Tax Incentives and Agricultural Productivity Growth in Ukraine

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Abstract:

In this paper we looked at how various tax incentives affected agricultural productivity growth in Ukraine. The empirical analysis was carried out using Ukraine-wide farm-level accounting data for an unbalanced panel of agricultural enterprises over the period 1995-2014. The results demonstrate that the impact of tax exemptions varies across different groups of agricultural producers and sectors. Overall, however, tax exemptions positively affect agricultural TFP growth, but they turned out to be very cost-inefficient instrument of stimulating TFP growth in agriculture. Also tax exemptions strongly undermined efficiency and productivity convergence in agriculture.

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1. Introduction

The effect of subsidies on agricultural performance and productivity receives a lot of attention in academic literature. Subsidies, however, can take many forms. In the meaning of the WTO Agreement on Agriculture, subsidies include budgetary outlays or direct payments from the budget, as well as implicit forms of subsidization that involve revenue forgone for the state budget1, e.g. various forms of tax exemptions and breaks. The effect of explicit budgetary outlays on efficiency and productivity is relatively well covered in the empirical literature, while the impact of implicit subsidies is not covered that well. Minviel and Latruffe (2016), for example, recently conducted a meta-analysis of the empirical literature on the relationship between the subsidies in the form of budgetary outlays and technical efficiency. Their results, however, show a mixed picture: one-quarter of the models included into the study find a significant positive effect of subsidies on technical efficiency, about a half find a significant negative effect, and the rest report non-significant effect. In the same vein, Latruffe et al (2016) found a mixed evidence for the dairy sector in Western EU countries over 1990-2007, with countries demonstrating negative and positive association between subsidies and technical efficiency.

The above empirical evidence is in line with the theoretical background that suggests that the sign of the effect of subsidies on efficiency cannot be determined theoretically (see, e.g. Martin, 1978; Martin and Page, 1983; Serra et al, 2008). Technical efficiency or X-efficiency in the literature is related to managerial efforts, and whether managers behave more relaxed and thus decreasing firms' technical efficiency, - depends on the balancing outcome between the income effect of subsidies, substitution effect for leisure and attitude to risk, thus the overall effect of subsidies depends on the empirical response of managers.

Furthermore, efficiency change enters productivity or TFP change as one of the components, along with the technical change (Coelli et al, 2005) making the overall effect of subsidies on productivity difficult to determine in advance. Kalaitzandonakes (1994), for example, concludes that the effect of subsidies on productivity depends on the prices that the firm faces as well as on its capital stock. Firms with a small capital stock and facing low prices may experience a positive effect on productivity growth by means of higher investments and technical growth. Firms with a large capital stock and high prices tend to have technical inefficiencies that translate into reduced productivity growth.

Quite surprisingly, but the effect of implicit forms of subsidization on agricultural efficiency and productivity is overlooked in the empirical literature. A search for the relevant peer-reviewed articles revealed no satisfactory results, and this is despite the existence of an extended literature on tax incentives (see e.g. Roca, 2010; World Bank, 2015). Moreover, implicit subsidies in the form of, for example, tax incentives – the focus of this paper – are very popular for developing countries (Bolnick, 2004). They are also very popular in transition countries and sometimes largely dominate

[1] See definition of terms: https://www.wto.org/english/docs_e/legal_e/14-ag_01_e.htm

the total volume of support to agriculture. In Ukraine, for example, tax benefits dominated in the total budget transfers to farmers until 2017. Kazakhstan and Russia also offer significant tax incentives to its agriculture (OECD, 2017; World Bank, 2016).

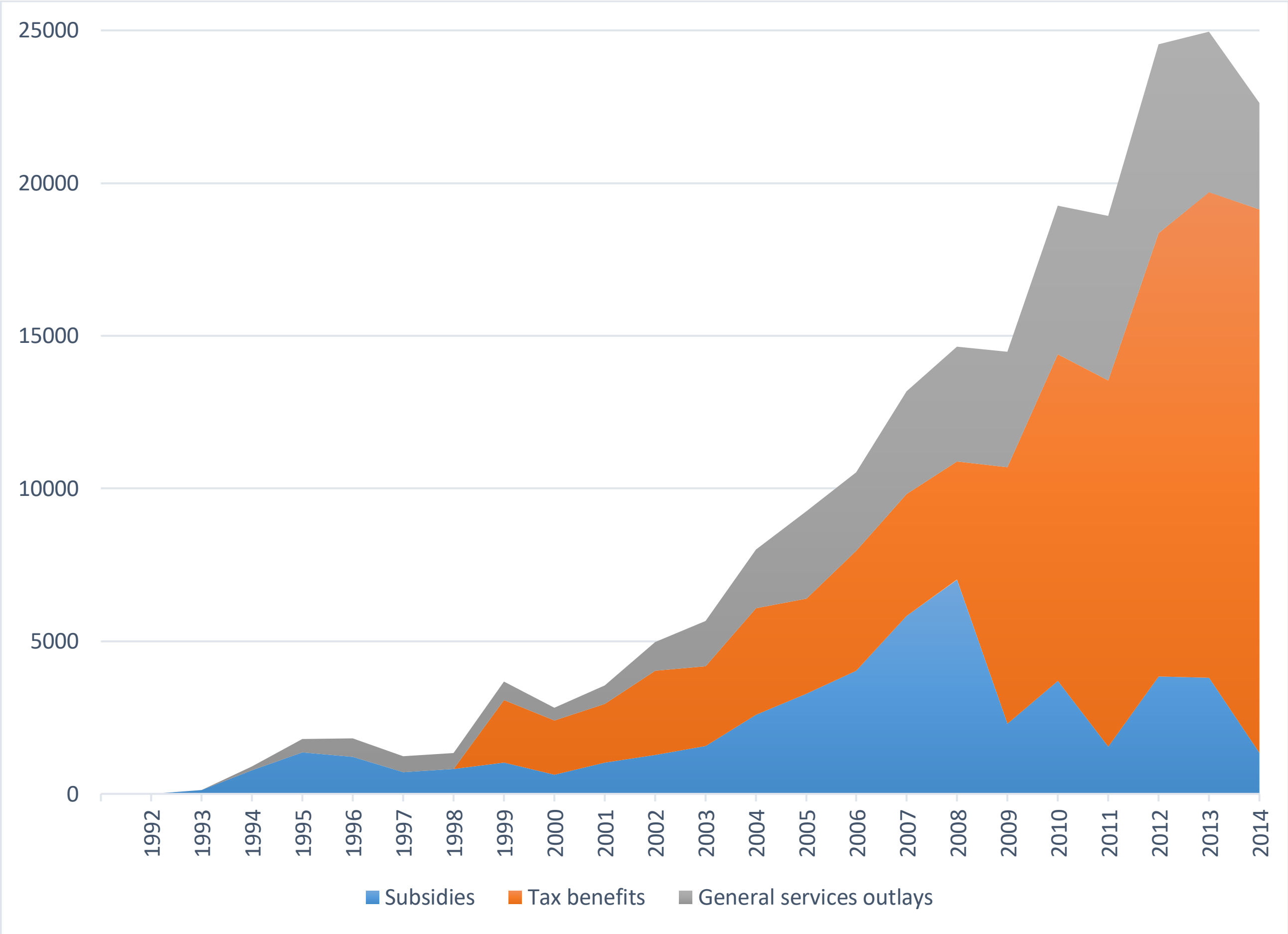
Tax incentives are mainly justified from the point of attracting additional investments into the sector that would increase firms capacity for replacement investments or investments in advanced technologies that translates into more rapid economic growth. There are, however, various ‘cons’ to tax incentives that are usually downplayed or ignored in the political discourse. Budget revenue cost could be high if the investments would have been viable anyway. Tax incentives generate abusive tax avoidance schemes. Fiscal revenue losses require fiscal adjustments in form of higher taxes to other sectors, cut expenditures on public goods, or serious economic distortions. All these facts are well documented for the case of tax incentives in Ukraine’s agriculture (World Bank, 2013). Tax incentives also score poorly in terms of transparency and accountability, and alternative instruments for promoting investments can have much more favorable and lasting effects on productivity, growth and development. International experience shows that tax incentives most often do not deliver favorable results. So, although tax incentives can indeed stimulate investment, their net impact on growth, however, could be adverse if the incentives reduce productivity. Moreover, non-tax factors are far more important in determining most investment decisions. If tax breaks cause fiscal problems that worsen other elements of the investment climate, the net effect of incentives on the volume of investment can be negative rather than positive (Bolnick, 2004).

In this paper we employ highly disaggregated farm-level data that spans from 1995 through 2014 and demonstrate the effect of tax benefits on agricultural sector productivity growth in Ukraine. We start from describing shortly agricultural tax incentives in Ukraine and then turn to data and modelling details. Section 4 discusses the results and conclusions wrap up the paper.

2. State agricultural support and tax incentives in Ukraine

State agricultural budget support in Ukraine is characterised by modest levels of public expenditures and relatively generous tax benefits (see Figure 1). Until recently budget subsidies to farmers (see ‘Subsidies’ category in the Figure 1) have been mainly sub-sector specific (field crops, pigs, cattle), primarily through payments based on area or animal numbers, payments based on commodity output, a large concessional credit programme (World Bank, 2013). This category of public subsidies combines outlays related to production, output and inputs (very thin since 2013). ‘General services outlays’ category includes financing such public services as infrastructure, education, research and development, sanitary and phytosanitary control, food security measures, agricultural insurance etc. Tax benefits made up about 90% in total budget transfers to farmers in 2011-14 (see Figure 1). In 2015 tax benefits via profit tax and value added tax exemptions accrued to USD 1.8 bn or 16% of agricultural value added (Nivievskyi, 2016).

Figure 1 Agricultural State Support in Ukraine (nominal), mln UAH



Source: own presentation based on the OECD PSE data for Ukraine; UAH – hryvnia, Ukrainian currency

Tax benefits accrue from a so-called single tax (or Fixed Agricultural Tax before 2015 - FAT) and a special value-added tax regime in agriculture – AgVAT (World Bank, 2013). The FAT is a flat rate tax that replaces profit and land taxes. Its rate varies from 0.09% to 1.00% of the normative value of farmland, depending on farmland's type and location. In 2010, the FAT resulted in an average tax payment of only roughly 0.75 US$/ha of arable land that left farm profits in Ukraine essentially untaxed. In 2015, due to significant increase of the normative value of land, FAT liabilities increased to roughly $US9/ha, which is also very low compared to what the farmers would have paid on the general tax system. In 2014, the benefits from the FAT accrued to US$ 0.32 bn (OECD, 2017).

According to the AgVAT regime, farmers were entitled to retain the VAT received from their sales to recover VAT on inputs and for other production purposes at the discretion of farmers. In 2016 and 2017 the AgVAT system was gradually eliminated, while the FAT or profit tax exemption is still in place and is expected to continue.

3. Methods and Data

In the paper we measure productivity growth using a conventional TFP Divisia index (see Star and Hall (1976) or Bruemmer at al (2002) for details). Formally it is written as:

$$(2)\ \dot{TFP} = \sum_{k=1}^{K} s_k \dot{x_k} - \sum_{m=1}^{M} r_m \dot{y_m}$$

where s_k denotes the cost share of input x_k, and r_m denotes the revenue share of output y_m. The key challenge of this method is to collect a representative cost and revenue shares for most countries. In this application we employ farm-level and time-specific data on cost and revenue shares.

Central focus of our empirical work is a model of farm-specific productivity growth as a function of tax benefits generated by FAT and AgVAT tax systems. Similar to the modelling framework of Alston et al (2010), the basis for our model is that farm-level productivity growth depends on the time-lagged tax benefits. As it was described in the section above, tax benefits generate extra incomes for farmers to finance working capital (purchase of seeds, agrichemicals, fuel, feed etc.) the expectation is that a farmer used tax benefits to purchase more productive seeds varieties to plant for the next season, this might trigger technical change and thus stimulate TFP growth. In the livestock sector, tax benefits can affect TFP growth in the same year already, for the production cycle is shorter for a number of livestock sectors, e.g. for poultry, pig and dairy sector.

As it was mentioned above already, the effect of tax benefits on technical efficiency or managerial efforts is difficult to determine in advance. The outcome will depend on the empirical response of managers, i.e. on the dominance of income and leisure effects in each particular case. So despite the expected positive impact of tax benefits on technical change component of the TFP growth, the resulting overall effect will depend on the weight of the impact on the technical efficiency change component that will either counterweight, reduce or reinforce the technical change.

We also allow for a dynamic structure in the impact of tax benefits on productivity growth and check for longer lag structures for the tax benefits variables.

Generally, our model could be expressed as follows:

$$(3)\ \dot{TFP}_{i,t} = f(T_{i,t-h}^{AgVAT}, T_{i,t-h}^{FAT}, Z_{i,t}),$$

where TFP growth of a farm *i* in year *t* depends on up to *h* period lagged tax benefits generated by AgVAT and FAT, $Z_{i,t}$ is a set of control variables.

The empirical analysis described above is carried out using Ukraine-wide farm-level accounting data provided by the State Statistics Committee of Ukraine (so called 50 AG Form data). This dataset is an unbalanced panel of 165,777 observations over the period 1995-2014. For each observation in the dataset (representing a farm), information on output aggregates ‘crop’ and ‘livestock’ products is available, as well as the breakdown of input costs for each of the output aggregates. Table 1 provides an overview of the resulting data structure and summary statistics for the first and last years of the panel. Table 1 also provides information on input cost and output shares necessary for constructing TFP growth indexes we discussed in the previous section.

Nominal input costs and output values were converted into the real ones using corresponding 1995 price indexes provided by the State Statistics Committee of Ukraine (Ukrstat) for various years. Crop and livestock outputs were converted into the real ones using corresponding (crop and livestock) price indexes available from the Ukrstat. These deflated or real outputs and inputs were then used in constructing Divisia TFP growth indexes.

Table 1 Description of data for TFP growth rates calculations: 1995 and 2014

	1995			2014		
	mean	min	max	mean	min	max
N of ag producers	11701			6182		
Labor	267.60	2.00	2301.00	62.10	1.00	4819.00
Land, ha	2811.20	4.00	74947.00	2602.42	1.00	319716.00
In nominal 000 UAH:						
Depreciation	41.78	0.00	1546.60	1219.40	0.00	642900.00
Seed cost	60.19	0.00	1226.97	1979.70	0.00	290603.50
Feed cost	165.10	0.00	7621.24	3255.35	0.00	1298711.63
Fertilizers cost	35.74	0.00	890.82	2209.64	0.00	176271.00
Fuel + energy cost	35.48	0.01	2331.89	496.68	0.10	180942.20
Other cost	149.59	0.54	4197.24	6835.11	1.00	1450451.88
Crop revenue	274.97	0.01	5183.88	10140.11	0.00	2209210.00
Livestock revenue	70.99	0.00	4882.03	4805.78	0.00	1603920.00
Cost shares:						
Labor	0.16	0.01	0.61	0.08	0.00	0.65
Land (rent payments)	-	-	0.00	0.12	0.00	0.64
Depreciation	0.06	0.00	0.73	0.06	0.00	0.85
Seed cost	0.08	0.00	0.62	0.11	0.00	0.73
Feed cost	0.21	0.00	0.78	0.08	0.00	0.96
Fertilizers cost	0.05	0.00	0.61	0.11	0.00	0.64
Fuel + energy cost	0.05	0.00	0.68	0.02	0.00	0.66
Other cost	0.40	0.05	0.98	0.42	0.00	0.97
Output shares:						
Crop products	0.79	0.50	1.00	0.80	0.00	1.00
Livestock products	0.21	0.00	0.50	0.20	0.00	1.00

Source: Own presentation.

4. Modelling Results and Discussion

4.1 TFP Growth Rates Distributions

Table 2 below demonstrates summary statistics for the resulting distributions of calculated Divisia TFP growth indexes. The table shows very volatile character of agricultural TFP growth in Ukraine and there is no sign of a sustainable TFP growth. The highest average TFP growth is observed in 2008 when TFP grew by 28%. The average TFP growth over the period analysed was only 0.9%.

Figure 2a) demonstrates the distributions of TFP changes and Figure 2b) demonstrates nonparametric relationship between TFP growth rates and the time. It shows very drastic short term fluctuations, basically, visualizing and confirming observations made from studying Table 2. Interesting, though, to observe is that TFP changes along an upward trend, thus giving an evidence that TFP does improve in Ukraine over time, though with some drastic short term fluctuations.

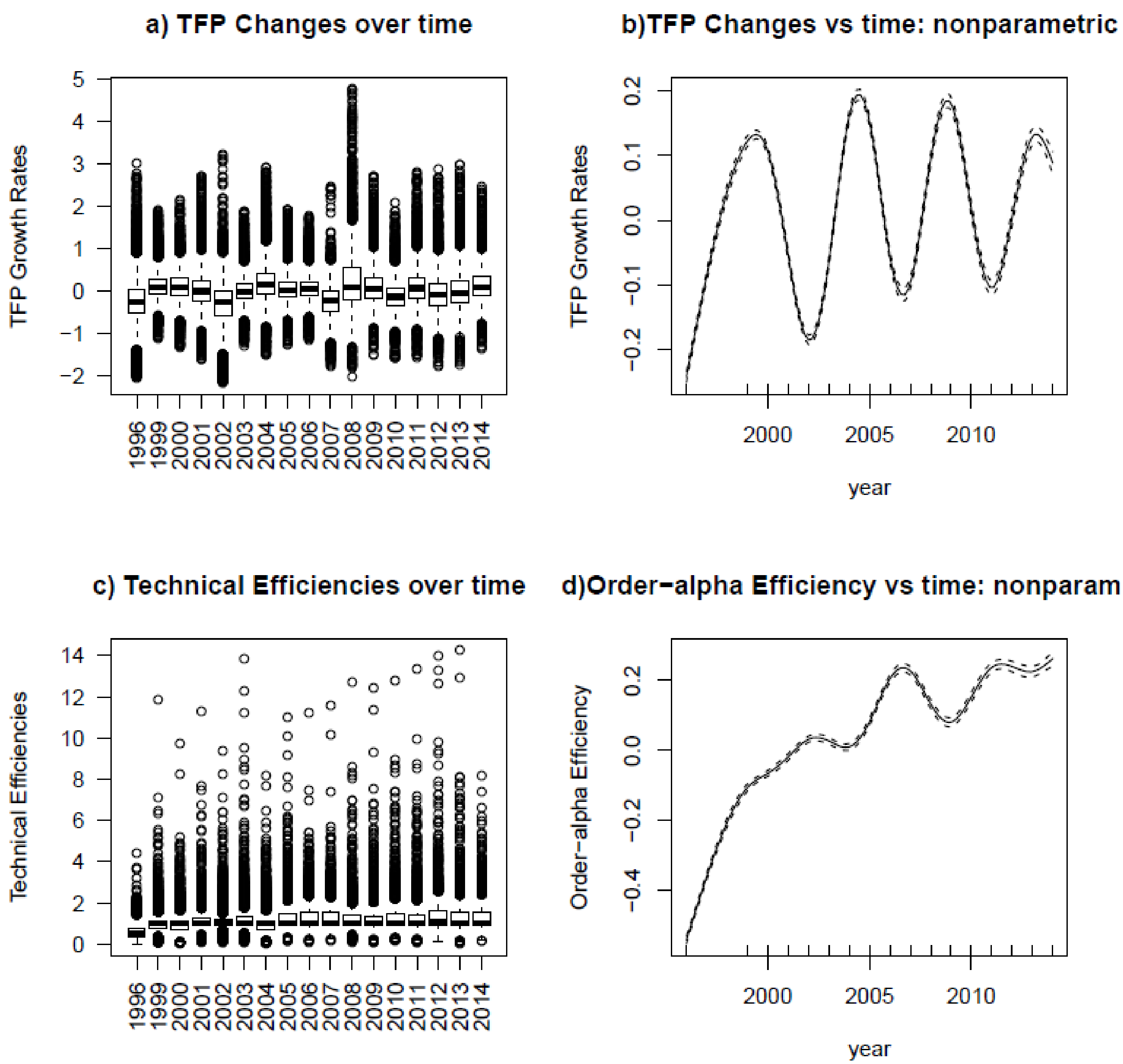
Table 2 TFP growth summary statistics

year	Min.	1st.Quartile	Median	Mean	3rd.Quartile	Max.

1996	-2.05	-0.53	-0.25	-0.24	0.04	3.00
1999	-1.13	-0.07	0.09	0.12	0.28	1.91
2000	-1.32	-0.10	0.10	0.11	0.31	2.16
2001	-1.62	-0.23	0.01	0.04	0.26	2.71
2002	-2.16	-0.60	-0.27	-0.32	0.00	3.20
2003	-1.30	-0.18	0.00	0.01	0.18	1.87
2004	-1.51	-0.08	0.16	0.22	0.43	2.91
2005	-1.28	-0.15	0.02	0.05	0.21	1.92
2006	-1.15	-0.11	0.05	0.07	0.22	1.78
2007	-1.79	-0.49	-0.23	-0.24	0.00	2.46
2008	-2.03	-0.20	0.09	0.27	0.55	4.75
2009	-1.52	-0.17	0.05	0.13	0.31	2.71
2010	-1.59	-0.34	-0.13	-0.11	0.08	2.08
2011	-1.58	-0.17	0.07	0.11	0.31	2.80
2012	-1.77	-0.33	-0.09	-0.02	0.18	2.89
2013	-1.74	-0.28	-0.04	0.04	0.25	2.98
2014	-1.37	-0.10	0.10	0.16	0.34	2.45

Source: Own presentation

Figure 2 Distributions of estimated TFP growth indexes



Source: Own presentation. Note: value 0 on a) means no TFP growth; on c) A score between 0 and 1 means inefficiency, while greater than 1 means super-efficiency; panel d) depicts nonparametric relationship between TFP growth rates and time; panel c) depicts nonparametric relationship between order-alpha efficiency scores and time

4.2 Second stage control variables description

In the second stage we regress TFP growth rates of a farm *i* in year *t* on lagged tax benefits from AgVAT and FAT systems accumulated by a farm i, and on a set of control variables $Z_{i,t}$.

vat variable is the second stage (see Annex: *Table 4*) denotes the amount of benefits that the AgVAT tax system generates for farmers. The variable was constructed as 20% from the aggregated crop and livestock revenues (VAT tax rate in Ukraine is 20%). As it was described already in the section 2 above, farmers are entitled to retain this amount to recover VAT on inputs and use the remaining amount for other production purposes at their discretion, e.g. for purchases of working capital.

fat in the Annex: *Table 4* denotes the amount of benefits that the FAT tax system generates for farmers. For each farm we calculated their profits as the difference between aggregated livestock and crop revenues and total costs. As we discussed it in the previous sections, FAT burden for agricultural producers was extremely low, i.e. less than US$1 per ha, so it would be relatively safe to assume that FAT benefits would be equal to profit tax liabilities. Profit or corporate tax rate in Ukraine was 23% until 2015. In case of losses, we set FAT benefits equal to zero.

In the model we also control for a potential heterogeneity of results using control variables $Z_{i,t}$

- year dummies (**d2001, …., d2014**) to account for differences in year specific conditions (e.g. climatic conditions, policy shocks etc);
- the size of farms' agricultural land holdings (***land*** variable) to account for differences in farm sizes;
- ***Crop share*** variable (share of crop revenues in the total farm revenues) controls for a broad specialization of farms and production environment of farms. Due to production cycles differences, purely crop farms can use tax benefits to finance only next year working capital, while mixed and livestock farms can use tax benefits in the current year already.
- dummy for dairy farms (***dairy***): 1 if a farm keeps at least one cow.
- dummy for pig farms (***pigs***): 1 if a farm keeps at least one pig
- dummy for poultry farms (***poultry***): 1 if a farm keeps at least one broiler.
- dummy for perennial crops (***peren***): 1 if a farm produces perennial crops

The above livestock products dummies are important to look at from the policy making point of view, i.e. for the purposes of finding an empirical justification of treating differently various farm groups and differentiating tax incentives for those groups.

- Interaction variables allow to infer more details and important information of the effect of tax benefits;

Second stage model is run as a fixed effect panel regression to control for other constant in time and farm-specific variables (e.g. soil quality, proximity to main roads and infrastructure objects etc).

4.5 Additional second stage control variable: technical efficiency

In the second stage we also introduce additional variable to control for the initial technical position of farms. This variable is output technical efficiency that measures the gap between the current output performance of the farms and its potential, or the distance to the best practice frontier (Shephard, 1970). Generally speaking one may expect that less efficient farms have larger scopes for improvements and thus have higher TFP changes. Also by controlling for the initial technical efficiencies one may test whether farms catch up with their best practice peers. In other words if we find a negative association between technical efficiency scores and TFP growth rates that would mean that less efficient farms tend to have higher TFP change rate thus moving closer to the best practice frontier. We estimated technical efficiency scores using partial or so-called robust order-α quantile-type frontier (Cazals et al., 2002; Daraio and Simar, 2007; p.65). The idea behind order-α method is to determine the frontier by fixing fist the probability (1- α) of observing points above this order-α frontier. In our estimation exercise, we fix α at 1%. These partial frontiers have nice statistical properties (consistency and asymptotic normality), so they do not suffer from the curse of dimensionality problem shared by DEA model and is robust to extremes (Daraio and Simar, 2007; p.74).

For estimation purposes, we used the same number and types of inputs and outputs that we used for TFP changes calculations. Table 3 and Figure 2c) demonstrate quite wide distributions of the estimated order-alpha output technical efficiencies, showing a significant scope for improvement for the farms in Ukraine. And Figure 2d) demonstrates nonparametrically that on average, Ukrainian farms do improve their efficiency over time, though with some short-term fluctuations.

Table 3 Estimated order-α efficiency scores: summary statistics

year	Min.	1st.Quartile	Median	Mean	3rd.Quartile	Max.
1995	0.02	0.31	0.50	0.55	0.76	4.37
1998	0.04	0.78	1.00	1.01	1.09	11.82
1999	0.03	0.69	1.00	0.97	1.07	9.70
2000	0.10	0.90	1.00	1.11	1.24	11.25
2001	0.08	0.96	1.00	1.11	1.17	9.40
2002	0.07	0.97	1.00	1.17	1.30	13.81
2003	0.02	0.70	1.00	0.99	1.08	8.13
2004	0.13	1.00	1.00	1.27	1.45	10.99
2005	0.10	1.00	1.00	1.28	1.52	11.22
2006	0.11	1.00	1.00	1.29	1.51	11.55
2007	0.10	0.99	1.00	1.22	1.38	12.70
2008	0.07	0.88	1.00	1.19	1.35	12.41
2009	0.18	1.00	1.00	1.30	1.48	12.76
2010	0.07	0.92	1.00	1.22	1.40	13.35
2011	0.14	1.00	1.05	1.40	1.62	13.95
2012	0.04	0.98	1.00	1.32	1.53	14.22
2013	0.12	1.00	1.00	1.35	1.56	8.18

Source: Own presentation; score between 0 and 1 means inefficiency, while greater than 1 means super-efficiency; we used 'frontile' package in R to estimate order-alpha output efficiency scores (see Daouia and Laurent, 2015)

4.5 Second stage estimation results

Annex: *Table 4* demonstrates estimation results of logged TFP changes - ***Log(TFP growth)*** - on tax benefits and a set of control variables for 3 models. Model 1 includes contemporaneous and one period lagged tax benefits, and models 2 and 3 add to the model 1 two and three periods lagged tax benefits, correspondingly. Below we discuss the modelling results for the AgVAT and FAT cases separately.

Special AgVAT regime and TFP growth rate

Models 1 through 3 demonstrate a dynamic structure of the impact of AgVAT on TFP growth rates. On average TFP growth rates tend to be positively and statistically strongly associated with the same period AgVAT tax benefits (***log(vat)t***), but negatively associated with the previous period tax benefits (***log(vat)t-1***, ***log(vat)t-2***, *and* ***log(vat)t-3***). The absolute magnitude of the contemporaneous AgVAT tax benefit effect is slightly higher, i.e. 1% increase of ***vat*** or AgVAT benefits is associated with acceleration of TFP growth by 0.15% in period ***t***, but with a slowdown of TFP growth by 0.12% in the next period. Combined effect of AgVAT in two consecutive periods makes up +0.034% of additional TFP growth. There is no strong evidence, though, of a longer effect of tax benefits on TFP growth rates.

Despite we found a positive effect of AgVAT benefits on TFP growth, this effect turned out highly inelastic, i.e. 1% increase of AgVAT benefits results only in 0.034% of additional TFP growth. This shows that this particular tax incentive is relatively cost-inefficient instrument of stimulating TFP growth. In absolute terms we could perform the following rough back on the envelop calculations. Assuming 1% increase of AgVAT is associated with acceleration of TFP growth by 0.15% in the first period ***t***, for a farm with, for example, 4t/ha grain yield (which is the current average grain yield in Ukraine), this would roughly generate additional 6 kg of grain per ha. Assuming price for grain at 3 UAH/kg, 1% increase of AgVAT is equivalent to additional 24 UAH/ha, while the return is only about 19 UAH/ha. If we add up next period negative effect, the return drops down to a meagre 4 UAH/ha.

The effect of the AgVAT differs for various groups of agricultural producers and sectors (see Annex: *Table 4*). *Farm size effect* - interaction between AgVAT and farm size (***log(vat)t*log(land)*** interaction) - shows that larger farms tend to benefit more. Increase in farm size by 1% reinforces the effect of AgVAT by 0.01% in the period **t**, but it also reinforces the negative effect in the following period by 0.008%. If one, however, takes into account the standard errors of the estimated coefficients, these effects statistically offset each other. This means that combined across the time periods AgVAT effect for various farms sizes is statistically neutral. Overall smaller farms in Ukraine (captured by ***log(land)*** variable) tend to have higher TFP growth rates, i.e. increase in farm size by 1% is associated with a decrease of TFP growth rate by 0.06%.

Sector specialization effect - interaction between AgVAT and farm size (***log(vat)t*log(Crop share)*** interaction) – demonstrates that crop farms tend to benefit less from AgVAT in both periods. Increase of the share of crop revenues in total farm revenues by 1% weakens the effect of AgVAT by 0.04% in the current and by 0.02% in the next periods, correspondingly. This indicates that cost-efficiency of the AgVAT system is lower for crop farms or for those that have higher shares of crops in their production mix.

Farms that have milk in their production mix – *dairy farms* in our model (***dairy*** dummy) - do benefit from such a mix with respect to TFP growth, i.e. on average their TFP growth is about 0.026% higher. Reaction of these farm to AgVAT is opposite in two consecutive years that essentially offsets the impact, i.e. 1% increase in AgVAT is associated with a 0.015% slowdown of TFP growth in the current period and acceleration by 0.011% in the following. If we account for the standard errors (in brackets), these two elasticities are statistically equal.

Farms that have poultry in their production mix – *poultry farms* in our model (***poultry*** dummy) – also do benefit from this mix with respect to TFP growth, i.e. on average their TFP growth is about

0.053% higher. Reaction of poultry farms to AgVAT is different to one observed for the dairy farms, but the overall effect is the same. The reaction changes in sign in three consecutive years (t-2 period reaction is statistically significant) with the offsetting absolute values: the absolute value of the second (i.e. t-1) period negative reaction is almost twice as big as the first period positive reaction (+0.0128% versus -0.0243%) and the 3d period reaction of +0.0143%. This tells for no particular overall effect of AgVAT specifically for poultry farms.

Farms that have pigs meat in their production mix – *pig farms* in our model (***pigs*** dummy) – do not show statistically significant effect on TFP growth.

Farms that have perennial crops in their production mix – *peren farms* in our model (***peren*** dummy) - on average have (statistically significant) 0.02% higher TFP growth rates. This productivity growth advantage is reinforced by the effect of AgVAT on TFP growth in the consecutive (t-1 period) year, i.e. 1% increase in AgVAT is associated with a 0.01% acceleration of TFP growth.

To sum up the above subsection discussion, we did find a positive impact of tax incentives stemming from the AgVAT system on TFP growth, but the impact is very inelastic. This shows that this particular tax incentive is relatively cost-inefficient instrument for stimulating TFP growth. We also found that the effect of AgVAT on TFP is different for various farm groups and it is more positive for the farms with higher shares of livestock production in their production mix.

FAT regime in agriculture and TFP growth rate

The overall effect of FAT is almost three times weaker than the overall effect of the AgVAT. Also FAT has almost offsetting effect on TPF growth in two consecutive periods, i.e. +0.056% in the current and -0.04% in the following periods. The combined effect for two consecutive years is also about 3 times higher than the AgVAT combined effect, i.e. 1% increase in FAT is associated with a combined 0.16% higher TFP growth in two consecutive periods. There is no strong evidence, though, of a longer effect of tax benefits on TFP growth rates.

Similar to the AgVAT impact, the effect of the FAT on TFP growth is also inelastic meaning that this type of incentive is even more cost-inefficient instrument of stimulating TFP growth.

The effect of the FAT differs for various groups of agricultural producers and sectors, although somewhat differently compared to the effect of AgVAT (see Annex: *Table 4*). *Farm size effect* (***log(fat)t*log(land)*** interaction) for FAT is the opposite to the effect of AgVAT, but overall it is ***not*** neutral. The combined effect of Farm size in two consecutive years is negative (-0.0056%), i.e. FAT is more advantageous for small farmers in term of the productivity growth. This is important finding from a policy making point of view that might justify using simplified taxation systems for small producers.

Sector specialization effect (***log(fat)*log(Crop share)*** interaction) demonstrates that farms specializing more in crops tend to benefit more from FAT than the farms doing more livestock. Estimated elasticities at interaction variable in t-1 and t-2 period are positive and combined effect is 0.0184%. In other words, increase of the FAT by 1% accelerates TFP growth of crop farms by additional 0.0184%.

Dairy farms effect is not statistically strong in our model with respect to the effect of FAT, i.e. this spells for no particular effect of FAT for dairy farms.

Poultry farms deserve a special attention with respect to the effect of FAT, for this effect lasts until t-3 period. T-3 effect is not particularly statistically strong, while t and t-1 period effects offset each other, so the combined effect (aggregated across the time) is negative (-0.0012%). So in contrast to AgVAT, overall FAT has a specific effect for poultry farms, and this effect weakens TFP growth of poultry farms.

For the *pig farms*, similarly to the AgVAT, the effect of FAT is not particularly statistically strong. For the *perennial crops farms* the effect of FAT is also not particularly statistically strong.

FAT and AgVAT and managerial efforts or technical efficiency

Results of the second stage estimation across all three models show a strong case for convergence in efficiency among agricultural enterprises, i.e. less efficient farms (by 1%) tend to have higher TFP growth rates (by 0.024%). This encouraging effect, however, is undermined almost by a half by the effects of AgVAT and FAT (***log(vat)t-1*log(eff)*** and ***log(fat)t-1*log(eff)***). In other words, AgVAT and FAT undermine efficiency convergence processes in the sector and extends advantages to more efficient farms. For example, holding tax benefits unchanged, more efficient farms (by 1%) will generate higher TFP growth rates, i.e. by about 0.01% in both cases. This evidence, generally speaking, raises question with respect to the rational of maintaining further such a tax incentive system in Ukraine's agriculture.

5. Conclusions and further research

Theoretical and empirical literature postulates that the effect of explicit forms of subsidies (direct budget outlays or tariffs protection) on efficiency and productivity growth is ambiguous and it is largely shaped by the external and internal conditions that farms face. Quite surprisingly, but the effect of implicit forms of subsidization on agricultural efficiency and productivity is overlooked in the empirical literature. A search for the relevant peer-reviewed articles revealed no satisfactory results, and this is despite the existence of an extended literature on tax incentives (see e.g. Roca, 2010; World Bank, 2015). Moreover, tax incentives are very popular in developing and transition countries (Bolnick, 2004). In Ukraine, for example, tax benefits dominated in the total budget transfers to farmers until 2017. Kazakhstan and Russia also offer significant tax incentives to its agriculture (OECD, 2017; World Bank, 2016). In this paper we contribute to literature by looking specifically at the effect of tax incentives on agricultural productivity growth in Ukraine by employing highly disaggregated farm-level data that spans from 1995 through 2014.

In particular we look at how agricultural value added regime (AgVAT system) as well as profit and land tax exemptions (FAT system) affect productivity growth in Ukraine's agriculture. The empirical analysis is carried out using Ukraine-wide farm-level accounting data provided by the State Statistics Committee of Ukraine (so called 50 AG Form data). It is an unbalanced panel of 165,777 observations over the period 1995-2014.

In the first stage of our analysis we calculate productivity growth using Total Factor Productivity index using a conventional Divisia TFP change index for each farm in the dataset. Resulting TFP growth distributions show very volatile character of agricultural TFP growth in Ukraine. This volatility, however, is taking place along an upward trend.

In the second stage we model farm-specific productivity growth as a function of tax benefits generated by FAT and AgVAT tax systems, accounting for a number of other control variables, like farm size, its specialization, specific production type. In our modelling exercise, we estimated three models with contemporaneous and one period lagged tax benefits, and models 2 and 3 add to the model 1 two and three periods lagged tax benefits, correspondingly. Estimated results are consistent across the model and a variety of conclusions stemming from the resulting regression outcomes might be grouped as follows.

Tax benefits showed a positive impact on TFP growth but they turned out to be a very cost-inefficient instrument of stimulating TFP growth. This conclusion results from very inelastic average reaction of the AgVAT and FAT with respect to TFP growth rates shows that this On average the TFP growth tend to react similarly to AgVAT and FAT over time, with changing signs across the time periods, but the effect of AgVAT is almost three times stronger. A combined effect of AgVAT in two consecutive periods is +0.034% (1% increase of AgVAT increases TFP growth by 0.034%), while a combined effect of FAT is 0.016%.

The combined effect of tax incentives in the form of AgVAT demonstrates some peculiarities across agricultural sectors and farm sizes. The combined effect of AgVAT on productivity grow turned out to be neutral across various farm sizes. Farms size influences the effect of AgVAT on TFP growth in specific time periods but these time-specific effects offset each other and result in a zero-combined outcome. Overall, however, smaller farms in Ukraine tend to have higher TFP growth rates. Tax benefits in the form of *AgVAT tend to be supportive for productivity growth of livestock farms versus crop farms*. Increase of the share of crop revenues in total farm revenues by 1% (keeping AgVAT constant) decreases productivity growth by combined 0.06% across the time. On average, increase of the share of crop revenues in total farm revenues by 1% tend to increase TFP growth rate by 0.082%.

AgVAT has no specific overall impact for dairy, poultry and pig farms. In our model the effect of AgVAT for these specific groups of agricultural producers is either not statistically significant or the combined across the time effects offset each other.

AgVAT tend to be supportive for productivity growth of farms producing perennial crops. Farms that have perennial crops in their production mix on average have 0.02% higher TFP growth rates. This productivity growth advantage is reinforced by the effect of AgVAT on TFP growth in the consecutive (t-1 period) year, i.e. 1% increase in AgVAT is associated with a 0.01% acceleration of TFP growth.

The effect of the tax incentives in the form of FAT differs for various groups of agricultural producers and sectors, although somewhat differently compared to the effect of AgVAT. *FAT is more advantageous for small farmers in term of the productivity growth.* The combined effect of farm size in two consecutive years is negative, i.e. 1% increase in farm size (keeping FAT unchanged) is associated with 0.0056% decrease of productivity growth. Which might demonstrate inefficiencies of scale and already large scale of farm operations in Ukraine.

FAT sector specialization effect is in favour of crop farms. Increase of the share of crop revenues in total farm revenues by 1% (keeping FAT constant) increases productivity growth by combined 0.0184%. *FAT exerts no particular effect for dairy, pig and perennial crops farms. FAT exerts, though, a special effect for poultry farms productivity growth.* In particular, 1% increase of FAT for poultry farms tend to decrease their productivity growth by combined (aggregated across the time) 0.0012%.

Tax incentives in the form of *FAT and AgVAT undermine efficiency and productivity convergence processes in agriculture.* We found a strong case for convergence in efficiency and productivity among agricultural enterprises, less efficient farms tend to have higher TFP growth rates. This encouraging effect, however, is undermined almost by a half by the effects of AgVAT and FAT. This evidence, generally speaking, raises question with respect to the rational of maintaining further such a tax incentive system in Ukraine's agriculture.

6. Literature

Alston, J. M., Andersen, M. a., James, J. S., & Pardey, P. G. (2010). *Persistence Pays. US Agricultural Productivity Growth and the Benefits from Public R&D Spending*. New York: Springer, 2010

Bruemmer, B., Glauben, T., & Thijssen, G. (2002). Decomposition of Productivity Growth Using Distance Functions: the Case of Dairy Farms in Three European Countries. American Journal of Agricultural Economics, 84(August), 628–644.

Bolnick, B. (2004). Effectiveness and economic impact of tax incentives in the SADC Region. Gaborone: SADC Tax Subcommittee, SADC Trade, Industry, Finance and Investment Directorate.

Croissant Y, Millo G (2008). \Panel Data Econometrics in R: The plm Package." Journal of Statistical Software, 27(2). URL http://www.jstatsoft.org/v27/i02/.

Daouia A. and T. Laurent (2015). Package 'frontiles' in R.

Daouia, A. and L. Simar (2007), Nonparametric efficiency analysis: A multivariate conditional quantile approach, Journal of Econometrics 140, 375-400.

Evenson R.E. and K.O. Fuglie (2009). Technology capital: the price of admission to the growth club. *J Prod Anal*.

Fuglie, K.O. (2008). Is a slowdown in agricultural productivity growth contributing to the rise in commodity prices? *Agric. Econ*. 39(supplement), 431–441.

Kalaitzandonakes, N.G. (1994). Price Protection and Productivity Growth. American Journal of Agricultural Economics 76 (Nov). p. 722-732

Latruffe, L., Bravo-Ureta, B.E., Carpentier, Y.D., and V.H. Moreira (2016). Subsidies and Technical Efficiency in Agriculture: Evidence from European Dairy Farms. American Journal of Agricultural Economics 0(0): 1-17; doi: 10.1093/ajae/aaw077

Martin, J.P. (1978). X-Inefficiency, Managerial Effort, and Protection. *Economica* 45 (Aug.), p. 273-286

Martin, J.P., and J.M. Page, Jr. (1983). The impact of Subsidies on X-Efficiency in LDC Industry: Theory and Empirical Text. The Review of Economics and Statistics 65(4): 608-17

Menviel, J.J., and L. Latruffe (2016). Effect of Public Subsidies on Farm Technical Efficiency: A Meta-Analysis of Empirical Results. Applied Economics, http://dx.doi.org/10.1080/00036846.2016.1194963.

Nivievskyi, O. (2016). 'Impact of the Agricultural Tax Exemptions on the Sector Productivity' article at VoxUkraine, http://voxukraine.org/2016/02/16/impact-of-the-agricultural-tax-exemptions-on-the-sector-productivity-en/

OECD (2017), *Agricultural Policy Monitoring and Evaluation 2017*, OECD Publishing, Paris. http://dx.doi.org/10.1787/agr_pol-2017-en

Spencer, S. and R.E. Hall (1976). An Approximate Divisia Index of Total Factor Productivity. Econometrica, Vol. 44., No 2, p. 257-263

Roca, J (2010). Evaluation of the Effectiveness and Efficiency of Tax Benefits. Inter-American Development Bank Discussion Paper # IDB-DP-136 http://services.iadb.org/wmsfiles/products/Publications/35422311.pdf

World Bank (2013). Ukraine: Agricultural Policy Review

World Bank (2015). Options for Low Income Countries' Effective and Efficient Use of Tax Incentives for Investments. A report to the G-20 development working group by the IMF, OECD, UN and World Bank. http://documents.worldbank.org/curated/en/794641468000901692/pdf/100756-Tax-incentives-Main-report-options-PUBLIC.pdf

World Bank (2016). VAT and Agriculture in Kazakhstan. Joint Economic Research Program.

Serra, T., D. Zilberman, and J. M.Gil. 2008. "Farms' Technical Inefficiencies in the Presence of Government Programs." *The Australian Journal of Agricultural and Resource Economics* 52: 57–76. doi:10.1111/ajar.2008.52.issue-1.

Zhu, X., and A. Oude Lansink. 2010. "Impact of CAP Subsidies on Technical Efficiency of Crop Farms in Germany, the Netherlands and Sweden." *Journal of Agricultural Economics*61 (3): 545–564. doi:10.1111/j.1477-9552.2010.00254.x.

Annex: Table 4 Second stage regression output

	Log (TFP growth)		
	Model 1	Model 2	Model 3
log(vat)t	***0.1642*** (0.0046)***	***0.1553*** (0.0051)***	***0.1575*** (0.0055)***
log(fat)t	0.0567*** (0.0019)	0.0589*** (0.0021)	0.0559*** (0.0023)
log(vat)t-1	***-0.1337*** (0.0046)***	***-0.1225*** (0.0062)***	***-0.1247*** (0.0067)***
log(fat)t-1	-0.0415*** (0.002)	-0.0397*** (0.0022)	-0.0397*** (0.0024)
log(vat)t-2	***-***	***9e-04 (0.0055)***	***0.0082 (0.007)***
log(fat)t-2	-	-7.8E-06	-9.4E-06
log(vat)t-3	***-***	***-***	***-0.0018 (0.0063)***
log(fat)t-3	-	-	0.0012 (0.0022)
log(land)	-0.0465*** (0.0019)	-0.0537*** (0.0023)	-0.0559*** (0.0028)
log(Crop share)	0.1185*** (0.0114)	0.1107*** (0.0133)	0.0822*** (0.0152)
d(dairy)	0.0096** (0.0037)	0.0234*** (0.0043)	0.0263*** (0.0049)
d(poultry)	0.0168 (0.0151)	0.0253 (0.0168)	0.0535*** (0.0192)
d(pigs)	0.0032 (0.0038)	-0.0038 (0.0043)	-0.0069 (0.0049)
d(peren)	0.0037 (0.0066)	0.0125 (0.008)	0.0201** (0.0095)
log(vat)t*log(land)	***0.0045*** (8e-04)***	***0.0079*** (9e-04)***	***0.0102*** (0.001)***
log(vat)t*log(Crop share)	***-0.0325*** (0.0054)***	***-0.0319*** (0.006)***	***-0.0411*** (0.0065)***
log(vat)t*d(dairy)	***-0.0105*** (0.0019)***	***-0.0123*** (0.0021)***	***-0.0151*** (0.0022)***
log(vat)t*d(poultry)	***0.0255*** (0.0018)***	***0.0165*** (0.002)***	***0.0128*** (0.0022)***
log(vat)t*d(pigs)	***-0.0089 (0.0054)***	***-0.0093 (0.0059)***	***-6.8E-05***
log(vat)t*d(peren)	***-0.0029 (0.0026)***	***-1.7E-05***	***-0.005 (0.0033)***
log(fat)t*log(land)	-0.0071*** (3e-04)	-0.0073*** (4e-04)	-0.0072*** (4e-04)
log(fat)t*log(Crop share)	0.0012 (0.0018)	-0.0026 (0.0021)	-7e-04 (0.0022)
log(fat)t*d(dairy)	1e-04 (7e-04)	-1e-04 (7e-04)	4e-04 (8e-04)
log(fat)t*d(poultry)	-0.0053*** (7e-04)	-0.0038*** (7e-04)	-0.0032*** (8e-04)
log(fat)t*d(pigs)	-0.0031** (0.0014)	-0.0041*** (0.0015)	-0.0036** (0.0016)
log(fat)t*d(peren)	7e-04 (8e-04)	0.0016* (0.001)	0.0023** (0.0011)
log(vat)t-1*log(land)	***-0.0028*** (9e-04)***	***-0.0072*** (0.0012)***	***-0.0078*** (0.0013)***
log(vat)t-1*log(Crop share)	***-0.0028 (0.0055)***	***-0.0073 (0.007)***	***-0.0212*** (0.0075)***

log(vat)t-1*d(dairy)	***0.0099*** (0.0019)***	***0.0081*** (0.0024)***	***0.0111*** (0.0026)***
log(vat)t-1*d(poultry)	***-0.0263*** (0.0019)***	***-0.0302*** (0.0024)***	***-0.0243*** (0.0025)***
log(vat)t-1*d(pigs)	***0.0065 (0.0056)***	***0.0067 (0.0069)***	***-0.0013 (0.0074)***
log(vat)t-1*d(peren)	***0.0017 (0.0027)***	***0.0069** (0.0034)***	***0.0107*** (0.0037)***
log(fat)t-1*log(land)	0.0022*** (3e-04)	0.0019*** (4e-04)	0.0018*** (4e-04)
log(fat)t-1*log(Crop share)	0.0016 (0.0019)	7e-04 (0.0021)	0.0069*** (0.0023)
log(fat)t-1*d(dairy)	0.0014** (7e-04)	0.0022*** (7e-04)	0.0016** (8e-04)
log(fat)t-1*d(poultry)	0.0046*** (7e-04)	0.0055*** (8e-04)	0.0036*** (8e-04)
log(fat)t-1*d(pigs)	7e-04 (0.0015)	4e-04 (0.0016)	0.0024 (0.0016)
log(fat)t-1*d(peren)	0.001 (8e-04)	0.0016* (9e-04)	6e-04 (0.0011)
log(vat)t-2*log(land)	***-***	***0.0029*** (0.001)***	***0.0019 (0.0013)***
log(vat)t-2*log(Crop share)	***-***	***0.0079 (0.006)***	***-0.0085 (0.0077)***
log(vat)t-2*d(dairy)	***-***	***0 (0.0022)***	***0 (0.0026)***
log(vat)t-2*d(poultry)	***-***	***0.0146*** (0.0021)***	***0.0143*** (0.0026)***
log(vat)t-2*d(pigs)	***-***	***-0.0023 (0.0058)***	***-0.0045 (0.0071)***
log(vat)t-2*d(peren)	***-***	***-0.004 (0.0032)***	***-0.0034 (0.0039)***
log(fat)t-2*log(land)	-	-4e-04 (4e-04)	-2e-04 (4e-04)
log(fat)t-2*log(Crop share)	-	0.0105*** (0.0019)	0.0115*** (0.0021)
log(fat)t-2*d(dairy)	-	-4e-04 (7e-04)	-6e-04 (8e-04)
log(fat)t-2*d(poultry)	-	-0.0021*** (7e-04)	-0.0024*** (8e-04)
log(fat)t-2*d(pigs)	-	0.0018 (0.0015)	0.0017 (0.0016)
log(fat)t-2*d(peren)	-	-0.0023*** (9e-04)	-0.0011 (0.001)
log(vat)t-3*log(land)	***-***	***-***	***-0.001 (0.0012)***
log(vat)t-3*log(Crop share)	***-***	***-***	***0.0469*** (0.0068)***
log(vat)t-3*d(dairy)	***-***	***-***	***-2e-04 (0.0024)***
log(vat)t-3*d(poultry)	***-***	***-***	***-0.0011 (0.0024)***
log(vat)t-3*d(pigs)	***-***	***-***	***0.0062 (0.0064)***
log(vat)t-3*d(peren)	***-***	***-***	***-2.3E-05***
log(fat)t-3*log(land)	-	-	-1e-04 (4e-04)
log(fat)t-3*log(Crop share)	-	-	-0.0014 (0.002)
log(fat)t-3*d(dairy)	-	-	-9.1E-07
log(fat)t-3*d(poultry)	-	-	0.0012* (7e-04)
log(fat)t-3*d(pigs)	-	-	-0.0016 (0.0015)
log(fat)t-3*d(peren)	-	-	-0.0015 (9e-04)
d2000	0.0198*** (0.0016)	-	-

d2001	-0.0638*** (0.0019)	-0.0819*** (0.0021)	-
d2002	-0.1594*** (0.0018)	-0.1793*** (0.002)	-0.09*** (0.0022)
d2003	-0.0123*** (0.0019)	-0.0282*** (0.002)	0.067*** (0.0023)
d2004	-0.0576*** (0.0027)	-0.0805*** (0.0029)	0.0077** (0.003)
d2005	-0.0633*** (0.0028)	-0.0774*** (0.003)	0.0092*** (0.003)
d2006	-0.06*** (0.0028)	-0.0788*** (0.003)	0.0126*** (0.0031)
d2007	-0.0183*** (0.003)	-0.0397*** (0.0031)	0.0485*** (0.0032)
d2008	-0.0779*** (0.0029)	-0.1053*** (0.0032)	-0.0202*** (0.0031)
d2009	-0.0702*** (0.0029)	-0.0816*** (0.0032)	-5e-04 (0.0032)
d2010	-0.0757*** (0.003)	-0.0938*** (0.0032)	-5e-04 (0.0032)
d2011	-0.0947*** (0.003)	-0.1153*** (0.0032)	-0.0274*** (0.0032)
d2012	-0.1055*** (0.0031)	-0.1213*** (0.0033)	-0.0353*** (0.0032)
d2013	-0.1006*** (0.0031)	-0.12*** (0.0033)	-0.0299*** (0.0033)
d2014	-0.0658*** (0.0032)	-0.0851*** (0.0034)	0.0037 (0.0033)
log(eff)*t-1*	-0.0546*** (0.0028)	-0.033*** (0.0036)	-0.0235*** (0.0044)
log(vat)t-1*log(eff)t-1	***-7e-04 (8e-04)***	***0.0126*** (0.0017)***	***0.0134*** (0.0019)***
log(fat)t-1*log(eff)*t-1*	0.0122*** (6e-04)	0.0119*** (7e-04)	0.0117*** (8e-04)
Observations	83823	66367	53792
Number of id	18311	12809	10291
R-squared	0.60335	0.61437	0.62839
Adj. R-Squared	0.47117	0.49518	0.50721
F-statistic	1914.82 on 52 and 65460 DF	1271.96 on 67 and 53491 DF	895.379 on 82 and 43419 DF
p-value	< 2.22e-16	< 2.22e-16	< 2.22e-16
*** p<0.01, ** p<0.05, * p<0.1			

Source: Own presentation. Note: standard errors are in brackets; estimations were performed using 'plm' package in R (see Croissant and Millo, 2008)