends on a set of other factors such as human capital, natural capital, social capital, financial capital, etc. (Ellis, 2000; Oseni and Winters, 2009; Mathenge *et al.*, 2014). According to Kilic *et al.* (2009), the impact of non-farm income on agricultural expenditure/input costs can be estimated by comparing non-farm income-recipient households with nonrecipient ones through the inclusion of a set of observable characteristics at the household and community level. The empirical previous studies applied the regression model in both ordinary least squares (OLS) and the instrumental variables (IV) methods to analyse the relationship between non-farm activities and agricultural input cost with the using the explanatory variables including household and community characteristics (Oseni and Winters, 2009; Kilic *et al.*, 2009; Pfeiffer *et al.*, 2009; Stampini and Davis, 2009). Thus, our paper also applies such a model to investigate the relationship between non-farm activities and the cost of agricultural inputs. The regression equation is calculated as follows:

$$Input\_exp = \beta_0 + \beta_1 NF_i + \beta_2 Z_i + \varepsilon_i, \quad (2)$$

where $Input\_exp_i$ represents the agricultural input cost of the i^{th} farm household. Specifically, the dependent variable used in this paper is the total inputs cost in all farm activities including agriculture (cultivation and livestock), forestry and aquaculture. In addition, our paper examined this relationship in terms of individual categories inputs, to analyse more deeply the different impacts, region by region. Consequently, other agricultural input dependent variables were also used, including seed and breed cost, fertiliser and feed cost, herbicide-pesticide-medicine cost, hired machinery cost and hired labour costs.

NF_i is the non-farm income variable. The coefficient β_1 indicates the marginal effect of the non-farm income variable. If negative, it would suppose that participation in non-farm activities reduces the expenditure on agricultural inputs. If positive, it indicates that the non-farm income could help farmers to overcome credit constraints by facilitating spending in agricultural production. Z_i is a vector of variables that comprises the socio-economic characteristics of the i^{th} farm household. The socio-economic characteristics variables include the household head's gender, age, education, the household size, ethnicity, the number of male and female workers in the household, and size of farmland. The dummy variable of household head's gender takes a value equal to one if the head of the household is male. The education level of the household head denoted by the number of completed years of schooling. The household size variable indicates the total number of members of the household. The ethnicity variable is a dummy variable that equals one if the household head is of *Kinh* ethnicity, the dominant racial identity of Vietnamese people, and zero for other minority ethnicities. ε_i is the error term.

The participation in non-farm activities is not exogenously determined in our model specification. The possible endogeneity of non-farm participation could influence agricultural input expenditure, thus leading to inconsistent estimation results. The endogeneity problem implies that non-farm variables (NF_i) correlated with the error term (ε_i). To treat this problem, we apply the instrumental variables (IV) approach. The IV framework tries to identify variables that are uncorrelated with ε_i but correlated with non-farm income variables and have no direct effect on agricultural input expenses. In other words, each instrument needs to satisfy two conditions, namely, instrumental relevance and instrumental exogeneity. This enables consistent estimation. A single endogenous regression equation estimates the relation between the instruments and non-farm income, as follows:

$$NF_i = \lambda_0 + \lambda_1 Z_i + \lambda_2 I_i + \mu_i, \quad (3)$$

where NF_i is a latent variable. In this empirical analysis, we treat the non-farm explanatory variable as non-farm income because the Tobit model is applied in the initial model. This is a nonlinear regression model; thus the explanatory endogenous variable must be a continuous variable. The non-farm income is the total earnings from non-farm jobs of all members of a household in million VND. Therefore, we use linear regression in the first stage model. The F-test of the joint significance of instrumental variables is applied in the first stage regression that indicates the instruments are weak or not. The F-test result must be greater than 10, so that we can conclude the instrument are strong instrumental variables and correlated with the non-farm variables. Z_i has been previously defined, I_i is a vector of instruments, and μ_i is the error term. Finally, the IV-Tobit is applied in our paper to determine the corner solution for the dependent variables and treat the endogenous regressor.

We identified three instruments that must satisfy the two conditions mentioned above. The first instrument, factory/manufacture location, is a dummy variable that takes a value equal to one if communes have a factory or manufactory or traditional occupation village located nearby, and zero otherwise. The proximity of a factory or traditional occupation village to the commune facilitates the participation of households in non-farm employment. The second instrument, Time_Town, is the time distance from the commune to the nearest town by private or public transportation. The last instrument, Time_City, is the time distance from the commune to the nearest city or provincial capital. These variables could explain the potential household's opportunities for participation in non-farm employment, which depends on whether they live near a town or city and the convenience of the travel time. The relevant data were obtained from the

commune survey of dataset, conducted on 2,218 communes. However, several surveys reported incomplete answers, which led to a significant reduction in the sample size of both communes and households.

Finally, the above discussion provides the main model analysed in the paper. Additionally, our purpose is to explore the difference in the role of non-farm activities on agricultural production between regions, thus, we estimate this relationship by the IV Tobit model in each region. To conduct this paper, we use STATA software to analyse the dataset and estimate the models.

Descriptive statistics

Table 2 displays the descriptive statistics of variables used of farm households in the country as a whole and by region. It provides a general overview of household socio-economic characteristics, the inputs cost in agricultural production, land, and instrumental variables in this analysis. To examine the impact of non-farm activities on farm investment, in particular the input costs of agricultural production, we use some of specific input cost variables including seed and breed, fertiliser and feed, pesticide-herbicide-medicine cost, hired machinery and hired labour.

The average total input cost is calculated from the total cost of seed and breed, fertiliser and feed, pesticide-herbicide-medicine cost, hired machinery, hired labour, energy, small tools, and other costs. This input cost of farm households in Vietnam is 26.81 million VND. The South Eastern Area and Mekong River Delta are two regions that have the highest expenditure for agricultural inputs, at 43.72 and 42.49 million VND, respectively. The cost of fertiliser and feed is the most important input in production process of farm household which constitutes around a half of the total cost of inputs. The average farmland held by households is about 0.86 hectares. However, in the Red River Delta, households have on average only 0.27 hectares of land for agricultural production, the smallest acreage in comparison

Table 2: Descriptive statistics of variables used by region.

Variables	RRD	MNM	NCC	CHL	SEA	MRD	Whole country
Dependent variables (agricultural inputs variables)							
Total input cost (million VND)	23.08	17.75	20.69	37.79	43.72	42.49	26.81
Seed and Breed cost (million VND)	4.23	4.15	3.74	2.40	4.62	6.98	4.47
Fertiliser and Feed cost (million VND)	13.59	10.54	9.33	21.93	24.56	17.89	13.77
Herbicide_Pesticide_Medicine cost (million VND)	0.96	0.60	0.73	2.03	2.69	5.01	1.71
Hired Machinery cost (million VND)	1.39	0.44	1.28	1.47	1.39	4.22	1.65
Hired Labour cost (million VND)	1.21	0.54	2.21	5.79	7.10	4.02	2.42
Household socio-economic characteristics variables							
Head's gender (male = 1, female = 0)	0.82	0.88	0.83	0.83	0.81	0.78	0.83
Head's age (year)	51.63	44.39	50.29	45.24	50.59	50.94	48.92
Head's education (Completed years of schooling)	8.26	6.13	7.27	5.84	6.05	5.24	6.68
Household size (Number of household members)	3.64	4.33	3.96	4.38	3.96	4.15	4.04
Ethnicity (*Kinh* ethnicity = 1, other minor ethnicities = 0)	0.98	0.31	0.87	0.53	0.89	0.92	0.74
Male labour (Number of male workers of households)	1.12	1.28	1.18	1.26	1.36	1.28	1.22
Female labour (Number of female workers of households)	1.42	1.46	1.38	1.35	1.37	1.50	1.43
Land							
Farmland (hectare)	0.27	1.16	0.74	1.45	1.50	0.89	0.86
Non-farm variable							
Non-farm income (million VND)	58.9	29.84	40.28	21.41	49.73	40.62	40.94
Instrumental variables							
Factory/manufacture location (The factory or manufactory or traditional occupation village is located near the commune. Yes = 1, no = 0.)	0.81	0.41	0.66	0.49	0.84	0.78	0.65
Time_Town (The time distance from the commune to the nearest town (minute))	18.10	50.50	27.87	33.97	27.50	28.86	31.79
Time_City (The time distance from the commune to the nearest city (minute))	50.46	128.11	87.40	102.56	80.37	68.99	86.58
Number of observations	1,058	1,159	1,145	364	229	868	4,823

[1] Source: VHLSS (2012).
[2] VND is Vietnam's currency (Vietnamese Dong).
[3] RRD: Red River Delta, MNM: Midland and Northern Mountainous, NCC: Northern and Coastal Central, CHL: Central Highland, SEA: South Eastern Area, MRD: Mekong River Delta.
[4] 1 million VND = 47.62 US$ in 2012 (calculated based on tradingeconomics.com).

to the remaining regions. Two regions have relatively large farmland per household, which are the Central Highland region and South Eastern Area, at 1.45 and 1.5 hectares, respectively.

The household socio-economic characteristics variables are included head of household's gender, age and education, household size, ethnicity, and number of male and female workers. The head of farm household in most cases is male in Vietnam: this was true for 83% of the total sample. The average age of the head household is about 49 years. The education level of the head household is 6.68 years on average - this education level is highest in the Red River Delta (8.26 years) and lowest in the Central Highland and Mekong River Delta regions (5.84 and 5.24 years, respectively). The statistics of ethnicity variable indicates the ratio of *Kinh* ethnicity to rule the sample – 74% of household heads are of *Kinh* ethnicity. The farm households in the Red River Delta and Mekong River Delta regions are almost exclusively of *Kinh* ethnicity, at 98% and 92%, respectively. However, this ratio is low in the Midland regions and Northern Mountainous Area, at only 31%.

The instrumental variables are used in the analysis to address the endogeneity problem introduced by the non-farm income variable. The results of the statistics of those variables by region also imply the difference in the opportunities as well as the convenience for engaging in non-farm jobs across developed regions and less developed regions. The factory/manufacture location variable indicates that a factory, manufacturing or traditional occupation village is located near the commune where household members can commute from daily. In the Red River Delta and South Eastern Area, the share of households that are located near the factory or place of manufacture are large (81% and 84%, respectively) compared to the total number of rural households that are found in these regions. However, these figures do not hold for the remaining regions - in Midland and Northern Mountainous and Central Highland, for instance, only 41% and 49% hold, respectively. The time distance from the commune to the nearest town and the nearest city are calculated by minute. From Table 2, we can see that the average time from the commune to the nearest town and the nearest city are the lowest in the Red River Delta region and South Eastern Area, while the travel time from communes to towns and cities of other areas is higher, especially in the Midland and Northern Mountainous and Central Highland regions.

Results and Discussion

The first stage regression on participation in non-farm activities is presented in Table 3. The estimation shows that the gender of the head household appears to be unrelated to non-farm income, while the age of head household had a positive correlation with non-farm income. The result for education indicates a positive relationship between education and non-farm income. This result also implies that education plays a role in determining levels of participation in rural non-farm activities. The significant and positive coefficient of the ethnicity variable shows that the major ethnicity (*Kinh* ethnicity) participated in non-farm activities more than the minorities. The results for male and female labour are similar, indicating that an increase in male or female labour induces greater non-farm earning. The farmland size is negative, which indicates that farm households with large amounts of land are less likely to participate in non-farm activities compared to those owning only small amounts as the family labour supply cannot meet the needs of a large amount of farmland.

The results of three instrumental variables (Time_Town, Time_City, and factory/manufactory location) are highly significant. As expected, the time distances from the commune to the nearest town and city have a negative impact on non-farm income. The location of a factory or place of manufacture near the commune is positively associated with non-farm income. The F-test demonstrates the relevance condition of all instruments. The result of this test is 27.63 (greater than 10) which indicates that these instruments are strong instrumental variables and satisfy the relevance condition.

The estimation results of the influence of non-farm activities on total agricultural inputs cost of the whole country are shown in Table 4. We apply both Two Stage Least Square (2SLS) and IV Tobit models for the whole sample, to compare the two models and test the validity of instruments. For the IV Tobit model, the parameter presented conditional on the censoring of the data. The parameters of independent variables of both 2SLS and IV Tobit are equivalent or not very different. The result of non-farm income variable indicates a positive relationship between non-farm activities and agricultural inputs cost. This finding of the paper is consistent with studies of Pfeiffer *et al.* (2009), Oseni and Winters

Table 3: First stage regression results.

	Non-farm income	
	Estimation	**S.E.**
Household characteristics		
Head's gender	-2.027	[1.72]
Head's age	0.166***	[0.05]
Education	2.298***	[0.18]
Household size	5.051***	[0.57]
Ethnicity	13.803***	[1.67]
Farmland	-5.956***	[0.52]
Male labour	10.113***	[0.90]
Female labour	6.396***	[1.14]
Instrumental variables		
Time_Town	-0.050**	[0.02]
Time_City	-0.031***	[0.01]
Factory/manufactory location	8.630***	[1.37]
Constant	-29.243***	[3.97]
Number of observations	4823	
R^2	0.238	
F-test for instruments	27.63	

Note: * P < 0.05, ** P < 0.01, and *** P < 0.001.
Values in parentheses indicate standard errors.
Source: Authors' estimation

(2009) and Hertz (2009) who indicated the role played by non-farm income in loosening credit constraints in agricultural production. However, this result contradicts the studies of Kilic *et al.* (2009), Mathenge *et al.* (2015), and Huang *et al.* (2009), showing that non-farm activities have a negative, or else no, effect on farm input expenditure.

The Wald test was applied on the Chi-squared of the instrumental variables performed on IV Tobit regressions. The null hypothesis is the absence of endogeneity in the estimation. The result of the Wald test is significant at the 1% level. This means that the null hypothesis is rejected, that is, non-farm income is an endogenous variable. Thus, our estimation based on IVs to treat the endogeneity problem is adequate.

The validity of instruments is performed in the 2SLS model. The value of weak identification test statistics is 27.63 (greater than 10). From this result, we consider the null hypothesis of weak identification is almost rejected and the relevance condition of instrumental variables is satisfied. The over-identification test Hansen J statistic is 1.713 with p-value 0.425. Thus, the joint null hypothesis that the instruments are valid is not rejected.

Table 4: Effect of non-farm activities on agricultural input costs in Vietnam.

Dependent variables: total inputs cost	**2SLS**	**IV Tobit**
Non-farm variables		
Non-farm income	0.668***	0.679***
	[0.15]	[0.15]
Household socio-economic characteristics variables		
Head's gender	3.537	3.563
	[2.82]	[2.84]
Head's age	-0.237**	-0.239**
	[0.10]	[0.10]
Education	-1.363***	-1.389***
	[0.46]	[0.46]
Household size	-1.268	-1.32
	[1.05]	[1.07]
Ethnicity	13.820***	13.598***
	[3.58]	[3.59]
Farmland	16.488***	16.561***
	[1.67]	[1.70]
Male labour	-2.809	-2.925
	[2.59]	[2.61]
Female labour	-1.884	-1.961
	[2.63]	[2.64]
Constant	4.085	4.463
	[7.17]	[7.27]
Number of observations	4,823	4,823
Wald test of exogeneity $\chi 2$		26.03***
Weak identification test	27.632	
Overidentification test (Hansen J statistic $\chi 2$)	1.713	
p-value	0.425	

Note: * P < 0.05, ** P < 0.01, and *** P < 0.001.
Values in parentheses indicate the robust standard errors clustered at the commune level.
Instrumental variables: Factory/manufacture location, Time_Town, Time_City.
Source: Author's estimation

The opportunity to participate in non-farm activities differs across the six regions because of geographical differences. The investment of inputs into agricultural production shows significant differences across regions. Given the marked difference across the country, it leads to questioning whether the relationship between farm and non-farm sectors is different across the six regions. Table 5 reports the results for the IV Tobit for each of the regions.

Results indicate that the effect of non-farm income on total agricultural inputs cost in the Midland and Northern Mountainous (MNM), Northern and Coastal Central (NCC) and Mekong River Delta (MRD) regions are significantly positive. These regions are comparatively less developed areas in the country; and the participation rates of head or spouse household in the non-farm works are lowest at 63.77% for MNM, 71.57% for NCC and 74.47% for MRD (Table 1) in comparison to the other regions. For the less developed regions in Vietnam, when the opportunity of participation in the non-farm sector is low, the farm households still depend on agricultural income, and they also face the credit constraints in production. Therefore, the non-farm income can help farm households to overcome the lack of credit and improve their household agricultural income through investment.

The results of the statistical analysis of dependent variables for the Red River Delta (RRD) and South Eastern Area (SEA) regions are not significant. This indicates that non-farm activities have no effect on the farm activities in both regions. They are the most developed regions in Vietnam with the two biggest cities, Hanoi City and Ho Chi Minh City. Thus, there exists a high level of opportunity for the farm labours to access the employment outside the farm. Although the average of non-farm income and non-farm participation rate of the two regions are highest in comparison with other regions (Table 1), but this relationship is not significant in these regions. Thus, for developed regions, the income sources from non-farm activities may be sufficient to guarantee for farm households' living and investing more in the farm activities for them does not seem to be a necessity.

Similarly, the estimation results of Central Highland are also not statistically significant. However, the non-farm activities of this region are the less developed region than the two areas RRD and SEA, and the agricultural production is the main activity. The average non-farm income of farm household is lowest (only 21.4 million VND) as compared to other regions, while the average of farm income is 51.6 million VND. Earnings from non-farm work make up a small proportion (29.6%) of the total household income. Therefore, the income from the agricultural production of farm households can be used for consumption purposes, as well as re-invested in agricultural production. Indeed, the non-farm sector has no effect on farm production in this region.

The coefficients for some of other variables differ across the six regions as well. The head's gender is positive and significant related to total inputs cost even when controlling for non-farm income in Midland and Northern

Table 5: The effect of non-farm activities on total agricultural inputs cost by region.

Dependent variables: total inputs cost (IV Tobit)	RRD	MNM	NCC	CHL	SEA	MRD
Non-farm variables						
Non-farm income	-0.031	0.391*	0.681**	0.956	0.892	1.221*
	[0.34]	[0.22]	[0.34]	[0.80]	[1.15]	[0.62]
Household socio-economic characteristics variables						
Head's gender	3.455	7.785***	7.766**	0.127	-16.756	7.252
	[6.14]	[2.59]	[3.17]	[8.41]	[25.63]	[7.18]
Head's age	-0.382**	-0.215**	-0.343***	-0.085	0.927	-0.216
	[0.16]	[0.09]	[0.13]	[0.17]	[1.24]	[0.22]
Education	0.987	-0.424	-0.496	-0.383	-3.247	-1.343
	[1.28]	[0.55]	[0.73]	[1.17]	[2.44]	[1.27]
Household size	0.18	-0.881	-2.455	-1.223	-12.191	5.338
	[3.15]	[0.90]	[2.43]	[2.88]	[13.23]	[3.37]
Ethnicity	27.913***	9.312	6.033	22.691**	25.942	-0.695
	[10.26]	[6.06]	[7.47]	[10.75]	[28.32]	[7.72]
Farmland	14.266	3.531***	7.620***	22.847***	24.499**	37.753***
	[12.05]	[1.12]	[1.93]	[5.80]	[11.58]	[5.23]
Male labour	5.231	1.582	-1.872	-3.404	4.08	-21.460**
	[6.85]	[2.61]	[4.62]	[5.08]	[18.50]	[8.81]
Female labour	13.161*	0.129	-3.847	0.612	-2.2	-15.959*
	[7.12]	[2.51]	[4.72]	[5.17]	[11.64]	[9.13]
Constant	-22.785	6.013	13.995	-13.146	-28.192	1.301
	[19.76]	[5.74]	[14.55]	[13.39]	[46.92]	[17.22]
Number of obs.	1,058	1,159	1,145	364	229	868

Note: * P < 0.05, ** P < 0.01, and *** P < 0.001.
RRD: Red River Delta, MNM: Midland and Northern Mountainous, NCC: Northern and Coastal Central, CHL: Central Highland, SEA: South Eastern Area, MRD: Mekong River Delta.
Values in parentheses indicate the robust standard errors clustered at the commune level.
Instrumental variables: Factory/manufacture location, Time_Town, Time_City.
Source: Authors' estimation

Mountainous Areas (MNM) and Northern and Coastal Central (NCC). This suggests that having a male head is significant for the agricultural inputs expenditure in these two regions. The coefficients of head age are negatively significant in the Red River Delta (RRD), Midland and Northern Mountainous Areas (MNM) and Northern and Coastal Central (NCC) regions. Younger heads tend to spend more on agricultural inputs compared to older households, indicating a generational difference in the investment on farming in these regions. The result of the ethnicity variable show that it has a positive significance in Red River Delta (RRD) and Central Highland (CHL) regions. This means that *Kinh* households tend to spend more agricultural inputs for production than the other minorities in these two regions. In the Red River Delta (RRD) region, female labour is important for agricultural inputs expenses, while male and female labour are not important for the investment in agricultural inputs in the Mekong River Delta (MRD) region. This indicates that having a higher number of male and female family workers reduces the inputs cost in these regions. The parameters of farmland are positively significant in all regions except Red River Delta, implying that agricultural expenses increase when the cultivated land size increases. The insignificant result of the Red River Delta region could be explained by the fact that average farmland of this region is too small compared to other regions (only 0.27 ha) and agricultural productivity largely relies on crop rotation. The other variables, such as education level and household size are not statistically significant.

Input costs can be analysed by individual categories as well. The purpose of such an analysis is to examine whether participation in non-farm activities is most likely to affect certain types of costs in agricultural production in different regions. A IV Tobit regression has been run, to deal with the zero dependent variables, and it has been conducted for each of the six regions separately. Results on the effect of participating non-farm activities on agricultural input costs categories following the regions are presented in Table 6. Of course, the results are statistically insignificant in all cases of input categories in the regions of Red River Delta, South Eastern Area and Central Highland. These estimation results are consistent with the analysis of the regions mentioned above, implying that participation in non-farm activities has no effect on the expenditures in agricultural production here.

Table 6: The effect of non-farm activities on agricultural input cost categories by region.

Dependent variables (IV-Tobit)	RRD	MNM	NCC	CHL	SEA	MRD
Seed and Breed cost	0.049	0.117**	-0.103	-0.057	-0.033	0.317*
	[0.11]	[0.05]	[0.13]	[0.15]	[0.48]	[0.18]
Fertiliser and Feed cost	0.297	0.244	0.386*	0.763	0.824	1.522*
	[0.30]	[0.17]	[0.20]	[0.65]	[1.18]	[0.78]
Herbicide-Pesticide-Medicine cost	0.006	0.015	0.118*	0.127	0.243	0.438
	[0.01]	[0.01]	[0.06]	[0.10]	[0.52]	[0.31]
Hired Machinery cost	-0.003	0.068**	0.289**	0.159	1.78	0.011
	[0.08]	[0.03]	[0.13]	[0.12]	[4.09]	[0.37]
Hired Labour cost	-0.049	0.057	0.916**	0.31	0.246	0.105*
	[0.17]	[0.04]	[0.44]	[1.82]	[0.42]	[0.06]
Number of observations	1,058	1,159	1,145	364	229	868

Note: * P < 0.05, ** P < 0.01, and *** P < 0.001.
RRD: Red River Delta, MNM: Midland and Northern Mountainous, NCC: Northern and Coastal Central, CHL: Central Highland, SEA: South Eastern Area, MRD: Mekong River Delta.
Values in parentheses indicate the robust standard errors clustered at the commune level.
Instrumental variables: Factory/manufacture location, Time_Town, Time_City.
Source: Authors' estimation

Results are positively and statistically significant in some cases in three regions: Midland and Northern Mountainous Areas, Northern and Coastal Central and Mekong River Delta. Specifically, in the Midland and Northern Mountainous Areas region, the coefficients of non-farm activities have positively significant in seed-breed expense and hired machinery cost models. This indicates that farm households use non-farm income to buy seed, breed and hire machinery for farm activity. However, in the Northern and Coastal Central region, the income source from non-farm activities seems to have a positive effect on many types of input costs in agricultural production. Farm households in this region tend to use non-farm income to invest in more fertiliser, feed, herbicide, pesticide, medicine and hired machinery for the production process as well as to hire labour possibly as a substitute for family labour lost through the non-farm market. In the Mekong River Delta region, the estimation results indicate that this income source contribute to an important role in purchasing seed, breed, fertiliser, feed, and hire labour for agricultural production. Consequently, the role of non-farm income in spending agricultural inputs is different region by region. Due to the difference in geographical location, land type, weather conditions and types of agriculture between regions, the tendency to use inputs in agricultural production is also not alike.

Our findings are consistent with the findings from previous studies of Oseni and Winters (2009) and De Brauw (2010) who found the difference in the relationship between non-farm activities and agricultural inputs expenses among regions. However, the paper of Oseni and Winters (2009) only pointed out the difference in the results but did not explain the reason. De Brauw (2010) also studied the relationship between migration and agricultural production in Vietnam and indicated the regional differences between the north and the south. The author explained that the effects of migration on input demand in rice production differs between the north and south due to the difference in the production process of the two regions. Our paper not only indicates that the difference in this relationship across six regions is due to the geographical characteristics of each region but is also based on the theoretical framework of the agricultural household model (Singh *et al.*, 1986), when the markets are imperfect and farm households always face credit constraints. The income from the non-farm activities can provide cash which may be used to purchase inputs or otherwise invest in agricultural production and can also be sued to hire labour to replace the farm labour lost. However, when farm households increase their participation in jobs outside of farm production activities, there is less household labour available for on-farm work. This family labour lost due to the shifting labour from farm to non-farm activities cannot be fully substituted by hired labour because of the imperfection of the labour market. Thus, in turn, this could limit the demand for credit to invest in agricultural production (Key, 2020). Indeed, the regions/households that have high non-farm income/ participation appear to be less credit-constrained, and as a result, non-farm income has no effect on investment in agricultural inputs in the developed regions. However, if farmers engage in non-farm activities at such a level that they can guarantee their family labour for farm activity and use non-farm income to hire labour to compensate for the loss of family labour, non-farm income has a positive effect in loosening credit constraints for them. Therefore, in the case of less developed regions, despite having a relatively lower chance of joining in non-farm activities, farmers who had this income source generally used it to purchase agricultural inputs.

Conclusions

In the context of incomplete credit markets, seeking an alternative income source could help farmers to overcome the credit constraint. The first contribution of the paper is

that it provides evidence and reinforces the theory that non-farm income can relax the liquidity constraint when credit is not available, or credit markets are imperfect.

This paper attempts to examine whether non-farm income could facilitate spending on agricultural inputs given differences in the level of credit constraints, by investigating the relationship among the different regions in Vietnam. Our paper found mixed results for the effect of non-farm income sources on the expenditure on agricultural inputs across the regions, which implies that the differences in investment behaviour are related to the difference in the level of credit constraints. It is observable that the ability or opportunity to access credit sources and the level of participation in non-farm activities of the farmers demonstrates the extent of credit constraints affecting their agricultural production. In the less developed regions, where farmers have less access to non-farm income sources and have more credit constraints, they tend to invest their non-farm income in on-farm activities. However, if farmers are significantly involved in non-farm work, as can be seen in developed regions, they could easily access credit sources and the demand for credit to invest in agricultural production will be limited due to constrained family labour. Therefore, this paper indicates that the difference in the level of credit constraints leads to variations in farm households' decision on whether to use non-farm income to invest further in agricultural production.

The findings of this paper also offer important policy implications that could help policymakers to introduce better policies for developing the Vietnamese rural economy and agricultural production. The policies should consider encouraging the development of the non-farm sector in the rural areas, with a particular focus on less developed regions which always face difficulties in respect of transportation, market access and trading activities. Those policies should support the construction of infrastructure, communication, market, and transport networks in rural areas to help diversify non-farm employment.

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Appendix

This is the result of Nguyen *et al.* (2019) paper which included the regional dummy variables in the first-stage regression. The result from table A1 indicates that the regional variables are correlated to the non-farm income variable in comparison with the base region.

Table A1: First stage regression results.

	Non-farm income	
	Estimation	**S.E.**
Household characteristics		
Head's gender	-2.479	[1.57]
Head's age	0.149***	[0.05]
Education	2.075***	[0.18]
Household size	5.449***	[0.58]
Ethnicity	13.081***	[1.58]
Farm land	-5.407***	[0.49]
Male labor	9.974***	[1.07]
Female labor	5.812***	[1.22]
Regional dummy (base region = MNM)		
RRD	8.573***	[2.13]
NCC	-3.241*	[1.70]
CHL	-10.994***	[1.82]
SEA	9.108***	[3.39]
MRD	-2.796	[1.86]
Instrumental variables		
Time_Town	-0.057**	[0.02]
Time_City	-0.025**	[0.01]
Factory/manufactory location	7.787***	[1.26]
Constant	-27.043***	[4.33]
Number of observations	4,823	
R^2	0.25	
F-test for instruments	22.96***	

Note: * P < 0.05, ** P < 0.01, and *** P < 0.001
RRD: Red River Delta, MNM: Midland and Northern Mountainous, NCC: Northern and Central Coast, CHL: Central Highland, SEA: South Eastern Area, MRD: Mekong River Delta.
Values in parentheses indicate robust standard errors.
Source: Nguyen *et al*. (2019)

Short communication

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The COVID-19 pandemic and the EU agri-food sector: Member State impacts and recovery pathways

This paper investigates the effects of three different simulated post-COVID-19 recovery GDP growth rates during 2021-2023 (baseline, optimistic and pessimistic scenarios) for agricultural markets in four selected EU Member States (the Netherlands, Germany, Italy, and Hungary) compared to a pre-COVID-19 projection. Empirical results are derived from the AGMEMOD model. A self-sufficiency ratio is utilised to summarise the net effects on consumption and supply in the agricultural markets. The country level analysis confirms that the agriculture sector in the EU has been quite resilient during the pandemic. The simulated impacts of the different GDP shocks on the agri-food sector are limited, which also conforms to reality, but changes in consumer behaviour could lead to longer lasting impacts on specific sectors.

Keywords: COVID-19, agri-food sector, AGMEMOD model, GDP shocks
JEL classification: Q11, Q12, Q18

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Introduction

The COVID-19 pandemic has affected many aspects of what we understand as 'normality'. Looking back at 2020, the implementation of lockdowns and other restrictive measures became a worldwide strategy to curb the spread of the virus. These measures have heavily affected the hotel, restaurant, and catering (HORECA) sector, the activities of local retailers, the way in which we work and possibilities for travelling.

Since March 2020, various global economic outlooks have reported on the potential impact of the pandemic on GDP (World Bank, 2020; IMF, 2020; OECD, 2020a). Most of these focus on the consequences globally or for large world regions, lacking insights at country and sector levels[1], especially in the European Union (EU).

The course of 2020 revealed that the sectors most affected by the pandemic were those with a lower share of jobs demanding tertiary education (McKinsey, 2020). However, the agri-food industry was extremely resilient in responding to a challenging context characterised by the lack of (or extremely low) demand from the HORECA sector, the 'stockpiling' behaviour of consumers in the early days of the pandemic, the increase in e-commerce, initial labour shortages, and some disruptions in logistics (OECD, 2020b; WTO, 2020). Since the start of the pandemic, a variety of measures were implemented by the EU and at Member State level, with the aim of providing social safety nets and financial liquidity in agriculture and other sectors.

This paper aims at assessing how COVID-19 affected the agriculture and food sectors in selected EU Member States – the Netherlands, Germany, Italy, and Hungary – and exploring potential mid-term recovery pathways by using the AGMEMOD (Agricultural Member State Modelling) model. The recovery pathways are captured in a baseline and two extreme scenarios, based on differing economic prospects. The main drivers are the degree of success of the vaccination campaign, removals of lockdown measures, implementation of recovery packages, and the magnitude of permanent damages to productive capacity caused by the virus outbreak and containment measures. More specifically, an optimistic scenario assumes that the vaccination campaign delivers positive outcomes which permit the economy to return to pre-COVID rates of growth by 2023. In contrast, a pessimistic situation is also considered in which vaccination would happen at a slower path with successive waves of coronavirus pandemic delaying economic recovery. The baseline scenario is consistent with the expected economic developments for the period 2020-2022 as projected by the World Bank (World Bank, 2021) for the Euro Area, Bulgaria, Croatia, and Poland.

Methodology

For assessing the consequences of alternative COVID-19 recovery pathways for the agri-food sector, a simulation exercise using the AGMEMOD model[2] is carried out. AGMEMOD is a dynamic, partial, multi-country, multi-market equilibrium system which represents the main

[1] OECD (2020c) uses the AGLINK-COSIMO model to simulate two different scenarios which assume a single and a second wave for the spread of the virus respectively. The study indicates a progressive reduction of agricultural output in response to lower consumer demand; with livestock production expected to experience larger declines than cereal production.

[2] The AGMEMOD model (Agricultural Member State Modelling) documentation is available at: https://agmemod.eu/.

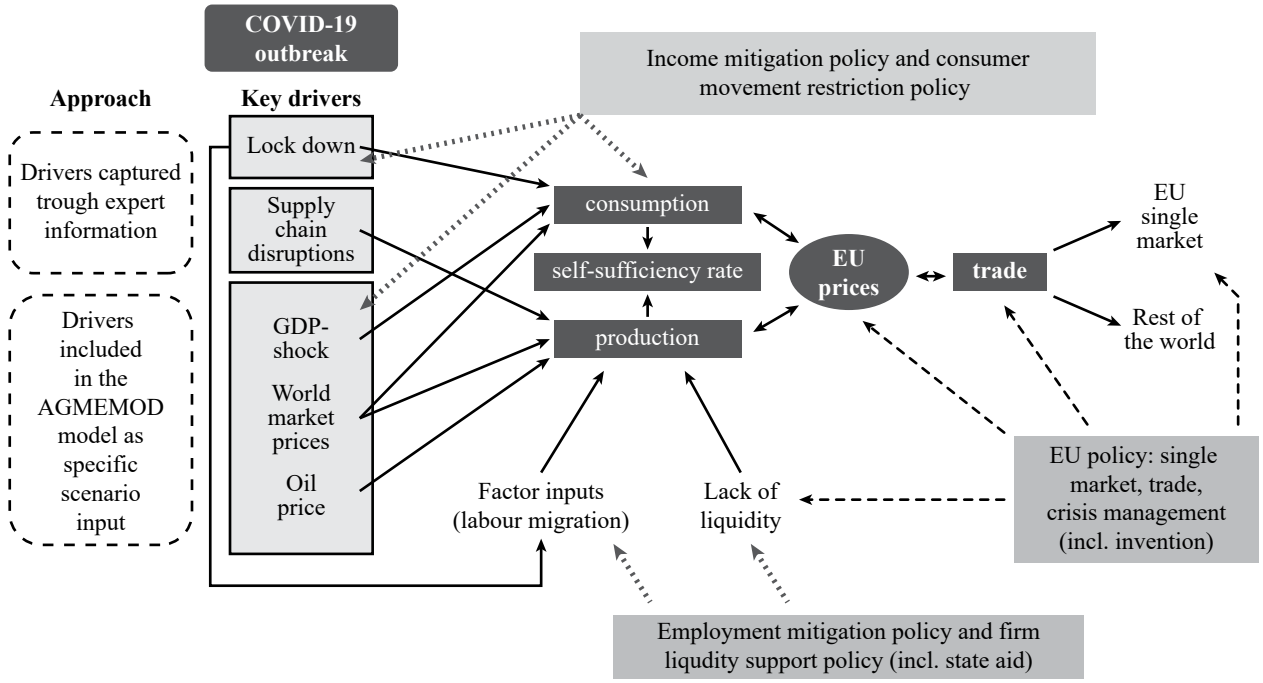

Figure 1: Analytical framework.
Source: Own composition

agricultural sectors in each EU Member State. The model incorporates behavioural responses of economic agents to changes in agricultural prices and policy instruments. How the pandemic has affected the agri-food sector, and how and the associated measures implemented by the EU and at Member State level were translated into assumptions about the rate of economic growth are summarised in Figure 1.

At the time of carrying out this assessment, the World Bank outlook (World Bank, 2021) was the most up-to-date. Since AGMEMOD is Member-State specific, information at country level is required for each scenario. Consequently, the economic prospects for the Euro Area as a whole need to be translated into country-specific projections. In doing so, the distribution projected by OECD (2020a) is applied to the aggregate World Bank figures. For countries which are not included in the OECD outlook, the projected rates of growth are taken from the World Economic Outlook October 2020 published by IMF. For the period 2023-2030, it is assumed that the economy will grow at the same 'speed', i.e. rate of growth, as could have been expected if the COVID-19 outbreak had never happened. For the selected Member States (the Netherlands, Italy, Germany, and Hungary) GDP assumptions were taken from national statistical sources for 2020 and 2021.

Of the three recovery pathways, the extreme optimistic and pessimistic scenarios are modelled for sensitivity purposes. The pessimistic scenario attempts to simulate the potential negative consequences of an unsuccessful vaccination campaign, the emergence of new variants of the coronavirus, negative economic sentiment, as well as important losses of productive capacity resulting from deterioration in the quality of education during this period and the shutdown of companies among other factors. All these could delay economic recovery with 'pre-COVID' GDP growth rates only reached by 2029. In this extreme scenario, the 2021 rates of growth are assumed to be half of those in the reference scenario. For 2022 and 2023, GDP growth rates are assumed to be 60% and 70% of the expected GDP rates for 2021 and 2023, respectively, in the baseline. For 2024, 80% of the average of the expected 2025 rate of growth in the baseline and the rate of growth in the previous year of the scenario are assumed. For the period 2026-2028, the rates of growth are calculated by applying the following percentages for the baseline rates of growth for the corresponding year: 80%, 85%, and 90% for 2026, 2027, and 2028, respectively.

The optimistic scenario assumes a successful vaccination campaign which leads to the containment of the virus in early 2022, accompanied by public measures which promote private sector investments and favour structural reforms supporting future economic growth. The GDP level that corresponds to this scenario is calculated as the average value of the projected GDP levels that were expected in March 2020 (2019 AGMEMOD baseline) and the current baseline. GDP developments that were assumed for each scenario are presented in Table 1 and Figure 2.

Other important scenario inputs are world market prices, oil prices, inflation, and exchange rates. The expected developments for exchange rates over the period 2020-2022 are taken from the OECD Economic Outlook (OECD, 2020a). Oil prices are updated to reflect the situation in March 2020. The developments for world market prices indicate a return to the pre-COVID level by 2025[3]. No differences in inflation rates among the scenarios are assumed. This is so since the optimistic and the pessimistic scenarios are simulated with the aim of examining the sensitivity of the results to changes in GDP.

[3] Available at: https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/farming/documents/agricultural-outlook-2020-report_en.pdf.

Table 1: GDP developments for EU27, average rate of growth (%).

Scenario	2020	2021	2022	2023
Pre-COVID	2.35	1.85	1.98	2.04
Baseline	-6.85	3.76	3.91	2.04
Optimistic	-6.85	7.88	2.91	2.04
Pessimistic	-6.85	1.88	2.26	1.43

Source: Own compilation based on OECD (2020a), World Bank (2021) and others

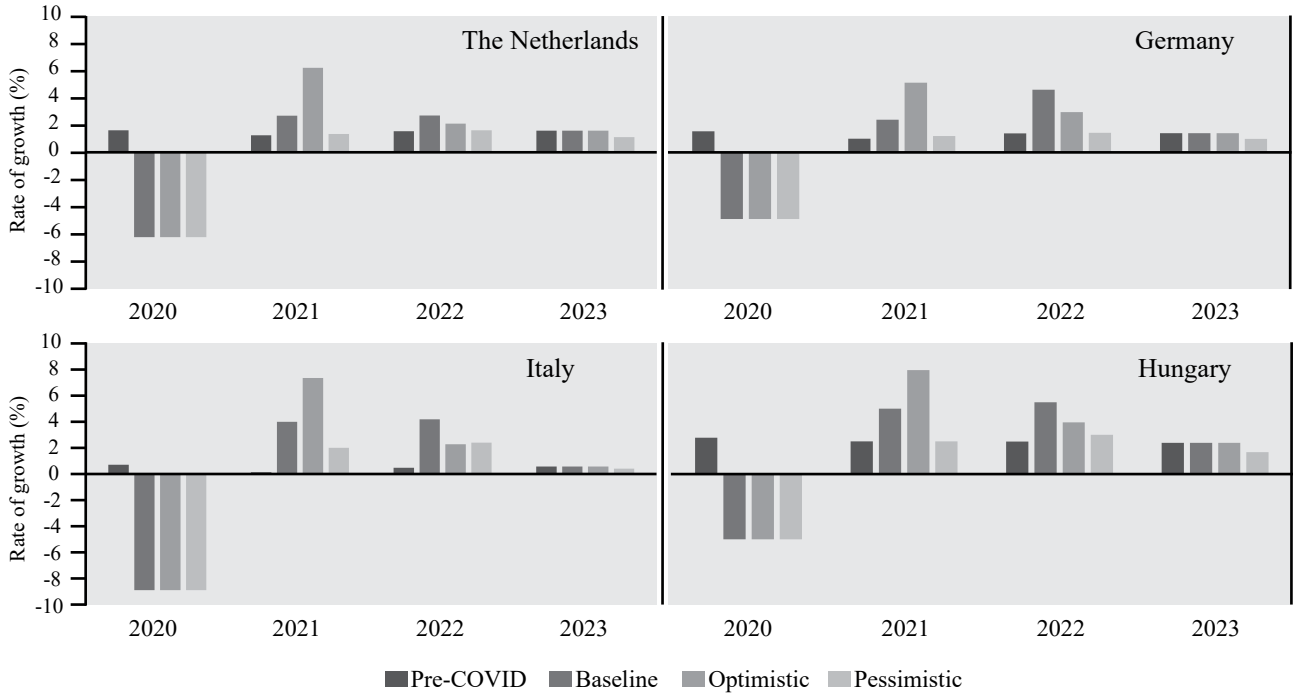

Figure 2: GDP developments for selected MS, rate of growth (%).
Source: Own compilation based on OECD (2020a), World Bank (2021) and others

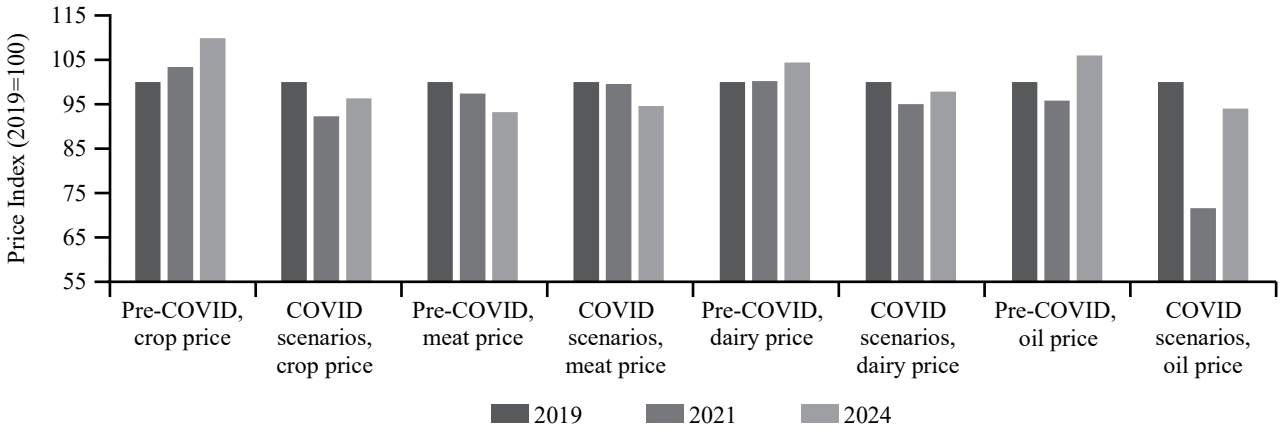

Figure 3: World Market Prices.
Source: Own compilation based on OECD (2020a) and others

Figure 3 provides a comparison of the assumptions made regarding the prospects for world market prices of broad agricultural commodity groups. These price assumptions take into consideration exchange rate impacts, among which some depreciation of the euro in relation to the dollar, confirmed in early 2021, is particularly noteworthy.

Results

At the time of conducting this assessment, Dutch GDP was expected to decline by 6.2% in 2020. The impact of the COVID-19 crisis on the Dutch agri-food sector has turned out to be smaller than expected during the earlier days of the

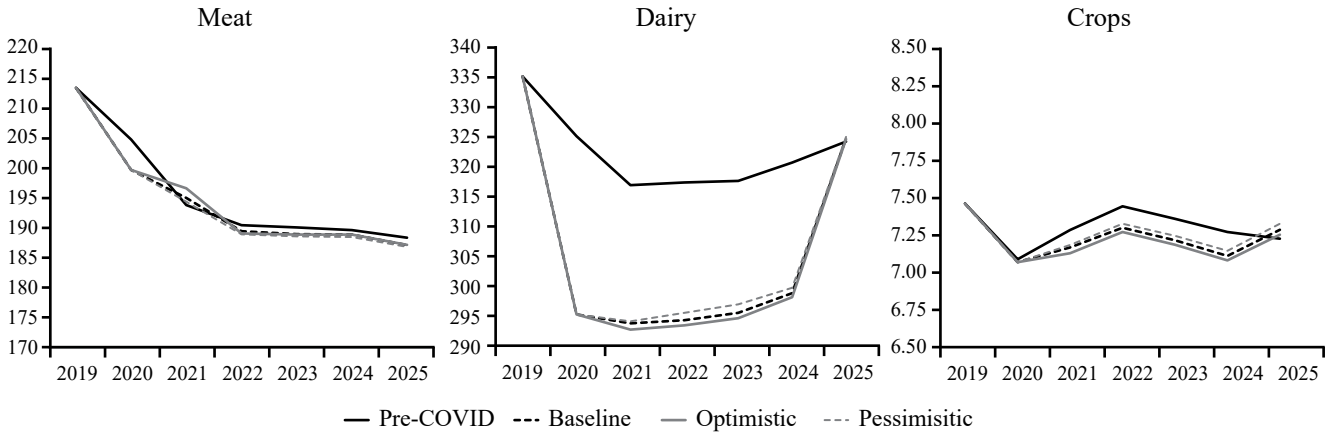

Figure 4: Self-sufficiency rate (%): Netherlands.
Source: Own compilation based on AGMEMOD simulations

pandemic. Initial trade disruptions, labour shortages and the adoption of a variety of containment measures were the key elements threatening the sector. Nevertheless, the measures taken at national (and international) level, including the partial closure of the Dutch HORECA sector since October 2020, have left some 'scars' in terms of sales and prices. Lockdown measures led to a strong decline in international sales of products such as flowers[4] and potatoes; while domestically, consumers' dietary concerns resulted in consumption increases of free-range eggs, milk, fruit, and vegetables. These effects on international and domestic sales were subsequently translated into price impacts leading, for example, to price increases for free-range eggs and vegetables. In contrast, potato prices are estimated to be around 16% lower for 2020 when compared the pre-COVID case and the COVID-19 scenarios, returning to a level of €14.4/100 Kg by 2022 in the baseline case.

When reporting the scenario outcomes, a synthetic indicator that condenses production and consumption developments into a single element is used, i.e. the self-sufficiency rate[5] (SSR) (Figure 4). In relative terms, dairy products 'suffer' more from the pandemic than crops or meat, which show only modest changes. The net demand for dairy products increased due to higher domestic and EU demand for fresh dairy products and cheese (irrespective of reduced exports, e.g. cheese to Japan), while milk production showed a slight increase. The result is a decrease in the self-sufficiency indicator. In the medium term, crop and dairy production are expected to remain slightly below the pre-pandemic situation, driven by price prospects at the international level. Total consumption of dairy products is expected to remain around 3-5% below the pre-COVID case over 2020-2024 in the pessimistic case.

In Germany, GDP fell significantly in 2020, by around 5.3%. During 2020, the closure of the HORECA sector and the services delivered by contact-based professions were compensated to a relatively high degree by increases in manufacturing. In general terms, agri-food was affected by shifts in demand. Other important elements that 'shaped' the development of the agri-food sector were COVID-19 outbreaks in some food-processing firms, a shortage of seasonal workers, increases in operating costs related to measures for preventing the spread of the virus, as well as market developments at the global level. Increases in demand for organic products, fresh fruit and vegetables were led by private households. In contrast, the closure of restaurants led to a reduced consumption of beef, frozen vegetables, and potatoes.

When aggregating the outcomes of the simulations, the German agri-food sector appears to be affected only to a limited extent. Stronger impacts are identified in the self-sufficiency rates of meat (Figure 5). It is important to note, however, that the pre-COVID baseline does not reflect the impacts of the African Swine Fever (ASF) outbreak in September 2020. All the scenarios suggest that self-sufficiency rates will increase at least until 2023 compared to the situation before the pandemic. In general, domestic demand is expected to be sluggish due to reduced economic activity. This would eventually create a need for exporting the surplus at reduced international prices, reinforcing the subliminal trend of meat consumption decline. This situation could prevail until 2025 in the pessimistic scenario. In the case of dairy, the pre-COVID baseline shows a higher self-sufficiency rate, reflecting lower world market prices. This expected trend could lead to a slight production decline. Nevertheless, the impacts of the COVID-19 scenarios on the self-sufficiency rate of the dairy sector are expected to be low although marginally stronger in the pessimistic case. In general, the self-sufficiency rates of crops are expected to be only marginally affected.

In 2020, Italian GDP showed a strong 8.8% contraction. The total or partial closure of the HORECA sector affected the various supply chains differently. Sectors such as wine, fish and horticulture were the ones that suffered the most.

However, an improvement in the agri-food trade balance was registered by the end of 2020. Compared to the previous year, the trade surplus exceeded 3 billion euros, given the stability of exports and a 5.1% decrease in imports. Exports

[4] In the first weeks of the pandemic, Dutch prices for ornamentals were 30-50% lower than usual with a significant share of the supply having to be destroyed. See, also: https://www.floraldaily.com/article/9199470/ornamental-industry-trying-to-survive-covid-19-frenzy/.

[5] The indicator is calculated as production/consumption ×100. Several considerations should be kept in mind when interpreting the outcomes. The meat indicator is not 'tracking' trade of live animals. The dairy indicator is a weighted average (based on fat content) including cheese, butter, drinking milk, cream, fresh dairy products, SMP and WMP. The crop indicator covers durum wheat, soft wheat, oats, barley, maize, triticale, rye, rapeseed, soybean, and sunflower. Weighting factors are based on end uses of each crop.

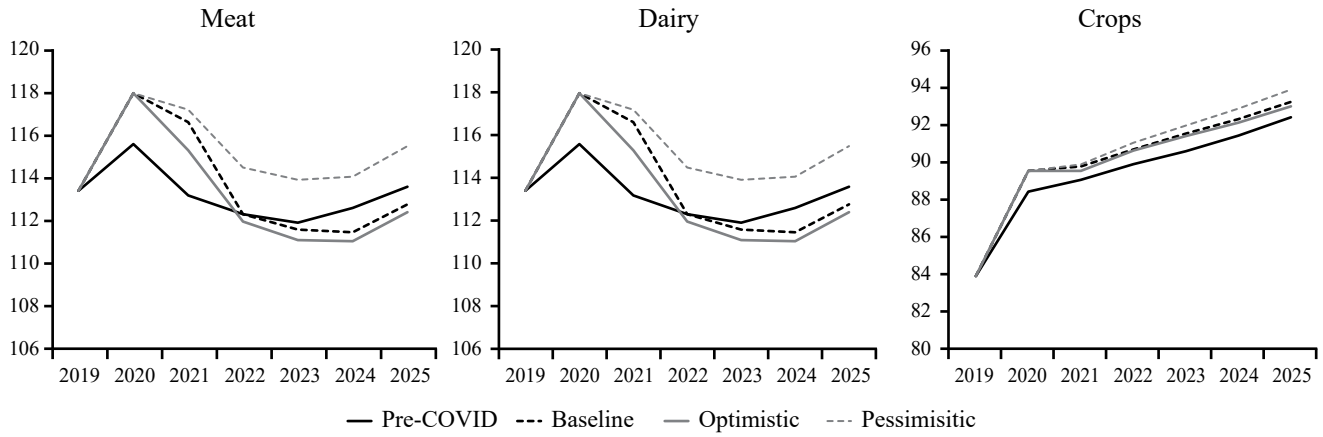

Figure 5: Self-sufficiency rate (%): Germany.
Source: Own compilation based on AGMEMOD simulations

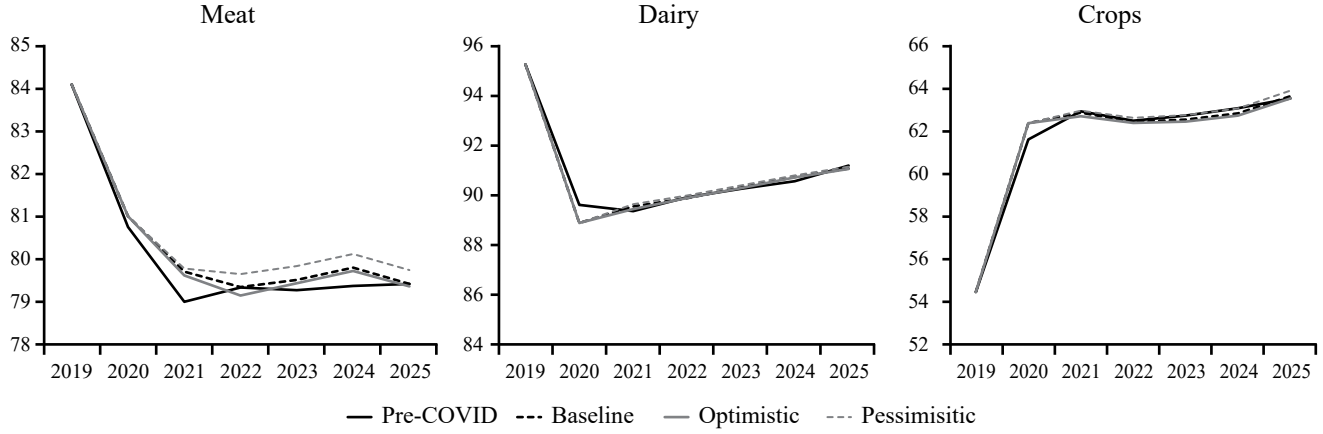

Figure 6: Self-sufficiency rate (%): Italy.
Source: Own compilation based on AGMEMOD simulations

of pasta, rice, olive oil and tomato preserves increased. Declines in imports were mainly registered for cereals, fish products, baked goods, and cheeses. As shown in the scenario simulations (Figure 6), the value of dairy exports is expected to recover to the pre-COVID level only by 2024 given the expected decline in global demand and prices.

An increase in domestic demand for meat products was observed in 2020, leading to a lower self-sufficiency rate. The scenarios suggest that per capita consumption could stabilise by 2022. For crops, available data for 2020 confirms the simulation results, with marginal changes when comparing the pre-COVID baseline with the pandemic situation. Nevertheless, the decrease in prices for the three sectors raises some concerns regarding the impact on farm incomes. In general terms, prices are expected to return to pre-COVID levels only by 2025.

Taking Hungary in Central-Eastern Europe as an example, Hungarian GDP declined by -5.0% in 2020. The slowdown of economic activities is expected to have a noticeable and, with respect to the projected strengthening of meat prices, lasting impact on meat consumption trends in some EU Member States. After the 'panic-buying' rush that characterised the first weeks of the pandemic, the demand for meat declined and remained sluggish through most of 2020. The closure of the HORECA sector, the erosion of consumer spending by 2.5% and the overall increase in food prices by 7.4% contributed to this.

National data on meat production and trade reflects the drop in domestic consumption. In 2020, total slaughter of cattle, sheep, pigs, and poultry, expressed in slaughter weight, decreased by 1%. In addition, imports of beef and pork declined by 6% and 22%, respectively, compared to 2019, respectively. The trade balance showed a slight improvement for beef and turned positive for pork. At the same time, poultry meat imports stagnated, while exports shrunk by 10% compared to 2019, which is explained, in part, by the avian influenza outbreaks in the country. The pressure on producer prices as well as increasing feed costs have forced many poultry farmers to suspend the placing of day-old chicks and to liquidate breeding flocks which resulted in a shortage of poultry for slaughter in early 2021.

If we look further ahead, meat consumption is expected to lag increasingly behind the pre-COVID scenario in the coming years from around 4% to 6% in the pessimistic scenario (Figure 7). Even in the optimistic scenario, this gap is unlikely to close before 2025. However, slack domestic demand for meat is expected to be overcompensated by growing exports, especially for poultry meat, driven by rising international prices and a weak domestic currency. Improving international competitiveness might help total Hungarian

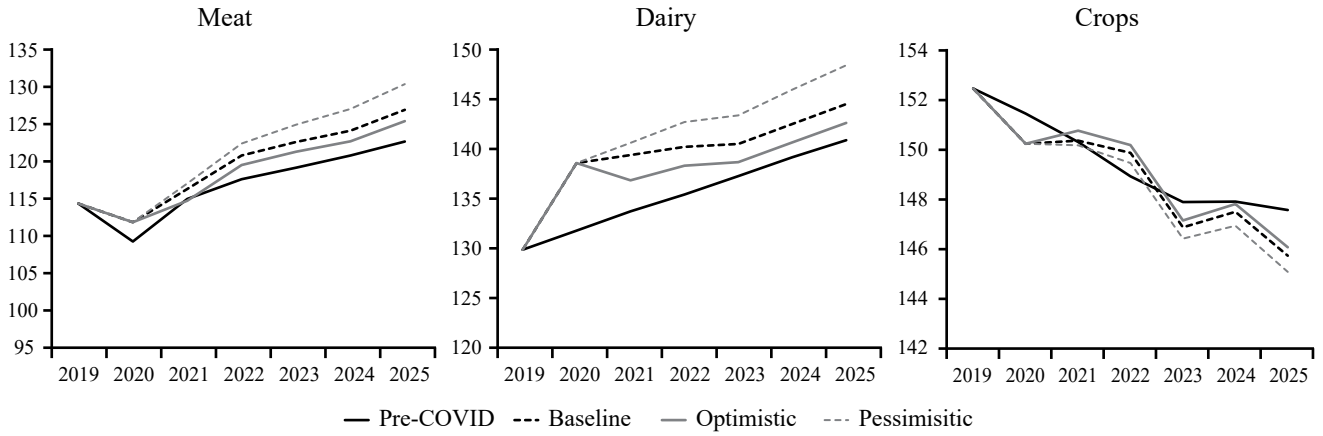

Figure 7: Self-sufficiency rate (%): Hungary.
Source: Own compilation based on AGMEMOD simulations

Table 2: Overview of country results.

	Meat	Dairy	Crops	Remark
The Netherlands	-	-	/	Domestic/EU demand increase for fresh dairy products and cheese which more than compensated a decline in exports to Asia/Japan. Modest changes in beef.
Germany	+	-	+	A decline in beef demand drives the meat outcome, with some impacts of ASF in the pork sector. For dairy, fluctuations in production explain the sector development.
Italy	-	/	/	Consumption and production of meat decline, with consumption declining faster.
Hungary	+	+	-	Consumption declines are driven the outcomes for meat and dairy.

Note: +(-) indicates an increase (decline) in SSR in the case of the 'COVID-19' scenarios compared to the pre-pandemic case / indicates that SSR remains stable.
Source: Own composition

meat production to overshoot the pre-COVID case slightly in all scenarios. As for dairy, the rising SSR values are also explained by contracting domestic demand.

The modelling results for the 'COVID-19' scenarios for meat, dairy and crops at the country level are summarised in Table 2.

Conclusions

The country level analysis confirms that the EU's agriculture sector has been quite resilient during the pandemic, and it is expected to remain so, even though the food sector in the Member States was affected in different ways. The impacts of GDP shocks on the agri-food sector are limited, but changes in consumer behaviour could lead to longer lasting impacts on specific sectors (e.g. meat production). Trade flows contributed to buffering domestic market disruptions but induced some strong price changes in local as well as world markets (e.g. the ornamental and potato sectors). On the supply side, price developments had a considerably larger impact compared to the effects related to implementation of lockdown measures. The partial closure of food services has imposed a variety of challenges for producers and food processors who had to react quickly to supply the 'private' kitchens of consumers who became increasingly concerned about adopting new dietary patterns. The impact of the income shock seems to have been limited due to the low-income elasticity of food products, as well as policy support measures implemented to mitigate the destruction of jobs and the overall economic collapse.

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