5. THE RELATIONSHIP BETWEEN TOTAL FACTOR PRODUCTIVITY AND SUBSIDIES IN THE CASE OF ROMANIAN FARMS

Cecilia ALEXANDRI[1]
Bianca PAUNA[2]
Corina SAMAN[3]

Abstract

The paper studies the determinants of total factor productivity of different size farms in Romania, and, in particular, the effect of the CAP subsidies on productivity. It uses the FADN public database and runs a multilevel mixed effects model.

The most important conclusion is that subsidies are not conducing to productivity in the case of the Romanian farms. This conclusion is valid irrespective of the size and the type of the farm, with the exception of medium-sized dairy farms. Subsidies introduce an additional distortion to the large farms, which increase their land holding simply because the subsidies per acre are larger than the rent per acre.

Keywords: CAP subsidies, investment, productivity, farm size, Romania

JEL Codes: D22, Q12, Q14, Q18

1. Introduction

Productivity in agriculture should have a steep growth until 2050 to meet demand. The FAO estimate for the production growth for food, feed and biofuel is about 50 percent compared to 2012 (FAO, 2017). The question is if Common Agricultural Policies (CAP) can transform the agricultural sectors in the countries like Romania with a very large rural populations and with smaller farm sizes through subsidy policy and mitigate the shocks.

In this paper, we investigate the relationship between productivity, measured by the ratio of total output to total inputs and subsidies, in the case of differently sized farms in Romania. The EU support for agriculture is a very complex scheme, which is constantly under revision. An example is the move from price support schemes towards direct payments connected to the agricultural land or the size of the livestock. Romania joined the EU quite late, in 2007, after the CAP has underwent several reforms, ending with the current single area payment

[1] *Institute of Agricultural Economics, Romanian Academy. E-mail: cecilia@eadr.ro*
[2] *Centre for Macroeconomic Modelling, NIER, Romanian Academy. E-mail: bpauna@gmail.com*
[3] *Institute for Economic Forecasting and Institute of Agricultural Economics, Romanian Academy. E-mail: csaman@ipe.ro*

scheme system in which subsidies are decoupled from production, and linked to the land area.

Our analysis uses the FADN public database, which is computed from information at the farm level. Therefore, the analysis does not capture subsidies which are not accessed by farmers like most subsidies under Pillar 2, which are funds directed towards rural development.

This study has contributed to finding that in Romania the subsidies do not promote productivity. However, either assets or investment or both have a positive influence on farms' efficiency.

The remainder of this paper is structured as follows. Section 2 reviews the literature. Section 3 describes the Romanian farm sector. Section 4 presents sample data and methodology. Section 5 interprets the empirical findings. Section 6 concludes.

2. Literature review

There is a large literature studying the effect of subsidies on economic performance, both at a theoretical level and at an empirical one. Farms economic performance was measured using different productivity measures, and various econometric techniques were employed in order to unveil the relationship. Although a large literature is devoted to the older EU member states, there is large interest in other countries as well, such as China, Australia, and, more recently, the new member states of the EU. For all the countries, but especially for the countries belonging to the European Union, there is a continuous preoccupation to designing optimal policies and schemes for supporting its farmers.

There are several identified channels through which subsidies can influence farms outcomes. A desirable direct effect is when the availability of the financial resources positively impacts efficiency and productivity by influencing the farms propensity to invest; therefore, increasing the technology available to the farm. This outcome is more likely in the case of restricted access to credit for the agricultural farms due to imperfect credit markets. At the other extreme, direct payments might relax the motivation of the farmers to work efficiently and to be competitive, since subsidies provide an additional source of income and, therefore, we would find a negative relationship between the two variables (Zhu, Demeter, & Lansink, 2012).

Subsidies might affect the labour market decision of the farmers, since additional income makes leisure cheaper than otherwise; therefore, the farmer might reduce the number of hours worked or decide not to work altogether. (Woldehanna, Lansink, & Peerlings, 2000) found that increased decoupled subsidies are likely to increase off-farm labour in the case of EU countries, while El-Osta, Mishra & Ahearn (2004) found that in the US economy the government payments tend to increase the number of hours worked on farm, and, consequently, decrease the farmers' participation in other economic activities. The effect of reduced/increased participation depends on the relative productivity of family work versus hired work. Garrone et al. (2018) studied the effect of CAP subsidies on labour productivity for the EU regions, and their conclusion was that, on average, they increase agricultural labour productivity, and decoupled subsides were the one responsible for the finding.

Kazukauskas, Newman & Sauer (2014) fail to uncover evidence at the farm level with regard to an increase in productivity due to decoupled subsidies. However, for Irish, Danish and Dutch farms they identified productivity increases in agriculture. (Rizov, Pokrivcak, & Ciaian, 2013) studied the effect of subsidies on 15 EU countries and their findings point towards a

negative impact of subsidies on productivity in the case of coupled subsidies, while after decoupling the effect became positive in some countries. (Zhu, Demeter, & Lansink, 2012) also found a negative relationship between subsidies and farm productivity in the case of dairy farms in Germany, Sweden, and the Netherlands. The same study found that the type of subsidy has little influence on the finding, as compared to the influence of the amount of the subsidy.

Tan, Guan & Karimi (2013) studied the impact of subsidies on TFP in China's cotton production, and concluded that TFP would be lower after the subsidy policy is introduced, even in the case of a decoupled subsidy.

Minivel & Sipilainen (2018) studied the link between subsidies and productivity in a dynamic setting in order to see whether ignoring the inter-temporal decision was the reason the research found a negative relationship between the two. They applied the model in the case of the French farms and found a negative relationship both in a static and a dynamic setting.

The question whether size matters in the context of economic profitability of farms was addressed by (Ren, *et al*., 2019) who found that larger Chinese farms have a higher net profit and are more economically and technically efficient and the labour productivity is also better. Large farms are more environmentally friendly since they consume less fertilizers and pesticides per hectare. (Bojnec & Latruffe, 2013) analysed the performance of Slovenia's farms and found that size does matter; especially, it has a positive impact on technical efficiency, and a negative one on allocative efficiency. The relationship between overall economic efficiency and size is positive, but it is negative in relation to profitability. (Sheng & Chancellor, 2019) studied the relationship between farm size and profitability for Australian farms and found a positive relationship which was linked to the farm's capital decision. The advantage could be breached by capital outsourcing. (Sheng & Chancellor, 2019). (Hu, Li, Zhang, & Wang, 2019) found that in China larger farms are more technologically advanced and more willing to acquire knowledge.

Common Agricultural Policies and especially measures under the 1st Pillar had a significant effect in raising farms revenue, but had produced mutations at the farm level with effect on agricultural structures and productivity incentives. Linking direct subsidies to land was beneficial, especially for field crop farms, with effect on increased productivity, especially land productivity and land consolidation (Alexandri *et al*, 2017). The appraisal of the effect of direct subsidies on field crop farms has highlighted the negative relationship between total factor productivity and the ratio of subsidies to total output in Romania, and in other Central and Eastern European countries as well.

The evaluation of the effect of granting direct subsidies to farms specialized in field crops, brought to the attention that there is an inverse relationship between the total factor productivity and the share of the value of subsidies in total output, both in Romania and in other Central and Eastern European countries (Alexandri, Saman and Pauna, 2019).

3. The Romanian farm sector

Romanian farms' current structure is the result of the political, legal, economic and social changes that occurred throughout Romania's recent history, but also the result of the agricultural and rural development policies since 1989, and after the accession to the European Union, respectively. The pursued liberalization of agricultural and trade policies in order to integrate into world markets cause vulnerabilities for Romania which has a negative net agricultural export (Saman & Alexandri, 2018.). Evidence show that also the financial

crisis had a significant impact on economic activity and behavior in Romania (Scutaru et al., 2015).

The agricultural structure of Romania is somewhat different from the agricultural structure of the older Member States of the European Union, with average farms up to 250 ha, and different from the agricultural structure of some of the Central and East-European countries (Bulgaria, the Czech Republic and Hungary), countries that continue the agricultural structure of the communist period, when agriculture was based on large entities, state-owned or cooperatives. Romania, due to the extremely large number of small farms resembles the agricultural structure of Poland; however, in Romania, the share of land farmed by the large farms is double (45%) as compared to Poland (21%), where agriculture is based on small and medium-sized farms.

Over the 2005-2016 period, in Romania there was a phenomenon of concentration of land in large farms. Thus, the areas used by the large and medium farms increased by 15% and the areas used by small and very small farms increased by 30% (Table 1).

Table 1

Utilized Agricultural Area by different size farms (hectares)

	2005	2007	2010	2013	2016
Very small (<2 ha)	1,941,520	1,807,510	1,718,360	1,584,500	1,539,790
Small (2-20 ha)	5,936,600	5,963,670	4,011,830	4,090,210	4,019,240
Medium size (20-100 ha)	803,020	809,510	1,067,550	1,080,670	970,060
Large (>100 ha)	5,225,560	5,172,370	6,508,390	6,300,460	5,973,450
Total	13,906,700	13,753,050	13,306,130	13,055,850	12,502,540

Source: Eurostat, ef_m_farmleg.xls.

Table 2

The evolution of number of farms

	2005	2007	2010	2013	2016
Very small (<2 ha)	2,856,620	2,565,130	2,866,440	2,655,810	2,480,770
Small (2-20 ha)	1,369,600	1,335,720	953,440	934,780	904,410
Medium size (20-100 ha)	21,020	20,850	25,420	25,990	24,530
Large (>100 ha)	8,930	9,660	13,730	13,080	12,310
Total	4,256,170	3,931,360	3,859,030	3,629,660	3,422,020

Source: Eurostat, ef_m_farmleg.xls.

Also, during the same period, the total number of farms decreased by 20% and that of small farms by 33%. According to the latest structural survey in agriculture, Romania continues to own the largest number of farms in the European Union (3.4 million), namely one third of the total number of European farms.

The agricultural area used decreased by 10% between 2005 and 2016, due to the removal of land from agricultural use, for real estate development, for industrial parks, and infrastructure works.

4. Data and Methodology

4.1 Sample Data

The data is extracted from the FADN public database available on the internet at the address *https://ec.europa.eu/agriculture/rica/database/database_en.cfm*. Typically, information published in the FADN refers to farms which are larger than 1 ha, or which produce more than a specified output (with a separate threshold for each country). The published data is an aggregation of farms belonging to similar categories. The available dimensions are time, country, region, type of farm and economic size. We extracted the information pertaining to Romanian farms. The recorded data covers 8 types of farms, located in the 8 regions of Romania (NUTS 2), from 2007, the year when Romania became a member of the EU, to 2017, the most recent year for which information is available. The data also contains the number of farms which are included in each record, which is needed in order to extend the data to the whole population, otherwise the results would be biased.

There is a problem with this type of information, due to the aggregation of farms across dimensions. The variation in aggregated variables is smaller than in individual data, making influences more difficult to unveil. For example, if a small number of farms invested large amounts in a particular year, the increase in the average investment might not be important, and although the increase in the average output might be larger, it would be difficult to ascertain the determinant of the increased productivity.

The multi-level data structure on the farms includes repeated time observations at level 1, on farms, at level 2 on type of farming and size. To address the hierarchical structure of our data, in the empirical section the paper uses models with mixed effects on several levels.

We limit our analysis to four types of farms, due to the characteristics of the Romanian agriculture, namely the fact that they are the predominant types and, therefore, we have enough information. Table 3 presents the distribution of farms by farm type in three years covered by the analysis. The table shows that the most farms operate in the area of field crops, closely followed by dairy farms, other grazing livestock and mixed.

Table 3

Distribution of farms by type (%)

Type of farms	2007	2012	2017
Field crops	18.01	18.20	18.20
Horticulture	1.21	1.20	1.11
Wine	0.55	0.59	0.62
Other permanent crops	1.14	1.48	1.44
Dairy farms	17.77	12.76	17.94
Other grazing livestock	11.97	18.75	16.79
Granivores	2.97	1.44	0.78
Mixed	46.38	33.70	31.05

Source: FADN database.

The next tables present some information on farms in the three years covered by our analysis, 2007, when Romania accessed the EU, which is also the first year for which data is available, 2012, a middle year and 2017, the last year for which data is available.

Table 4 presents the average subsidies received by the Romanian farms depending on the type of farms. Subsidies on investment are almost non-existent, with the exception of field crops farms, but even for them they are very low as compared to total subsidies. Subsidies are mostly direct payments and in the most recent years they are decoupled payments. Since farms, on average, do not access other type of subsidies, we include in our analysis only total subsidies. The trend in total subsidies across the three years is positive for all types of farms, and with the exception of filed crop farms they doubled or almost doubled in the 11 years of the analysis.

Table 4

Average subsidies by type of farm and year (euro)

		2007	2012	2017
Field crops	Total subsidies - excluding on investments	3911	4489	4882
	Total direct payments	2281	4181	4487
	Subsidies on intermediate consumption	1044	147	186
	Decoupled payments	1137	3202	4150
	Subsidies on investments	139	8	172
Dairy	Total subsidies - excluding on investments	957	1195	1861
	Total direct payments	899	861	1817
	Subsidies on intermediate consumption	54	4	9
	Decoupled payments	210	555	845
	Subsidies on investments	0	1	10
Other	Total subsidies - excluding on investments	1067	1408	2439
	Total direct payments	1025	1237	2358
	Subsidies on intermediate consumption	40	5	14
	Decoupled payments	396	820	1179
	Subsidies on investments	0	0	14
Mixed	Total subsidies - excluding on investments	521	733	939
	Total direct payments	469	599	911
	Subsidies on intermediate consumption	42	3	6
	Decoupled payments	214	430	645
	Subsidies on investments	4	0	21

Source: FADN database.

Field crops farms had very large subsides as compared to the other type of farms, and although the increase is important almost 1000 Euros, since they started with almost 4000 Euros, the increase is 25%. The large amount of subsidy received by field crops is explained by the fact that there are some field crop farms which are very large even by European standards, and they receive subsidies correlated to the size of the land.

A characteristic of Romanian farms is the extensive use of unpaid labour, because most farms (mostly small and very small) are family owned and operated. Table 5 shows that evolution of total and paid labour in the three moments in time. For all types of farms, there is a decrease in total labour, especially in the case of paid labour[4]. Rural areas are suffering

[4] *The information refers to the average farm; thus, if the characteristics of the average farm changed over time (became smaller, better from a technological point of view, etc.), the figures in the table reflect those changes as well.*

from the effects of migration of its labour force in search of better paid jobs outside the country. Whether the picture presented in the table is due to lack of labour supply (the migration of the unpaid and paid labour from the rural areas towards better job opportunities, either to urban regions or abroad), or of labour demand, due to decrease in the number of jobs in agriculture it is not possible to know. The average size of the total utilized land for each farm type is presented in Table 6.

There is an increase in the agricultural holding for field crops and dairy farms, but mostly due to the increase in rented land. Since subsidies in Romania are given to the individual that farms the land and not to the owner, there is a strong incentive to rent land as long as the rent paid on the land is lower than the received subsidies.

Table 5

Average total and paid labour income per farm type

Year	2007		2012		2017	
Type of Farming	Total labour	Paid labour	Total labour	Paid labour	Total labour	Paid labour
Field crops	2.27	1.04	1.28	0.3	1.12	0.22
Dairy	1.83	0.09	1.1	0.06	1.03	0.04
Other grazing livestock	2.33	0.26	1.31	0.08	1.16	0.05
Mixed	1.91	0.12	1.16	0.04	1.06	0.04

Source: FADN database.

Table 6

Total UAA and rented UAA per farm type

Year	2007		2012		2017	
Type of Farming	Total Utilised Agricultural Area	Rented U.A.A.	Total Utilised Agricultural Area	Rented U.A.A.	Total Utilised Agricultural Area	Rented U.A.A.
Field crops	23.23	12.24	26.84	19.13	27.89	19.45
Dairy	4.31	1.03	4.69	0.96	4.96	2.08
Other grazing livestock	7.9	4.16	6.89	2.87	6.71	3.34
Mixed	4.42	0.48	3.68	0.71	4.1	1.01

Source: FADN database.

Table 7 presents the subsidies[5] received by farms for rented land against the rent paid. For all types of farms, the balance between subsidies and rent is positive and increasing during the analysed period.

[5] *The subsidies received on rented land were derived from the subsidies per ha and multiplied by the rented land.*

Table 7

The average subsidies received on rented land and the average rent paid per farm type

Year	2007		2012		2017	
Type of Farming	Subsidies on rented land	Rent	Subsidies on rented land	Rent	Subsidies on rented land	Rent
Field crops	2060.7	1142	3199.5	2040	3404.6	2089
Dairy	228.7	69	244.6	68	780.4	181
Other grazing livestock	561.9	190	586.5	168	1214.0	239
Mixed	56.6	30	141.4	65	231.3	140

Source: FADN database.

Table 8 presents the farm productivity as defined in the paper by output per input, for the analysed types of farms. Both output and input are measured in monetary terms (as opposed to produced quantity). For all the farms, there is an increase in the productivity in 2012 as compared to 2007. The trend is not sustained in the case of other grazing livestock and mixed farms, which experience a decrease in 2017 as compared to 2012.

Table 8

Farm productivity by farm type

Type of Farming	2007	2012	2017
(1) Field crops	0.96	1.31	1.32
(5) Dairy	1.67	1.71	1.93
(6) Other grazing livestock	1.42	1.62	1.3
(8) Mixed	1.33	1.52	1.43

Source: *FADN database.*

4.2 Methodology

Our model fits a multilevel mixed-effects model predicting productivity of farms as a function of farms characteristics. Multi-level hierarchical methods have the advantages of taking into account the dependency resulting from the grouping at higher hierarchical levels and of allowing the specification of parameters / coefficients at the individual level as varying randomly within groups. We applied this kind of model because the dependent variable (productivity) shows variation associated with the predictors for different types of farming and farm (Figure 1 presents some evidence).

The variables included in the analysis as predictors for productivity are:

- The ratio of subsidies to output ($r\_subsidies$), in the case that subsidies contribute to simulate farm's efficiency one would expect to find a positive relationship between the variable and productivity.
- The total utilized agricultural area ($land$), the expected sign of the coefficient is positive, since land is an important factor of production in agriculture.

- Total labour ($labour$) expressed in AWU (annual work unit), one would expect to find a positive causality between labour and productivity, since labour is an important production factor as well.
- The ratio of paid labour to total labour (r_labour). A high coefficient means that a large share of labour is paid labour. One would expect that unpaid labour have a more important effect on farm productivity, since they do not add to the costs, but if the paid labour has significantly higher productivity, the effect might be reverse.
- Total assets (million Euros) (*asset*), there should be a positive influence of assets on farm productivity, in the case when assets are synonymous to capital. But if assets are loosely correlated to capital, the sign might be negative
- Investment (million Euros) (*invest*), is the flow into assets, which are a stock. We expect a positive influence of investment on productivity, since it is expected that they represent additions to capital.
- Ratio of specific costs to inputs (*r_scost)*. Specific costs might be used by farmers for increasing productivity.
- The value of contract work (million Euros) (*c_work)*. Contract work is a cost incurred by farms. It is viewed as a means for small farms to have access to new technology without incurring the large investment costs. A positive coefficient is indicative of the fact that farms use contract work as an alternative to buying machinery.
- The ratio of long-term liabilities to total assets (*r_liab)*. Liabilities are incurred in order to raise the technological level of the farm. We would expect that to be a positive relationship as well.
- The ratio of rented land to total utilized land (*r_land)*. If the motivation of increasing the total utilized land is strictly due to production purposes the coefficient should be positive, but if the coefficient is negative it might be an indication that farms are viewing renting land as a means to increase revenue, since subsidies received per ha are larger than the rent paid by ha.

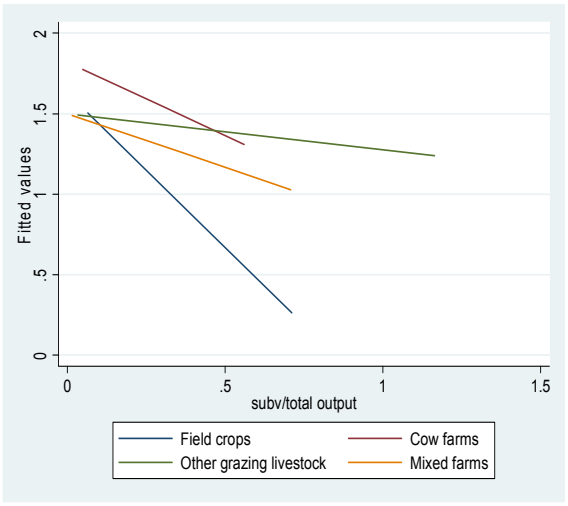
The model expresses farm productivity (*p*$_{its}$) over year *i,* type of farming *t* and size *s* on fixed-effect predictors (*y*$_i$) and also on random-effects predictors x_k (*i.region*, $r\_subsidies_{its}$, $land_{its}$,r_land_{its} , $labour_{its}$, r_labour_{its} , $invest_{its}$, $asset_{its}$, r_liab_{its} , r_scost_{its} , c_work_{its}). It includes fixed slopes (α_1) on fixed-effect predictors, fixed slopes (β_k) and random slopes (u_{kt}) on predictor x_k for each type of farm *t* and size of farm *s* and random intercepts (v_{0t} and v_{1s}):

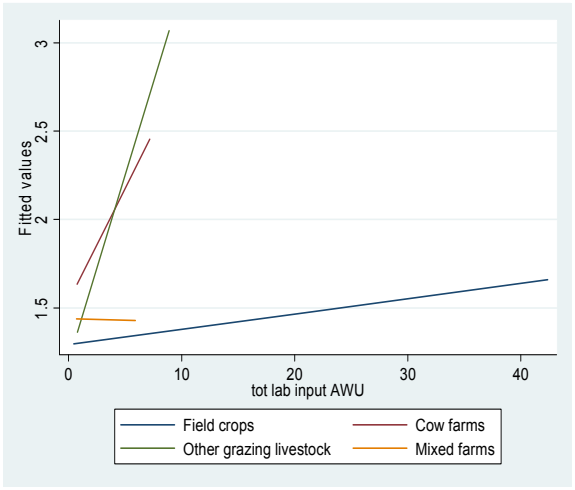
$$\begin{aligned} p_{its} = \alpha_0 + \alpha_1 y_i + \beta_1 r\_subsidies_{its} + u_{1t} i\_region_{its} \\ + u_{1t} r\_subsidies_{its} + u_{2t} land_{its} + u_{3j} r\_land_{its} + u_{4j} labour_{its} \\ + u_{5t} r\_labour_{its} + u_{6t} asset_{its} + u_{7t} invest_{its} + u_{8t} r\_liab_{its} \\ + u_{9t} r\_scost_{its} + u_{10t} c\_work_{its} + v_{0t} + v_{1s} + \varepsilon_{its} \end{aligned}$$

The first type of parameter of fixed effect type does not vary depending on the groups, while the second type of parameter (are allowed to vary between groups) is represented by random slopes represented in the equation by u_{kt} and random intercepts represented by v_{0t} and v_{1s}.

Figure 1

Productivity versus the ratio of subsidies to output (left) and productivity versus type of farming (right)





Source: FADN data.

5. Empirical results

The constructed model allowed us to differentiate the random effect coefficients depending on the size of the farm and the type of farm. Table 9 and 10 present the coefficients for the total effects, obtained by adding the fixed and the random coefficients.

The total utilized land has mostly a positive influence on farm productivity. The stronger the influence of the land, the smaller the firm, which is an indication that small farms make better use of the land, in the sense that they are more efficient in producing output. For two types of large farms we can notice that the marginal effect of land on productivity is negative, suggesting that the farms are too large and it does not make economic sense to expand their land holding.

Total labour input effect on productivity is mixed. Depending on the type and size of the farm it can be positive or negative. In general, labour has a positive influence in the case of dairy farms and mixed farms of all sizes. In the case of the other two types of farms, labour has a positive marginal effect only for small farms.

The ratio of paid to unpaid labour captures the relative productivity of the two types of labour. As already mentioned, unpaid family labour plays an important role in the agricultural small farms in Romania. Small farms are quite dependent on family labour, and unpaid labour[6] has a positive effect on small farms' productivity.

Table 9

The total effect by size and type of farms for land, labour, assets and investment

Size		*Filed crops*	*Dairy farms*	*Other livestock*	*Mixed*
Small	Total utilized land	0.061	0.005	0.03	0.035
	Total labour	0.274	0.225	0.159	-0.009
	Total assets	-11.5	3.4	-6.2	-3.7
	Investment	54.7	27.5	15.8	67.7
	Ratio of paid labour to total labour	-0.837	-3.531	-0.705	-0.067
Medium	Total utilized land	0.003	0.009	0.004	0.000
	Total labour	-0.091	0.085	-0.026	0.084
	Total assets	-0.155	-1.03	-0.796	-0.483
	Investment	8.18	8.99	2.89	9.4
	Ratio of paid labour to total labour	0.177	0.436	-0.469	-0.52
Large	Total utilized land	0.0004	-0.0033	0.0005	-0.0033
	Total labour	-0.0156	0.0273	-0.0814	0.0046
	Total assets	-0.153	0.777	-0.294	0.205
	Investment	0.159	-4.24	-0.366	-0.615
	Ratio of paid labour to total labour	-0.037	-0.072	0.201	0.025

Source: Author's computation based on FADN database.

[6] *The coefficient of paid labour to total labour is negative, which means that with the increase in paid labour the productivity decreases.*

The total assets variable was introduced as a proxy for capital stock. It was expected that a more capitalized farm would produce more output, but an agricultural farm might invest in storage and in manufacturing, which count as assets, but not as machinery. They contribute towards raising farm revenues, but ultimately have no impact on the output of the farm. The coefficients on assets show a negative impact of assets on farm productivity in almost all cases. The large dairy and mixed farms are the exception, assets positively influencing the farm output.

Table 10

The total effect by size and type of farms for subsidies, specific costs, contract work, liabilities, rented land

Size		*Filed crops*	*Dairy farms*	*Other livestock*	*Mixed*
Small	The ratio of subsidies to output	-2.341	-2.430	-0.444	-2.094
	Ratio of specific costs to inputs	0.0013	-0.837	-0.307	-0.094
	The value of contract work	69.8	-368.7	128.7	35.8
	The ratio of long-term liabilities to total assets	-3.548	0.050	1.083	10.933
	The ratio of rented land to total utilized land	-0.714	0.873	-0.176	-0.012
Medium	The ratio of subsidies to output	-2.488	0.067	-1.317	-1.372
	Ratio of specific costs to inputs	-0.771	-0.818	-1.000	-0.614
	The value of contract work	-38.4	-171.8	-36.8	2.54
	The ratio of long-term liabilities to total assets	-0.284	-1.406	-0.030	-0.355
	The ratio of rented land to total utilized land	-0.018	-1.062	0.022	-0.565
Large	The ratio of subsidies to output	-1.285	-1.400	-1.436	-1.368
	Ratio of specific costs to inputs	-0.440	-0.026	-0.572	0.020
	The value of contract work	-1.48	-35.5	8.51	-20.1
	The ratio of long-term liabilities to total assets	0.097	0.131	1.207	-0.043
	The ratio of rented land to total utilized land	-0.487	-0.027	0.099	0.005

Source: Author's computation based on FADN database.

An alternative measure which captures the technology of the farms is investment. For the small and medium-sized farms, there is a positive marginal influence of investment on productivity. For all the farms, either assets or investment or both have a positive influence on efficiency.

The effect of subsidies is almost in all cases negative, they do not contribute towards the increase in the farms' efficiency. The subsidies in the case of Romanian farms work towards relaxing the incentive of farms to be efficient and competitive, since the subsidy provides an additional source of income. Since the subsidies have a perverse effect on farmers, it appears that the current scheme of subsidies is hindering the development of a competitive agricultural sector in Romania. It suggests that there is a need to develop another scheme of subsidies.

The ratio of specific costs to inputs do not have the expected influence towards efficiency. For the most types of farms and sizes the influence on productivity is negative. But small crop farms make use of the crop specific inputs, like seeds, fertilizers, crop protection as a means to increase farm productivity.

Contract work has a positive influence on the productivity of small farms, indicating that it may be used as an alternative to acquiring technology. This is a result similar to (Sheng & Chancellor, 2019).

The effect of liabilities to assets is mostly positive for small and large farms. It is an indication that small farms, which have restricted access to credit, are more careful with their investment decision. This might indicate that investments from recent years[7] (which are showing in liabilities) are more production-oriented than assets as a whole.

The last variable introduced is the ratio of rented land to utilized land. The influence of this variable is mostly negative, and it can be an indication that farms do not base their decision to increase their total utilized area on economic purposes. Their decision is distorted by the subsidies which are significantly above the rent paid on land.

6. Conclusions

The most important conclusion of this paper is that subsidies are not conducing to productivity in the case of the Romanian farms. This conclusion is valid irrespective of the size and the type of the farm. The notable exception is medium-sized dairy farms.

The small farms use the land productively, while the large farms' use of the land is distorted by the decoupled subsidy, whose value is above the value of the rent. Labour is another input which is efficient in the case of small farms, especially unpaid labour. The database lacks a measure of the farms' capital stock. Most recent capital can be captured by long term liabilities, and the current year's investment. Both measures of capital have a positive marginal effect in the case of small farms. Investment has a positive marginal effect for the medium-sized farms, while long term liabilities have a positive effect for the large farms. The technology gap between small and large farms is bridged by the small farms with the help of subcontracting.

In the actual context of COVID-19 crisis, we witness a large drop in economic growth due to the reduction of consumer spending, including food. There are already several global estimates of the impact of pandemic on the economic growth (e.g. IMF, 2020; OECD, 2020) and also contry-like projections (e.g. for Romania Albu *et al.*, 2020). An important open question for future research would be to examine the extent to which there is a disruptive impact of the COVID-19 pandemic on the agricultural sector affecting the demand and supply of agricultural commodities and whether a set of new common EU subsidy policies can be effective in mitigating the negative side-effects.

References

Albu, L.L., et al., 2020. Estimates of Dynamics of the COVID-19 Pandemic and of its Impact on the Economy. *Romanian Journal of Economic Forecasting*, 23(2), pp.5-17.

Alexandri, C*. et al.* 2017. Agricultura □i spa□iul rural - Evaluări la 10 ani de la aderare.

[7] *For which the farm is still paying the loan.*

Alexandri, C., Saman, C. and Pauna, B., 2019. Exploring the relationship between farm productivity and the CAP subsidies for the NMS. *The 173 EAAE Seminar*, Bucharest, Romania, September 2019.

Bojnec, S. and Latruffe, L., 2013. Farm size, agricultural subsidies and farm performance in Slovenia. *Land Use Policy*, 32, pp.207-217.

El-Osta, H.S., Mishra, A.K. and Ahearn, M.C., 2004. Labor Supply by Farm Operators Under "Decoupled" Farm Program Payments. *Review of Economics of the Household*, 2(4), pp.367-385.

FAO. 2017. The future of food and agriculture – Trends and challenges. Rome.

Garrone, M., Emmers, D., Olper, A. and Swinnen, J., 2018. Subsidies and Agricultural Productivity: CAP payments and labour productivity (convergence) in EU agriculture. *LICOS Discussion Papers* 40918. LICOS - Centre for Institutions and Economic Performance, KU Leuven

Hu, Y., Li, B., Zhang, Z. and Wang, J., 2019. *Journal of Rural Studies*, forthcoming. https://doi.org/10.1016/j.jrurstud.2019.01.009.

IMF, 2020. World economic outlook, April 2020: the great lockdown. International Monetary Fund, Washington, DC.

Kazukauskas, A., Newman, C. and Sauer, J., 2014. The impact of decoupled subsidies on productivity in agriculture: a cross-country analysis using microdata. Agricultural Economics, 45(3), pp.327-336.

Minivel, J.J. and Sipilainen, T., 2018. Dynamic stochastic analysis of the farm subsidy-efficiency link: evidence from France. *Journal of Productive Analysis*, 50: 41-54.

OECD, 2020. OECD-FAO Agricultural Outlook. Available at: <http://www.agri-outlook.org/data/>.

Ren, C. et al., 2019. The impact of farm size on agricultural sustainability. *Journal of Cleaner Production*, 220, pp.357-367.

Rizov, M., Pokrivcak, J. and Ciaian, P., 2013. CAP Subsidies and Productivity of the EU Farms. Journal of Agricultural Economics, 64(3), pp.537-557.

Saman, C. and Alexandri, C., 2018. The impact of the world food price index on some East-European economies. *Journal of Business Economics and Management*, 19 (2), 268-287.

Scutaru, C., Saman, C. and Pauna, B., 2015. The Dynamics of Household Consumption in Romania during Economic Crisis. *Procedia Economics and Finance*, 22, pp.820-827.

Sheng, Y. and Chancellor, W., 2019. Exploring the relationship between farm size and productivity: Evidence from the Australian grains industry. *Food Policy*, 84, pp.196-204.

Tan, Y., Guan, J. and Karimi, H.R., 2013. The Impact of the Subsidy Policy on Total Factor Productivity: An Empirical Analysis of China's Cotton Production. *Mathematical Problems in Engineering*, Article ID 248537. https://doi.org/10.1155/2013/248537

Woldehanna, T., Lansink, A.O. and Peerlings, J., 2000. Off-farm work decisions on Dutch cash crop farms and the 1992 and Agenda 2000 CAP reforms. A*gricultural Economics*, 22(2), pp.163-171.

Zhu, X., Demeter, R.M. and Lansink, A.O., 2012. Technical efficiency and productivity differentials of dairy farms in three EU countries: the role of CAP subsidies. *Agricultural Economic Review*, pp.66-94.