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New Rural Development and Hierarchical Governance in Vietnam: Impacts of government support on rural households' income using a Hierarchical Linear Modelling

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Abstract

The New Rural Development (NRD) program is one of the most important policies in agriculture and rural development of Vietnam by 2020. In the period of 2010 – 2015, the government mobilized about 851,380 billion Vietnam Dong (VND) (approximately US$38.7 billion) for investments in rural development projects across the country. Among the top priorities, solving a broadening income and poverty gap between urban and rural areas, between leading and lagging regions, and among ethnic groups are one of the most essential issues. This research paper is targeted to provide an empirical evidence for answering the question whether the government assistance could effectively and positively impact on rural households' income through the NRD program by using a hierarchical linear modelling (HLM). The results of the mixed effect model could firmly reveal that the financial assistance could positively influence on rural households' income through investments in roads, income generation models, and technical trainings.

Keywords

Hierarchical Governance, Multilevel Analysis, Hierarchical Linear Modelling, New Rural Development, Vietnam.

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Introduction

Since the economic and political reform in 1986 (the Doi Moi), Viet Nam's economy has transformed positively and significantly from an impoverished and closed economy into an open socialist-oriented market economy. Consequently, the annual growth rate since 1990 has been among the fastest countries in the world with an average of 5.5 % in 1990s and 6.4% in the 2000s. Recently, Vietnam's economy continued to accelerate in 2015 with an estimated GDP growth rate of 6.7% and became a member of the lower middle-income group in 2010 (The World Bank, 2018). However, the current situation shows that the nation is now facing numerous challenges such as slowing down economic growth, over exploitation of natural resources, and, especially, an unbalanced development between urban and rural regions up to nearly 50% between the two regions (GSO, 2016).

The dramatic change of Vietnam's economy towards modernization and urbanization process created a biased development between the urban and rural regions that the rural areas are homes of more than 70% of Vietnam's population and about 92% of poor households living on about $0.50 a day (GSO, 2010). Moreover, the rural regions in Vietnam are also a combination of large majority of the population, poor households, and ethnic groups. Poverty and low levels of education are among the factors of social vulnerability beside population growth, gender inequality, fragile and hazardous locations, and lack of access to resources and services, including knowledge and technological means, disintegration of social patterns (Damas and Israt, 2004).

As a result, there are some critical issues

in rural communities such as a wider income gap with urban areas, a poor rural institution for agriculture and rural development, poor living conditions and infrastructure in rural areas, and unsustainable farming methods which could negatively impact on the local environment and human health. Among them, solving a broadening income and poverty gap between urban and rural areas, between leading and lagging regions, as well as among 54 ethnic groups is one of the most essential issues. This is crucial not only in Vietnam, but also in any developing countries.

In order to resolve the above critical issues, the Prime Minister of Vietnam issued the Decision No. 800/QĐ-TTg dated 04/06/2010 to approve the National program of New Rural Village Development between 2010 and 2020. Later, the government replaced the policy by the Decision No. 1600/QĐ-TTg dated 16/08/2016 to renew the National program of the New Rural Village Development for the period of 2015-2020. The main purposes of the new policy are to encourage and mobilize a revolutionary campaign to improve local infrastructures, living conditions, comprehensive development of production-related activities, attach agricultural development with industrial development in rural regions, as well as increase income, and improve physical and mental health of people living in rural communities. The specific objectives of the program by 2020 will be aimed at (i) ensuring the percentage of communes achieved "New Village Standard" at 50% (varying from region to region); (ii) improving rural infrastructures for production and living such as roads, electricity access, water supply, educational and medical facilities, and (iii) improving rural households' living conditions and developing production models in commercial manner to create stable jobs and increase households' income of at least 1.8 times higher than that of 2015.

Rural development or rural community development is so complex, across several sectors, and involves various policies and actions that have direct or indirect impacts on the rural areas and the livelihood of the rural people (Rudengren et al., 2012). Particularly, rural development will not only involve farmers or non-farming households, cooperatives, production groups, but it also includes civil organizations, central and local governments, both private and public sectors. In the case of Vietnam, rural development is even more difficult and sensitive than other countries because most of the population and minority groups (54 minorities) are living in rural regions. Therefore, rural development might make a huge impact on social, political, and economic perspectives of rural communities.

Besides, rural development is not a new concept, however new approaches and methodologies for rural community improvement keep changing and updating to follow the changes of global development. Saemaul Undong, a famous rural development program of South Korea in 1970s, is gradually adapting and becoming a global model and an exemplary of Vietnam's rural development program. Sooyoung (2009) pointed out that government's in-kind support was one of the successful factors of Saemaul Undong which effectively helped increase rural households' income and improve living conditions. In the Saemaul movement, South Korea's government provided in-kind support such as cement, steel, fertilizers… to local communities to ignite people's awareness of community development and, significantly contributed to the development of rural community and better households' income (Cho and Kim, 1991). Between 2010 and 2015, the government mobilized up to 851,380 billion Vietnam Dong (VND) (approximately US$38.7 billion; US$ 1 ~ 22,000 VND) for investments in rural development projects across the country such as infrastructure constructions, technical supports, and income generation models (Economic Committee, 2016).

The implementation of the NRD program apparently shows a hierarchical governance structure and effectively disseminates the NRD as an innovation throughout the country (Manh et al., 2016). Generally, this NRD program is a top-down policy flowing hierarchically from the central government to local governments. One of the advantages of hierarchical rules is that they can resolve commitment problems through the formal rule structure and shape the agreement between state and local governments (Sang-Chul et al., 2012). Since the NRD is still implementing, researchers and policy-makers might be wondering whether the government's support could actually have a positive impact on the rural communities or help improve living conditions by investing in infrastructure, providing assisting projects, and improving human resources in rural regions. This is a foundation for applying a Hierarchical Linear Modelling (HLM) to assess the relationship between factors at provincial levels and factors at communal levels.

The HLM or multilevel analyses were widely used in algorithm development (Dempster et al., 1977), social studies and psychology (Paterson and Goldstein, 1991; Woltman et al., 2012), commercial aviation (Beaubien et al., 2001), and land uses and housing (Sang-Chul et al. 2012). Especially, in the field of health and medical studies, Keon-Hyung et al., (2013) examined factors affecting medical costs, medical practices… between hospitals (Level 2) and patients (Level 1) using nested data with HLM approach. Besides, Rice and Leyland (1996) and Rice and Jones (1997) emphasized HLM's significance in health economics research. More popularly, the HLM was applied to estimate the impacts of teaching methods, teachers' instruction, and principal characteristics… on classes' or students' performance in the field of education effects research (Raudenbush and Bryk, 1986; Garner and Raudenbush, 1991; Lee et al., 1991; Raudenbush et al., 1991; Ma, X. and Klinger, D. A., 2000; Desimone et al., 2002; Marks, H. M. and Printy, 2003). However, thus far, there has a few studies researching on the impacts of government policies at local levels, particularly the relationships between central and local governments, between local government and local communities in rural development and agricultural policies in developing countries.

Hence, this research paper is targeted to provide an empirical evidence for justifying whether the government' budget for rural development (Level 2) could effectively and positively impact on rural households' income (Level 1) through the NRD program by using a multilevel analysis. The paper would play an important role in providing evidence and implications to significantly contribute to the implementation of the NRD program in Vietnam in the next period of 2016 – 2020. Besides, findings from this paper could be used for recommending effective and efficient investments in rural community development and benchmarking with other developing countries that are currently implementing rural development programs. More importantly, this research paper could be considered as the first trial for estimating multilevel effects of government's assistance on rural households' income using a HLM.

Materials and methods

Research method

In general, analytical strategies used to deal with multilevel data could be aggregation or disaggregation methodologies. However, there are some critical problems using these two methods. While aggregated models ignore within group variance and aggregated lower level variables with higher levels, disaggregated models ignore between group variance and disaggregated higher-level data with lower levels (Keon-Hyung et al., 2013). In this case, multilevel analysis (or Hierarchical Linear Modelling) which simultaneously analyses both within and between group variances can help eliminate the loss of information. Besides, Keon-Hyung et al. (2013) also concluded that applying hierarchical modeling will be more powerful in treating multilevel variables (for example Medicaid inpatient expenditure within patients' and hospitals' groups) than aggregated or disaggregated modeling.

The HLM is a complex form of ordinary least squares (OLS) regressions used to estimate the variance of outcome (dependent) variables when predictor (independent) variables vary hierarchically from level to level by taking multilevel regression relationships into estimations. Moreover, the HLM can accurately investigate multilevel data's relationships and disentangle between and within group variance's effect. In the HLM, the effect size and standard errors are not distorted and it also retained the potentially meaningful variance estimated by aggregation or disaggregation methods (Beaubien et al., 2001; Gill, 2003; Osborne, 2000). As a result, using HLM is considered as a preferred method for nested data because it requires a fewer number of assumptions than other statistical and analytical methods (Raudenbush and Bryk, 2002) and, especially, it could help prevent researchers' analysis from facing a Type-I error (Huta, 2014).

Research data

The paper will rely on the data of Vietnam Households Living Standard Survey (VHLSS) which is conducted every 2 years with the newly published and updated version in 2014 (the 2016 data has not officially published yet). The data of this survey is one of the most reliable sources of analyzing social aspects in Vietnam. Basically, the survey is conducted at the households and communal levels with scientific sampling and professional interviews. While the communal questionnaire is aimed at collecting social – economic information, that of households is detailed in gathering households' aspects and mostly covered income and expenditure

of each household. The total numbers of respondents are 9,399 households and 1,716 communes. Due to the availability of the data, this research paper will employ a multilevel analysis using the data of 1,226 communes representing 34 provinces and cities from different geographical regions across the country (Table 1).

In this multilevel analysis, the unit of analysis is local communities (communes) and the only outcome variable (dependent variable) is the average households' income. At level 1, there are geographical location, government's assistance, extension service, and road network representing internal and external resources for community development. These independent variables denote the second objective of the NRD which is aimed at improving rural infrastructures for production and living to raise rural households' income level (spontaneously is the dependent variable and the third objective of the program). These level 1 variables are identified by the level 2 cluster variable which is local government budget (at provincial level) in a multilevel model. This model can accurately estimate lower level-1 slopes and their implementation in estimating higher-level outcomes by taking both the level-1 and level-2 regression relationships into account (Table 2).

Model specification

Multilevel models or hierarchical linear models are also known as linear mixed-effects models which includes fixed effects and random effects. In other words, mixed effect models are a generalization of conventional linear regression which can include random deviations (the so-called "effects") rather than the overall error term (StataCorp, 2015). On the one hand, the fixed effects denote a variable's discrete, intentionally elected,

Hierarchical level/Variables	Denotation	Description and Measurement
Level 2 - Local government (Provincial level)		
Governments' budget	BUDGET	Governments' budget for the NRD program including both central and local government budgets, and other types of reciprocal capital of villagers from 2010 – 2014; Billion VND.
Level 1 - Local communities (Communal level)		
Dependent/Outcome variable		
Households' income	INCOME	Average households' income at communal level in 2014; Thousand VND.
Independent variable		
Geographical location	GEO	Geographical location; dummy variable: Delta region = 1, other regions = 0
Government's assistance	GOVTPRO	Government provision of economic development program and projects in the last 3 years; dummy variable: Yes = 1, No = 0
Extension access	EXTENSION	Participation in extension trainings; Average number of times
Road network	ROAD	Accessible road network for motor vehicles (cars, buses, and trucks…) to villages, dummy variable: Yes = 1, No = 0

Source: own processing, VHLSS

Table 1: Variables and their measurement.

Hierarchical level/Variables	Obs.	Mean	S.D.	Min	Max
Level 2 - Local government (Provincial level)					
BUDGET	**1,226**	**19,570.73**	**31,647.64**	**1,199**	**176,263**
Level 1 - Local communities (Communal level)					
Dependent/Outcome variable					
INCOME	1,226	93,332.30	47,671.33	11,891	301,570
Independent variables					
GEO	1,226	0.54	0.45	0	1
GOVTPRO	1,226	0.73	0.45	0	1
EXTENSION	1,226	11.20	9.65	1	48
ROAD	1,226	0.94	0.23	0	1

Source: own processing, VHLSS

Table 1: Variables and their measurement.

or existing values and exert a constant effect on the dependent variable. On the other hand, random effects are considered as the continuous and randomly chosen values of a variable and influence variable impact on the dependent variable.

In terms of multilevel analysis, Intraclass Correlation Coefficient (ICC) is statistically significant to address the question whether we really need to conduct a multilevel analysis. Or in other words, if the sufficient variances represented in a higher level could justify the linear mixed approach. Besides, the reasons of using HLM is that the authors are believing that there might have a variability in individual and group levels (Boedeker, 2017) and a larger value of ICC will indicate a larger variability between levels. So, the ICC could be used to confirm the use of HLM in analyzing individual and group levels. In this case, we will conduct an empty model analysis (this model is similar to use One-way ANOVA model for variance component estimation) to obtain the variance components for ICC estimation. We have an empty 2-level multilevel modelling:

$$Y_{ij} = \beta_{0j} + \beta_{1j} X_{ij} + r_{ij}$$

With the random effect:

$$Y_{ij} = \beta_{0j} + r_{ij}$$

Where $\text{Var}(r_{ij}) = \sigma^2$ and group mean $\beta_{0j} = \gamma_{00} + \mu_{0j}$ (i.e. grand mean + a random quantity) assuming that uncorrelated with r_{ij}. Then, we have ICC definition as following:

$$Corr(Y_{ij}\ Y_{i'j}) = \tau_{00}/(\tau_{00} + \sigma^2)$$

Theoretically, there is no solid or "official" rules that could suppose how large the ICC value is enough for stating non-negligible nesting effect. However, a rule of thumb which is currently and widely being used says that about 10% (or double digits of ICC on percentage scale) of the total variance might represent a given level (Occhipinti, 2012) or as low as 5% could be considered as sufficient (Kreft and de Leeuw, 1998). Particularly, a two digits of ICC value could be considered as adequate for warranting a multilevel analysis because a single digit of ICC on percentage scale might denote that a single-level analysis could be more appropriate (Yu, 2012).

The result of variance component estimation in the Table 3 shows that the variances estimated at level 2 is 241,000,000 and 2,020,000,000 at level 1 ($p < 0.000$). This makes the total variance equal to 2,261,000,000 and the ICC = 0.11. The ICC value implies that there are approximately 11% of the total variance in communal households' income represented at provincial levels. This is slightly higher than 10% which is a sign of no design effect. Therefore, the variance component is statistically significant.

In term of this research, we will construct a simple random-intercept model to answer the research question that to what extent the budget at provincial level can affect the households' income at communal levels. Basically, this multilevel model will help conceptualize lower-level units (the analysis units) as individuals and higher-level units as groups (nested). This research would be a two-level hierarchical model with level-1 model (communes) and level-2 unit (provinces). In addition, this model is also called a within-unit model because it can estimate the effects of a single group context (Gill, 2003).

"Hierarchical level/ Variables"	Obs.	Mean	S.D.	Min	Max
Level 2 - Local government (Provincial level)					
BUDGET	1 226	19 570.73	31 647.64	1 199	176 263
Level 1 - Local communities (Communal level)					
Dependent/Outcome variable					
INCOME	1 226	93 332.30	47 671.33	11 891	301 570
Independent variables					
GEO	1 226	0.54	0.45	0	1
GOVTPRO	1 226	0.73	0.45	0	1
EXTENSION	1 226	11.2	9.65	1	48
ROAD	1 226	0.94	0.23	0	1

Source: own processing

Table 3: Variance component analysis using empty model.

To examine the relationship within lower level units, we proposed a simple regression model developed for each individual i with simple intercept as the following mixed model with one level-2 variable (BUDGET) and four level-1 variables (GEO, GOVTPRO, EXTENSION, and ROAD):

$$INCOMEij = \gamma_{00} + \gamma_{01}BUDGET_j + \gamma_{10}GEO_{ij} + \gamma_{20}GOVTPRO_{ij} + \gamma_{30}EXTENSION_{ij} + \gamma_{40}ROAD_{ij} + u_{0j} + r_{ij}$$

In which,

- $\gamma_{00} + \gamma_{01}BUDGET_j + \gamma_{10}GEO_{ij} + \gamma_{20}GOVTPRO_{ij} + \gamma_{30}EXTENSION_{ij} + \gamma_{40}ROAD_{ij}$ represents fixed effects; and
- $u_{0j} + r_{ij}$ plays the roles of random effects.

Estimation method

In the case of multilevel analysis models, they offer several options for estimation method such as Maximum Likelihood (ML) or Restricted Maximum Likelihood (REML). In general, ML and REML estimations provide a similar variance estimates, however, if they do not share this similarity, REML can produce a better estimate in multilevel analysis (Browne, 1998; Hox, 2010). In particular, ML estimators are relied on the usual likelihood theory, the notion of REML is to convert the response into a group of linear contrasts whose distribution is not affected by the fixed effects (β) (StataCorp, 2015). Basically, the restricted likelihood can be formed from this linear contrast group by considering the distribution and helps minimize the problem of β. The unbiased characteristics of REML extend to all mixed models to deal with the unbalanced data. However, likelihood-ratio (LR) tests fits which are used for comparing the goodness of two nested models based on REML are not appropriate because REML supposes to change the fixed effects specification and this could change the meaning of the mixed effects (Pinheiro and Bates, 2000). Hence, the researchers would apply the ML estimation method for the multilevel analysis to test whether the 4 predictors of households' INCOME at communal levels can reduce the within-province variance.

Results and discussion

The impact of government support on rural households' income

Generally, the mixed effect model is conducted with 1,226 observations in 34 groups. The results show that all variables have a positive impact on the dependent variable which is average households' income at the communal level. Among them, GEO, GOVTPRO, and EXTENSION are statistically significant at 1%, while ROAD has a significant level of 5%. Interestingly, the level-2 variable BUDGET from provincial governments positively exerts the households' income, but the extent of improvement is minor (Table 4).

Among the 4 level-1 variables, the geographical locations make the largest impact on rural households' income. This indicates that the income of rural communes in delta regions is approximately 12 million VND (equivalent to about 30%) higher than the other regions (costal, mountainous, and midland regions). On the contrary, the coefficient of extension access shows the least impact on raising the income. Particularly, it signifies that technical training can help improve 2.8 million VND of rural households' income for every 1 training class people participating in. Another interesting aspect is that communes having government provision of economic development program and projects in the last 3 years have a larger income of 7.5 million VND (approximately 20% higher) compared with the other without-support communes.

There is a striking feature that communes with car-accessible road to village levels could have an income of 10.3 million VND higher than those do not have. This indicates that investments in transportation facilities can make a huge difference in economic development in rural areas up to 26%. An implication from this finding is that rural development programs should put more emphasis on transportation infrastructures which might not only increase the local households' income, but also help ensure a sustainable development of the income increase strategies.

Apparently, the level-2 variable of local government budget for the NRD program at communal levels has a positive impact on households' income. However, the 0.167 coefficient of BUDGET shows a weak influence on directly increasing rural families' income. This implies that each 1 billion expenditures of local provinces could only help improve 167 VND (equal to US$ 0.008) for each household.

This can be explained that financial assistance through infrastructure, production facilities, and education only has an indirect impact on rural households' income. On the one side, most of the investments in infrastructure have been

Mixed-effects ML regression		Number of obs. =	1 226
Group variable: PROVINCE		Number of groups =	34
		Obs. per group:	
		Min =	24
		Avg. =	36.1
		Max =	62
		Wald chi² (5) =	488.98
Log restricted-likelihood =	-14698.497	Prob. > chi² =	0.0000

INCOME	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
_cons (γ_{00})	39 459.880	5 975.073	6.60	0.000	27 748.950	51 170.810
BUDGET (γ_{01})	0.167	0.062	2.69	0.007	0.045	0.289
GEO (γ_{10})	12 019.430	2 738.633	4.39	0.000	6 651.807	17 387.050
GOVTPRO (γ_{20})	7 540.864	2 539.680	2.97	0.003	2 563.183	12 518.540
EXTENSION (γ_{30})	2 580.656	123.610	20.88	0.000	2 338.385	2 822.926
ROAD (γ_{40})	10 270.020	5 084.123	2.02	0.043	305.325	20 234.720

Random-effects Parameters	Estimate	Std. Err.	[95% Conf.	Interval]
PROVINCE: Identity				
Var (_cons) (τ_{00})	81 600 000	30 900 000	38 800 000	171 000 000
Var (Residual) (σ^2)	1 470 000 000	60 300 000	1 360 000 000	1 600 000 000

Note: LR test vs. linear model: chibar2 (01) = 25.86 ; Prob >= chibar2 = 0.0000

Source: own processing

Table 4: The results of mixed effect model analysis.

made recently (but its benefits and impacts can only be estimated in the longer term. For example, infrastructure and production facilities like road, irrigation system, rice field designation might positively affect the income of families in rural areas. Moreover, some of the expenditure which is for local living conditions such as clean water supply, cultural halls, schools, or medical care stations will indirectly make an impact on rural households' income. Therefore, the coefficients of the other level-1 variables such as ROAD, GOVTPRO, and EXTENSION could play a complementary role in explaining the impact of BUDGET.

Comparison between the empty model and random coefficient model

On the results table, the lower part shows the estimated variance components (random effects) of the model. In the case of this research, we have only one random effect (a simple random-intercept model), therefore "Identity" will be the only possible covariance structure which stands for "Multiple of the Identity" having that all variances are equal variances for random effect and all of covariance are equal to 0. In any case, the variance of the level-two errors is estimated as 81,600,000 and the standard error is 30,900,000. The var (Residual) demonstrates the estimated variance of the overall error term as 1,470,000,000.

In the estimation method section, the authors argued about the reasons of selecting ML method instead of REML to compare between variances of the empty and random coefficient model to test whether 4 predictors of households' INCOME at communal levels can reduce the within-province variance. The comparison between variances in the empty model and (One-Way ANOVA) and random coefficient model as the following formula:

$$\frac{\sigma^2(Empty\ model) - \sigma^2(with\ predictors)}{\sigma^2 Empty\ model}$$

$$= \frac{2{,}020{,}000{,}000 - 1{,}470{,}000{,}000}{2{,}020{,}000{,}000} = 0.272$$

Apparently, adding 4 variables as predictors of households' income can reduce the within-province variance by 27.2%. Hence, the 4 predictors (GEO, GOVTPRO, EXTENSION, and ROAD) comprise 27.2% of the commune-level variance in the outcome.

Maximum Likelihood vs. Restricted Maximum Likelihood

In the estimation method section, the authors have mentioned about Maximum Likelihood (ML) and Restricted Maximum Likelihood (REML) in HLM and the reasons why this paper applied ML instead of REML in its multilevel analysis. In order to discuss more about these methods, Boedeker (2017) indicated that REML should be employed when the variance estimates are significantly different between two methods and when the number of groups is small because REML could conduct a less-biased estimate of variances than ML. Nevertheless, how many groups could be considered as "small"? This paper discovered that, with the number of 34 groups, the difference of ME and REML is not significant. The variance estimates of ML and REML are 1,470,000,000 and 1,480,000,000 respectively. (See the appendix – Table 8 for the REML regression results). In this case, ML is strongly recommended to allow some model comparisons. From the findings of the paper, the authors recommend that HLM with less than 34 groups should apply REML for the estimation instead of ML to have less-biased estimates of variances.

Conclusion

The results of HLM point out that all of 4 level-1 variables and 1 level-2 variable positively influence on the households' income and are statistically significant. Especially, households in the delta areas have a higher income up to 12 million VND than those living the other areas, technical trainings can help improve 2.8 million VND of rural households' income for every 1 training class, communes having government provision of economic development projects in the last 3 years have a differential of 7.5 million VND compared with the other without-supported communes, and communes with car accessible road to village level could have a 10.3 million VND higher than those do not have. These results indicate that the program might help achieve the ultimate target to increase rural households' income at least 1.8 times between 2015 – 2020. However, the prioritized investments should increase in transportation infrastructures.

Despite the positive impacts of the NRD on rural households' income, there still exists another critical problem that is the gap between the convenient and inconvenient regions. In particular, the households in delta areas where have better conditions for agricultural farming or are usually close to the urban areas earning more up to 12 million VND (approximately 30% higher) than the other regions (mostly remote, more difficult conditions for agricultural production). This poses a serious challenge to achieve the ultimate goal of improving rural households' income and shortening the gap between regions in spite of the government's incentives that poor and remote communes could receive a higher substantial assistance.

Although the budget support from provincial levels does not have a major impact on households' income, it still exerts an indirect influence on families' earning through investments in infrastructure (ROAD), education (EXTENSION), and economic development program and projects (GOVTPRO). These level results indicate that infrastructure and income generation models are the most important solutions to improve families' income which could help improve 26% and 20% respectively. It implies that development programs in developing countries should put more emphasis on transportation infrastructures which might not only increase local households' income, but also help ensure a sustainable development of the income increase strategies.

The empirical evidence can firmly answer the question that the local government budgets could effectively and positively influence on rural households' income through the NRD program. However, more in-depth analyses of the program's impacts on different aspects such as households' living conditions, local economy's development, and environment improvement need to be conducted to provide more detailed impacts of the NRD on rural communities in the social-economic development, political, and local security.

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Appendix

Number of obs	=	1 226
F(5, 1220)	=	113.57
Prob > F	=	0
R-squared	=	0.318
Adj R-squared	=	0.315
Root MSE	=	39 460

Source	SS	df	MS
Model	884 220 000 000	5	176 840 000 000
Residual	1 899 700 000 000	1 220	1 557 100 000
Total	2 783 900 000 000	1 225	2 272 600 000

INCOME	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
_cons	37 783.970	5 554.201	6.800	0.000	26 887.130	48 680.820
BUDGET	0.167	0.036	4.660	0.000	0.097	0.237
GEO	13 210.550	2 275.186	5.810	0.000	8 746.837	17 674.260
GOVTPRO	5 910.342	2 553.170	2.310	0.021	901.252	10 919.430
EXTENSION	2 603.712	117.805	22.100	0.000	2 372.589	2 834.834
ROAD	12 427.610	4 901.058	2.540	0.011	2 812.170	22 043.040

Source: own processing

Table 5: Conventional regression analysis.

Variable	VIF	1/VIF
GOVTPRO	1.02	0.981
EXTENSION	1.02	0.984
GEO	1.01	0.987
BUDGET	1.01	0.992
ROAD	1.00	0.996
Mean VIF	1.01	

Source: own processing

Table 6: Multicollinearity test.

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of INCOME

$chi^2(1)$ = 368.43

Prob > chi^2 = 0.0000

Source: own processing

Table 6: Multicollinearity test.

Mixed-effects REML regression		Number of obs. =	1 226
Group variable: PROVINCE		Number of groups =	34
		Obs. per group:	
		Min =	24
		Avg. =	36.1
		Max =	62
		Wald chi^2 (5) =	483.97
Log restricted-likelihood =	-14659.057	Prob. > chi^2 =	0.0000

INCOME	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
_cons (γ_{00})	39,540.150	6,029.397	6.56	0.000	27,722.750	51,357.550
BUDGET (γ_{01})	0.167	0.065	2.58	0.010	0.040	0.294
GEO (γ_{10})	11,961.41	2,770.604	4.32	0.000	6,531.125	17,391.690
GOVTPRO (γ_{20})	7,600.832	2,545.458	2.99	0.003	2,611.826	12,589.840
EXTENSION (γ_{30})	2,580.742	124.156	20.79	0.000	2,337.401	2,824.082
ROAD (γ_{40})	10,168.790	5,106.353	1.99	0.046	160.519	20,177.060

Random-effects Parameters	Estimate	Std. Err.	[95% Conf.	Interval]
PROVINCE: Identity				
Var (_cons) (τ_{00})	91,700,000	34,500,000	43,900,000	192,000,000
Var (Residual) (σ^2)	1,480,000,000	60,600,000	1,360,000,000	1,600,000,000

Note: LR test vs. linear model: chibar2 (01) = 25.86 ; Prob >= chibar2 = 0.0000

Source: own processing

Table 4: The results of mixed effect model analysis.

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ICT Intervention in the Socio-Economic Development of Udupi Jasmine

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Abstract

Jasmine growing community in coastal Karnataka of India is a successful viable community-based enterprise. For this community despite having other sources of income, jasmine cultivation has provided them with a sustained regular income. It safeguards them against poverty even if their other sources of income diminish. This study explores the areas in this community-based enterprise where information and communication technology (ICT) can be integrated. Thus, focus of the study was to visualize how this community-based enterprise works, understand the challenges faced and to provide possible ICT solution to overcome these challenges. ICT awareness among the growers and agents involved in the supply chain was also captured. Willingness of accepting ICT among the agents was analyzed using logistic regression and K-NN classifier machine learning models. Study showed a significant socio-economic impact of jasmine production on growers. To overcome the challenges faced, ICT solutions are proposed in place of current crude system.

Keywords

Udupi jasmine, ICT, community-based enterprise, socio-economic, policy making, agriculture.

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Introduction

India is one of the centers of origin of jasmine. The genus Jasminum is reported to comprise of 500 species. A critical analysis of these species, however, has revealed the number of true species to be only 89, of which 40 inhabit the Indian sub-continent (Lakshmi and Ganga, 2017). Udupi Jasmine which has got a Geographical Indication Tag is one of these species belongs to Jasminum Sambac–1 species of jasmine (Ashok and Sarma, 2016). Majority of the Udupi jasmine is grown in the Shankarapura region of Udupi district of coastal Karnataka, India. Udupi jasmine is coveted for its exquisite scent. It is a favored flower in ceremonial events and for personal use. Udupi jasmine flower growing community of coastal Karnataka have maintained a community-based enterprise for more than 85 years. Many of the farmers of this region depend directly on cultivation of Udupi jasmine for their livelihood (Krishnamurthy et al., 1995). With efficient system of pricing and distribution, trust and cooperation among the community and an accepted method of matching demand and supply just by thumb rule, the community has kept poverty away for nearly three generations.

In an era where information and communication technology (ICT) is pervading in all service sectors and business development models (Kramer et al., 2007) keeping up with the demands of this digitally driven market becomes crucial for surviving one's business. Access to information has increased considerably due to the usage of mobile phones. The number of mobile phones per 100 people in developing countries often exceeds access to other information technologies, such as landlines (Jensen, 2010), newspapers, and radios. ICT in agriculture have the potential to facilitate greater access to information that drive or support knowledge sharing. The application of ICT can play a pivotal role in efficient dissemination of information. ICT can deliver fast, reliable and accurate information in a user-friendly manner for practical utilization by the end user (USAID, 2010). The growth of ICT in developing countries offers a new technology and new opportunities for accessing information.

One of the mechanisms is sharing information via agricultural extension, which has long been plagued with problems related to scale, sustainability, relevance, and responsiveness (Aker, 2011). Although its application is evolving in the agriculture sector, ICT has demonstrated its ability to reach the farmer community (Ali and Kumar, 2011).

ICTs in agriculture have the potential to facilitate greater access to information that drive or support knowledge sharing. ICTs essentially facilitates the creation, management, storage, retrieval, and dissemination of any relevant data, knowledge, and information that may have been already been processed and adapted (Batchelor, 2002; Chapman and Slaymaker, 2002; Rao, 2007; Heeks, 2002). There are several instances in India where ICT has been used to improve the agricultural system. The application of ICT in Madhya Pradesh, Uttar Pradesh and Tamil Nadu among farmers have helped them in reducing transaction cost that involved information acquisition and facilitating transactions in input and output markets (Adhiguru and Devi, 2012). Similarly, in Uttar Pradesh use of ICT by life stock farmers has helped them to make better decisions than non-ICT users (Ali, 2011). In a study, (Jensen, 2007) shows, using micro-level survey data, that the adoption of mobile phones by fishermen and wholesalers in South India is associated with a dramatic reduction in price dispersion, the complete elimination of waste and an increase in both consumer and producer welfare. This paper presents robust empirical evidence that information improves the functioning of rural markets by increasing the competitiveness of buyers.

The way in which ICT projects access, assess, apply, and deliver content may increase the likelihood of ICT use by farmers and thus may become an important factor in a project's success. To address the information needs of farmers, relevant content is a key component of ICT projects. The extent to which content is customized and localized to a farmer's condition influences its relevance (Glendenning and Ficarelli, 2011). Local content has been defined as content that is intended for a specific local audience, as defined by geographic location, culture, or language or as content that is socially, culturally, economically, and politically relevant to a given society (Glendenning and Ficarelli, 2011). Hence localization of content is important, where a question and answer approach or the direct involvement of users in content production can improve such localization. The content sources tend to be local experts and organizations with expert local knowledge. This can support localization of content (Glendenning and Ficarelli, 2011).

Udupi jasmine is synonymous with Udupi district and is an important aspect of life for the actors associated with it. Thus, the present study was envisaged to analyze the working of this local enterprise, identify the key correspondents that drive this enterprise and check for the socio-economic impact of jasmine cultivation.

This would also shed light in understanding the challenges faced by the key correspondents involved. Thus, the convergence of the study is to provide necessary ICT intervention to overcome these challenges which in turn would help in the socio-economic development of Udupi Jasmine.

Materials and methods

The study was conducted in Udupi Jasmine growing regions of Shirva, Shankarapura, Belle (Moodubelle and Padubelle) of Udupi district, India. The correspondents for the study were Jasmine growers, agents and traders. In total 240 growers, 95 agents and 6 traders were identified. Snowballing technique was employed to identify the correspondents.

Interactions based on personal interview was conducted to understand the working of the whole system and how the actors played their role in the system. Various challenges were identified with these interactions. To understand the socio-economic impact of jasmine on growers and to gauge the awareness of ICT among the grower's community relevant questionnaire was used. Variables such as involvement of family members, total land used for cultivation, average income per week, jasmine cultivation as primary source of income and employment were identified to understand the socio-economic impact. For ICT awareness, variables such as availability and usage of smartphones, internet access and usage, mode of communication for price details and knowledge of using computers were used.

For the agents a separate questionnaire was used to understand the knowledge of ICT and their willingness to adopt ICT in the existing system. Variables identified were type of phone used, knowledge to use SMS facility, use of mobile banking services, social network, knowledge of computers, mobile banking services and willingness to automate the existing system. Logistic regression and K-NN classifier are best

suited prediction models on linearly separable data set. As the data set consists of linearly separable variables, Logistic regression and K-NN classifier predication models was used to predict the willingness of agents to automate the existing system.

System overview

The first approach to this study was to understand the working of this whole enterprise. The excerpt of the working of the enterprise is given below:

Jasmine crop is a year-round crop and it mostly involves the entire family. Jasmine buds are collected and tied together to a 6-inch chain approximately. Then they are wrapped in banana leaves with a slip containing information like household name, number of buds put inside. This entire process is finished by 10 am. This proves advantages to the growers as they can tend to other jobs. From here these bundles of tied buds are collected by agents. Each household is connected to one among 150 agents who operate in the Shankarapura area.

Responsibility of the agent is to collect the buds from the household and then arranging them for commercial units called as "chendu" comprising of 800 - 805 buds each. Four "chendus" make one "atte" (bundle) for which price is fixed by traders each day. As not all households will be able to produce a unit (chendu) with desired number of buds, the agents form these units with whatever buds they have collected from multiple households. Each agent is connected to multiple households from whom they collect these buds. The agents also collect the slips of each household and are stored in a small plastic Box. A separate book is also maintained with the information of each farmer and price to be given for that day. Every seven days the farmer gets the payment based on the flowers supplied.

Once the agents create these commercial units, they are then given to a designated trader in Shankarapura. The traders sell the collected units from agents to wholesale dealers from outside the region. These units reach wholesalers as far as Mumbai and Dubai. The traders keep track of the units received from agents and appropriate payments are made to them on weekly basis. Everyday units arrive Shankarapura by 11 a.m. There are 6 traders who operate from Shankarapura region who contact their wholesalers across the country to determine the demand for the day. Once the demand is established the six traders determine the price and the amount that they need to pay for each unit to the growers.

There is a unique method in determining daily price for one "atte" (bundle) of jasmine. For example, one of the 6 traders based on the demand from his wholesalers establishes a price X for that day. If this price X is not acceptable by the wholesalers of other 5 traders, they decrease their demand. So, these 5 traders are left with excess supply of jasmine for that day. The price X will be agreed upon by the other 5 traders only if the trader who quoted price X agrees to buy the excess supply that remaining 5 traders have. Hence the 6 traders with negotiations on price X and will reach on a consensus in establishing a price for jasmine for that day. The overall price for jasmine for that day is determined on the demand the 6 traders receive from their wholesalers. The wholesalers purchase decision depends on the overall market demand. Based on the demand and the supply for that day, price to be given to the growers is determined. The traders pay the agents on the amount of buds received. Finally, growers receive appropriate payments on weekly basis from the agents who keep track of the grower's produce. This process has been followed for decades is still in practice.

Results and discussion

Scio-economic impact and ICT awareness

The socio-economic impact of Jasmine cultivation and the ICT awareness among growers analyzed through questioner and the results in percentage is shown in Table 1.

Jasmine cultivation has a significant impact on the socio-economic development of growers. It provides full time employment for nearly 46.17% of the growers and for more than half (51.9%) of the of the growers it serves as a primary source of income. Even with small land holdings (<2178 sq. Ft.) jasmine cultivation proves to be a significant source of income for majority of the growers (71.7%).

ICT awareness among growers was found to be significantly low. Majority (84.75%) of the growers used feature phones for daily use, hence the knowledge of internet usage was considerably low (9.17%).

Similarly, the agents were subjected to a questionnaire about their ICT awareness and willingness to adopt ICT in the existing system. The results in percentage are shown in Table 2. Among agent's ICT awareness was found to be

considerably high. Majority (91.5%) of the agents used smartphones for daily transactions and usage. Most of the agents (92.6%) were active on social networking applications available on smartphones. Significant ICT awareness among agents and the role they played in the enterprise provides ample opportunity for ICT interventions.

	Category	Percentage
Involvement of family members in Jasmine cultivation	Husband & Wife	45.64
	All	55
Total land used	Small (<2178 sq. Ft.)	43.33
	Medium (2178 - 4356 sq. Ft.)	36.67
	Large (>4356 sq. Ft.)	20
Average income per week	< ₹. 2000	71.7
	₹. 2000 – ₹.3000	16.52
	> ₹. 3000	11.78
Jasmine cultivation as a source of income	Primary	51.9
	Secondary	48.1
Jasmine cultivation as a source of employment	Full time	46.17
	Part time	42.16
	Hobby	11.67
Availability and Usage of smartphones	Personally	15.25
	Someone in family	84.75
Internet access and usage	Yes	9.17
	No	90.83
Contacting Agents/traders for price details	Calls	88.64
	SMS	11.36
Knowledge of using computers	Yes	4.7
	No	95.3

Source: own research and processing

Table 1: Socio-economic impact and ICT awareness among growers. (N=240).

	Category	Percentage
Type of phone used	Smart phone	91.5
	Featured phone	8.5
Knowledge to use SMS facility	Yes	100
	No	0
Mode of Contact with respect to Farmer/ Trader	Call	100
	SMS	0
Usage of Mobile Banking services	Yes	1
	No	99
Use of social networking using mobile phones.	Yes	92.6
	No	7.4
Online purchases using mobile phones.	Yes	4.3
	No	95.7
Knowledge of using computers	Yes	5.3
	No	94.7
Opinion on whether they will use mobile app to automate their current process	Yes	87
	No	13

Source: own research and processing

Table 2: ICT awareness and willingness to adopt ICT among agents. (N = 95).

Identification of challenges

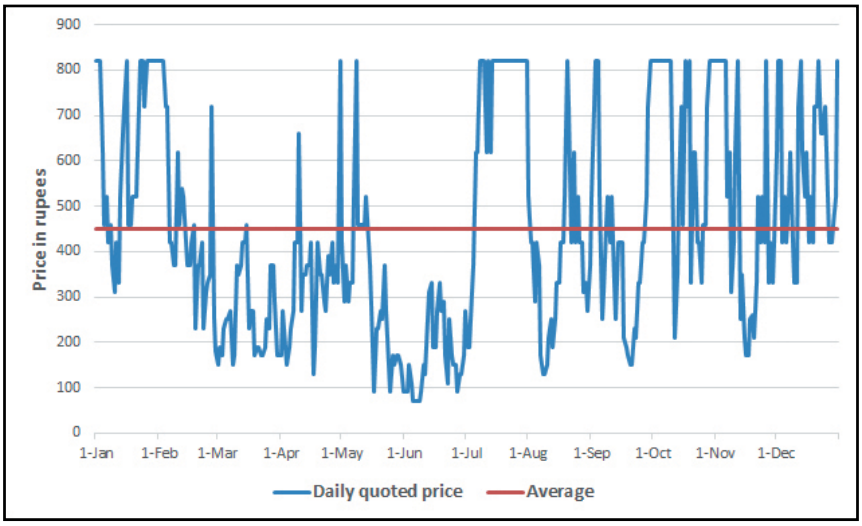
1. Generally, 88.64% of communication between the growers and agents/traders is done through calls and usually it's for price information which is quite difficult to manage on daily basis. Growers lively hood depends on the price that they get on the jasmine production for that day. For more than half (51.9%) of the correspondent's jasmine cultivation serves as primary source of income. Growers have no control on the price decision, collection and on the distribution of jasmine trade. Decision on the price for that day lies entirely on the six traders which leaves the grower particularly exposed. This makes the growers condition particularly vulnerable. While taking the daily price for one "atte" (bundle) of jasmine for the year 2016 (Graph 1), it was seen that maximum price received was ₹. 820 and minimum was ₹. 70. So, on an average, grower gets a sum of ₹. 448 (SD=235.12). Price fluctuation is major cause of worry as this impacts the socio-economic status of growers.
2. There are no digital records of information of jasmine grower and daily jasmine production. Electronic data storage is more efficient and important for reasons such as policy making, timely intervention in farming practices etc.
3. Agents find it difficult to manage data such as amount to be paid to growers, quantity of jasmine produced on daily basis etc., as the data is stored on a hard copy. Digitizing records is an essential step in moving towards harnessing the potential of ICT.

ICT as a solution

The rate at which technology innovations like the internet information is adopted by consumers constitutes an important part of the technology change or integration (Jamaluddin, 2013). Availability of timely information can enhance quality decisions made by farmers on what crops to grow given the preceding weather conditions, resources available, and market place supply chain. The use and availability of ICT can be used to improve agricultural productivity of farmers (Glendenning and Ficarelli, 2011). It is strongly believed and has been demonstrated that ICTs, primarily mobile phones, have the potential to reduce information asymmetry and can play a role in facilitating the adoption of technologies community (Ali and Kumar, 2011). ICT can be used as an effective tool to cater to the challenges found in the study.

Communication between growers and agents/ traders

Communication is a corner stone for any enterprise to flourish. Majority (88.64%) of the growers used call feature as a primary source of contact. This is tedious on daily basis for the agents and traders to receive calls and communicate during the peak working time. Price updates can be given to growers through a mobile application but only 15.25% of growers used smart phones personally. When most of the growers use feature phones, sending SMS to all the growers regarding price information seemed to be a more viable solution.



Source: own research and processing

Graph 1: Jasmine price variation in the year 2016.

This can be achieved using a SMS application, based on python using raspberry pie. GSM Module is interfaced to raspberry-pie to send SMS to growers on prices daily as soon as the price is decided. The same information can also be stored in the system for future analysis. The entire SMS module is cost effective to build and can be easily deployed.

Need to create demand for a stable price

Presently the system relies heavily on the 6 traders for demand and fixing of price. Price fluctuations (as discussed in identification of challenges) is a major cause of worry as it has a significant impact on the socio-economic development of growers. Along with the traders if the agents too can quote their demand then price fluctuations can be minimized. Demand can be increase if product is made available for a larger set of customers.

ICT gives an opportunity (with finite framework investment) to link individual actors in the jasmine growing chain together irrespective of their location. This has the potential to increase market access through online transactions exposing the market to a wide range of customer across geographic locations. E-Commerce may offer solutions by integrating individual actors to improve organizational structures. Many aspects of business, even at the farm level, may be managed through the Internet. The advantage of an e-Marketplace is their ability to replicate offline behavior online. This is achieved by offering a range of applications tailored to meet the needs of both target buyers and sellers (Paul. 2001). An e-commerce model for jasmine can be developed where jasmine will be available for general customers online as well as retailers of other districts and states. Using the available data from the study conducted e-commerce model can be easily developed.

Digital repository

One of the biggest benefits agricultural community can get is through statistical analysis of growing pattern, increase or decrease in production of their agricultural products. The present system does not have a database of Jasmine farmers and their agricultural output.

There are two ways to create and maintain this database using ICT:

1. Involve Jasmine growers to update their daily agricultural outputs.
2. Involve agents to update the grower's agricultural outputs.

Involvement of grower poses several practical difficulties:

1. ICT awareness among farmers is very less. Majority (84.75%) of the growers do not use smart phones and nearly 90.83% them do not know about internet usage.
2. There is no motivational factor for them to update flower quantity data on daily basis as it is not necessary for them.
3. It's practically difficult to identify all farmers and persuade them to give this information.

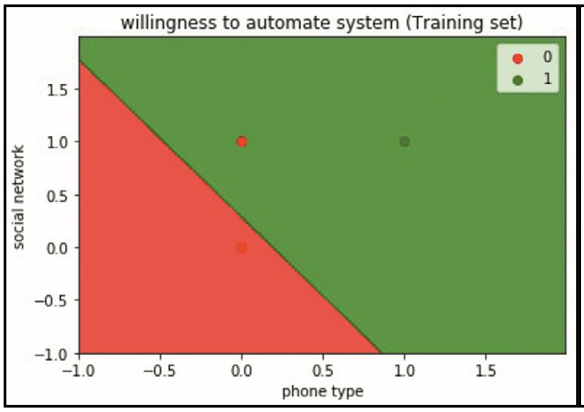
On the other hand, involving the agents would be a better approach. The following reasons can be taken into considerations of taking this approach:

1. The agents collect information about the daily quantity of jasmine produced by the growers. Although this data is in written format it can be converted into digital format.
2. Nearly 91.5% of the agents use smartphones and they have significant level of awareness in usage.

To classify and predict the willingness of agents to automate the existing system using ICT, Logistic regression and K-NN classifier machine learning algorithms was used on the data set. The results are shown in Figure 1 and Figure 2.

Logistic Regression model was used, where phone type and social network vs willing to automate are taken as variables. Here phone type and Social network are taken as independent variables and willingness to automate is taken as dependent variable. The result is shown in Figure 1. Similarly, in Figure 2, shows the graph where K-NN model is used. Here phone type, the average of the all the other variables except willingness to automate are considered as weights and are taken as independent variables. Willingness to automate is taken as dependent variable. From both the prediction models (Figure 1 and 2) there is a clear (green section) indication that the probability for the willingness of agents to use ICT to automate the existing system. To automate the system a mobile application can be developed that will assist them in their daily work with respect to Jasmine. The application will give reports such as sales, money to be given to farmers etc.

Information about jasmine growers, quantity of jasmine grown by them and price can be tracked using a backend database of the mobile application. This data can be used to have complete information on the jasmine output in the district



Source: own research and processing

Figure 1: Logistic Regression model for phone type, social network vs willing to automate.

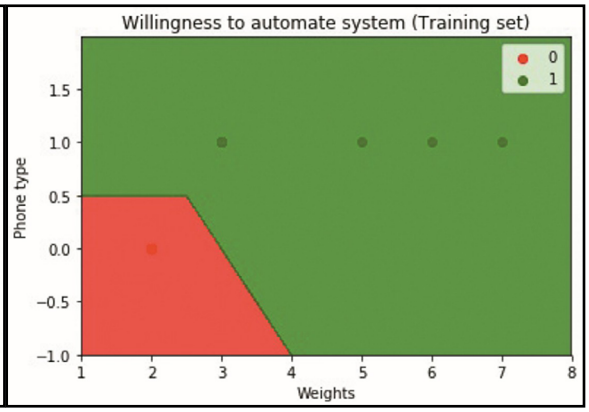


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Figure 2: K-NN model for phone type, weights vs willing to automate.

for each grower. The data can be used to monitor each grower and timely intervention can be given if there are negative variations in the growing pattern. This is valuable for government policy building so that a fully-fledged strategy is formed to harness ICT's potential for assisting overall development.

Conclusion

There is a positive correlation between price and the livelihood of the jasmine growing community. For most of the people jasmine growing community jasmine cultivation has an influence in the economics of their daily life. Jasmine cultivation has a significant socio-economic impact on Udupi jasmine growing community. This community-based enterprise has been facing some significant challenges. While there is a substantial ICT awareness among the agents and growers, ICT has not been used to overcome the challenges faced. The correspondents involved still use crude techniques in communicating and storing information. With India moving rapidly ahead with digital literacy in all spheres, use of ICT in agriculture is the need of the hour. With the identification of the challenges involved, the study suggests the possible ICT solutions to overcome these challenges. If these solutions are used effectively a complete effective ecosystem can be created that can work as a single system.

With the help of the study conducted future scope would be:

1. To build and develop a model for mobile application for the agents and price SMS module for growers for efficient dissemination of information.
2. Build an e-commerce model exclusive to market Udupi jasmine. While there have been successful Indian ICT projects in agriculture like Gyandoot, iKisan, e-Choupal, TARAhaat etc., the protentional of e-commerce in marketing agricultural product is yet to be explored. Agricultural e-commerce models cannot be similar to other the traditional of e-commerce models. It needs to evolve based on the geographical area, policies governing that area, entities involved in the production and distribution of that agricultural crop. Although agriculture e-commerce development is facing several challenges, the development of agriculture and new e-business models, e-commerce will have more application in agricultural production and business activities. Thus, an e-commerce model for jasmine, will help in building a web application which will provide a market to a wide range of consumers.

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Food-Biofuels Interactions: The Case of the U.S. Biofuels Market

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Abstract

Corn refers to the main feedstock for U.S. biofuels production and together with soybean oil, as typical biofuel food commodity that can be converted into biodiesel, accounts for over 90 percent of biofuels production in the United States. The paper focuses on the nexus of agri-food and energy markets in U.S. and investigates the interrelationships between the biofuel prices and prices of soybean oil, corn and wheat. Co-integration analysis and vector error correction model are carried out in order to investigate the relationship between the price series. The results show that biofuels and food price levels are co-integrated in the long run. These links show that food prices increment with a rise in biofuels prices. Additionally, not only food prices are determined by biofuels prices, but also vice versa.

Keywords

Biodiesel, biofuel, co-integration, ethanol, price.

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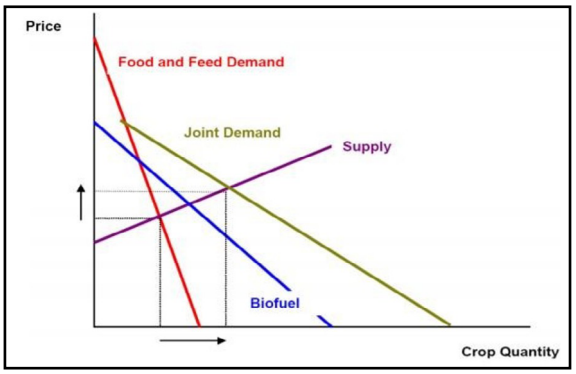
Introduction

In recent years, the role of biofuel in the determination of high agricultural commodity prices has become one of the ongoing issues debated by energy, environmental and agricultural economists interested in the question of the sustainable development of biofuels (Bentivoglio and Rasetti, 2015). Later on, Bentivoglio et al. (2016) add that the issue of food-biofuels interactions gained a new dimension and the research on price interdependencies between food, energy and biofuel markets has become a frequently debated topic since the food crisis.

Chakravorty et al. (2015) mention that biofuels have been blamed universally for past increases in world food prices, and many studies have shown that energy mandates in the United States and European Union may have a large (30 – 60 percent) impact on food prices. Alexander and Hurt (2007) state that the primary impact of biofuels on food inflation is from increases in the farm prices of commodities that contribute to producing our food supply, like corn, soybean meal, soybean oil, wheat, barley, and oats. Condon et al. (2015) conduct a meta-analysis to identify the factors that drive the variation in crop price impacts and add that the baseline and policy ethanol volumes, projection year, inclusion of ethanol co-products, biofuel production from other feedstocks, and modelling framework explain much of the differences in price effects across studies and scenarios. Pfuderer and Castillo (2008) show how new biofuel demand will shift the food and feed demand curve outwards, resulting not only in higher feedstock output but also higher prices (Figure 1).



Source: Pfuderer and Castillo (2008)

Figure 1: Food crops´ demand and supply.

On the other hand, Baier et al. (2009) estimate that the increase in world biofuels production accounts for just over 12 percent of the rise in global food prices, with increased U.S. biofuel production accounting for roughly 60 percent of this total increase and conclude that nearly 90 percent of the price increase in global food prices is due

to factors other than biofuels production. Flammini (2008) says that the persistent critique of biofuels' impact upon global food price increases depends upon a number of factors and not least natural constraints, markets and policies development and, importantly, upcoming pipeline technologies. Moreover, the different projections of the impact of biofuel production on food prices are difficult to resolve due to the specific assumptions underlying each model, the scope of the studies, their time horizon, the choices of different policy scenarios, or even more simply the definition of "food prices" and of aggregate commodity prices, as noted by Gerber et al. (2008). Also Ajanovic (2011) finds out that within the period 2000 - 2009 the volatility of feedstocks prices has not been only the consequence of continuously increasing biofuels production, but the largest part of these volatilities was caused by other impact parameters such as oil price and speculation. Furthermore, Zilberman et al. (2013) demonstrate that biofuels have not been the most dominant contributor to the recent food-price inflation and different biofuels have different impacts. Hochman et al. (2012) show that although biofuel was an important contributor to the food-price inflation of 2001–2008, its effect on food-commodity prices declined after the recession of 2008/09. Kristoufek et al. (2012) show that ethanol is positively affected by corn and it causes changes in the US gasoline, but not vice-versa. Additionally, their results confirm that biodiesel is very strongly influenced by German diesel prices and also by soybeans prices. Other studies related to the U.S. evidence of biofuel and food price interactions are presented in Table 1.

The biofuel market in U.S.: An overview

As stated by Trujillo-Barrera et al. (2012), policy has played a crucial role in stimulating biofuel

Author (year)	Data	Time period/ Methodology	Results
Bastianin et al. (2016)	ethanol corn soybeans wheat cattle	Jan. 1987- Mar. 2012 Granger causality test	no evidence that ethanol returns Granger cause food price variations; ethanol is Granger caused and can be predicted by returns on corn; no linkages between ethanol and cattle
Serra et al. (2010)	ethanol corn	daily futures Jul. 2005 - May 2007 STVECM	the existence of long-run relationships and strong links among the prices
Filip et al. (2016)	ethanol corn wheat sugarcane sugar beets	weekly prices 2003 -2016 Minimum spanning trees	feedstock commodities lead the prices of U.S. ethanol, and not vice versa
Gardebroek and Hernandez (2013)	ethanol corn	weekly prices Sep. 1997 – Oct. 2011 MGARCH	significant volatility spillovers from corn to ethanol prices but not the converse
Saghaian et al. (2018)	ethanol corn	daily, weekly, and monthly futures prices Jan. 2007 – Nov. 2015 BEKK-MGARCH	asymmetric volatility-spillover effects between food and biofuel markets; these effects were bidirectional, going both ways from biofuel prices to food prices and vice versa, depending on the data frequency
Trujillo-Barrera et al. (2012)	ethanol corn	mid-week closing futures Jul. 2006 – Nov. 2011 VECM, MGARCH	volatility transmission is found from the corn to the ethanol market, but not the opposite
Zhang et al. (2009)	ethanol corn soybean	weakly wholesale prices Mar. 1989 – Dec. 2007 VECM, MGARCH	ethanol does not appear to influence the long-run equilibrium level of corn and soybean prices; ethanol prices may potentially cause transitory short-run agricultural commodity price inflation
Drabik et al. (2014)	ethanol corn	2009 Monte Carlo analysis	biofuels affect the price transmission elasticity in the food chain compared to a no biofuel production situation but the effect depends on the source of the market shock and the policy regime

Source: authors´ processing

Table 1: Literature review.

production growth. The Energy Policy Act of 2005 took the first noticeable step towards building the biofuel industry in the U.S. by requiring a specific amount of ethanol to be consumed as fuel, which was followed by the Energy Independence and Security Act of 2007 (EISA 2007) establishing the Renewable Fuel Standard (RFS) that set the apportioned mandated quantity for the different feedstock (Hochman et al., 2017). The Energy Independence and Security Act modified RFS1 and enacted the second and most recent RFS program, called RFS2, in order to differentiate among different types of renewable feedstock depending on whether it was cellulosic biofuel, biomass-based diesel, advanced biofuel, or renewable fuels (Adusumilli and Leidner, 2014). Additionally, RFS2 increases the mandated usage volumes and extends the time frame over which the volumes ramp up through at least 2022 (e.g. the mandate grows from a minimum of 9.0 billion gallons of total renewable fuels in 2008, to minimum volume of 36 billion gallons per year by 2022) (Schnepf and Yacobussi, 2013). The U.S. fiscal incentives and mandates are different from state to state and they are complemented by those at the federal level (Janda et al., 2012). U.S. Federal policy incentivizes biofuel production using three main instuments: (1) offering tax credits to biofuel blenders; (2) imposing import duty on fuel ethanol; and (3) offering direct payments to producers of non-corn biofuel feedstocks and to biofuel manufacturing facilities toward purchasing biomass (Adusumilli and Leidner, 2014). The Volumetric Ethanol Excise Tax Credit (VEETC), known as the "ethanol blenders' credit", was the major federal tax incentive that supports the use of ethanol and expired at the end of 2011 (Diggs, 2012). The tax credits included in VEECT were: (1) an import tariff of 0.54 USD per gallon aimed to offset the ethanol blending tax credit, so that only domestic ethanol producers would benefit from credit and to prevent large-scale direct import from Brazil; (2) a 0.45 USD per gallon credit of pure ethanol blended with gasoline to blenders of ethanol provided as an incentive to encourage ethanol use in gasoline after the renewal of the VEETC under the Farm Bill in 2008 (U.S. Energy Information Administration, 2012; Wu and Langpap, 2015; Monteiro et al., 2012). The biodiesel market remains much smaller than the market for ethanol, though its rate of growth has been faster (The federal biodiesel blender's tax credit, valued at $1 per gallon, expired several times, most recently at the end of 2016 (U.S. Energy Information Administration, 2017).

The paper intends to contribute to the better understanding of the transmission of biofuel prices to food commodity prices by using time series econometric methods. The paper focuses on the nexus of agri-food and energy markets in U.S. with the aim to confirm or refute that biofuels are contributor to the food prices through the farm prices of commodities that contribute to producing the food supply as well as interrelationships between biofuel and agricultural prices are investigated. Another contribution of our paper is that our study is extended to the research not only focusing on ethanol – corn nexus, as many studies are dealing with, but also on the price relationship between ethanol –wheat and biodiesel - soybean oil. The paper is structured as follows: Section 2 (Materials and methods) presents the methodology approach, performed to estimate price relationships, as well as data needed for analysis are described. The empirical results are presented in Section 3 (Results and discussion) and conclusion is provided in Section 4.

Materials and methods

Corn, soybean oil and wheat refer to typical biofuel food commodities that can be (and have been) converted into biofuel and whose price links with biofuels (biodiesel, ethanol) are investigated in the paper. Monthly prices of ethanol (USD/gallons), biodiesel (USD/gallons), corn (USD/metric ton), soybean oil (USD/metric ton), wheat (USD/metric ton) are collected over the period January 2007 to February 2017. The food prices as well as prices of biofuels are extracted from United States Department of Agriculture (National Agricultural Statistics Service).

Time series model is an appropriate technique to study causal linkages between biofuels and food prices and to evaluate price level connections using co-integration analysis and Vector error correction model (VECM) (Bentivoglio, 2016; Hassouneh et al., 2011).

In order to avoid incorrect inference, as a result of failure to meet the assumption of stationarity, it is important to take properties of the data into account (Johansen, 2012). Hence, the stationarity of the time series is investigated. A time series is considered stationary, when its mean, variance and auto-covariance are not influenced by time; however, most economic time series have nonstationary characteristics because they exhibit trend, seasonality or other cyclical fluctuations (Katrakilidis et al., 2015).

Non-stationarity means presence of unit roots, thus a variable contains a unit root if it is non-stationary (Kharin, 2018). Differencing the time series, that contains a unit root, is often used to render it stationary (Box and Jenkins, 1976). A procedure for testing non-stationarity based on the presence of a unit root was developed by Dickey and Fuller (1979). The augmented version of original Dickey-Fuller test (Dickey and Fuller, 1981) is one of the best known and most widely used approach to determine a unit root in a time series sample under the hypotheses H0: I (1) (presence of unit root - the series is nonstationary) versus H1: I (0) (absence of unit root – the series is stationary), and it allows testing of higher orders of autoregressive processes. The Augmented Dickey-Fuller (ADF) test is based on the following form:

$$y_t = \mu + \beta t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \, y_{t-1} + \varepsilon_t \qquad (1)$$

where μ is the constant, β is the coefficient on the time trend, k is the lag order of the autoregressive process, y_{t-i} is the lagged difference of y whose magnitude is measured by c and ε is the error.

If the series of the variables are integrated of the same order, Johansen co-integration test is performed for finding the presence of a long-term relationship (co-integrating vector) between the selected time series (Kapusuzoglu and Karacaer Ulusoy, 2015). The analysis of cointegration and model based inference in the vector autoregressive framework was introduced by Johansen (1988). The evidence of co-integration between food and fuel price series means that two series (commodity price series) ´move together´ over time towards equilibrium (Bracco, 2017; Bakhat and Würzburg, 2013). Johansen's method takes as a starting point the vector autoregression (VAR) of order p given by:

$$\mathrm{Y_t} = \Pi_1 \mathrm{Y_{t-1}} + \Pi_2 Y_{t-2} + \ldots + \Pi_p Y_{t-p} + u_t \quad (2)$$

where Y_t is an n×1 vector of variables that are integrated of order one, that is, I(1), u_t is an n×1 vector of innovations while Π_1 through Π_p are m×m coefficient matrices. Johansen (1991) defines two different test statistics for indicating the number of co-integrating relations: the Trace Test and the Maximum Eigenvalue Test. The Trace test is a joint test that tests the null hypothesis of no co-integration (H_0: r = 0) against the alternative hypothesis of co-integration (H_1: r>0). The Maximum Eigenvalue test conducts tests on each eigenvalue separately. It tests the null hypothesis that the number of co-integrating vectors is equal to r against the alternative of r+1 co-integrating vectors.

However, co-integration does not reveal anything about the direction of causality (Avalos, 2014; Ciaian and Kancs, 2011). Thus, VECM is applied in order to evaluate the short run and long run properties of the cointegrated series (Obadi, 2014). The standard VECM is considered according to the following equation (Bentivoglio et al., 2016):

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \, \Delta Y_{t-i} + v + \varepsilon_t \qquad (3)$$

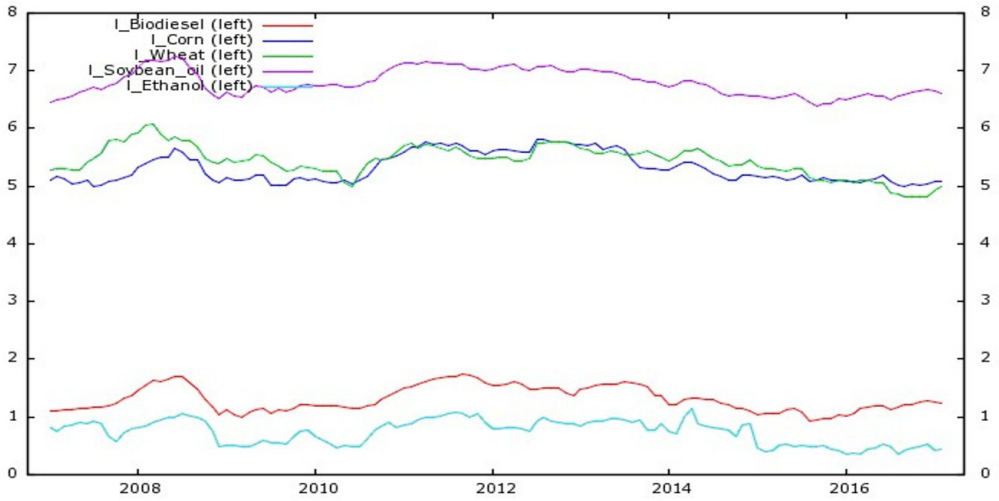
where Y_t is an m x 1 vector of variables as in a VAR; ΔY_t is an m x 1 vector of the first differences of the variables in Y_t; Y is an m x 1 vector of intercept coefficients; Π and the Γ_i are m x m coefficient matrices; ε_t is an m x 1 error vector with contemporaneous correlation, but no autocorrelation, like the error vector in a VAR. The Π matrix can be decomposed as $\Pi = \alpha\beta'$ with β, namely the cointegrating vector, describing a long run equilibrium and α gives the speed of adjustment with which prices return to the long run equilibrium (or error correction term ECT) (Cabrera and Schulz, 2013). A high absolute value for α, indicates a high speed of price adjustment and a more efficient market (Growitsch et al., 2013). Since the prices are expressed in logarithms, the coefficient β is the long-run elasticity. The long-run causality is tested by the significance of the speed of adjustment (α) in the equations (weak exogeneity test). Schreiber (2011) explains that weak exogeneity means that a variable is not (Granger-) caused by others in the long run. Once a number of variables are found to be cointegrated, then in the short run, deviations from this long-run equilibrium will feed back on the changes in the dependent variable in order to force the movement towards the long-run equilibrium (Bekhet, 2009).

Results and discussion

The econometric models, mentioned earlier, provide an alternative way to estimate the effect of biofuels price on food price. In the past decade, the prices of most agrarian commodities reached the historic maximum in 2007 - 2008. This situation, apart from climatic, production conditions was affected by the development of biofuel production (a decline in world cereal stocks), which has increased demand for cereals, oilseeds

and sugar cane for non-food use and encouraged farmers to increase their offer on domestic and international markets. Prices of most agricultural commodities began to decline again as a result of the consolidation of world cereal stocks and the onset of the economic recession at the end of 2008. Food prices have moved in a close relationship with biofuels prices apart from 2012 and the first two-thirds of 2013 when drought sharply reduced supplies (see logarithmic transformations of prices from January 2007 to February 2017 in Figure 2). Furthermore, ethanol production experienced slowdown at the rates of prior years because of the saturation of the U.S. gasoline market with E10 coupled with less-favourable export markets during 2012 - 2013. Irwin and Good (2017) explain that biodiesel prices were pushed up substantially due to diesel blenders racing to take advantage of the $1 per gallon biodiesel tax. The price of soybean oil could increase sharply in 2018 as a result of US anti-dumping action against vegetable oils for biodiesel produced by Argentina and Indonesia (Gyekye, 2017).The summary of descriptive statistics is shown in Table 2. In the next step the stationarity properties of the series will be discussed followed by the co-integration analysis.

The standard test proposed by Dickey and Fuller in its augmented form (ADF) is used in order to investigate the stationarity/non-stationarity properties of the selected price series. The ADF test tests the null hypothesis of a unit root process against the alternative of a stationary process. In our case, null hypothesis of ADF test is confirmed meaning that the level of price series has a unit root i.e. are integrated of order 1. On the contrary, the ADF provides evidence of stationarity of the first differences of the time series (Table 3). All tests are carried out without constant or including either just a constant, or a constant and a trend in the test equation. The lags of the variables were determined by Akaike criterion, Schwartz



Source: authors´ processing based on National Agricultural Statistics Service

Figure 2: Food and energy prices, January 2007 – February 2017 (logarithmic transformation).

	Ethanol	Biodiesel	Corn	Soybean oil	Wheat
Mean	2.14149	3.80746	210.092	920.295	238.76
Median	2.21000	3.44625	179.215	860.820	237.70
Minimum	1.42000	2.55000	147.130	590.250	122.51
Maximum	3.15000	5.74200	332.950	1414.42	439.72
Std. Dev.	0.441215	0.852418	57.2397	214.518	63.043
C.V.	0.206032	0.223881	0.272450	0.233097	0.26405
Skewness	0.00951078	0.727826	0.727826	0.478245	0.43755
Ex. kurtosis	-1.19141	-0.979234	-0.979234	-1.06046	0.28773

Source: authors´ processing

Table 2: Descriptive Statistics.

		ADF test		
	Lag	without C	C	C&T
Ethanol	1	-0.765411	-1.96732	-2.22747
Biodiesel	2	-0.480151	-2.58669	-2.71352
Corn	1	-0.515662	-1.69147	-1.71287
Soybean oil	2	-0.516727	-2.50135	-2.96652
Wheat	1	-0.69215	-2.11946	-2.97522
d_ethanol	1	-9.91265***	-9.885***	-9.85316***
d_biodiesel	1	-5.38551***	-5.36234***	-5.36495***
d_corn	1	-6.44123***	-6.41346***	-6.44047***
d_soybean oil	1	-5.46871***	-5.44419***	-5.48522***
d_wheat	1	-7.3663***	-7.33834***	-7.38793***

Note: "C" and "C&T" indicate whether a constant and a constant and a trend have been respectively included in the test equation; *** null hypothesis of non-stationarity rejected at 1% significance level

Source: authors´ processing

Table 3: Augmented Dickey- Fuller test.

Bayesian criterion and Hannan-Quinn criterion.

Cointegration test could be used for testing long run relationship of the time series because of proving non-stationarity of the level of variables by the above stationarity test (ADF test). Co-integration is tested by Johansen trace test and L-max test, where the null hypotheses of no co-integration (r = 0) are rejected at 5% significance level, whereas the null of r = 1 cannot be rejected, thus the test gives an evidence for a long run relationship between the price series. The co-integration test confirms the presence of one co-integrating vector for the selected price pairs (Table 4).

The prices are transformed into natural logarithms for the estimations, since the long-run coefficients can then be interpreted as long-run price transmission elasticities (Busse and Ihle, 2009). The coefficients in the long-run relationship are long-run elasticities. Thus, 1 percent increase in biodiesel price leads to 1.16 percent increase in the price of soybean oil (Table 5). On the contrary, the co-integrating parameter is 1.77 for the corn-ethanol price pair, implying that 1 percent rise in price of ethanol will bring about, in the long run, a 1.77 percent increase in the price of corn. Co-integration vector has a following form in wheat-ethanol price pair: (1.0000; -1.3609), meaning that an increase in price of ethanol by 1.00 percent results in a rise of wheat price by 1.36 percent. Adjustment coefficient α represents the error correction term. The adjustment parameter of the corn error correction model is statistically significant and corn prices adjust to a change in ethanol prices by 9.9 percent in one month. The estimated coefficient α of the ethanol error correction model is also positive and statistically significant, meaning that maize prices are determined by ethanol prices and vice versa, with a long run bidirectional causal effect which runs from one price to another. Similar findings are confirmed by Merkusheva and Rapsomanikis (2014) who consider corn as quasi-fixed input in the production of ethanol, and thus its price can influence the price of ethanol. Saghaian et al. (2018) also show that corn-ethanol links exist and corn and ethanol price volatility influence each other. Given a change in the corn price, ethanol prices respond to a change in corn prices fast and adjust to a change by 22 percent each month. The alfa parameter is statistically significant for both variables in case of wheat-ethanol system. About 17 percent of the disequilibrium is corrected within one month in case of wheat. The relationship between wheat and ethanol prices is simultaneous. According to Allen et al. (2017), price movements in agricultural commodities (corn, wheat) are related to the prices of ethanol and these linkages vary according to whether they are in low or high volatility regimes. The error correction coefficient of biodiesel is negative and significant at 5 percent level. Soybean oil prices as well as biodiesel prices adjust to their long-run path by 31 percent each month. The relationship for soybean oil-biodiesel price pair is also simultaneous, the biodiesel price drives that of soybean oil, but also vice versa. The empirical results of Carriquiry (2015) indicates that the price of soybean oil does not have a strong direct impact on the price of biodiesel in the short run, however, the study did not attempt to analyse whether the price of biodiesel affected that of soybean oil. On the other hand, Busse et al. (2010) found evidence for the influence in relation

	Hypothesized no. of co-integrating equation(s)	L – max test	Trace test
Ethanol – Corn	r=0**	14.815	17.368
		(0.0393)	(0.0282)
	r=1	**2.5528**	**2.5528**
		(0.5929)	(0.5929)
Ethanol – Wheat	r=0**	13.78	14.162
		(0.0302)	(0.0234)
	r=1	**0.38211**	**0.38211**
		(0.5993)	(0.6076)
Biodiesel – Soybean oil	r=0**	22.551	30.827
		(0.0219)	(0.0276)
	r=1	**8.2981**	**8.2981**
		(0.2676)	(0.2641)

Note: **denotes rejection of the hypothesis at 5 % significance level; p-values are given in parentheses ()

Source: authors´ processing

Table 4: Johansen cointegration test.

	α adjustment coefficient	β co-integrating vectors	Constant
Δsoybean_oil	0.312848*	l_soybean_oil 1.0000	-1.65360**
Δbiodiesel	-0.315790**	l_biodiesel -1.1640	1.67738**
Δcorn	0.0989273**	l_corn 1.0000	-0.398943**
Δethanol	0.220637***	l_ethanol -1.7725	-0.888609***
Δwheat	-0.171532***	l_wheat 1.0000	0.758232***
Δethanol	0.100318*	l_ethanol -1.3609	-0.448981*

Note: ***/**/* statistically significant at the 1% 5% and 10% levels

Source: authors´ processing

Table 5: VECM.

Equation	Diagnostic test			
	Unadjusted R^2	Normality of residuals	ARCH test	Breusch -Godfrey test
Δsoybean_oil	0.73652	0.512156	0.964784	0.202463
Δbiodiesel	0.87755		0.801994	0.195568
Δcorn	0.697842	0.569274	0.973204	0.344744
Δethanol	0.706623		0.889009	0.124104
Δwheat	0.323228	0.00208567	0.285868	0.205473
Δethanol	0.42279		0.799891	0.217322

Source: authors´ processing

Table 6: VECM diagnostic checks.

between biodiesel and soybean oil in Germany, while the influence of soybean oil prices appears to be higher than that of biodiesel prices.

The diagnostic tests of VECM equations are computed in order to check autocorrelation (Breusch-Godfrey test), heteroscedasticity (ARCH test) and whether the residuals are normally distributed (Table 6). The models are considered as stable and reliable, do not include autocorrelation according to the Breusch-Godfrey test and the ARCH test indicates that the null hypothesis of homoscedasticity was accepted for all equations.

The null hypothesis that the residuals are normally distributed is accepted for soybean oil – biodiesel and corn – ethanol equation.

Conclusion

The paper investigates price relationship in the food-biofuel nexus using time series modelling. Corn, soybean oil, wheat refer to typical biofuel food commodities that can be (and have been) converted into biofuel and whose price links with biofuels (biodiesel, ethanol) are investigated in the paper. The results of Johansen co-integration test provided an evidence for a long run relationship between feedstock and biofuels prices. Co-integrating parameters showed that implying rise in price of biofuels would bring, in the long run, an increase of the farm prices of the selected commodities that contribute to producing the food supply. Thus, biodiesel and ethanol have a positive impact on food prices. However, the results of weak exogeneity test also showed a long run bi-directional causal effect which runs from one price to another, indicating that not only the prices of biofuels drive food prices, but also vice versa. Furthermore, the speed of the reaction of corn, wheat prices upon the deviation of the system from the state of equilibrium is low in comparison to soybean oil prices that adjusted to their long-run path by 31 percent each month.

Our findings contribute to the current discussion about the biofuel-food nexus and brings new evidence on price interdependencies between food and biofuel markets that have become a frequently debated topic since the food crisis. Our findings are in line with Irwin (2013) who argues that ethanol prices have largely driven corn prices since the start of the ethanol boom. He adds that this does not mean that other factors have not also been important at times, such as weather, but, rather, that ethanol prices have consistently been the most important driver of corn prices at the margin since 2006. Zhang et al. (2009) also believe that fuel prices in general may potentially cause transitory short-run agricultural commodity price inflation. According to

Drabik et al. (2014) explain that the effect of biofuels on price transmission along the food chain depends also on the biofuel policy. It should be noted that Wisner (2014) also think that whether the corn-ethanol price relationship will be as close in the future as in the recent past will depend partly on whether the blend wall can be raised and domestic ethanol demand expands substantially in the years ahead. Therefore support system, aimed at the development of production and use of biofuels through standards that affect the proportion of bio-components in fuels used in a country, should not create an incentive to grow more e.g. corn as in case of U.S. Furthermore, the direct competition between food and biofuel, associated with the first generation of biofuels and their sustainability, could be solved by the increased development of second-generation biofuels produced from ligno-cellulosic feedstocks.

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Global Agri-food Trade Competitiveness: Gross Versus Value Added Exports

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Abstract

One of the most important features in the international trade over the recent decades has been the increased fragmentation of the production process. This has been facilitated, in part, by the development and maturation of global value chains (GVCs).The improved availability of value-added trade data allows us to identify more clearly what fragment in the production chain is internationally competitive in a particular country. The paper examines global agri-food export performance in the light of these changes with special emphasis on the impacts of economic crisis using the concept of normalised revealed comparative advantage (NRCA) in terms of both gross exports and value-added for 61 countries over period 1995 and 2011. Systematically comparing these distributions reveals significant differences for NRCA based on gross exports versus value-added data.

Keywords

Global agri-food trade, revealed comparative advantage, gross and value added exports.

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Introduction

The international fragmentation of production has attracted much recent attention both in international trade theory (e.g. Grossman and Rossi-Hansberg, 2008; Costinot et al., 2013) and empirical work (Feenstra and Hanson, 1999; Hummels et al., 2001; Johnson and Noguera, 2012; Baldwin and Lopez-Gonzalez, 2014; Timmer et al., 2013, 2014; Koopman et al., 2014). International trade in goods has evolved, especially during the last two decades from trading mostly goods destined for final consumption to trading intermediate goods destined as inputs for further processing at least once prior to final consumption either domestically or traded abroad. Laipis (2009) shows that the majority of agricultural trade can also be considered as trade of intermediate products as commodities. The rise of new global competitors and the development of GVCs have challenged the dominance of major players in (agri-food) trade. Ceglowski (2017) finds countries’ export competitiveness in the GVC industries looks different through the lens of domestic value added than on the basis of conventional measures of gross exports. She shows that there are significant differences in the degree of export competitiveness. There is growing literature on various aspects of the competitiveness of European agri-food trade (e.g. Bojnec and Fertő, 2015, 2017a; Carraresi and Banterlee, 2015) but the research on global agri-food market is still limited (Bojnec and Fertő, 2017b). However, all of earlier studies are employing gross exports data to calculate various competitiveness indicators. The paper is the first attempt to analyse the global agri-food competitiveness through the lens of value added exports data. The aim of the paper is to assess countries’ agri-food export competitiveness through recently developed measures of revealed comparative advantage (RCA) that facilitate comparisons across countries. product and time. It also expands the assessment of export performance in two important dimensions. First, it moves beyond measuring RCA based on gross exports by also calculating measures based on the domestic value added in foreign final demand. Second, we analyze systematically the differences between the two measures over the complete RCA distribution of agricultural and food exports separately.

Materials and methods

We employ the recently released Trade in Value-Added (TiVA) database published jointly by the OECD and the WTO. The TiVA database provides estimates of the value that is added by source in the production of goods and services for export, compiled from an international input–output model. It reports estimated dollar values of several measures of the value added in trade for 61 individual countries. a rest-of-the-world residual and the world as a whole. For each country in the database, each value-added measure is reported for an aggregate total and 18 constituent industry categories. These categories are industry-based because the estimates are constructed from underlying input– output tables that are organised at the industry level. Thus, the analysis of countries RCA pertains to industries, not products. According to NACE code within 18 industries we can identify two agri-food related sectors: agriculture, hunting, forestry and fishing (agriculture: AtB) and food. beverages and tobacco (food: 15t16). We use the TiVA measures for gross exports and the domestic value added in foreign final demand.

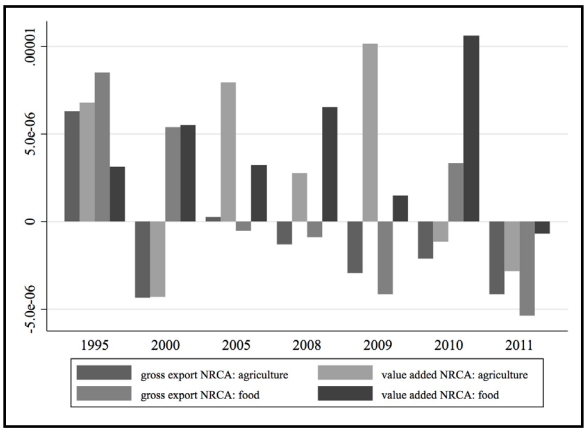
The most widely used indicator in empirical trade analysis is based on the concept of revealed comparative advantage (RCA) index, which was developed by Balassa (1965). and its variants. Despite some critiques of the RCA index as a static export specialisation index, such as the asymmetric value problem and the problem with logarithmic transformation (De Benedictis and Tamberi, 2004; Hoen and Oosterhaven, 2006), the importance of the simultaneous consideration of the import side (Vollrath, 1991), and the lack of a sound theoretical background (Leromain and Orefice, 2014), it remains a popular tool for analyzing export competitiveness in empirical trade literature. Recently, Yu et al. (2009, 2010) adopted an alternative measure to assess the dynamics of comparative advantage. utilizing the normalised revealed comparative advantage (NRCA) index to improve certain aspects of the original RCA index in static patterns in comparative advantage in order to create an appropriate export specialization index for comparison over space and the changes in comparative advantage and its trends over time. Yu et al. (2009) define the NRCA index as follows:

$$\mathrm{NRCA_{ij}} = \frac{\mathrm{E_{ij}}}{\mathrm{E}} - \frac{\mathrm{E_i}}{\mathrm{E}}\frac{\mathrm{E_j}}{\mathrm{E}} \qquad (1)$$

where E denotes total world trade, E_{ij} describes country i's actual export of commodity j in the world market, E_i is country i's export of all commodities and E_j denotes export of commodity j by all countries. If NRCA>0, a country's agri-food comparative advantage on the world market is revealed. The distribution of NRCA values is symmetrical, ranging from −1/4 to +1/4 with 0 being the comparative-advantage-neutral point. Because it evaluates deviations from a country's comparative-advantage-neutral point, the NRCA index avoids the original RCA's tendency to yield higher values for countries or products with small world shares (Yu et al., 2009). The index is additive; thus its value does not depend on the degree of aggregation. For our purposes, additivity also facilitates the construction of NRCA indices for the industry level aggregates. Due to these desirable properties, we employ the NRCA measure to assess countries' export competitiveness in the agricultural and food sectors. The NRCA indexes are calculated for both gross exports and domestic value added in foreign final demand for both agriculture and food sectors and each of the 61 individual countries over period 1995 and 2011. Note that the data are available only for following years: 1995, 2000, 2005 and 2008-2011.

Results and discussion

The evaluation has focused on a comparison of two different bases for measuring NRCA: a conventional basis using gross export values and a second based on the domestic value added in foreign final demand. The median values of NRCA indices fluctuate considerable year by year from negative to positive values (Figure 1).



Source: own calculations based on OECD TiVA database

Figure 1: Median values of NRCA indices by year.

Medians of value added NRCA are consistently higher than gross NRCA median

for both agriculture and food sectors, except 1995 in food sector. However, mean comparison tests and Wilcoxon signed rank tests are accept the equality of means and medians hypotheses between gross exports and value added NRCA indices (Table 1).

	t tests	Wilcoxon signed rank test
Agriculture	0.7705	0.8190
Food	0.8285	0.1119

Source: own calculations based on OECD TiVA database

Table 1: Mean and median comparison tests between gross export and value added NRCA indices (p values).

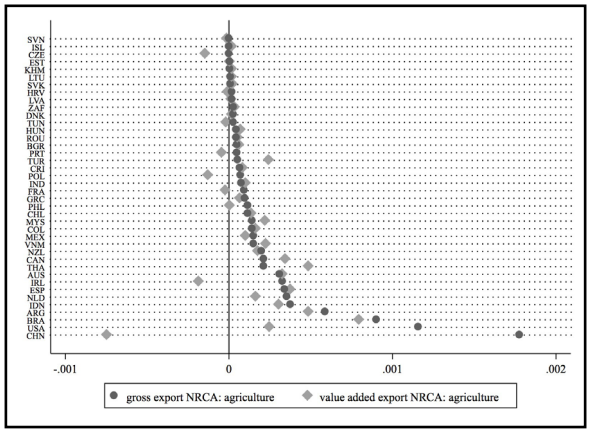
In addition, pattern of NRCA do not show clear trend during the analysed period. We simply divide the sample into two sub periods; pre-crisis (<2009), post-crisis (>2009). Kruskal-Wallis tests shows that there is not significant difference between sub periods for all of four indices (Table 2).

	Gross exports	Value added exports
Agriculture	0.7773	0.8190
Food	0.8899	0.7525

Source: own calculations based on OECD TiVA database

Table 2: Kruskal-Wallis tests (p values).

Now we restrict our attention on countries with comparative advantage based on gross exports. Best performing countries for agriculture are China, United States, Brazil, Argentina and Indonesia using gross export NRCA indices (Figure 2).

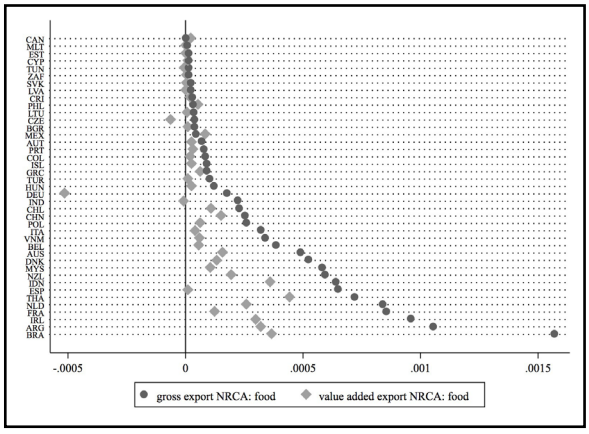


Source: own calculations based on OECD TiVA database

Figure 2: Median values of NRCA indices for agriculture by country.

However, the ranking of top countries are not necessarily coincides between gross exports and value added NRCA. For example, China is the best performing countries in terms of gross exports, but it lost its competitiveness in terms of value added. Similarly, one can observe relatively large gap between two indicators for the U.S.

Top five countries for food sector are Brazil, Argentina, Ireland France and Netherlands based on gross export NRCA (Figure 3). Note that China is in the middle of the rank, while the U.S. is not competitive in food sector. Furthermore, gross export NRCA indices are higher almost for all countries with comparative advantage. Visual inspection of Figure 3 also indicates that ranking based on two different indicators may not be necessary consistent. In other words difference between gross export and value added NRCA indices may larger at the country level as we can expect from the quick time series analysis. We investigate this issue later in more details.



Source: own calculations based on OECD TiVA database

Figure 3: Median values of NRCA indices for food by country.

Identifying strong and weak sectors

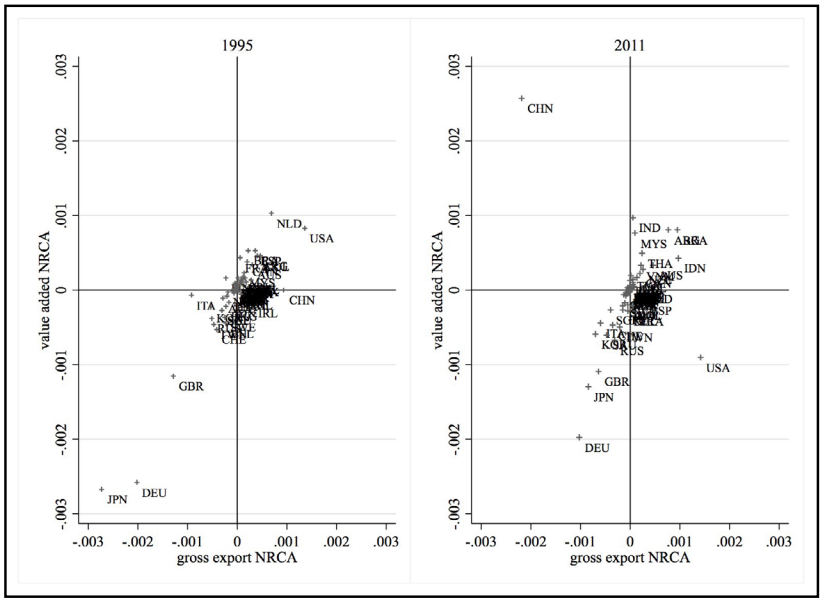
Following Brakman et al (2017) we identify four possible sector classifications. First, a sector may reveal to have a comparative advantage for both gross export RCA and value-added RCA; we label this sector strong – strong. Second. a sector may reveal to have a comparative disadvantage for both gross export RCA and value-added RCA; we label this sector weak – weak. Third, therefore a sector may reveal to have a comparative disadvantage for gross exports and simultaneously a comparative advantage for value added trade; we label this sector weak – strong. Finally, a sector may reveal to have a comparative advantage for gross exports and simultaneously a comparative disadvantage for value added trade; we label this sector strong – weak.

First, we employ the scatterplot of the agriculture aggregate for the entire sample of 61 countries to show country position based on both

NRCA measures in starting and ending years (Figure 4). Visual inspection of scatterplots indicate that majority of countries are lying around the diagonals with few exceptions (e.g. China and U.S in 2011). Top (strong-strong) countries in 1995 are Netherlands and U.S., whilst bottom (weak-weak) countries are Japan, Germany and UK.

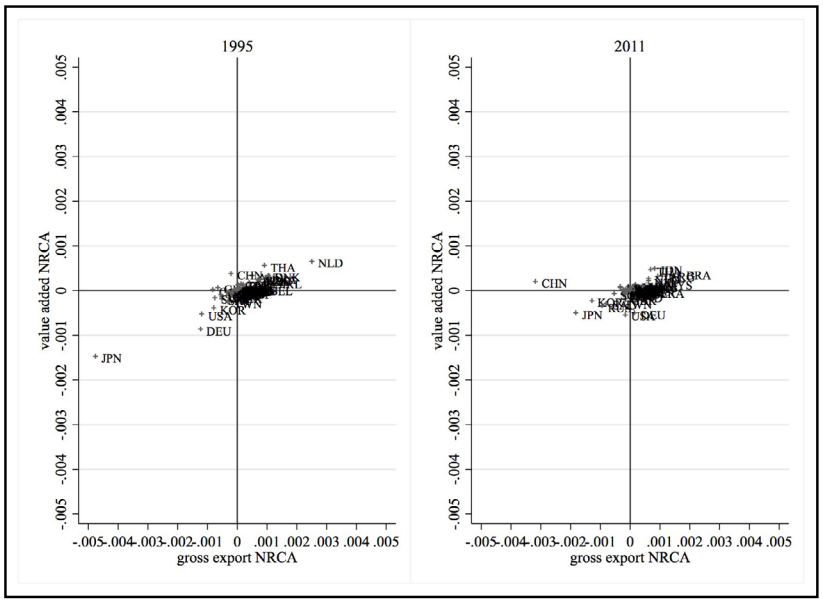
The situation has remained the same on the bottom part of rank, but one can observe considerable changes among top countries at the end of analyzed period. Most striking observation is that U.S. has lost its competitiveness in terms of value added and one can find emerging countries in the top performers including Argentina, Brazil, India, Indonesia Malaysia and Thailand.

The scatterplots are flatter for food sectors in both year indicating larger gap in values between gross exports and value added NRCA indices (Figure 5). Top (strong-strong) countries in 1995 are Netherlands and Thailand, whilst bottom (weak-weak) countries are Japan, Germany and U.S. The situation has slightly changed on the bottom part of rank, some countries were able to improve



Source: own calculations based on OECD TiVA database

Figure 4: Gross versus value added NRCA for agriculture.



Source: own calculations based on OECD TiVA database

Figure 5: Gross versus value added NRCA for food.

their relative position including Germany and U.S. Similarly to agriculture, emerging countries are performing even better.

Table 3 provides an overview of the sector classification for all countries over the period 1995 and 2011. The weak-weak class and strong-strong class covers the majority of observations in agriculture ranging between 70 and 83 percent altogether with considerably yearly fluctuations. Remaining part of observations are roughly evenly distributed between strong-weak and weak strong sectors. The picture is similar for food sector, with wider range in the share of weak-weak and strong-strong sectors (75-90). These classes include 80-95 percent of observations. The share of weak strong group is higher than strong-weak class.

Consistency between gross exports and value added based measures

Following Fertő and Hubbard (2003) we check the consistency of NRCA indices based on gross exports and value added exports. Ballance et al. (1987) suggest some simple statistical tests for examining the extent to which various RCA indices are consistent in their identification of comparative advantage. The usual interpretation of an RCA index is that it identifies the extent to which a country has a comparative (dis)advantage in a product. Ballance et al. (1987) offer two other interpretations: that the index provides a ranking of products by degree of comparative advantage; and that the index identifies a binary type demarcation of products based on comparative advantage and comparative disadvantage. Referring to these three interpretations as cardinal, ordinal and dichotomous. they suggest a test of consistency for each.

The consistency test of the indices as cardinal measures of comparative advantage is based on the correlation coefficient between paired indices in each of the seven years and the whole period (Table 4). For agriculture, of the seven possible pairings, five (1995-2009) show a high level of correlation (≥ 0.83). Estimations present low level of correlation coefficients for last two years inflating the correlation coefficient for total sample (0.60). This suggests that the indices are still relatively consistent as cardinal measures of comparative advantage. Our calculations suggest that NRCA indices of total sample are more consistent as a cardinal measure for food industry (0.74), with lower correlation coefficients within period except last two years.

The consistency test of the indices as ordinal measures is similar but based on the rank correlation coefficient for each pairing. Results show that the indices are slightly more consistent in ranking countries by NRCA for food industry than agriculture. The test of the indices as a dichotomous measure is simply the share of countries in which both of the paired indices suggest comparative advantage or comparative disadvantage. This test indicates that all two of our indices are reasonably consistent, with all cases being ≥ 80 per cent. Contrary to earlier tests, results are slightly better for food industry.

sector	period	weak-weak	strong-weak	weak-strong	strong-strong
agriculture	1995	45.9	9.8	9.8	34.4
	2000	34.4	11.5	11.5	42.6
	2005	31.1	21.3	8.2	39.3
	2008	39.3	9.8	8.2	42.6
	2009	32.8	16.4	6.6	44.3
	2010	39.3	9.8	9.8	41.0
	2011	37.7	8.2	11.5	42.6
	total	41.9	7.7	9.4	41.0
food	1995	49.2	1.6	3.3	45.9
	2000	44.3	8.2	3.3	44.3
	2005	42.6	6.6	18.0	32.8
	2008	44.3	4.9	14.8	36.0
	2009	44.3	3.3	9.8	42.6
	2010	47.5	3.3	11.5	37.7
	2011	36.1	11.5	13.1	39.3
	total	43.3	6.3	13.1	37.2

Source: own calculations based on OECD TiVA database

Table 3: Overview of sector classification in per cent.

	Cardinal tests		Ordinal tests		Dichotomous tests	
	Agriculture	Food	Agriculture	Food	Agriculture	Food
1995	0.9126	0.8997	0.8011	0.8097	82.0	80.3
2000	0.8632	0.8730	0.7581	0.8581	85.2	80.3
2005	0.8498	0.7231	0.8636	0.7315	86.9	75.4
2008	0.8617	0.5806	0.8091	0.7962	83.6	80.3
2009	0.8361	0.6886	0.8252	0.8491	82.0	86.9
2010	0.2182	0.7984	0.6509	0.8084	80.3	85.2
2011	0.0557	0.4977	0.6524	0.6123	80.3	75.4
total sample	0.5970	0.7401	0.7631	0.7851	82.9	80.6

Source: own calculations based on OECD TiVA database

Table 4: Consistency tests for gross and value added based on NRCA indices.

Stability of classification of strong and weak sectors

The stability of sector classification that of the value of the NRCA index for particular product groups, is analyzed in two ways. First, we employ transition probability matrices to identify the persistence and mobility of classification of sectors as measured by the NRCA index. Second, the degree of mobility in patterns of specialisation can be summarised using indices of mobility. These formally evaluate the degree of mobility throughout the entire distribution of B indices and facilitate direct cross-country comparisons. The first of these indices (M_1, following Shorrocks, 1978) evaluates the trace (tr) of the transition probability matrix. This index thus directly captures the relative magnitude of diagonal and off-diagonal terms and can be shown to equal the inverse of the harmonic mean of the expected duration of remaining in a given cell.

$$M_1 = \frac{K - tr(P)}{K - 1}, \qquad (2)$$

where K is the number of cells, and P is the transition probability matrix.

The second index (M2, after Shorrocks, 1978; and Geweke et al., 1986) evaluates the determinant (det) of the transition probability matrix.

$$M_2 = 1 - |det(P)|. \qquad (3)$$

In both indices, a higher value indicates greater mobility, with a value of zero indicating perfect immobility.

Furthermore, to test the equality of different Markov transition probabilities we apply Anderson and Goodman's (1957) test statistics, which under null hypothesis $p_{ij} = \overline{p_{ij}}$, for each state i has an asymptotic distribution:

$$\sum_j n_i^* \frac{(p_{ij} - \overline{p_{ij}})^2}{\overline{p_{ij}}} \sim \chi^2(m-1), \quad n_t^* = \sum_{t=0}^{T-1} n_t(t),$$

where m is the member of states, p_{ij} are the estimated, $\overline{p_{ij}}$ are the probabilities under null, and $n_t(t)$ describes the number of sectors in cell i at time t.

Information on the dynamics of the competitiveness classification can be obtained by analysis of Markovian transition matrices, showing the probability of passing from one state to another between the starting year (1995) and the end year (2011). We employ pooled data with one year lag. The transition matrix in Table 5 suggests that classification of the NRCA index are fairly persistent for observations with weak-weak and strong-strong sectors in agriculture. The diagonal elements for these class are 0.88-0.89, indicating a high probability that a country with a weak-weak or strong-strong sectors will have the same status at the end of the period. However, indices in classes strong-weak and weak-strong display considerable variation in their pattern. The probability of moving from strong-weak status to weak-strong and strong-strong groups is relatively high (0.31-0.31). There is a small chance of moving from class weak-strong to class strong-strong. However there is considerable chance of moving from the weak-strong class to the weak-weak class. Anderson and Goodman's (1957) test reject the equality of Markov transition probability matrices relative to as estimated benchmark. In other words, changes across different NRCA classes are significant.

Table 6 presents the Markov transition probability matrix for the food sector. Estimation indicates that, similarly to agriculture, typology of the NRCA index is fairly persistent for observations with weak-weak and strong-strong sectors

	weak-weak	strong-weak	weak-strong	strong-strong
weak-weak	0.88	0.07	0.05	0.00
strong-weak	0.19	0.19	0.31	0.31
weak-strong	0.47	0.16	0.26	0.11
strong-strong	0.00	0.05	0.05	0.90

Source: own calculations based on OECD TiVA database

Table 5: Markov matrix for agriculture.

	weak-weak	strong-weak	weak-strong	strong-strong
weak-weak	0.92	0.01	0.03	0.04
strong-weak	0.27	0.27	0.19	0.27
weak-strong	0.24	0.10	0.66	0.00
strong-strong	0.04	0.01	0.05	0.89

Source: own calculations based on OECD TiVA database

Table 6: Markov matrix for food.

(0.89-0.92). The probability of staying with weak-strong class is still relatively high (0.67). The strong-weak class present a high level mobility with relatively equal distribution. Anderson and Goodman's (1957) test reject the equality of Markov transition probability matrices relative to as estimated benchmark.

Table 7 reports the mobility indices, M_1, and M_2 which summarize the degree of mobility in the typology of NRCA indices. Estimations suggest that the classification of NRCA for food sector is less mobile than for agriculture.

Mobility index	Agriculture	Food
M_1	0.593	0.416
M_2	0.870	0.491

Source: own calculations based on OECD TiVA database

Table 7: Mobility indices for Markov matrix.

Conclusion

One of the most important features in the international trade over the recent decades has been the increased fragmentation of the production process. This has been facilitated, in part. by the development and maturation of global value chains (GVCs). The rise of new global competitors and the development of GVCs have challenged the dominance of major industrial countries in trade. There is an increasing literature on value added trade on manufacturing industries and service sectors. but research on agricultural and food trade is still limited.

We present an analysis of comparative advantage using gross export trade data and value added trade data focusing on agricultural and food trade. With respect to comparative advantage the differences between the two types of data are often illustrated by means of examples using a few sectors; usually measures of RCAs calculated with gross export data are compared with RCAs calculated with value added data. Systematically comparing these distributions shows that the distributions of NRCA calculated with gross exports and value added data are indeed significantly different from each other. Our results indicate that a value-added approach to assessing NRCA can provide further insights that are not apparent from an exclusive focus on gross exports.

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Shopping Via Mobile Phones in the Central European Czech Republic Market

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Abstract

Information and, in particular, mobile technologies play an increasingly important role in the economic environment. The article surveys attitudes of Central European Czech customers to mobile phone usage for purchasing products and payments. Based on the results that were gained by the survey the paper suggests opportunities for further business development in the stated areas. The data was obtained by a combination of quantitative and qualitative research using a standardised questionnaire survey among respondents of all age groups. Data was collected throughout the year 2017. By random and targeted selection, 1335 respondents were selected for the survey. Based on the survey data analysis it was observed that Internet shopping via mobile phones has not been widespread up to now. Entrance tickets and fare tickets, electronics, clothing, and cosmetics are the most frequently purchased products via mobile phones. Despite an enormous potential of smartphones current users have not deployed their functions entirely so far.

Keywords

Customer, ICT, mobile device, mobile payment, retail consumers' goods, retail store, shopping.

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Introduction

Information and, in particular, mobile technologies play an increasingly important role in the economic environment. Internet connection is perceived as a key factor in the further development of society (Vaněk et al., 2010a). The Internet can generally be recognised as a means of working with information. The rapid growth of the Internet as a medium for communications, as a channel of distribution, and as a way of reaching individual customers efficiently and effectively 'has not only affected marketing managers' decision-making but has created the need for new directions in marketing thought'. (Steckel et al., 2005). Highly educated people use the Internet more actively, and their use is more information oriented whereas the less educated ones seem to be interested particularly in the entertainment functions of the Internet (Bonfadelli, 2002). Many strategies like 'mass customization, relationship marketing, interactive marketing, etc. have gained increased attention, in part, from advancements in manufacturing and information technology'. (Varki and Rust, 1998) Mobile phones represent this specific platform, which is becoming increasingly important nowadays. However, further development of shopping via mobile phones, which offers a vast amount of possibilities, depends largely on the acceptance of new technologies by customers (Bruner and Kumar, 2005). Nevertheless, certain prospective customers may not accept the services offered despite their widespread availability (Wang et al., 2006); the fear of privacy loss accounts for the most common reason (Xu and Gupta, 2009). Moreover, as demonstrated by some studies, the adoption of new mobile services by European users is slower than expected (Carlsson et al., 2006). As Inman and Nikolovova (2017) suggest "retailers are understandably overwhelmed by the options and may adopt technologies without a clear picture of both how they fit into their strategy and, potentially more important, how shoppers will react." Furthermore, intensive use of smartphones and specific mobile applications

has been influenced by gender, age, and so-called 'personal innovativeness' significantly (Jung et al., 2013).

Mobile Internet connectivity enables a user's localisation and targeted advertising (certainly, with the user's permission and an offer the customer might be interested in). Proximity marketing can be perceived as an emerging form of marketing built upon advances in wireless and social technology (Levesque et al., 2015). However, certain rigors were observed when applying proximity marketing for business purposes. According to Ojala et al. (2012), merely 1.1% of the devices received the message and on average 3.3% of the device owners signed up for the marketing campaign.

The use of ICT and mobile devices is becoming increasingly visible in all sectors (Vaněk et al., 2010b). ICT development and access to all mobile services stands as a matter of the utmost importance (Köppelová and Jindrová, 2017). Business operations and customer contact via mobile devices has a large potential due to the very personal and intimate nature of the devices and high targeting possibilities (Aalto et al., 2004). The mobile world can be referred to as a place where business takes place anytime and anywhere (Balasubramanian et al., 2002). The expansion of mobile phones (and smartphones in particular) offers numerous new business opportunities. Consumers are more accessible through these devices, and communication via mobile Internet can be interactive more easily (Ferris, 2007). Likewise, this is confirmed by estimates of future global smartphone sale volumes provided by Canalys (2013), independent analysts, who predicted a rise in smartphone sales up to 17.9% between 2012 and 2017, to the detriment of regular mobile phones. It is believed that, 'with the introduction of Apple's iPhone into the market, the mobile Internet promises to be one of the most important technological developments for the future' (West and Mace, 2010 in Koenigstorfer and Groeppel-Klein, 2012: 917). However, as further stated by Koenigstorfer and Groeppel-Klein (2012: 917), 'forecasts for the diffusion of both the mobile Internet and mobile commerce worldwide were overoptimistic'.

In the Czech Republic, smartphones for Internet browsing are used by up to 52% of users, who establish the continuously expanding group of potential customers of sales and marketing via mobile phones. Mobile phones are increasingly used to browse web presentations; thereby companies are bound to customise their websites regarding the format or, as the case may be, develop mobile phone versions of their websites. Another option to optimise mobile phones websites is to develop an application based on the specific platforms (for example, iOS, Android, BlackBerry, etc.). Since such applications are developed directly for the mobile phone specific operating system, brand new features can be designed. Generally, such new properties are not available for mobile phone websites as the data is extensive or the sites are not functional in all mobile phone operating systems.

The survey aims to investigate the forms of mobile phone use for shopping and payment purposes. Furthermore, it provides an overview of the kinds of retail consumers' goods that are most frequently purchased via mobile devices.

Materials and methods

Consumer behaviour research on use of mobile phones focused on identifying key factors that affect mobile phone usage in relation to consumer purchases. The data was obtained by a combination of quantitative and qualitative research using a standardised questionnaire survey among respondents of all age groups. Data was collected at the end of 2017 in the Czech Republic. A portion of the respondents completed the questionnaire electronically using the Internet, while the other respondents were addressed in person. By random and targeted selection, 1335 respondents were selected for the survey.

The questionnaire contained a maximum of 30 questions. The number of questions was dependent on the usage of the mobile phone; the questionnaire focused on users of mobile phones, smartphones in particular. On average, respondents answered 15 questions. Initial questions aimed to survey basic facts associated with the influence of the operating system used and the ways of utilising mobile phones. Furthermore, the respondents provided information on mobile phone Internet access emphasising wireless Wi-Fi access, especially in public places. In the next section, the questionnaire focused on identifying a preferred website customisation for mobile phone displays and the extent of applications' use to gather various information. In addition, the survey was comprised of issues linked with mobile marketing perceptions held by mobile phone users, feasibility of mobile phone payments and, likewise, customers' attitudes towards mobile

shopping. The last part of the questionnaire contained demographic characteristics of the respondents.

The data was analysed based on mathematical and statistical methods. Simple Microsoft Office Excel 2011 contingency tables were created to provide interrelations between selected variables. Subsequently, they were construed in details. Interpretation of statistical data, analysis, and synthesis were performed as constituent methods. Based on the measurable data, structured tables were created using a quantitative analysis of the numerous responses for selected factors. Unquantifiable factor data was analysed by an analogy method based on the previously performed qualitative research results.

The respondent reference group consisted of 64.9% females and 35.1% males. An age structure of the respondents followed by education structure is demonstrated in Table 1.

Contingency tables were created as a tool to analyse actual interrelations between particular demographic characteristics (gender, age, economic status, size of residence) and the survey data. More thorough research focused on mobile phone operation systems, particular forms of mobile phone use with regards to searching the Internet, social network connections, and game playing is, however, necessary. Special attention was given to advertisements through free Wi-Fi connection in public places. Moreover, mobile applications used by customers to search for various information were analysed and, likewise, particular forms of mobile marketing and mobile payment methods were investigated. Simultaneously, the analysis focused on Internet shopping and activities related to regular retail stores shopping, i.e. product quality assurance, price analysis, and store locations, in particular.

Results and discussion

The data demonstrated that mobile technologies are utilised preferably by young people between the ages of 16 to 24 (almost 50% of the respondents) and the group of productive age customers that are 25 to 34 years old (almost 28%). In total, 22.7% respondents were older than 35 years and 3.3% were 55+ years old. Considering the younger age group (from 16 to 24), mobile phones constitute an inseparable part of their lives, and many of these respondents cannot imagine their lives without such technologies. Individuals aged from 25 to 44 use mobile technologies primarily as a necessary part of their both private and work lives.

A prevailing number of the respondents own a mobile phone (99.5 %). However, so-called smart phones are used just by 61.5% of them. Almost everybody owns a mobile phone; on the contrary, smart phones have only been recently establishing its market position. Obviously, an increase in smart phone use can be expected with regards to various complementary functions offered to the users (Šimek et al., 2014).

Despite the extensive expansion of smart mobile phones and their capabilities (including shopping anytime and anywhere), only 19% of the respondents use their mobile phones for Internet shopping; the remaining 81% prefer other forms of Internet shopping, preferably by shopping on a computer. The customers who utilise mobile phone shopping value the speed, accessibility, and comfort of the purchase. Satisfaction of the final users with any service is directly linked with the network quality and performance (Habibi et al., 2016). They appreciate the effective use of their travel time, the ability to purchase retail consumers' goods on the way home, QR code scanning that displays a particular product or complete invoice data, and facilitate a payment. People often purchase mobile phone games, which have been increasing both in quality and hardware requirements. Data service quality and multimedia application requirements of the final users keep growing (Olwal, 2016). (Figure 1)

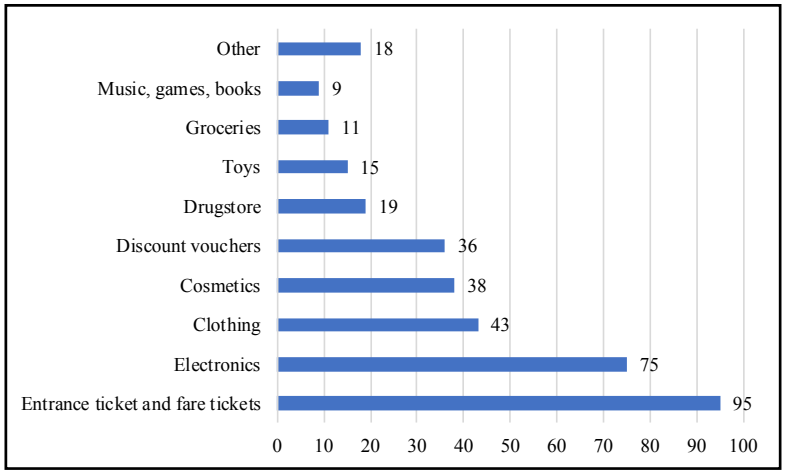
The Czech Republic is also on the top position in the number of e-shops per capita in the Europe (Ulman et al., 2016). Smart phones can be used during the shopping process to expand information

Less than 15	16 – 24	25 – 34	35 – 44	45 – 54	55 – 64	65 plus
2.6%	46.9%	27.8%	13.2%	6.2%	2.6%	0.7%

Secondary incl. vocational (with no graduation exam)	Elementary (incl. unfinished)	University (bachelor, master)	Secondary incl. vocational (with graduation exam)
7.2%	12.1%	35.3%	45.4%

Source: Authors' research, 2017

Table 1: Demographic characteristics of the respondents (age structure and highest education obtained).



Source: Authors' research, 2017

Figure 1: Retail consumers' goods and services most frequently purchased via mobile phone.

on the product. The customer may discover the product rating, opinions, and experiences of other customers regarding the product´s quality and functions. Moreover, product price may be compared in numerous internet shops and, thus, the cheapest purchase can be located (either in a physical retail store or electronically including additional transportation costs or time used for product personal collection). In the case of a specific product or store in need, the customer may locate the particular product or store very easily. Numerous mobile applications and websites facilitate comparisons and ratings of almost all products on the market. Mobile technologies represent active opportunity for retailers to influence decision-making process of numerous consumers (Faulds et al., 2018). However, sufficient mobile network coverage is a substantial prerequisite of such mobile phone activities (Habibi et al., 2017).

1. Payment methods

Payments constitute inseparable part of Internet shopping. Effortlessness and security stand for the efficiency and frequency of mobile payment use. (Shankar and Datta, 2018). However, mobile phone payments can be facilitated even without Internet connection. Nowadays, numerous brand new technologies support contactless mobile payments or easy access to internet banking. Both retailers and consumers report growing interest in mobile payments (Liebana-Cabanillas et al., 2018).

M-payments offer numerous benefits in comparison with traditional payment services (Johnson et al., 2018). It was observed that m-payment is the most used method of payment. It was deployed by up to 37% of males of the age from 25 to 34. Likewise, almost 30% of females adopted such services; however, they are more favourable among females of the age from 35 to 44. The survey demonstrated that education does not affect a mobile payment adoption significantly, with the exception of university graduates. Almost one third of university graduates perform mobile payments regularly. Considering the age range, the results show that m-payments are generally not used by males of the age from 55 to 65 and by males under the age of 15. It was claimed that females perform mobile payments across all age categories.

Quick response (QR) code payment has become a significant component of mobile transactions (Zhu et al., 2016). A QR payment is the second most common type of payment that is the most frequently used by males from the ages of 16 to 44. Generally, other age categories stated no mobile payment performance. Regarding females, the QR payment is facilitated across all age categories; however, it is noticeable that the most significant usage is applied by middle-aged females aged 35 to 44. On average, females than males perform QR payments more frequently. NFC accounts for another important technology utilised for regular shopping payments. However, payment security is more difficult to secure due to the NFC user authentication (Chen et al., 2017). NFC technologies, NFC payments, and NFC tags in particular were observed to be the least adopted types of payment. The NFC payment is the most frequently used in the age category of 16 to 44; nevertheless, the utilisation rate is gradually declining and, simultaneously, the demand for this type of technology has been decreasing. Such payments are not deployed at all by males of the age 45 plus and, as the case may be, females employ it minimally. On the contrary,

NFC tags are being used only to a limited extent by males aged 25 to 44. The remaining age categories do not use them at all. The use of NFC tags by females is even lower and, if at all, they are used by younger age groups. Likewise, it was observed that education does not barely impacts NFC payment adoption.

2. Shopping with mobile phones

Based on the survey data analysis, it was observed that internet shopping via mobile phones has not been widespread up to now in spite of high rate of mobile phone use (Marriott and Williams, 2018). It was demonstrated that there is a relation between mobile internet general use and an increasing trend in mobile internet shopping (Citrin et al., 2000). A monitored group of the respondents demonstrated very little usage of mobile phones for shopping. Neither education nor gender affect the actual data substantially. Merely a slightly higher interest rate was proved for males (approximately one third, on average) and lower for females (approximately just one seventh, on average). Simultaneously, this form of shopping is impacted by economic status to a very little extent.

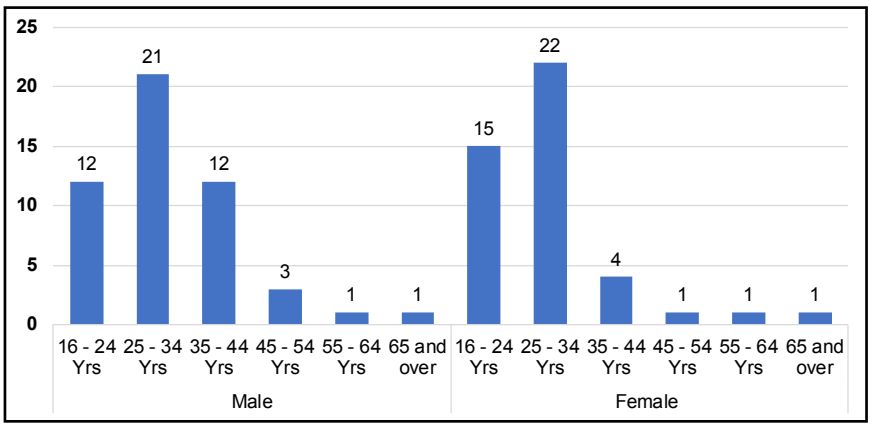
Moreover, age accounts for an important demographic indicated by the research. It was recognised that a higher proportion of males across all age categories has adopted such a shopping method. Nevertheless, on an average 72% of them (similarly, 80% of females) do not use mobile phones for shopping purposes entirely. The only male age group showing an extreme value is the age group of 15 years and less; the interest is zero. Possibly, such behaviour is caused by a lack of funds. In the female category, it was noticed that women between the ages of 16 and 24 and older women aged 55 to 64 in particular are the least likely to shop via mobile phones. A higher willingness to this type of purchasing was observed in the middle age group of 25 to 44. Age and education levels account for an important factor in m-commerce use (Chong, 2013). Just under 20% of people have adopted the method of shopping via mobile phones. These users buy entrance tickets and fare tickets, electronics, clothing, cosmetics, and, when the opportunity arises, discount vouchers.

Purchases of entrance tickets and fare tickets by mobile phones (see the Figure 2 below) are most frequently performed both by males and by females of the age of 25 to 34. Remarkably, this type of product is purchased more by males and, at the same time, a significant drop in the number of these purchases by females over the age of 34 was observed.

Electronics are more frequently purchased via mobile phones by males up to the age of 44 when their interest diminishes considerably. On the contrary, females purchase electronics via their mobile phones merely up to the age of 34 when this method of purchasing electronics declines rapidly.

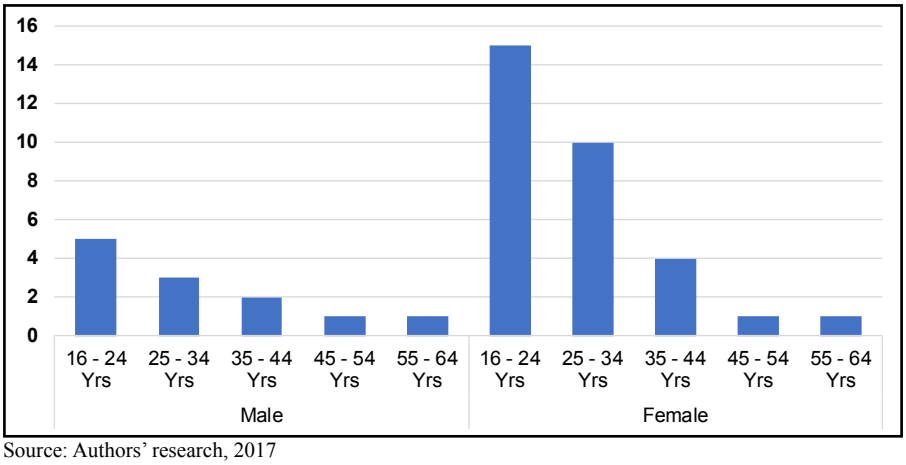
Internet shopping for clothing is mostly performed by females of the age from 16 to 34 when their willingness to browse and compare budget-wise offers is substantially high. Obviously, these women are less likely to tolerate the risk of choosing the wrong size of a piece of clothing or, as the case may be, they choose retail stores in which they can easily return purchased clothes or try it on before buying. It was discerning that men are not interested in Internet shopping for clothes extensively (Figure 3).

Cosmetics belong to favourable retail consumers' goods, which is often purchased via mobile phones. It was recognised that it is a preferred method



Source: Authors' research, 2017

Figure 2: Internet shopping via mobile phones – entrance tickets and fare tickets.



Source: Authors' research, 2017

Figure 3: Internet shopping via mobile phones – clothing.

of shopping among women between the ages of 16 and 44. Obviously, the following reasons stand for such a method of shopping: significantly lower price, unavailability of the brand or product in the physical retail stores or the convenience of shopping. It is worth noticing that a higher rate of males purchasing was detected (as opposed to the clothing category that clearly does not attract men's attention). The highest proportion of Internet purchases by mobile phones is executed by men aged 35 to 44, who may shop for gifts for their spouses or just want to look youthful and purchase beauty products for themselves.

3. Retail store location search

Store location search is applied mostly by females of the ages from 16 to 24; i.e. up to 30% of the total respondents who use this function. On the contrary, males of the same age category significantly less deploy this function (almost by 50% less than by women). In the second age category of 25 to 34, the data for males and females is equal; however, higher age categories use the function minimally, or they do not adopt it entirely. Most likely, lower shopping enthusiasm of males in general accounts for the reasons of such a trend.

4. Comparison of product prices

It was noticed that females considerably utilise mobile phones more to compare Internet product prices; specifically, the percentage of these women is 50% higher than of the men within the age from 16 to 24. In the subsequent age category of 25 to 34 years, the data is more equal and, furthermore, in higher age categories the function is hardly deployed. Similarly, the structure of people who use mobile phones to check customer forums to determine the quality and feasibility of products before purchasing them is comparable to those who compare product prices and, thus, it is not being specified within this paper repeatedly.

5. Recommendations for further development of trade activities via mobile phones

Research has demonstrated that so-called smartphones are being increasingly utilised among consumers, and their increasing market share can be expected to grow at the detriment of ordinary mobile phones. Owing to fast advancements of these technologies, new opportunities for both traders and marketers arise. From the traders' point of view, it will be important to expand alternatives for using different types of mobile payments in the future. Such an expansion of payment options can attract new customers or directly affect the decision to purchase. The decision-making process on a purchase could be influenced by, for example, the customer not having enough cash available or the retailer not having adequate funds to give the change back. Likewise, administrative procedures associated with invoice settlement could be potentially simplified and accelerated with QR payments. Additionally, retailers would be able to focus on products that are purchased via mobile phones and optimise the user-website interface. For example, restructuring a cosmetics e-shop may emphasise and promote beauty care products focusing on females aged 16 to 24 and males of the age from 35 to 44. Furthermore, in these types of e-shops it would be feasible to offer male and female gift products separately to simplify customers' choice of presents.

In some market sectors, free access to wireless Wi-Fi is already very common (and often necessary) as demonstrated within the accommodation or boarding industry, for example. Wi-Fi is

a required standard in most restaurant facilities. However, Wi-Fi connection does not need to be installed solely for restaurant customers; it could be utilised for information and promotion purposes. It could be employed to build and promote brand awareness, extend the existing client database, or advertise new products and special offers.

These new mobile technologies bring enormous opportunities for traders; nevertheless, they stand for a substantial threat simultaneously. The consumer is significantly more knowledgeable and well-informed and, furthermore, he/she is able to compare prices and quality of retail consumers' goods, all online in the store. On the other hand, a customer who does not utilise these options is at a disadvantage as he/she relies solely on information that the retailer chooses to provide. Moreover, the consumer is able to locate specific retail stores (via the Internet or GPS embedded in a mobile phone) and desired goods. The traders are threatened at the same time as their competitors become more accessible even for a visitor who is not aware of the local distribution of stores. Owing to the mobile phone and its up-to-date functions, the location of specific stores within the vicinity and selection of goods before actually entering the store, restaurant, or boarding facility is currently very simple.

Similarly, mobile technologies are becoming more important in marketing campaign development. None of the larger companies ought to ignore this kind of communication tool. With regard to operating systems, the research has demonstrated that if companies focus on higher educated consumers, they should not neglect the BlackBerry operating system. Within the sector of discount portals, application developers should concentrate especially on younger women under the age of 34, who adhere the most to this type of shopping. Free distribution of applications that provide information about the company, business, and products is considered a very soft and natural form of promotion. Consumers download this type of application by themselves because it is linked with certain benefits, for example, advanced orientation in the assortment, awareness of special offers or, as the case may be, simplification of orders and payments made.

The suggestions stated above represent several pieces of advice for company strategic planning processes in the sphere of mobile interaction in shopping. Specific recommendations would have to be customised considering the requirements of a specific company, its product portfolio, and customer structure.

Conclusion

Despite their enormous potential, current users have not deployed smartphone functions entirely so far, even though some features would be highly beneficial for them. For example, searching for specific products and purchasing retail consumers' goods from e-shops via mobile devices have been almost unused. Similarly, following online customer forums or utilising navigation properties to locate retail stores have not been utilised thoroughly. Concurrently, such services may be highly beneficial for the customers and even potentially save large amounts of money when purchasing goods and services. From the discussion above, it can be derived that new opportunities are spreading out in front of both companies and customers; however, new threats are also emerging. It is of utmost importance to respond to them adequately and prepare thoroughly.

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Determinants of Willingness to Adopt M-Commerce among Fisher Women Retailers in Karnataka, India

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Abstract

The study assesses the potential for an intervention of m-commerce in the fisher women retailer community of coastal Karnataka region of India. The study was conducted using primary data with a sample size of 383 fisher women across 26 markets in Udupi, Uttara Kannada and Dakshina Kannada districts of Karnataka, who are engaged in fishing practices. This study analyses m-commerce adoption and digital literacy among fisher woman retailers. Study identifies an insight into the degree of acceptance, zeal to learn and willingness to experiment technology change and shift in the trade practices with a digital platform. The result, using binary logistic regression also identifies variation of significant variable and behaviour of the population across 3 districts. The present study provides the basis for further research to build m-commerce model for the fish retailers in coastal Karnataka..

Keywords

Common Agricultural Policy, enter barriers, motivation, young farmers.

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Introduction

The Coastal Karnataka has 191 marine fishing villages spread across the three districts, so on average every 1.6 km there is one fishing village. One of the major trade and commerce in coastal Karnataka is marine fisheries (Bhatta et al., 2000). According to Central Marine Fisheries Research Institute, Karnataka has 30,713 fishermen families, 167,429 fisher's population. Women formed 48% of the population (CMFRI, 2010).

In an era where Information and communication technology (ICT) is pervading all service sectors and business development models, keeping up with the demands of this digitally driven market becomes crucial for surviving one's business (Kramer et al., 2007). The coastal belt of Karnataka has been a hotspot for fishing practices and trade. There are many different communities that live on trading fishes or acting as middlemen or resource providers to other giants of this industry. However, lack of infrastructure and basic technology at the grass root level is affecting the business of several fisher women in this part of the state (Gunakar and Bhatta, 2016). Their digital illiteracy becomes a cause for their exploitation and marginalization by other big traders in the market and cause a drop in their commerce (Sathiadhas et al., 2011; Tax Research Team, 2016). During the demonetization period (8 Nov 2016 – 30 Dec 2016) in India, although it attracted a lot of flak from all spheres of the society, people eventually prepared themselves for the new era of digital age (Singh and Mittal, 2017). It became the need of the hour to equip oneself and their business tools to keep abreast with the demands of the market.

(Gupta, 1984) and (Srivastava and Uma, 1985) had studied the marketing of fish and fishery products in India, wherein they had analysed price variations among species across states and had identified infrastructural bottlenecks in efficient marketing system. (Abraham, 2006) study show how with the adoption of mobile phones by the fishing community, there was reduction in price variation in marketing fish products in Kerala. But this study fails to give the real life situations where retailers can directly sell their goods to the customers. In the fishing industry issues include high perishability and bulkiness of material, high cost

of storage and transportation, high heterogeneity in size and weight among species, no guarantee of quality and quantity of commodity, low demand elasticity and high price spread recur on an everyday basis (Gunakar and Bhatta, 2016; Aswathy et al., 2014). It becomes challenging for the supplier to reach the customers to sell their fish in the same day. This results in selling the fish abruptly, resulting in low income.

ICT plays a major role in connecting the customers with the sellers (Rock, 2009). To penetrate through ICT solution, their current adoption and willingness to use the technology has to be studied (Li and Huang, 2009). With more than one billion mobile subscriber's in India (Ministry of Communications and Information Technology, India 2016), m-commerce plays a potential role for farmers to directly sell their goods to the customers (Norman, 2009).

The paper intends to explore the socio-economic perspective of fisher women retailer on their current digital adoption, their readiness to move towards and their willingness to go digital in their business. Thus, the focused objectives of this study are: Conducting a comprehensive survey of Socio-demography of the fisher women retailers, to assess their readiness to adopt mobile commerce and identify the determinants to analyse the fisher women retailer's willingness to use mobile commerce.

Materials and methods

As per 2010 survey (CMFRI, 2010), 14867 people are involved in marketing of fish with 12382 women making the larger share. In this study, fisher women retailers were considered across 3 districts of Coastal Karnataka based on the primary data collected from survey of sample size 383 respondents of across 26 fish markets. These 26 fish markets were chosen as per the accessibility covering both Urban and rural areas representing all 3 districts. Fisher women retailers were selected randomly from the total population.

In this study, major and minor markets were chosen as per the accessibility of location to include fisher women retailer's from both the segments. A market with number of retailers more than 30 were considered as major market and lesser than 30 as minor market. Although some information on the number of fresh retailers in the market were available, it was challenging to arrive at a number, as these retailers change their market place from one to another or stay absent for many days.

Udupi District: In this district thirteen markets were selected with five major markets Malpe, Udupi fish market, Kalianpura, Sastan and Kundapura and eight minor markets Kodi Bengre, Shirva, Parkala, Brahmavara, Uchilla, Kapu, Uchilla and Padubidri.

Dakshina Kannada District: Here seven markets were selected with two major market -State Bank fish market and Suratkal, and five Minor markets Urva market, Bejai, Kankanady, Mulki and Kavoor.

Uttara Kannada District: here five major markets were selected namely Karwar, Honnarvara, Bhatkal, Kumta, and Ankola and one minor market Murdeshwara.

For the study, Questionnaire based personal interviews were conducted to understand current adoption, readiness and willingness of the population to adopt digital platform (Davis, 1989) (Gebauer and Shaw, 2004).

District	Frequency	Percentage
Udupi	166	43.3
Dakshina Kannada	85	22.2
Uttara Kannada	132	34.5
Total	383	100

Source: own survey and processing.

Table 1. Distribution of sample fish retailers in 3 districts of coastal Karnataka.

In the pre-survey, it was observed that the fisher women were initially reluctant or suspicious to be part of the survey without agents and union leader's approval. After due approval from the agent and the union leader, survey was conducted among fisher women retailer's. Table 1 provides the distribution of population and markets/ area among the districts considered for the study.

The Primary data was analysed using the Statistical Package for Social Science (SPSS version 14.1). Correlation matrix was used to understand the relation between their willingness to use m-commerce against their age and education. Binary logistic regression backward stepwise method was used to identify the key determinants to analyse the fisher women retailer's willingness to use m-commerce and the statistical significance was set at $P < 0.005$.

Results and discussion

Convenient Random Sampling technique was

used by choosing selected areas in Udupi, Uttara Kannada and Dakshina Kannada district. The repondents mean age was 45 (standard deviation, 8.45) with minimum age 25 and maximum age of 75. The chosen sample size for research is 383 with confidence level 95% and with margin of error 5%.

Survey details provides a comprehensive insight into the various characteristics of fisher women retailer. Table 2 presents the data collected on these fisher women retailers in all three districts.

For any adoption of digital platform it is important to have a bank account. Survey details shows that around 89% of the respondents have a bank account with 100% Aadhar (Aadhaar number is a 12-digit number issued by the government of India to the residents of India after sufficient verification process laid down by the Authority) enrolment and 72.8% have a nationalized bank account. 91.4% of the respondents own a featured mobile phone and only 2.3% have a smartphone. This gives us an opportunity to explore the digital services for featured phone through Unified Payments Interface (UPI).

It was very intriguing to see 63.4% of the respondents were interested to undergo digital literacy training with 59.8% showing their willingness to use m-commerce for their day to day business. Correlation Matrix was used to see whether there is a relation between age and willingness to use m-commerce and between education and willingness to use m-commerce.

Table 3 illustrates there is significant relationship between age and willingness to use m-commerce with p-value < 0.001 with 71% of the respondents under age of 45 willing to use m-commerce.

Table 4 presents a statistically significant relationship between education and willingness to use m-commerce with p-value < 0.001. Result highlights that education has a major role in fisher women life for bringing any technological change in their day to day life as well as business.

Variables	Category	Frequency	%
Age	<= 35	58	15.1
	36–45	159	41.6
	46–55	131	34.2
	> 55	35	9.1
Education (Class)	Illiterate	56	14.6
	1-3	56	14.6
	4-7	197	51.4
	8-10	68	17.8
	>10	6	1.6
Average/ Day Sales(₹)	<= 2500	104	27.2
	2501–5000	171	44.7
	5001–7500	61	15.8
	>7500	47	12.3
Bank Account	Not Present	42	11
	Present	341	89
Bank Type	National	279	72.8
	Cooperative	62	16.2
	NA	42	11
Aadhar-linked	Yes	383	100
	No	0	0
Phone model	No Phone	24	6.3
	Featured	350	91.4
	Smart	9	2.3
Know to use SMS	Yes	82	21.4
	No	301	78.6

Source: own survey and processing

Table 2: Survey details with N=383 (to be continued).

Variables	Category	Frequency	%
Have Debit Card	Yes	282	73.6
	No	101	26.4
Awareness about Cashless Payment	Yes	277	72.3
	No	106	27.7
Customer request for Digital Payment	Yes	65	17
	No	318	83
Interested in digital training	Yes	243	63.4
	No	140	36.6
Willingness to use m-commerce	Yes	229	59.8
	No	154	40.2

Source: own survey and processing

Table 2: Survey details with N=383 (continuation).

		Age				Total	p-value
		<=35	36-45	46-55	>55		
Willingness to use m-commerce	Yes	42	112	64	11	229	
	No	16	47	67	24	154	< 0.001
Percentage		72.4	70.4	48.8	31.4	59.7	

Source: own survey and processing

Table 3. Correlation matrix on age and fish retailers willingness to use m-commerce.

		Education Level				Total	p-value
		0	1-3	4-7	8-10		
Willingness to use m-commerce	Yes	10	21	129	63	229	
	No	46	35	68	5	154	< 0.001
Percentage		17.8	37.5	65.4	92.6	59.7	

Source: own survey and processing

Table 4: Correlation matrix on education level and fish retailers' willingness to use m-commerce.

		District			Total	p-value
		Udupi	Dakshina Kannada	Uttara Kannada		
Willingness to use m-commerce	Yes	97	70	62	229	
	No	69	15	70	154	< 0.001
Percentage		58.4	82.3	46.9	59.7	

Source: own survey and processing

Table 5: Correlation matrix on fish retailers' willingness to use m-commerce in each district.

Table 5 reveals the respondents from three districts and their view on using m-commerce with p-value < 0.001. Result infers that Dakshina Kannada District (82.3%) respondents are keen to move their business to m-commerce platform in comparison to Udupi (58.4%) and Uttara Kannada (46.4%) districts.

Table 6 shows the combined result of respondents of three districts. It reveals that **education** (p-value < 0.001) of fisher women, **having a debitcard** (p-value < 0.001) and **awareness about cashless payment** (p-value <0.001) had a significant influence on the output variable i.e. willingness to use m-commerce. Our analysis showed that **average per day sales** (p-value < 0.004) of fisher women with sales greater than Rs. 5000/- had a significant, yet weakly positive relation.

Key Determinants for individual districts Udupi, Dakshina Kannada and Uttara Kannada districts were analysed using binary logistics regression – backward stepwise method. Result analysis shows that in Udupi district **awareness about cashless payments** (p- value < 0.002) had a significant influence. In Dakshina Kannada district **using SMS** (p-value < 0.001) had a higher positive significance. In Uttara Kannada district **education** (p-value <0.001) and **having debit card** (p-value < 0.001) had a higher significance value.

Variables	P value	Exp(B Odds Ratio)	95% C.I for Exp(B)	
			Lower	Higher
Education	.000	1.258	1.133	1.397
Average Per day sales	.004	1.000	1.000	1.000
Phone Type	.054	0.219	.047	1.025
Use Debit Card	.000	3.605	1.752	7.417
Heard about Cashless Payment	.000	6.230	3.294	11.786
Customer request for digital payment	.014	2.845	1.231	6.577

Source: own survey and processing

Table 6. Identification of significant variables that have positive impact on willingness of fisher women retailers of coastal Karnataka to use m-commerce.

Conclusion

This study reflects upon education and age of the fisher women retailers are important determinants for their willingness to adopt to the digital platform. Fisher women who were aware of promotion of cashless payments and related commercial created willingness among women to accept digital platform for their trading activities. As the study reveals different determinants based on the districts, a thorough study on determinants of each districts individually would throw some other dimensions for adoption of m-commerce model. Further investigation and studies are necessary to fine tune the customer's readiness and willingness among three districts. Income of fisher woman retailers and quality of their life can be enhanced by an appropriate m-commerce model which is built by considering the above all determinants.

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Proposing of Single Entity Design Pattern in Big Agricultural Positioned Data Sets (ADS)

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Abstract

With emerging usage of positioned devices such as drones, cell phones or IoT, the amount of data that can be collected expands drastically. At any given time, there is usually at least one nearby device that has positioning capabilities. Smart phones, smart TVs, personal computers, or even cars contain localization features. These vast amounts of data require a lot of effort in analysis and understanding in order to be properly utilized, which is especially true for the field of agriculture, where proper analysis can yield tremendous improvements in terms of production.

Current computer technologies offer plenty options for such analysis. However, not every agricultural subject has access to a mainframe with performance in petaflops to perform complicated analyses of such big data in a timely manner.

The defined design patterns for creation of data offers potential for speeding up the analysis of ADS on personal computers.

This article describes known and used creational patterns and compares their benefits regarding ADS and offers possible usage and improvements.

Keywords

Big data, agricultural, designing patterns, software engineering.

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Introduction

Generally, the design pattern may be described as a generalized solution to a programming problem with particular purpose. The design patterns are used as a high-level programming idiom especially by professional software engineers.

The reasons why usage of design patterns is common are many - because most of the programming problems are often comparable to those that have already been solved, creating new algorithms that tackle the same issue in a similar manner is a waste of time. On the other hand, it is always up to the software engineer to decide if the given programming problem should be solved with design patterns, because their usage may not resolve in improvement (with requirements of readability and understanding of its architecture) (Dascalu et al., 2005).

Big Data is defined by several characteristics apart from size, particularly, the volume, velocity, variety, and veracity of the data (Coble et al., 2018). Big data is often mistakenly thought of as a huge database storage. This, however, is not precise, because every kind of data has a connection or relation to its origin, usage and utilization. This system approach leads to questions such as: what kind of relations are between data, what it the usage of data, what is the real information which the data bear. And this system conception leads to the emergence of design patterns. Every single one of these questions can lead to more complex systems which use more processing time and cost more money. So the overall complexity of the system is of crucial importance as it is directly linked to the required resources. Correctly designed and engineered system can be measured, and its complexity can be calculated (Pavlic et al., 2008).

Emerging usage of autonomous positioned devices such as smartphones, IoT devices and so on, leads to new problems, questions and different approaches

to seek the answers. The Internet of Things (IoT) has opened productive ways to cultivate soil with the use of low-cost hardware (sensors/actuators) and communication (Internet) technologies. Remote equipment and crop monitoring, predictive analytic, weather forecasting for crops or smart logistics and warehousing are some examples of these new opportunities (Ferrandez-Pastor et al., 2018). Also, remote sensing, as one of the sources for big data, is generating earth-observation data and analysis results on a daily basis, utilizing wide variety of technologies, ranging from satellites, manned/ unmanned aircrafts, to ground-based structures. Agricultural remote sensing is one of the backbone technologies for precision agriculture, which considers within-field variability for site-specific management instead of uniform management as in traditional agriculture (Huang et al., 2018). The Big Data by itself is changing and the procurement of data and its analysis has becoming more structured and complex. The challenge of analyzing and processing a huge amount of data is becoming increasingly important in this fourth industrial revolution era (Guardo et al., 2018). Many researches point to optimization and effectiveness of whole processes such as data transfers, querying, mining or other methods in Big Data and particularly in agricultural sector can be divided into two data groups internal (private) data and external data (Stočes et al., 2018). Other sources present part of application assumption of agriculture network monitoring system and design the big data processing and analysis module (Chen et al., 2018). Also, the aspect of real time availability of data is more and more obvious in web-based systems. All of these requirements are important and change the perspective these issues are being looked at (Singh at al., 2018).

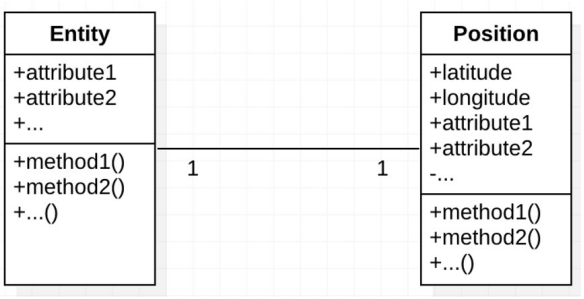
Materials and methods

Let the Agricultural positioned data (ADS) sets be defined in its simplicity as a data which carry the position of its creation or position of discrete behavior (globally named as state). One ADS entity can be imagined as one simple entity with its information, behavior (state) and position of its state. Basic principle on which would be agricultural data set described is that every entity has its own geographical position. This concept has become common in past years thanks to emerging number of devices aggregating data with geographical positioning (Zhou and Li, 2018).

This data is usually stored in cloud or distanced databases. Every representation of entity in ADS consists of two parts:

- structural data information – state (constants, behavior, methods)
- position – global geographic position

In the traditional object paradigm this information set would be described as the following system:



Source: authors

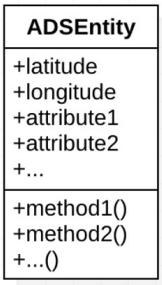
Figure 1: Traditional ERM/ORM.

The usage of this relation is to prevent duplicity inside relation-based databases and utilize the relation logic between objects more similarly to object-oriented databases. However, this traditional approach may be extremely dangerous in terms of big data. Even if the ADS system entity has always one and only one position, system must allocate memory and processing power to query (or hold relation) between two entities. In most cases SQL or noSQL systems are sufficient in these situations. But in case of millions of records, this approach may lead to significant slowdown. Key question would be how this pattern behaves in large data sets known as Big Data (Zhu, 2018).

The complexity of such system may be described in two ways – polynomial and data complexity. (Papadimitriou et al., 1999) Approximated mathematic description of data query complexity (Q) for the example above would be:

$$Q = f(n) = 2^n$$

ADS entity as part of simple one entity system stores the position data inside each entity. In object form the following scheme can be used:



Source: authors

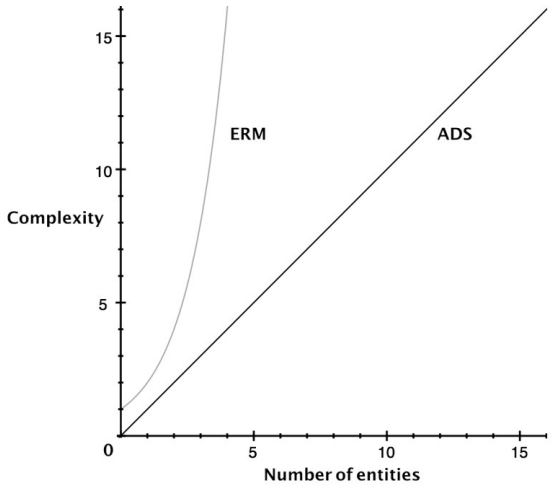
Figure 2: ADS entity.

Results and discussion

The ADS approach leads to linear n complexity because every ADS entity has the contextual position data available in one query or instance. Accordingly, the approximated mathematic description of data complexity would be following:

$$Q = f(n) = n$$

When comparing the complexity to the traditional ERM, it is obvious how the system can be simplified. With increasing amounts of data, the complexity of ADS is always linear and can be easily predicated. The graph of the complexity shows this relation with traditional ERM model.



Source: authors

Figure 3: Complexity comparison of traditional ERM/ORM to ADS.

The whole idea of measuring complexity of the system could be seen from three perspectives – computational, psychological, and representational. The ADS may be defined as a non-traditional design pattern which by itself - in software engineering - can make process of finding solution easier and a more understandable (Mangalaraj et al., 2014).

Additional minor questions may arise. Firstly – how to resolve duplicity and redundancy in data? For example, let the given ADS consist of weather measurements from multiple (hundreds to thousands) of IoT devices. The question of duplicity and redundancy of data – in this case position for every device – must be thought about in a complex way. Can be a location really be generalized on level of information base? Because what if the IoT device is movable? Such as smartphone, smart watch or drone. Should it be really generalized to separate entities? Next and more important question is – how could the duplicity problem be solved algorithmically? Should the DBS check if there is same location in the database? In this case, the system would use valuable computer processing time for such queries. With the use of ADS this problem can be easily eliminated. The last question is – will the removal of redundancy be a significant benefit for data size? How much processing time is it worth to reduce the data size by let's say 1%? Such calculations are however out of the scope of this paper.

The last thing is that the usual information context of the position in ADS type systems is pointless without other data or context. This means that positional data in terms of ADS does not describe anything useful (apart from the position itself). To understand and use the location data we would need more information or metadata to describe the position itself. But by doing that, the location would become its own entity and should be stored separately, which would break the ADS paradigm by increasing the structure complexity.

Finally, the goal to understand ADS on a deeper level leads to other areas, such as research in spatial databases, tree indexing algorithms, synthetic databases and so on. It is important to mention, that recent researches show that finding highly effective algorithms and querying methods may not be possible (Roumelis et al., 2017).

Conclusion

Proposed approach to store position in ADS can be used and is recommended to use in atomic systems where ADS entities are of discrete character. This means that there is no prediction for continuous changes of position data in ADS entities. For example, atomic measurements from IoT, timed analysis and so on.

ADS could be represented in many forms in GIS analysis and system automatization processes. It is also important, that ADS stand on the premise of abandoning database relation between position and information. This means that it may not meet the conditions of Boyce-Codd forms or equivalent relation or object-based data schemes. However, this does not prevent the ADS concept or at least some parts of it to be utilized in design patterns of object programming and software engineering. If the positional data were to be separated from other information into special sets (like tables in SQL), it would lead only to extreme data swelling with no speedup or system

improvement (except elimination of duplicity and redundancy). Proposed solution offers simple and fast approach to solve issue of growing data complexity in big positioned data sets. Importance of similar approaches is increasing regarding the different architectures and kind of meta-data which are stored for upcoming big data mining (Guerrero, 2017).

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Digital Technology and Rural Livelihood - A Study of Peasant Communities in Pru District

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Abstract

There are a number of ways by which access to ICT can help boost economic activities of communities in a country with the mobile phone being the most common ICT tool especially in Sub Saharan Africa. To examine the impact of digital technology on rural livelihoods in the Pru district of the Brong Ahafo region of Ghana, a survey of 212 peasant farmers was conducted. The probit regression results indicate that, digital technology adoption is significantly influenced by age, cost and availability of the technology. Furthermore, digital technologies contribute to the improvement of rural livelihoods by expanding and strengthening social capital, increase people's ability to deal with emergencies and enhanced efficiency.

Keywords

Adoption, digital technology, livelihood, ICT, rural communities, peasant farmers, social capital.

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Introduction

Many technologies can be used for human development particularly with regards to increased income and improvement in human health which permit people to participate more fully in their communities (United Nations Development Programme, 2001). Globally, there are evidences to show the impact of digital technology on development. Countries which were once "**third world**" are now rated "**first world**" due to their rapid development in technology. China, Sweden, Korea, Singapore are among many nations which have developed rapidly through technology (United Nations Development Programme, 2001).

Chambers (1997) stated that the *rural development* concept connotes overall development of rural areas with a view to improve the quality of life of rural people. It is a strategy to enable a specific group of people; mostly the poor, to gain for themselves and their families more of what they want and need. In this sense rural development is comprehensive in nature and encompasses development in agriculture, craft industries, socio-economic infrastructure, community services and human development (Chambers, 1997).

Digital technology is an important tool for empowering the poor. It contributed largely to Sweden's excellent infrastructure (Baller et al., 2016). In agriculture for example, Jensen (2007) seminal study of Kerala fishermen in India provided a clean identification of significant impacts of mobile phones on earnings, price volatility and waste management. A study of farmers conducted in Bangladesh, China, India, and Vietnam found that 80% of farmers in these countries owned mobile phones which they use to connect with agents and traders and to estimate market transactions (Reardon et al., 2010).

ICT infrastructure in Ghana is progressing as compared to other low-income countries globally and above 1.1% average for the Sub Saharan Africa (World Bank, 2016). Cell phone penetration rate had increased to 80.5% in August 2011 (Akanlisikum et al., 2014). In 2010 mobile subscription rose from 21.2 million to 35.9 million by April 2017 representing 59% increase in total subscription over the period. Ghana's total mobile data subscription at the end of December 2016 stood at 19.6 million (National Communication Authority, 2017). However, the digital gab between urban and rural Ghana is still very wide

even though some initiatives have started to deal with the challenges. In 2009, Ghana's Ministry of Communication for example pursued a programme to provide one model Community Information Centre (CIC) in each of 230 constituencies of Ghana to benefit the peri-urban and rural communities to help bridge the digital gap. While Internet adoption is growing steadily in Accra and other major cities, there is virtually no connection in most parts of rural Ghana.

Theoretical and conceptual framework

The theoretical foundation of the study is Diffusion of Innovation (DOI). DOI is one of the oldest social science theories originated in communication to explain how over time, an idea or product gains momentum and diffuses through a specific population or a community (Rogers, 1983). Rogers, (2004) posited with the DOI theory that, a person moves from first knowing about a particular innovation which he describes as the 'knowledge stage' to forming an attitude about that innovation called the 'persuasion stage', to making a decision whether or not to use a particular innovation usually referred to as the 'decision stage' to using an innovation (implementation stage) and to finally deciding whether to continue using an innovation (confirmation stage).

Technologies play an important role in economic development. Adoption and diffusion of technology are two interrelated concepts; describing the decision to use or not and the spread of a given technology among economic units over a period of time. Innovation adoption is not also a one step process. Tt takes time to complete. First time adopters may continue or cease to use the new technology. The duration of adoption of a technology vary among economic units, regions and attributes of the technology itself. Therefore, adequate understanding of the process of technology adoption and its diffusion is necessary for designing effective programmes.

The objective of the paper is to assess the adoption level of digital technology by rural folks and its impact on livelihoods in the Pru District of the Brong Ahafo Region of Ghana.

Materials and methods

Method of analysis

This study employed a combination of regression model and descriptive statistics to investigate the impact of digital technology on livelihood activities of the people in the Pru District of the Brong Ahafo region of Ghana. Specifically, we used the probit model to investigate the factors that influence the adoption of digital technology by rural folks while descriptive statistics was used to assess its contribution to rural livelihood activities. The data for the study was collected using questionnaires and personal interviews

1. Empirical model specification

The probit model can be stated generally as;

$$P_i = c + (1-c)F(Z_i) \quad (1)$$

P_i is the probability that the ith case experiences the event of interest. Z_i is the value of the unobserved continuous variable for the ith case. F is a link function, transforming Z from real line into the 0-1 interval, c is the natural response rate. The natural response rate is the probability of getting a response with no dose, and is equivalent to the constant term in the OLS regression.

The probit model also assumes that Z is linearly related to the predictors by the function

$$Z_i = b_0 + b_1 x_{11} + b_2 x_{12} + \ldots + b_k x_{ik} \quad (2)$$

Since Z cannot be observed, we must relate the explanatory variables to the probability of interest by substituting for Z in the equation for probability. This produces

$$P_1 = c + (1-c)F(b_0 + b_1 x_{11} + b_2 x_{12} + \ldots + b_k x_{ik}) \quad (3)$$

However, the empirical model for this study is stated as;

$$P(Adopt) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + u \quad (4)$$

Where;

P (Adpt) is probability of adoption which is a dummy variable (1 if the rural folk adopts digital technology and 0 is otherwise).

The β_s are the unknown coefficients to be estimated X is a vector of independent variables, which include *(X_1)-age, (X_2)-gender, (X_3)-educational background, (X_4)- total expenditure on digital technology usage, (X_5)-cost of digital equipment, (X_6) attitude towards ICT, (X_7)-proximity to the nearest town or city* and μ is the error term.

2. Hypotheses and description of variables

The hypothesis of our study is that adoption of digital technology is significantly influenced by personal, environmental and socio economic factors.

Adoption of digital technology is the dependent variable and it is represented by 1 if the rural folks adopt and 0 is otherwise. The independent variables that influence the adoption of digital technology were selected based on literature and personal experience.

- ***Age (AGE):*** It is a continuous variable and measured in years. Literature reveals that young people are more flexible in deciding for change than aged people (Motamed and Singh, 2003). Therefore, we anticipate a negative relationship between age and adoption. Thus young people will adopt digital technology more than the older people.
- ***Gender (GENDER):*** This is a dummy variable measured by 1 if the respondent is male and 0 if the respondent is a female. The gender of a respondent in the rural setting is more likely to affect the decision to adopt the digital technology. In a study of ''Gender Differences in Technology Adoption and Welfare Impact among Nigerian Farming Households, Adekemi (2014) observed that adoption level was 26% higher among male than their female counterparts. Our anticipation is that males will adopt digital technology more than the females.
- ***Educational background (EB):*** the use of digital technology involves technical know-how. Feder et al. (1985) noted that education improves the decision making process and influence the level and or composition of other inputs. Education increases the understanding and application of the technology. This variable was measured based upon whether or not the respondent had formal education. The dummy variable was measured by 1 if the respondent had any formal education (from primary to tertiary level) and 0 is otherwise. The expected sign of this variable is positive. Thus farmers with some level of formal education are likely to be more adoptive than those without any formal educational background
- ***Total expenditure (TEXn):*** It is a continuous variable and measured by the total amount of money the respondent spends on the use of digital technology. The expenses covered the cost of repairs, airtime, electricity bill among others. We expect a negative sign for this variable.
- ***Total cost of digital technology (TCTD):*** it is a continuous variable and measured by the total amount of money the respondent spends in the acquisition of the technology device. The cost of the digital technology is hypothesised to negatively affect the decision to adopt.
- ***Attitude towards ICT(ATTU):*** this is a dummy variable and a combined measure of respondents' perception of the usefulness of ICT and the ease with which it can be used. One (1) represents a respondent who believed that digital technology is useful and easy to use and 0 is otherwise. The apriori expectation for this variable is positive. In their investigation of Factors Affecting ICT Adoption in Rural Areas in Iran Vosough et al (2015) reported that households' attitudes towards ICT, compatibility and contact with agricultural extension agents are significant determinants for ICT adoption.
- ***Proximity (PROXIMITYN):*** it is a continuous variable and denotes the distance between the rural community and the nearest town or city where digital technology is sold. It was hypothesized that the closer the community to a city or town where the digital technology could be acquired, the more likely it is for the respondent to adopt.

The study area

Pru District is one of the 22 districts of the Brong Ahafo Region of Ghana. The district lies between longitude 0*30''W and 1*26''W and latitudes 7*50''N and 8*22N. The district experiences tropical continental or interior savannah type of climate with mean annual temperature ranging between 26.50°C and 27.20°C. It also has double maxima rainfall pattern with annual rainfall ranging between 800 mm to 1400 mm hence their activities are dominated by fishing and farming. It shares boundaries with seven (7) other Districts, namely, East Gonja to the North of the Northern Region, Sene East and West Districts to the East, Nkoranza and Atebubu-Amantin to the South and Kintampo North and South Districts to the West, all in the Brong Ahafo Region. The District of Pru covers an area of 3220.kmsq and the capital is Yeji. The population of Pru District is 129,248 representing 5.6%

of the Region's total population. The District has a household population of 127,069 with a total number of 22,579 households. Of the population of 12 years and above, 20% have mobile phones and only 0.5% of the total households in the district have access to internet facility while 0.8% own desktop or laptop computers (GSS, 2014).

Sampling procedure

Sample size can be determined by the application of one of several mathematical formulae. For populations that are large, the Cochran (1977) equation yields a representative sample for proportions. With a cross – sectional design, multi- stage sample technique was employed. At the first stage, purposive sampling was employed to select the 5 peasant communities. These are Sawaba, Daman Nkwata, Zambrama, Abease, and Beposo. These communities have relatively larger populations in the district. In the second stage we used the Yamane (1967) formula to determine a representative sample for the populations of the study communities. However, these samples were further scaled down through the Fisher et al. (1991) method taking into consideration the maximum budget, time limit and nature of the study. According to Yamane (1967), for a 95% confidence level and p = 0.5, size of the sample should be estimated as;

$$\mathbf{n} = \frac{N}{1+N\,(e^2)} \qquad (5)$$

where, **n** is the sample size, ***N*** is the population size and **e** is the level of precision.

The sample size based on simplified formula from Fisher et al. (1991) is stated as;

$$\mathbf{n} = \frac{(1.96)^1 * pq}{d^2} \qquad (6)$$

where **n** is the sample size, ***d*** is the desired level of precision (which is 95%, p0 is the proportion of the population with a key characteristic and ***q*** is 1-q. Using the population of the study communities in Table 1 below, ***p*** is calculated as

$$p = \frac{21,305}{129,248} \times 100 = 16.5\% = 0.165 \qquad (7)$$

and q is (1-p) = 1- 0.165 = 0.835

$$\text{Therefore, } n = \frac{(1.96)^2(0.165)(0.835)}{(0.05)^2} \qquad (8)$$

$$= 211.6$$

$$\cong 212$$

This sample was divided equally among the five selected communities as shown in Table 1.

Community	Population	Sample Size (by Yamane Formula)	Selected Sample (by Fisher formula)
Beposo	3 112	354	42
Zambrama	5 182	371.3	42
Sawaba	4 850	369.52	42
Abease	4 117	364.6	42
Daman Nkwata	4 044	363.9	42
Total	**21 305**	**1823.32**	**212**

Source: authors' elaboration 2017

Table 1: Targeted population of the study area and selected sample.

Results and discussions

This section presents the results, discussion and findings of the study. It highlights the socio economic characteristics of respondents, factors influencing adoption of digital technologies and the impact of adoption on livelihood activities.

Demographic characteristic of respondents

From Table 2, it can be seen that 56% of respondents are male while 44% are female. Of the 212 respondents, about 58% are between the ages of 20 and 30 years while only 5.6% were 61 years and above, an indication of a growing population in the study area. About 56% of the respondents have no formal education, while about 41% had attended school up to Senior High level and less than 1% had tertiary education. In terms of employment, about 48% are farmers while 38% are employed in the informal sector. The results also showed that 56.6% have access to mobile phones. Those who own both mobile phone and digital TV are 16% while 0.5% of the respondents have access to mobile phone and personal computer only. Overall less than 1% of the study population have access to all the three components of digital technology while 29.7% do not have access to any.

Variable	Response category	Frequency	Percent
Gender	Male	104	56
	Female	98	44
	Total	212	100
Age	20 -30 yrs	124	58.5
	31 - 40 yrs	40	18.9
	41 - 50 yrs	19	8.9
	51 - 60 yrs	17	8
	60yrs & above	12	5.6
	Total	212	100

Source: authors' elaboration 2017

Table 2: Demographic characteristics of respondent (N= 212) (to be continued).

Variable	Response category	Frequency	Percent
Education	Non formal	120	56.6
	primary	33	15.6
	JHS	28	13.2
	SHS	30	14.2
	Tertiary	1	0.5
	Total	212	100
Occupation	Formal sector	20	9.5
	informal	80	37.7
	farming	102	48.1
	Apprentership	10	5
	Total	212	100
Digital Tool	Mobile phone	120	56.6
	Mobile phone & digital TV	34	16
	Mobile phone & pc	1	0.5
	Mobile phone, digital TV & PC	1	0.5
	None	56	26.4
	Total	**212**	**100**

Source: authors' elaboration 2017

Table 2: Demographic characteristics of respondent (N= 212) (continuation).

Factors influencing adoption of digital technologies by rural folks

The probit model was used to analyse the factors influencing adoption of digital technology in the study communities and the results are presented in Table 3. Overall the estimated model was significant at 1% level. The likelihood ratio was 37.21($p<0.0000$). The pseudo R – square value of 0.7753 and the model correctly predicted 77.53% of the sample. The results show that certain socio demographic and economic factors are important in explaining adoption of digital technology by rural folks.

The explanatory variables that fit the model are age, expenses on use of digital technology, cost of digital technology, and proximity to the nearest town or city where digital technologies can be acquired. These were found to be significant as hypothesized. Gender, educational background, and whether or not the respondent had ever lived in a city were insignificant.

Age of rural folks were found to be significant at 1% and negatively related to the adoption of digital technology by rural folks. The negative coefficient effect means that, younger folks had a higher probability of adopting digital technology than the older folks. This result is supported by the findings of Motamed and Singh, (2003) that youthful exuberance is an important aspect of decision making in the adoption process.

As shown in Table 3, the total expenditure on the use of digital technology were found to be significant at 5%. The negative sign implies that, the higher the expenditure on the use of digital technology, the less likely it is for the rural folks to adopt. Ali et al. (2015) also confirmed that transportation and other related cost negatively affects the returns of adoption in their study of the Impact of transport cost on technology adoption in Nigeria. The total cost of digital technology was also found to be significant at 1%. Thus increment in the cost of using digital technology which include maintenance, power and call credit, significantly influence the people of Pru district to adopt digital technology in their livelihood activities.

Proximity to the nearest city or town was found to be significant at 1% and positively related to adoption of digital technology by rural folks. The positive coefficient means that the closeness of the community to the nearest city where digital technologies are found significantly increase the probability of adoption.

Adopters	Coefficient	Robust Coef. Std. Err	P>z	Marginal effect
GENDER	-0.503	0.407	0.217	-0.056
AGE	-0.594	0.192	0.002 ***	-0.058
EB	-0.135	0.387	0.728	-0.013
TEXn	0.012	0.006	0.045 **	0.001
TCDT	0.019	0.003	0.000 ***	0.002
CITY	0.014	0.515	0.978	0.001
PROXIMITYn	-0.097	0.024	0.000 ***	-0.009
Constant	-1.706	0.852	0.045	-

Note: Dependent variable: rural folks adopt digital technology or not (1= Yes, 0 = No);
*** significant at 1%; **significant at 5%

Wald $chi^2(7) = 37.21$; Prob > $chi^2 = 0.0000$

Source: authors' elaboration 2017

Table 3: The probit model explaining adoption of digital technologies.

Contributions of digital technology to livelihood activities

Table 4 below shows the contribution of digital technology to the livelihood activities of rural folks in the Pru District. We used mean scores to measure the perception of respondents about the impact of digital on their livelihood. The livelihood activities (LA) measured are social capital (S), human capital (H), vulnerability (V), financial capital (F), processes and institutions and policies (PIP). These variables were measured against certain key aspects of livelihood in relation to how digital technology has improved their status and these include *relationship with friends and relatives, efficiency in daily activities, dealing with emergencies, membership in groups and networking, status of culture, communication with government departments and agencies, general neighbourhood security, business activities, social functions, household income and money transfers.*

Social networking and relationship building were the most important benefits of using digital technology as 66.7% of respondents indicated that DT had either improved or greatly improved their relationships and contacts with friends and relatives. A mean score of 3.3 on a scale of 1 to 4 indicates highly positive responses. The results further revealed that social benefits of digital technology were also linked to reduced physical visits and decreased cost of travel. These findings suggest that digital technologies enabled rural folks to overcome vulnerabilities related to social exclusion apart from the important role it played in saving time and cost associated with travel.

The link between digital technology usage and efficiency of daily activities also produced highly positive response, with a mean score of 3.1 Overall, 61.7% of the respondents admitted that the efficiency of their daily activities had either improved or greatly improved. These results tally with the opinions from the field interview in which participants reported that the use of digital technology had enabled them to do more livelihood activities efficiently which is a significant contribution to human capital. The use of digital technologies allows rural folks to engage in many activities, something that can be translated into improved income earning and cost savings.

Getting support during emergencies was also a significant contribution of digital technology to human security. With a mean score of 3.1, more than half (56.8%) of the respondents believed that digital technology enhanced their ability to deal with emergencies. In an interaction with the rural folks during the field survey, some respondents reported the important role of these technologies in contacting the Community-Based Health Planning and Services CHPS compound in the Pru District which is approximately (20) miles away from the sampled communities to address their health needs.

Digital technology has also contributed significantly to the general security in the neighborhood recording a mean score of 3.1 in the perception rating. During the field survey, a key informant in Beposo described how the mobile phone was used to communicate with neighbouring communities, leading to a joint effort to arrest armed robbers who had operated in the community. Most crimes were prevented and arrests made through the on time information delivery through the mobile phone.

Another significant area that is worth looking at, is the contribution of digital technologies to the business status of the rural folks. About 58.5% approved of its usefulness to their businesses with a mean of 3.1. According to reports during the field survey, most of the respondents gave account of how digital technologies have reduced the cost of doing business. They now spend less on transportation, and go through less stress to find out the prices of products from distant markets. They are able to communicate with their business counterparts to effectively execute their transactions. Some of them access market information through the internet while others do money transfers through their smart phones.

Household income is a very vital component of financial capital. Results from the Table 4 shows that 57.7% of respondents reported that digital technology has significantly improved their household income. With a mean value of 3.1, digital technologies have had a positive impact on improving the financial capital of the rural folks. A study by Statistics New Zealand (2001) also suggest that households with more internet access are likely to increase their annual incomes five times more than household with less internet access.

The results also show that 51.3% of the total respondents believed digital technologies has improved their ability to do money transfers. In an interaction with the respondents during the field survey, most of the rural folks reported that digital technologies have made their financial transactions easier. They are able to send and receive money from their wards and business clients at any timer. The inconveniences associated with banking

Livelihood aspect	LA	N	Percentage				Mean score
			Worsened	No change	Improved	Greatly improved	
Relationship/ Contacts With Friends And Relatives	S	156	0	3.6	42.8	23.9	3.3
Efficiency In Daily Activities	H	156	0	8.6	49.1	12.6	3.1
Help In Case Of Emergencies	V	155	0	13.1	40.1	16.7	3.1
Membership In Groups And Networks	S	156	0	20.7	45	4.5	2.8
Status Of Culture	S	156	0.5	33.3	14	22.5	2.8
Communication With Government Departments	PIP	156	0.9	50.9	17.1	1.4	2.3
General neighborhood Security	V	156	3.2	14.4	39.2	13.1	3.1
Business Status	F	155	0.9	9.9	45.9	12.6	3.1
Arrangement Of Social Functions	S	156	0	20.7	45.5	4.1	2.8
Household Income	F	156	0.9	11.7	31.1	26.6	3.1
Sending and receiving money	F	155	0.5	18	31.5	19.8	3

Note: S= social capital, F = financial capital, H = human capital, V = vulnerability, P = physical capital, PIP = Processes, Institutions and Policies Source

Source: authors' elaboration 2017

Table 4: Analysis of the impact of digital technologies on livelihood (N=212).

institutions according to the respondents have been minimized. A key informant at Beposo, who happens to be the 2015 District Best Farmer, reported how he used the Mobile Money system technologies to facilitate a quick transfer of money to his ward in the northern part of the Volta Region, who was at the verge of being prevented from taking an examination in school because she defaulted in paying on time.

Conclusion

The main objective of the study was to assess the adoption of digital technology by rural folks in the Pru district of the Brong Ahafo Region of the republic of Ghana, and its contribution to rural livelihoods. The literacy level in the study area is low. The factors affecting the adoption of digital technologies by the rural folks as revealed by the probit regression were age, cost of use and maintenance, price of the digital technologies, and proximity to the nearest town or city where the digital technologies are available for procurement. The results from the descriptive statistics on the contributions of digital technologies to livelihood activities revealed that contact with relations, family and friends were the most significant aspects of livelihood the people benefited from the adoption of digital technologies besides the help they get in cases of emergency, efficiency in daily activities, general neighborhood security, improved household income, improvement in business status, and the ease with which they do money transfers among relatives, friends and business associates.

Digital technology has proven to have immense contribution to social capital as the social relationships of the peasants in the study area had improved. However, the main challenge is poor telecommunication network. Therefore, the telecommunication networks can do more to extend their services to these deprived communities. Government policy should be put in place to ensure that digital technologies are more accessible and affordable to all, especially those in peasant communities. Talk tax and other communication levies should be reviewed downwards to reduce call cost.

Accessibility to digital technology devices had impacted negatively on peoples' adoption behaviour. The digital industry especially the telecommunication companies should make their products and services accessible to the peasant communities in the Pru District and Brong Ahafo Region in general. The cost on the use of digital technologies was significant at 5%. Government subsidies should be given to these folks especially on electricity so as to reduce power expenditure and its related cost.

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What Are the Motivation and Barriers of Young Farmers to Enter the Sector?

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Abstract

Ensuring the generation renewal in the agriculture is crucial. There are policy incentives to attract young people, but the motivation to enter the sector depend on many factors and there are also barriers. The aim of the paper is to assess the motivation and barriers of the young farmers, newcomers to the agrarian sector in the Czech Republic and to draft the conclusions for policy and incentives creation.

Based on answers of 510 young farmers, the main motive to enter was the wish to continue with farming on the farm of the parents or other relatives and to work in nature and with animals. The hardest was to purchase the agricultural land, administrative burden and ensuring the finances for the development and for start-up. Hence, to facilitate the start-up it is useful to support the land purchase and provide investment subsidies. The research was financed from internal research project 1113/2018.

Keywords

Common Agricultural Policy, enter barriers, motivation, young farmers.

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Introduction

"Young farmers problem" is well acknowledged in the European Union (EU). Policy makers are concerned about decreasing number (and share) of young farmers. In 2016, there were on average 10.6% of farmers younger than 40 years in EU-28, but 32.8% older than 65 years, i.e. in retirement age (Eurostat, 2018). In the Czech Republic (CR), there were 10.2% of young farmers and 26.8% of retired. Rovný (2016) found a negative correlation between young farmers under 35 years and old farmers above 55 years in years 2007 and 2010 in the EU. Further projection of age-and-sex structure done for the CR by Šimpach and Pechrová (2015) is also not positive. They deducted the development of the agricultural population from the trends in total population and predicted that the number of agricultural workers older than 55 years will exceed the number of young in 2026.

"The lack of young farmers puts under risk the survival of the sector itself, due to an inadequate rate of generational turnover in the sector." (Kontogeorgos et al., 2014) According to Zagata and Sutherland (2015) "young sole holders on average operate more economically robust farms than their older counter-parts." Similarly, Galanopoulos et al. (2011) see as the main reason of poor adoption levels of novel production techniques and improved management systems the fact that the farmers at transhumance sheep and goat farms are old and lack the successors. However, according to Davis, Caske and Wallace (2009) only simple replacement of old farmers by young ones would not bring any significant improvement of the company's performance. Nevertheless, young farmers "have a longer planning horizon and tend to invest more heavily in business growth than comparable older age groups" (Davis, Caske and Wallace, 2013). They also tend to be more technically efficient as showed by Pechrová (2015a), but the differences were not statistically significant.

Despite that young farmers are well studied on EU level (e.g. Zagata et al., 2017), detailed study on the CR is missing. Therefore, the aim of the paper is to assess the motivation and barriers of young farmers in the CR to enter the sector. In the next section we provide the literature review of the main motivators or barriers when setting up

a new business. Next section describes the data and methods. Then the results are presented and discussed. Final section concludes and suggests policy implications.

Motivation and barriers to enter the agricultural sector

The identification of the main motives and barriers for our research was based on literature review and work of Šimpachová Pechrová (2017). We identified and 9 motives and 15 barriers.

Renko and Freeman (2017) proclaimed that "the most commonly thought-of motivation for starting a new business, financial motivation, involves reasons for entrepreneurship that relate to individual's intention to earn money and achieve financial security." We also included the "Way of ensuring the income" as one of the motives. In accordance with a trend of a healthy / organic food, we can also consider as a motive also "Way of ensuring the food for own family". Another motive is "To be an independent entrepreneur" related with the possibility to put into practice personal skills and capabilities to run own business which was identified by de Silva Moreira Ferreira, Loiola, and Guedes Gondim (2017) as one of the motive for the entrepreneurial career of the university students in Brazil. Besides, Renko and Freeman (2017) also highlight the importance of the individual opportunity nexus in entrepreneurship. Young people from agricultural family probably have a motive to start in agriculture to "Continue with farming on the farm of the parents or other relatives". There are also other factors – e.g. Zhao, Seibert and Lumpkin (2010) found that personality plays a role in the emergence and success of entrepreneurs.

Agricultural sector is specific due to biological processes in the production, spatial and seasonal character of production, influence of the natural factors on the process and output of production (Homolka, Pletichová and Mach, 2008). The character of the work determines the motivation (demotivation) to enter the sector. Young people might be motivated to "Work in the nature", "Work with the animals" or by their "Interest in modern technologies" as many advanced technologies that facilitate the work in agriculture are available.

There are "Subsidies for start-up and development of agricultural activities" provided from RDP and "Increased direct subsidies for young farmers" provided under the Pillar I of CAP. The measure Setting up of new farmers "has the objectives of facilitating new farmers' initial establishment and the structural adjustment of their holdings after initial setting up. Beneficiaries have to be less than 40 years of age, set up for the first time as head of an agricultural holding; possess adequate occupational skills and competence; and submit a business plan for the development of their farming activity" (Kontogeorgos et al., 2014).

Regarding the main barriers Šimpachová Pechrová (2017) identified that the main issue is the access to land and credits. "Additionally, CAP support pushes up land prices and thus adds to the time required for new entrants who are not inheriting to put together the necessary capital. Consequently, it gives an incentive to older farmers to hold on to their land in order to receive the single farm payment" (Kontogeorgos et al., 2014). Also Matthews (2013) names main difficulties with start in agriculture. We included the barriers related to finances: "Obtaining finance for business start-ups", "Obtaining finance for business development"; and to obtaining of production factors: "Purchase of agricultural land", "Lease of agricultural land", "Purchase of livestock", "Purchase of buildings", "Lease of buildings", "Purchase of other tangible assets (machinery)", "Lease of other tangible assets".

Each firm shall have a business plan that includes "aims of the organization, strategy of the organization and projects that are about to be realized in period. (Kovář, Hrazdilová Bočková, 2016) However, "Strategic planning (what to manufacture for whom)" and "Ensuring sales" can be difficult, especially for newcomers, but also young people, who inherited the farm usually want to make some changes in the production. Not all farmers have managerial skills and they lack experience with strategy planning. Farmers can also "lack knowledge and experience" in many other fields and obtaining them can be problematic.

Besides, a personal planning is needed. In small agricultural holdings, it is usually a family work force working on the farm, but in the CR it is not an exception that a young farmer overtakes large farm To "Obtain the qualified / unqualified workers" is important. Personal planning ensures that the firm has enough workforce, with needed knowledge, experiences and skills, with desirable personal features and characteristics, and work attitude, and right motivation, flexible, on the right time with adequate costs (Kovář, Hrazdilová Bočková, 2016).

With founding of a firm are linked also certain administrative tasks and needs to comply with veterinary laws or laws on the environment protections etc. Hence, there is "Administrative

burden" and related controls from responsible bodies.

Materials and methods

Motives and barriers stated in previous chapter were included into the questionnaire. We held quantitative primary survey from 15 June to 1 July 2018 on a sample of young farmers that was obtained from Land Parcel Identification System (LPIS) database from which were selected farmers younger than 40 years and from the database of subsidy recipients. Both databases were provided by Ministry of Agriculture. Hence, we had contacts on both, on financially supported and non-supported farmers. The questionnaire was distributed in electronical version programmed in Google form by the link in the e-mail to the respondents. It was strictly anonymous. Answers were collected via Google form and it was not possible to identify the farmer. We asked over 6000 respondents and collected 510 completely filled-in questionnaires.

Data

One quarter of the respondents were women. Average age was 33 years. Mostly, the household of the farmers had 4 members including the farmer (in 39.4% cases). Then there was 20% households with 3 members (probably families with one children), 16.5% with 5, 11.0% with 2 members and 4.1% with 1 member. 8.8% of farmers indicated larger household, probably because they included also parents or grandparents living with them.

Mostly the respondents (43.5%) graduated from high school with leaving exam, 32.9% had the university. It shows that the educational structure of the young farmers is relatively high. It is in line with total educational structure of farm managers (see Eurostat (2017) for the data of 2013) where farmers younger than 35 years have mostly, in 45.0% cases full agricultural training and then in 36.7% practical experiences only. In comparison with other age categories, it is the only one, where most members have the highest grade of agricultural education.

94.7% of respondents were physical persons and 4.7% limited liability companies. The size of the agricultural holdings was relatively large – 42.4 ha on average, from which 62.4% (26.4 ha) was rented. The median of the acreage was, however, much lower – only 18 ha of UAA (Utilized Agricultural Area), from which 8 ha were rented. It therefore visible that the division of land between enterprises is uneven, there is a relatively small number of large holdings which diverge the average upwards and a large number of smaller enterprises. There were farmers without land and maximal acreage was 1000 ha. Majority of respondents were new agricultural entrepreneurs registered in 2015 (20%) and 2016 (19.8%). Most of them started their farming activities already in the year when they registered (80.4%). The average existence of an enterprise since registration was almost 5 years (4.9), but the median was only 3 years. Young farmers' businesses operated on average for 5.2 years, but half of them only 3 years. Over one fourth of the holdings (26.5%) was organic farmers. They employed mostly only 1 (in 45.3% of cases) or none employee (42.0%). From this amount there were mostly (63.5%) no employees from the family or only 1 (29.4%). An average firm employed 0.89 worker, but 50% of firms employed 1 person. The average number of family workers was lower (0.56).

Methods

The questionnaire consisted of several parts: data about the agricultural holding and type of start-up, motivation, barriers, and data about farmers.

A scale from 1 point (*Certainly important / Certainly yes*), 2 points (*Rather important / Rather yes*) to 3 points (*Rather unimportant / Rather not*), 4 points (*Certainly unimportant / Certainly not*) and 0 point (I cannot assess) was used to assess motivation and barrier, respectively. The weighted average mark was calculated (answers with 0 were excluded). The lower was the score, the more important motivation or barrier was for the farmer. Similar approach was also used to evaluate the contribution of subsidies to facilitate the start-up. At the scale 0 points meant that the respondent did not receive the subsidy and could not evaluate its contribution.

The data are described using arithmetic mean, median and histograms. The answers are grouped in contingent tables in MS Excel and it is tested, whether the motivation to start with agriculture or the barriers depends on the gender or on the type of start-up – overtaking the farm / starting with certain background or starting a new farm. We used χ^2 goodness of fit test where null hypothesis is independence of the variables (H_0: $\pi_{ij} = \pi_{i\cdot}\, \pi_{\cdot j}$; where $1 \leq i \leq r$, $1 \leq j \leq s$). When the calculated test criterion G (1) exceeds or is equal to the critical value of the test on level of significance $\alpha = 0.05$ and degrees of freedom $v = (r\text{-}1)(s\text{-}1)$, H_0 is rejected and alternative hypothesis retain (H_A: non H_0).

$$G = \sum_{i=1}^{r} \sum_{j=1}^{s} \frac{(n_{ij} - n_{ij}^{'})^2}{n_{ij}^{'}} \quad G \approx \chi^2 \left[(r-1)(s-1)\right] \quad (1)$$

where r represents the number of rows and s of columns in contingence table. Critical field is $W_\alpha = \left\{G; G \geq \chi^2_{1-\alpha}\right\}$. If there is a dependence of two features, it can be calculated an intensity of this dependence by Cramer contingence coefficient V (2). The maximum value of this coefficient is derived from the dimension of the contingency table.

$$V = \sqrt{\frac{\chi^2}{n(q-1)}} \qquad q = \min\left\{r, s\right\} \qquad (2)$$

Results and discussion

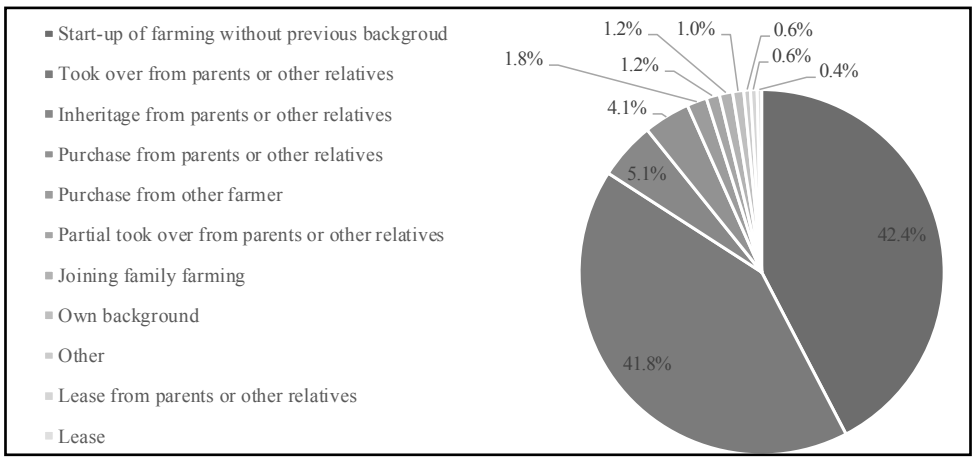
There were different ways of starting up of the farming stated by the farmers (besides 5 pre-defined options) – see Figure 1. 42.4% of young farmers started farming without previous background and 41.8% took it over from parents or other relatives. The takeover was not always complete, as some farmers started operating only with little background. The farms were gained by inheritance in 5.1% cases and 4.1% of respondents bought the farm from parents or other relatives and 1.8% from other farmers. 6 respondents also joined in a various form to the existing family holding and the same number of respondents partly took over the holding from parents or other relatives. 5 already had their own background from elsewhere. In addition, 3 young starting farmers rented land from their parents or other relatives and 2 from other farmers. 29.0% of farmers overtook the farm from a farmer older than 55 years. In 46.1%of cases the farmers started farming up to 10 years since the graduation. Then 31.0% of farmers started later and 22.9% of farmers already during studies.

Motivation

Regarding the motivation for the start-up, there were 9 reasons stated and evaluated by the farmers on the scale from, 1 – *Certainly important* to 4 – *Certainly unimportant* (0 – *I cannot assess*). The results are displayed at Figure 2. For 42.2% of respondents was important to continue with the farming of their parents or relatives, 12.9% considered this option as rather important, 5.5% as rather unimportant, 2.7% as certainly unimportant, 36.7% could not assess this type of motivation as it was irrelevant for them.

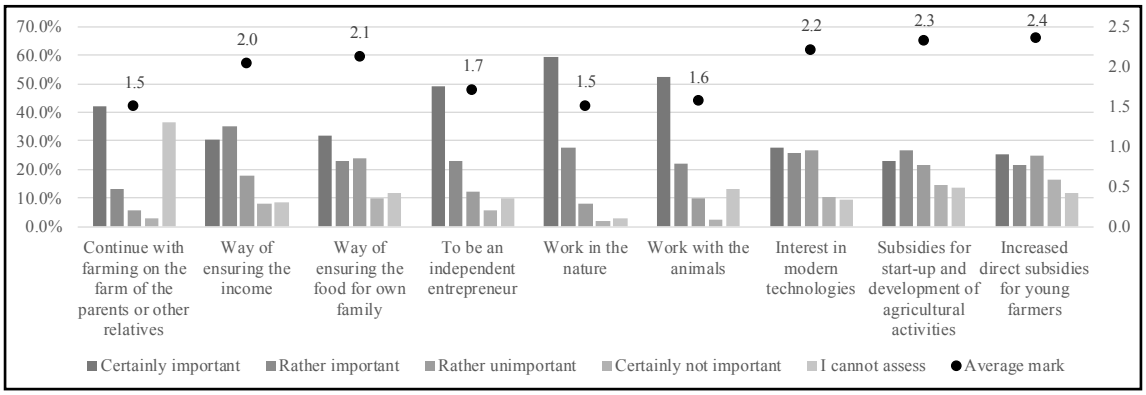
Agriculture as a way of ensuring income was rather important (in 35.3% of cases), but certainly important only in 30.2% of cases. Similarly, the way of ensuring food for the family was certainly important for less than a third (31.8%) of respondents. Almost half (49.0%) considered it to be an important motivation to be an independent entrepreneur. But the majority of young people was attracted to work in nature (it was certainly important for 59.2% of them and rather important for 27.8%). Similarly, work with animals was crucial for more than half of respondents (52.2%). On the other hand, the interest in modern technologies in agriculture was not so important (roughly one-fourth of the respondents replied that this theme was of certain importance for them, 25.7% rather important and 26.5% rather unimportant).

Subsidies did not emerge as one of the important motives. For 26.9% of the respondents were rather important and 23.1% certainly important. Almost 14% did not assess it and for over 14% were certainly unimportant. A similar distribution



Source: own elaboration

Figure 1: Ways of start-up of young farmers.



Source: own elaboration

Figure 2: Motivation of young farmers to enter the agricultural sector.

of responses was also for the increase in direct payments for young farmers, which were certainly important in 25.5% of cases and rather important in 21.6% of cases. Nearly for a quarter of young farmers (24.7%) it was rather unimportant and for 16.5% certainly unimportant and for 11.8% this was irrelevant. The finding is in line with the proclamation of Carbone and Subioli (2008) for the case of Italy: "... the size of the payment provided by the EU measure for young farmers offers an ineffective incentive to attract young people into the sector, and it is also insufficient to finance an increase in the competitiveness of the existing holdings through the familiar turnover within the farm".

Based on the average mark (see Figure 2) the most prevalent motive was the continuation of parents' farming followed by work in nature or work with animals. On the contrary, subsidies were not so strong motive (although the average over 2 means that the respondents moved on the border between *Rather important* and *Rather unimportant* with the important prevailing).

Farmers also stated other reasons that were not included in the close question. The most frequent answers were "I like it", "I am enjoying it", "It is my hobby", "I like animals", "I like horses", "I like nature" or "family tradition" which points on the strong relation of the young people towards the agriculture and nature. The other motives were mainly intrinsic (coming from inside of the people) which are hard to be influenced.

It was tested, whether the motivation depends on the gender and type of the start-up. Research of Hazudin et al. (2015) indicated that women are more likely to engage in business if their family matters still can be prioritized and that it is more challenging for them to succeed in without knowledge and skills competency. We also suppose that there might be differences. Continue with farming on the farm of the parents or other relatives depends on the gender, similarly as the work with animals (when it can be supposed that women have warmer relation towards certain animals such as horses). Interest in modern technologies, on the other hand, was a domain of men.

Continue with farming on the farm of the parents or other relatives dependent on the type of starting-up as same as the way of ensuring the income and food. It can be supposed that farmers with background from a family feel that it is important for them to continue with family business. They also perceive that it is possible to have an income from agriculture and food from home production that ensures their living. The differences were also in the interest in modern technologies, where people with background perceive it as more important. The subsidies also depend on whether the farmer overtook the farm, or he started without previous background. Crammers' V was 0.14 and pointed out on weaker dependence.

Barriers

Main barriers were related to the obtaining of production factors. Results are displayed at Figure 3a and 3b. Purchase of agricultural land and obtaining the finances for start-up of the business was a problem for 62.2% and 52.2% of respondents, respectively. Also purchase of tangible assets (machinery) was important for 40.0% of respondents. Besides, administrative burden was a great barrier for 62.0% of starting young farmers. Strategic planning was certainly a barrier only for 16.7% of respondents. 21.4% considered that it is rather a barrier, but for the rest it was not a problem and it could not be assessed by 8.2%. Obtaining the finances for a start-up was certainly (52.2%) and rather

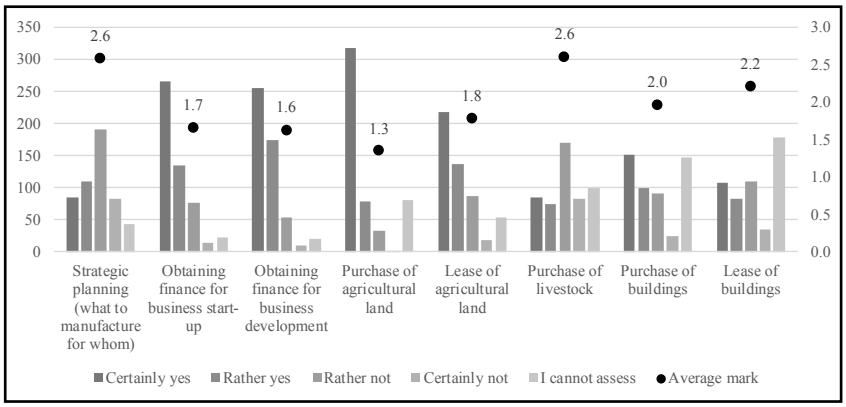
(26.5%) problematic as same obtaining the finances for the development (49.8% - certainly yes and 33.9% - rather yes). Only about 4.1% of respondents did not need finances for their start-up.

Lease of agricultural land was less problematic (42.5% - certainly yes and 26.9% - rather yes) than its purchase (62.2% - certainly yes and 15.5% - rather yes), but 15.7% (10.4%, respectively) farmers did not need agricultural land. Purchase of livestock was rather not a problem in 33.3% cases and certainly not a problem in 16.3%. 19.4% of farmers did not solve this issue at all. Similar share of young farmers that consider the purchase of the buildings as certainly problematic (29.6%) did not have to buy them at all (28.6%). While lease of the buildings was certainly a problem for 21% of respondents, it was rather not problematic for 21.4% and 34.9% did not have to solve it at all. Purchase of tangible assets was a problem for 40.0% (certainly yes) and 27.8% (rather yes) farmers. Lease was not problematic, but mainly due to the fact that 36.3% of respondents did not have to solve this problem.

Obtaining the workers was according to the expectations not that important, because, the holdings were mainly small or used family labour. 48.4% did not need qualified workers and 52.2% unqualified workers. If they needed them, non-qualified workers were easier to obtain. To ensure sales was rather not a problem for 30.0% of farmers, but for 25.30 it was rather a and for 17.6% it was certainly a problem. Many farmers see as problematic an administrative burden (60.2% - certainly yes, 20.8% - rather yes).

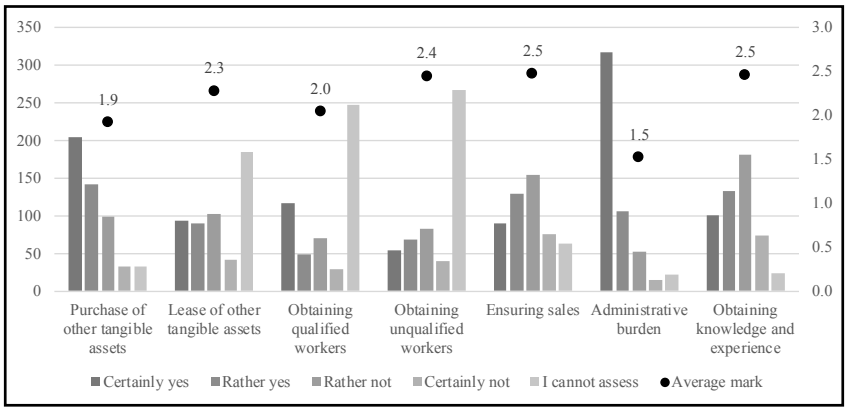
Obtaining the knowledge and experience was rather important for 25.9%, but rather unimportant for 35.3%. We must note that only people who actually started the activity were questioned. There are graduates from high schools or universities who did not enter the sector at all for various reasons. For example, Khayri, Yaghoubi and Yazdanpanah (2011) identified barriers to enhance entrepreneurship in the agricultural higher education.

The highest average mark (1.3) was given just to purchase of agricultural land and 1.5



Source: own elaboration

Figure 3a: Barriers of young farmers to enter the agricultural sector (part 1).



Source: own elaboration

Figure 3b: Barriers of young farmers to enter the agricultural sector (part 2).

to administrative burden. On the other hand, strategic planning and purchase of livestock (2.6) were seen as less problematic.

From other barriers were mainly stated again the "administrative and bureaucracy" – related to subsidies, setting-up of the firm, register the animals etc. Then again the "financing" and "investments", "obtaining the land", "legislation" in the CR such as building law etc.

Crammers' *V* was 0.14 and pointed out on weaker dependence between barriers and gender or type of start-up. Strategic planning depends on the gender as same as the lease of agricultural land. It seems that women have more problems with planning, but less with a lease of a land. Regarding the type of start-up, we originally assumed that there might be strong dependence between the type of start-up and the barriers – probably those farmers, who started with certain background might have their way easier and the barriers shall not be that pronounced, but we found only the dependence in obtaining finance for business start-ups.

Research by Zondag et al. (2016) revealed that among five most important general needs of young farmers belong availability of land to buy, land to rent, subsidies, access to credit and qualified labour (that was more important in new MS than in EU 15). This is in line our findings where the lack of available land and the ensuring of finances was seen as a main problem. Besides, Zondag et al. (2015) identified that Czech farmers lack the experience with multi-generational farming and knowledge and experience in the management of plant growing and/or animal breeding.

Results can be considered during formulation of the measures and incentives. However, we the survey was done only on 510 young farmers (despite that we asked over 6 thous. respondents). It is difficult to assess whether this is representative sample as its consistence is purely random. In future research we would like to focus on case studies on the farms and perform face-to-face interviews with the farmers to find out more about the incentives that could help them when they were starting their business and what was their major motivation.

Conclusion

Generation renewal in agriculture is crucial and shall be supported. The motivation of young people to enter the sector depend on many factors. On the other hand, there are barriers that are sometimes too hard to overcome. The aim of the paper was to assess the motivation and barriers of the young farmers in the CR and to draft the conclusions for policy and incentives creation. Based on the data from a primary survey among 510 young farmers we found that the main motive to enter the agriculture was the wish to continue with farming on the farm of the parents or other relatives and to work in nature and with animals. Opposite, the hardest was to purchase the agricultural land, administrative burden and ensuring the finances for the development and for start-up.

The results of the analysis could be of use for the design of Common Agricultural Policy in the next programming period 2020–2027. To facilitate the start-up of young farmers, it is useful to support the purchase of the land. It is currently done by Supporting and Guaranteeing Agricultural and Forestry Fund in the CR which subsidies the interests of a loan for the purchase of land. Besides, there are investment subsidies for a setting up of young farmers or increased direct payments from Common Agricultural Policy that can help them with the start-up. However, the necessity of business plan (that is often difficult for farmers to assemble), long demanding administration process and related requirements (minimal and maximal standard production of the farm etc.) there are difficult to be obtained by young farmers. In this case an advisory system shall play its role. There are certified advisors by the Ministry of Agriculture, but the young farmers shall get used to use the agricultural extension services.

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Sector-Wide and Country-Specific Drivers of Firm Performance in the Visegrad Group Dairy Industry

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Abstract

The paper investigates the effects of sector-wide and country-specific determinants on profitability of the dairy industry in the Czech Republic, Slovakia, Poland and Hungary over the period of years 2006-2014. Using an econometric approach, a hypothesis about the impact of various drivers of firm performance on both sector and country level was tested. The findings confirm that these factors have a significant impact on the dairy firms' performance in the V4 countries. It was found out that foreign competition measured by the import penetration ratio had significant negative impact on dairy firm performance. The positive development of GDP and market concentration affected profitability positively. The results could help in designing common agricultural and industrial policy in the European Union as well as in managing the mutual trade of milk products in V4 countries.

Keywords

Industry performance, return on assets (ROA), dairy industry, Visegrad group countries.

JEL Classification: M21, Q13, Q17

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Introduction

It is commonly observed that profitability in the dairy industry differs across countries and over time (see e.g. Zdráhal et al., 2017). This is in contradiction to the propositions of the competitive environment hypothesis and the statement that the European food markets are characterized by high market saturation and strong competition (Hirsch and Gschwandtner, 2013; Verter and Osakwe, 2015). Zdráhal et al., 2017) found out that there are similarities as well as differences in the average economic performance of dairy processing enterprises among the Visegrad group (V4) countries. The average economic performance of the enterprises of the dairy industry in the Czech Republic is relatively low in the comparison to its western counterparts, however, in the recent years its level and dynamics has been growing in the comparison with the average economic performance of the enterprises of the dairy industry in the Slovakia, Poland and Hungary.

The EU milk sector experienced significant economic, political and structural changes in the last decades (Ernst and Young, 2013; European Commission, 2015a; Zdráhal and Bečvářová, 2018). The Visegrad group countries had to deal also with the specifics of transformation processes in transition economies (Blažková and Dvouletý, 2018a). Currently, the challenges of the European milk sector are especially the ability to adapt on the market dynamics caused by the abolition of the EU milk quotas (European Commission, 2015b) and the embargo on food imports imposed by Russia (European Commission, 2016). High performance and competitiveness of the dairy industry and the ability to finalize the basic raw material into products with higher value added (and to successfully face the competition within the European and global market) are important prerequisites for keeping dimension of the milk production in the EU regions. This is valid not only for long-term development of these sectors but also in the periods of shocks and volatile markets.

The question of what drives the business performance is a central issue in corporate finance. While part of the economist (e.g. Rumelt, 1991)

assume that performance is driven by firm-specific factors, the proponents of classical industrial organization theory (e.g. Porter, 1990) attribute the influence to industry-wide effects. Empirical studies have shown that firm-specific factors dominate the industry ones. However, this general finding is not of equal validity for all economic sectors. McGahan and Porter (1997) found that the importance of particular effects differs substantially across broad economic sectors. While the industry effects dominate in services, retail and transportation, the firm specific factors account for a larger portion in manufacturing. Based on these findings many empirical studies regarding the performance in food processing sector have been conducted focusing on the analysis of internal profitability drivers. However, there is a lower evidence on industry-wide and country-specific effects in spite of the fact that it would be beneficial for policy makers.

In this study we focus on the determination of the industry-wide and country-specific factors influencing the development of profitability in the dairy sectors of V4 countries in the time period of years 2006-2014. We have limited our time series by the year of 2014 as this was the last year with milk quotas and the next period was significantly influenced by the decision to abolish quota system. The results of this research have important implications for V4 dairy firms, they are also of a great interest to policy makers with respect to agricultural and industrial policy as well as to investment analysts assessing the effects of changes in the external environment on the return from dairy firms. This paper aims to provide existing and potential stakeholders of the dairy industry with information on the development of dairy sectors performance in particular V4 countries and on the intensity of particular performance drivers.

Theoretical background and hypothesis development

Findings on the interaction between industry-wide and firm-specific factors of a firm performance do not yield consistent results. According to McGahan and Porter (1997), the industry structure is a central determinant of firm performance, which is in compliance with the theory of industrial organization. On the other hand, the opposite approach (according to McGahan and Porter (1997) called the resource based view) argues that firm performance is most influenced by unique organizational processes.

Hawawini et al. (2003) focused on the firm performance drivers and found out that only for a few dominant firms in the sector firm-specific factors matter significantly more than industry factors. For most other firms the industry factors are of a greater importance in the comparison with the firm-specific ones. Similar result was concluded by Schumacher and Boland (2005), who focused their research on food processing firms. Their results indicated that firm specific factors are less important for the vast majority that are not the industry high or low performers. The industry factors as drivers of profitability could not be disregarded also in the Czech food processing sector, as reported by Blažková and Dvouletý (2018b). This evidence provides support that industry nature matters more for firms that are not high or low performers, which is characteristic for the majority of firms in the industry.

Performance variation of a firm and its industry drivers as a research area have a long tradition. Schmalense (1985) using the sample of US manufacturing firms found out, that industry effects accounted for about 20 per cent of variation in firms´ profits. Rumelt (1991) extended his research by including longer observing period, which led to relatively lower proportion attributed to industry effects (only 9-16 per cent) compared with firm-specific factors. Similarly, McGahan and Porter (1997) confirmed the intensity of sector influence on the firms´ profitability. It accounted for 19 per cent of the aggregate variance in the profitability. Blažková and Dvouletý (2018b) estimated the industry effects to be more important after excluding outliers (the industry effects increased from 0.4 to 7.5 per cent when using ROA).

While the debate has mainly focused on firm and industry effects, our aim is to integrate country and year effects in order to account for macroeconomic fluctuations. However, compared to the disagreement between inter-firm and sector-specific factors, the empirical evidence on differences in profitability among countries and over time is rare. Chen (2004) shows that despite the EU single market the national boarders strongly restrict trade within the EU. Based on this finding it can be assumed, that the profits will differ among particular countries due to different import and export penetrations. Several other country-specific aspects such as economic level, interest rates will be controlled. Besides variation across countries, the performance can vary also over time. There are several empirical studies on profit variation over time, e.g. McGahan and Porter

(1997) or Makino et al. (2004), which discovered very weak linkage on profitability.

The hypothesis is elaborated based on the existing literature concerning the drivers of firms´ performance. Prevailing research is not consistent regarding the range of palette of particular sector-wide and country-specific factors. Classical industrial organization theory (e.g. Bain, 1956) assumes that from the perspective of wide-sector character, the performance mainly depends on the industry structure (Hirsch et al., 2013). This can be described by market concentration, conduct of suppliers, vertical integration etc. Justification for systematic differences in profitability between countries can be found in different intensity of the intra-national and inter-national trades. To integrate time factors, prevailing studies incorporated the standard macroeconomic measures (Makino et al., 2004). A time effect is here referred to as a component capturing the macroeconomic cycle.

The hypothesis addresses the relationship between performance of firms and sector, country and year aspects and reflects the findings of the above mentioned studies.

H1: Sector-wide and country-specific factors had a significant impact on the dairy firms´ performance in the V4 countries in 2006-2014.

H0: Sector-wide and country-specific factors had an insignificant impact on the dairy firms´ performance in the V4 countries in 2006-2014.

There are various measures that can be used for the analysis of the financial performance of firms. Since the majority of observed firms are not listed, accounting indicator return on assets (ROA) is used as a proxy for performance. To comprehend the dynamic aspect of V4 dairy sector performance, the industry-wide and country-specific aspects have to be operationalized. This analysis uses market concentration, number of firms in the sector, growth of demand and growth of the price of agricultural producers as proxies for the industry-wide aspects. The country specific aspects are influenced by the market openness and foreign competition, therefore the import penetration ratio becomes a proxy for this area, similarly to Olper et al. (2016). To capture the time effects and their connection to the macroeconomic cycle, the changes in the gross domestic product and interest rate become proxies for these aspects.

The article proceeds as follows. The next part provides the description of the data, variables and methodological approach. The empirical study in the third part focuses on the calculation of performance measure and its interaction to the sector-wide and country specific factors. Concluding part discusses the main results, particular limitations and possible further research.

Materials and methods

Data

AMADEUS, the trans-European database compiled by Bureau van Dijk Electronic Publishing, was used as the main data source. The dataset covers the period from 2006 to 2014 and consists of enterprises operating in the dairy processing industry (NACE class 105) within the Visegrad countries, i.e. the Czech Republic, the Slovak Republic, Hungary and Poland. Further, the data published by the European Commission in the Eurostat database were employed to have relevant information for calculation of variables described below.

	The Czech Republic			The Slovak Republic			Poland			Hungary		
	Population	Sample		Population	Sample		Population	Sample		Population	Sample	
	(N)	(N)	(%)	(N)	(N)	(%)	(N)	(N)	(%)	(N)	(N)	(%)
2006	146	47	32.2	49	21	42.9	736	186	25.3	91	35	38.5
2007	146	52	35.6	50	23	46.0	682	203	29.8	90	53	58.9
2008	178	52	29.2	38	23	60.5	724	225	31.1	100	58	58.0
2009	186	52	28.0	58	23	39.7	656	233	35.5	98	93	94.9
2010	207	51	24.6	229	41	17.9	663	236	35.6	116	93	80.2
2011	199	50	25.1	231	45	19.5	604	239	39.6	112	101	90.2
2012	188	52	27.7	197	49	24.9	603	238	39.5	108	98	90.7
2013	178	46	25.8	189	54	28.6	523	218	41.7	106	100	94.3
2014	181	36	19.9	168	51	30.4	521	154	29.6	115	96	83.5

Note: Population refers to all firms active in the dairy processing industries within the particular analysed countries.
Source: Eurostat, AMADEUS; authors elaboration

Table 1: Shares of observations by country within the sample and in the population.

The sample of the accounting data of enterprises is made out of 3,427 observations across 9 years and 4 countries. To see the representativeness of the sample, the shares of observations by countries in the sample with those in the population are compared in Table 1. This data sample was used for calculating the average value of ROA indicator and the value of concentration ratio for each of the observed country and year.

Variables

The profitability variable acting as the dependent variable is represented by *Return on Assets (ROA)*, which is the most common indicator of profitability and measures the firm's management ability to generate profits from the firm's assets (Megginson et al., 2008). As stated by Hult et al. (2008), ROA belongs to the most used measures of financial performance in previous empirical studies.

Theoretical models and previous empirical studies indicate that both country and industry characteristics play a role in determining profitability, therefore seven independent variables reflecting these characteristics were tested in our analysis. Country specific factors are represented in the model by two variables – *Gross Domestic Product (GDP)* and *Interest rate (IR)*, which reflect the effect of macroeconomic fluctuations in the economy (macroeconomic factors). A firm's performance and distress (failure) can be significantly influenced by the performance of the macro economy. For example, the failure risk of a geared firm is augmented by macroeconomic instability and, therefore, the determinants of failure (low profitability) should also be seen in the macroeconomic context. Industry specific factors reflect especially structural characteristics and are represented in the model by five variables – *Growth of sales revenues (SalesGrowth), Number of firms (NF), Market concentration (CR4), Growth of price of agricultural producers (PAP)* and *Import penetration ratio (IMP)*. The list of all variables, their calculations and data source are given in the Table 2.

Gross Domestic Product (GDP) is an indication of the economy and market development that could foster the development of dairy firms, mainly due to the greater possibilities for extending the production, as characterized by increasing economies of scale. Moreover, a larger GDP frequently means that the country is better equipped in terms of capital, a condition which favours the development of the processing industry (Lapinska, 2014). Also, we expect that the larger the markets are, the larger the scope for product differentiation is. That could positively affect firms´ profitability. Generally, this indicator is an independent variable expressing macro-economic development. Therefore, this variable is related mainly to factors that act in a general sense for most organizations directly, but to a specific product or service covered by the organization it usually acts indirectly. The potential impact of this indicator is primarily an empirical matter, however, the GDP growth should go hand in hand with the growth in the performance of manufacturing industries.

Interest rate (IR) is another macroeconomic determinant of firms' performance. The increase in interest rate rise the cost of debt at which the required rate of return will be lower than the cost of debt, therefore firms reject profitable projects due to the high cost of borrowing, which affected negatively firm's profit. As in the previous case, the influence of this indicator is mainly empirical.

Growth of sales revenues (SalesGrowth) of the dairy industry is an indicator of the size of the demand. It captures developments of the competitive position on both domestic and export markets at the same time. It can be supposed that growth of industry demand would exert a positive influence on profitability, since firms in industries facing growth probably do not feel so competitive pressure than firms in stagnating industries. The classical empirical literature has provided some evidence on this hypothesis, i.e. that growth of industry demand has a positive impact on profits (e.g. Khalilzadeh-Shirazi, 1974; Bradburd and Caves, 1982) and therefore we expect the positive sign of the parameter in the model.

Number of firms (NF) characterizes the size of the dairy industry from the viewpoint of the number of firms operating in the given country. Economic theory says that larger markets with a high number of companies on the market are expected to generate greater competition among companies and smaller ability of the firms to influence prices, therefore negative relationship between ROA and number of firms is expected, i.e. negative sign of the parameter in models.

Market concentration is expressed in models by the concentration ratio of four largest companies on the market *(CR4)*. It can be assumed that higher market concentration leads to higher market power implying higher prices, which should positively influence the profitability of firms on the concentrated markets. Therefore positive coefficient in the model is expected.

Growth of price of agricultural producers (PAPgrowth) reflects the substantial financial risks arising from wide fluctuation in milk prices that milk processing companies face. Farm milk prices have been more volatile in the past decade (Dudová and Bečvářová, 2015). Generally, higher price (of agriculture producers) of input (raw milk) negatively affects the profitability of processing firms. This is especially true for the milk processing industry, which is facing significant market power of retailers on the demand side. Also, by contrast to other manufacturing industries, there are specific supply-side conditions (raw milk availability and contracting of deliveries) of the dairy industry, which could have an impact on profitability. The expected sign is negative since an increase in price of raw material should lower the profitability.

Import penetration ratio (IMP) measures the importance of foreign competition in the domestic country (Lindner, 2001). In general, the international trade increases the competitive pressure (Kalínská, 2010), therefore the import competition can significantly reduce overall market share of large companies in the industry. As a result of the increase in imports, large domestic firms can experience significant losses in market share. On that account the sign of the estimated parameter in the model is expected to be negative.

Variable	Variables description
ROA	$ROA_{it} = \frac{EBIT_{it}}{Total\ Assets_{it}}$ where *i* denotes each of the four Visegrad countries and *t* denotes the year (dimensionless variable). Data source: Bureau van Dijk Electronic Publishing (2014). AMADEUS database.
GDP	Year-to-year difference of the Gross Domestic Product of the country *i*, in the time period *t*, i.e. $GDP_t - GDP_{t-1}$ where *i* denotes each of the four Visegrad countries and *t* denotes the year (in mil. EUR, in comparable prices 2010). Data source: European Commission. Eurostat.
IR	Year-to-year difference of the interest rate in the country *i*, in the time period t, i.e. $IR_t - IR_{t-1}$ where *i* denotes each of the four Visegrad countries and *t* denotes the year (dimensionless variable). Data source: European Commission. Eurostat – Interest rates database.
SalesGrowth	$SalesGrowth_{it} = \frac{Sales_{it} - Sales_{i,t-1}}{Sales_{i,t-1}}$ where *i* denotes each of the four Visegrad countries and *t* denotes the year (dimensionless variable). Data source: European Commission. Eurostat - Annual enterprise statistics for special aggregates of activities.
NF	Number of firms operating in the country *i* in the time period *t*. Data source: Bureau van Dijk Electronic Publishing. AMADEUS database.
CR4	$CR4_{it} = \sum_{j=1}^{4} S_{ijt}$ where S_{ijt} denotes the market share of *j*-th firm in the country *i* and the time period *t*. The market share of the *j*-th firm is calculated as the production of the company divided by the sum of production of all firms in the market. We calculated the market concentration on the basis of sales data, i.e. sales of own products and services, because this indicator seems to explain more about the market share than the output. (*CR4* is expressed as dimensionless variable). Data source: Bureau van Dijk Electronic Publishing. AMADEUS database.
PAPgrowth	Growth rate of prices of agricultural producers in the country *i* in the time period *t* (expressed as dimensionless variable). Data source: European Commission. Eurostat.
IMP	$IMP_{it} = \frac{M_{it}}{Y_{it} + M_{it} - X_{it}}$ where *i* denotes each of the four Visegrad countries and *t* denotes the year, M_{it} and X_{it} are, respectively, the total imports and exports of dairy products of the country *i* in the year *t*, and Y_{it} is the total production of the dairy processing industry in a particular country *i* expressed by the total sales of own products and services. (*IMP* is expressed as dimensionless variable). Data source: European Commission. Eurostat.

Source: authors elaboration based on Megginson et al. (2008), Viscusi et al. (2005) and Lindner (2001)

Table 2: Variables used in empirical investigation.

Variable	Mean	Median	Max.	Min.	Std. Dev.	Obs.
ROA	-0.01395	-0.0044	0.08473	-0.15303	0.06806	36
GDP	4 607.35	8 161.85	29 574.05	-7 730.40	-1 293.60	36
IR	-0.00192	0.0003	0.015	-0.0197	0.00784	36
SalesGrowth	0.03281	0.04224	0.22119	-0.21031	0.10136	36
NF	263	180	736	38	226	36
CR4	0.45624	0.44815	0.75298	0.15877	0.15046	36
PAPgrowth	0.04292	0.08213	0.30413	-0.35146	0.16006	36
IMP	0.26648	0.28031	0.50673	0.03622	0.13664	36

Source: Gretl, authors elaboration

Table 3: Descriptive statistics.

Table 3 reports the descriptive statistics for all variables used in the regression analysis and gives an overview of the variability of the data sample (the units of analysis are particular V4 countries).

The variables involved in the analyses were formed into the balanced panel structure, where particular units of analysis are four V4 countries observed across period of nine years. Since panel structure requires estimating regression models only based on the stationary variables, we used the unit root test Levin, Lin and Chu (Levin et al., 2002) to check the stationarity of variables. All variables except for *IR* was found out to be stationary, the variable *IR* was, therefore, transformed into the year-to-year differences to be difference-stationary.

Methods

The regression model was estimated in the software Gretl. Based on the Hausman (1978) test, we used the Fixed Effects Estimator. We estimated the econometric model (see equation below) investigating the relationship between industry profitability and its main determinants:

$$ROA_{it} = \alpha_i + \beta_1 CR4_{it} + \beta_2 NF_{it} + \beta_3 IMP_{it} + \beta_4 GDP_{it} + \beta_5 PAPgrowth_{it} + \beta_6 GDP_{it} + \beta_7 IR_{it} + \beta_8 SalesGrowth_{it} + u_{it}$$

where i = 1, 2, 3 and 4 denotes countries and t = 1, 2, …9 denotes years of observation. The results are presented in Table 4.

All models were estimated with the White cross-section standard errors and covariance (d.f. corrected) which deals with the consequences of heteroscedasticity and autocorrelation. The model was controlled for collinearity using correlation matrices, no multicollinearity was detected. Estimated econometric model has a good explanatory power of the variability of the dependent variable in terms of the R-Squared and was found out to be statistically significant (Verbeek, 2012).

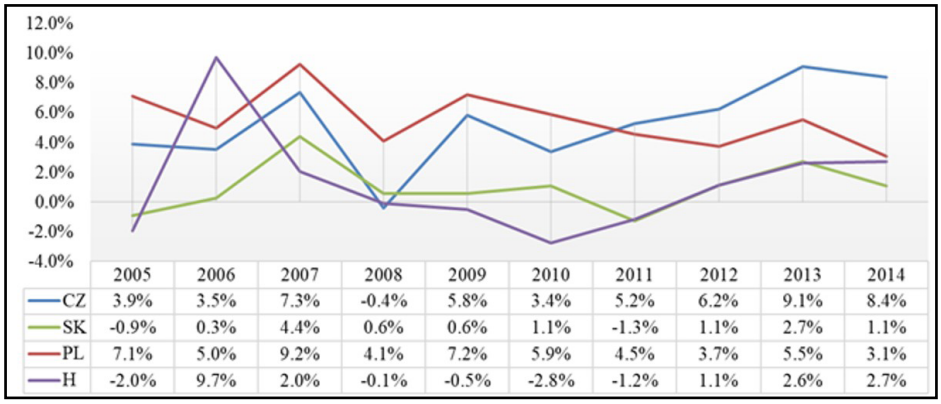
Results and discussion

Economic performance of milk processing companies in CZ, SK, PL and HU

There are similarities as well as different patterns in the changes of average economic performance (ROA) of milk processing companies among the Czech Republic, Poland, Slovakia and Hungary. Figure 1 presents values of average Return on Assets (ROA) of milk processing companies in the Czech Republic, Poland, Slovakia and Hungary during the period 2005-2014.

The milk processing companies in the Czech Republic reached an average ROA of 4% between 2005 and 2010. In 2008, average value of ROA dropped down as a consequence of the crisis in the milk sector due to the global economic crisis and decline in the prices of processors in the fourth quarter of 2008 and in 2009. The average ROA in the sector recovered already in 2009 to a level of around 6% in 2009. As noted by Špička (2013), this was specifically caused by relatively favourable input-output price relations (the low producer prices of milk, which partly compensated the low prices of processors) that induced higher profitability in the 2009. Since 2010, average values of ROA are increasing to the level of between 8% and 10% at the end of the reporting period.

Throughout the reporting period, milk processing companies in the Slovak Republic reached lower values of ROA compared to the enterprises in the Czech dairy industry (with the exception of 2008). Generally, the Slovak milk processing companies achieved very low levels of profitability, ROA fluctuated typically between plus 2% and minus 2%. Also, it took longer time to the milk processing industry of the Slovak Republic to overcome the effects of the crisis in 2008 in terms of profitability. Since 2011, the improvement in average ROA can be identified. Čechura and Malá (2014) investigated technology



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CZ	3.9%	3.5%	7.3%	-0.4%	5.8%	3.4%	5.2%	6.2%	9.1%	8.4%
SK	-0.9%	0.3%	4.4%	0.6%	0.6%	1.1%	-1.3%	1.1%	2.7%	1.1%
PL	7.1%	5.0%	9.2%	4.1%	7.2%	5.9%	4.5%	3.7%	5.5%	3.1%
H	-2.0%	9.7%	2.0%	-0.1%	-0.5%	-2.8%	-1.2%	1.1%	2.6%	2.7%

Source: own processing based on AMADEUS

Figure 1: Average ROA of milk processing companies in the Czech Republic (CZ), Poland (PL), Slovakia (SK) and Hungary (H) in 2005-2014.

and efficiency differences between food processing companies in the Czech and Slovak Republic and concluded that there are significant differences in the technology between the Czech and Slovak dairy industry. These differences cause negative effects for Slovak dairy companies (productivity parameters, technological change). Also, technical efficiency is higher in the Czech dairy companies in comparison to the Slovak ones.

Another measure of competitiveness is the mutual balance of foreign trade with milk products between the Czech Republic, the Slovak Republic and Poland. Milk processing industry in Poland can be seen as more successful in comparison with the dairy industry of the Czech and the Slovak Republic. This is also in line with the research results published by Špička (2015), who found out the lower rate of technological progress in the Czech and Slovak dairy food industries in comparison with Poland in the period of years 2008-2013.

The above-mentioned context corresponds with the average level of ROA of the milk processing industry in Poland. In the years 2005-2010 the milk processing companies in Poland reached higher values of ROA in comparison with the Czech Republic. It is worth mentioning the declining tendency of the average ROA in Poland, and the question arises, what are the causes of this development.

In the period of 2005-2010 the milk processing companies in Hungary reported the lower values of ROA (except of year 2006) compared to Czech Republic and Poland. From the viewpoint of the level and changes in the average ROA values, Hungary is very similar to the Slovak Republic. There can be observed an increasing trend of ROA values in Hungary (similarly to the Czech and Slovak Republic), during the second part of the observed period.

Factors affecting economic performance of milk processing companies

To test our hypothesis, we take the standard measure of business performance ROA (*ROA*), which represents the average value of return on assets of enterprises operating in the dairy industry. Our independent variables are represented by a set of control variables from both sector-wide and country-specific areas. The results of regression analysis are presented in Table 4.

	Dependent Variable ROA	
Independent Variables	Coefficients	Standard Errors
GDP	1.277773e-06***	1.71E-07
IR	-2.09379***	0.59316
SalesGrowth	0.0429	0.10029
CR4	0.28172***	0.09727
NF	0.00002	1.00E-05
PAPgrowth	-0.06379	0.07569
IMP	-0.47626***	0.12248
CONSTANT	-0.02892	0.01826
R-squared	0.79737	
Observations	36	

Note: *** statistical significance at 1% level, ** statistical significance at 5% level, * statistical significance at 10% level.
Source: Gretl, authors elaboration

Table 4: Model table: The determinants of industry profitability.

As follows from the results, the increase in Gross Domestic Product (*GDP*) in particular year was related to the increase in ROA of milk processors in the given year, which is in line with our expectations and the economic theory. Increase in GDP signals positive development of the economy, which is reflected also in the dairy

industry. This indicates that during the period 2006-2014, the increase in GDP in the Czech Republic, Slovakia, Hungary and Poland was associated with higher profitability of milk-processing companies. Increase in GDP usually means that the country is better equipped in terms of capital, a condition which favours the development of the processing industry. The larger the markets are it also allows in larger scope to differentiate products.

The analysis has shown that also the interest rate (*IR*) as a country specific factor significantly matters for performance of enterprises in dairy industry. This factor affects the profitability negatively, which supports the idea that the increase in the interest rate raises the cost of debt and therefore firms reject profitable projects due to the high cost of borrowing. This causes the lost opportunities and affects negatively firm´s profit. The results of the empirical research conducted by Blažková and Dvouletý (2017) among the Czech food processing companies confirmed that there is a negative relationship between profitability and indebtedness.

Growth of demand (*SalesGrowth*) for dairy industry products (on the domestic market or on the foreign market) seems to be positively associated with higher profitability. However, the coefficient was not statistically significant, therefore, we cannot make any conclusions about the impact of the sales growth on profit of milk processing companies.

The results of the research confirm that market concentration (*CR4*) significantly and at the same time positively effects the increase in profitability. As concluded by Čechura et al. (2015), the European milk processing market is characterized by oligopoly market power on average, but significant differences exist among the EU countries. Among countries with high oligopoly market power belongs Hungary. The Czech Republic, Poland and Slovakia belong among countries in which relative mark-up power increased in the most intensive way. These results are also in line with some other studies investigating the relationship between market concentration and profitability, such as e.g. Setiawan et al. (2012), Hersch et al. (1994), Blažková and Dvouletý (2017), or Blažková and Chmelíková (2016).

The structure of the industry can be assessed not only by the size distribution of firms on the market, i.e. by the market concentration indicators, but also by the number of firms (*NF*) on the market. Contrary to our expectations, we observed positive sign of the coefficient for this variable in the model. However, we cannot make any conclusion about the impact of the number of firms on the profitability of dairy industry regarding the fact that the coefficient is not statistically significant. As concluded by Čechura et al. (2015), majority of EU milk processors are characterized by only a small or almost no degree of market power. There are several large firms in the dairy industry, but on the other hand, very small firms are represented in large numbers that can be successful and profitable from the regional point of view or due to the discovering and occupying of the market niches. Therefore, the number of firms in the sector is not considered as an important determinant of profitability in the dairy industry.

Given that milk is the main intermediate input used in dairy industry, we observed negative sign of the coefficient for the growth of price of agricultural producers (*PAPgrowth*) in the model, which is in accordance with our expectations. Regarding the fact that the coefficients were not statistically significant, we cannot make any conclusions about the impact on profitability of the milk processing industry.

The impact of imports expressed by import penetration ratio (*IMP*) was confirmed to be significant factor when explaining profitability of milk processors. This determinant influences profitability negatively, i.e. during the period 2006-2014 the increase in IMP in the Czech Republic, Slovakia, Hungary and Poland was associated with lower profitability of milk processing companies. Our strong evidence for negative relationship between import penetration ratio and performance is in accordance with our expectation that the international trade increases the competitive pressure, therefore the import competition reduces overall market share of large companies in the industry, and results in increase in imports and losses in market shares of domestic firms.

Conclusion

One of the main challenges for agricultural policy makers is to support institutional frameworks that enable sustainable and competitiveness development of agribusiness sector. In our study, we therefore investigated the determinants of profitability of the dairy industries in the Czech Republic, Slovakia, Poland and Hungary, in order to assess whether both the country-specific (gross domestic product and interest rate) and industry-specific

(sales growth, market concentration, number of firms, growth of price of agricultural producers and import penetration ratio) determinants exert a significant effect on sectoral profitability (operationalized by ROA). Based on this research question we built a hypothesis, which we tested for the time period 2006-2014.

Our empirical results indicate that there are similarities as well as differences in the average economic performance (ROA) of milk processing companies the Czech Republic, Poland, Slovakia and Hungary. Levels of ROA are generally higher in the Czech Republic and Poland in comparison to the Slovak Republic and Hungary. In the first half of the observed period, the changes in the ROA were quite similar among analysed countries. All the countries were affected by crisis in the milk sector in the year 2008. Recovery after the crisis was faster in the Czech Republic and Poland in comparison to the Slovak Republic and Hungary. In the second half of the observed period, ROA was steadily increasing in the Czech Republic, Slovakia and Hungary. On the other hand, ROA was on a downward trend in Poland. These results correspond with the results and conclusions of studies by Špička (2013, 2015) and Čechura and Malá (2014).

The results suggest that there exist sector-wide and country-specific factors that have a significant impact on performance of the milk processing companies. The results show profitability (ROA) to be significantly related to the interest rate (negatively) and market concentration (positively). This suggests the important role of economies of scale and of investment activity on profitability of milk processing companies. Additionally, it was also found that profitability is significantly related to import penetration ratio (negatively). This suggests the importance of effects of ongoing agri-food trade liberalization.

Our main recommendations for agricultural, industry and trade policy makers is to support macro-economic as well as the dairy industry environment and strengthen competitiveness. The European Single Market is a very demanding market requiring high enterprise performance. Currently, increasingly liberal world dairy markets and the abolition of milk production quotas will further strengthen the competitive pressure on performance of milk processing companies in the Czech Republic, Slovakia, Poland and Hungary. Management of milk processing firms should be more oriented toward product diversification, brand name development and other marketing management activities. At the same time, technological efficiency and synergies in supply chains have to be improved. Public funds should be geared precisely to support innovation in the above areas. Regarding the further research, it would be very appropriate to extend the time period of the analysis as more data become available and to investigate the effects of the abolition of dairy production quotas on the dairy markets.

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