TAX BENEFITS IMPACT
ON PRODUCTIVITY GROWTH
IN UKRAINIAN AGRICULTURE

by

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Kyiv School of Economics

Abstract

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Agricultural producers all over the world are substantially supported by governments in a variety of ways. Academic literature studying productivity growth effects caused by agricultural support provide a mixed picture: some studies find positive effect on productivity growth, but some argue that such policies are ineffective. Agricultural VAT accumulation system and fixed agricultural tax benefits have been the main form of support for agricultural producers in Ukraine for more than 20 years.

In this thesis we build a model to estimate how benefits obtained by agricultural producers due to tax breaks correspond to their productivity growth that is decomposed into technical efficiency growth and technological change. Stochastic frontier analysis is applied to estimate productivity growth. This work finds empirical evidence that the productivity growth tends to decline following the periods of experiencing greater tax benefits.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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LIST OF ABBREVIATIONS

EU. European Union. Economic and political union between 27 European countries.

FAT. Fixed Agricultural Tax. Tax benefit for agricultural producers in Ukraine that let farms to pay a flat rate instead of a number of taxes which enterprises under the general tax system are subject to.

SFA. Stochastic Frontier Analysis. Method of parametric economic modeling used to estimate cost or production functions which explicitly account for the existence of firm inefficiency.

DEA. Data Envelopment Analysis. Method of nonparametric economic modeling used to estimate production frontiers.

SSSU. State Statistics Service of Ukraine.

TFP. Total Factor Productivity. An economic indicator which attempts to measure the impact of technological advancements and changes in production techniques on production output volume.

TE. Technical Efficiency. The level of input utilization efficiency compared to the most efficient peers in a sample.

VAT. Value-added Tax. Tax imposed on extra value of goods/services created above the original value of inputs (goods and services).

Chapter 1

INTRODUCTION

The use of tax incentives is widespread and constantly evolving in many countries. It is used to stimulate investments and economic growth, especially when the economy is in a downturn or recession (Yongzheng and Jie 2019). At the same time, agriculture is one of the most supported sectors worldwide. The OECD agricultural support evaluation shows that in recent years the EU supported its agricultural producers in amount equal to a quarter of the total value of the EU agricultural production, and this share has declined since early 1990-s. On the contrary, Chinese government is increasing its support for agriculture which amounted 18% of the total production in 2020 (Figure 1). However, OECD states that agricultural support often fails to achieve its stated goals of improving food security, livelihoods and environmental sustainability (OECD 2021).

In Ukraine governmental support of agriculture looks like very low (see Figure 1) and even sometimes negative according to OECD data. This is mostly due to significant negative market price support for wheat, barley, maize, sunflower and milk usually taking form of export quotas (Kulyk, Herzfeld and Nivievskyi 2014). However, if we look into the structure of agricultural support in Ukraine (see Figure 2) we find that a significant (after 2008 major) portion of this support took the form of tax benefits that basically consist of two parts: value-added tax (VAT) accumulation benefits and fixed agricultural tax (FAT) benefits.

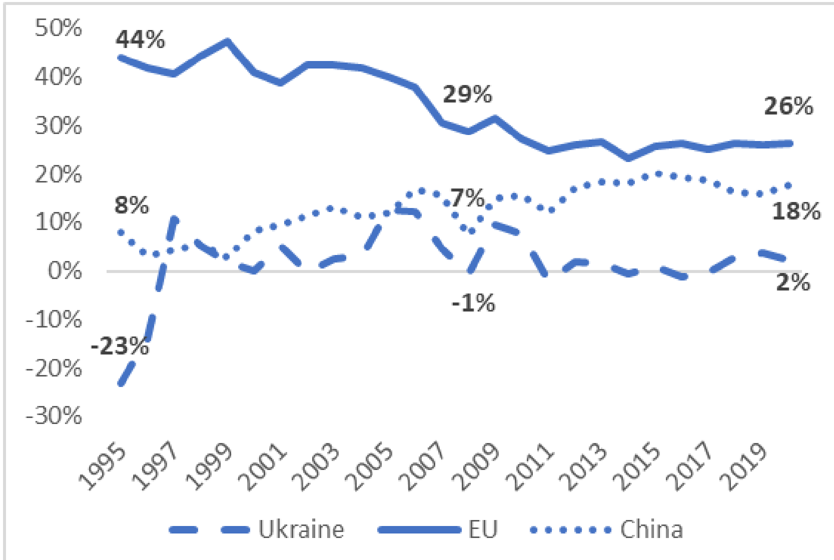

Figure 1. Total Agricultural Support Estimate as a % of Total Value of Production (at farm gate)

Source: OECD PSE Database

While tax benefits in, for example, the US, EU and China constituted only 0-4% of the total agricultural support (OECD database) in the last three decades, implicit subsidization through tax breaks constituted about 55% of fiscal agricultural support in Ukraine on average for the period from 1999 until 2017 (Figure 2).

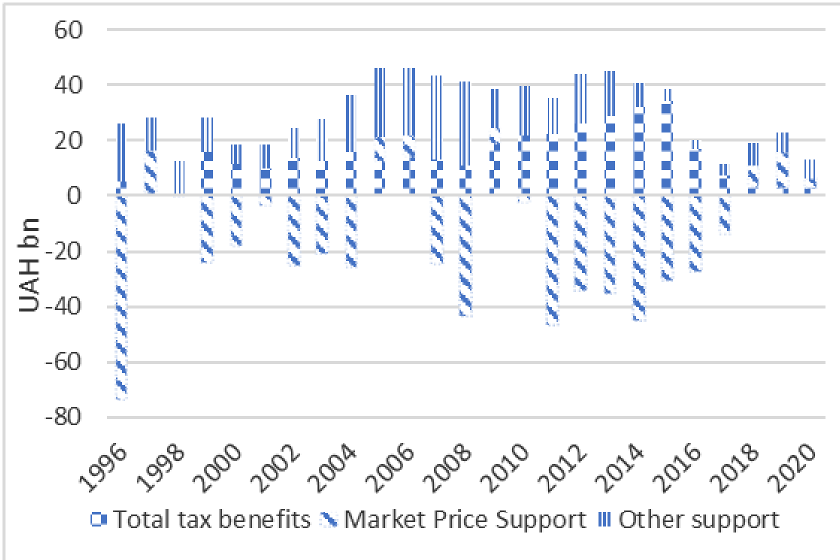

Figure 2. Structure of Agricultural Support in Ukraine, in 2016 prices
Source: OECD PSE Database

Starting from 2017 the portion of tax benefits in the total agricultural support is reduced to about 30% because one of the major benefits – VAT accumulation special regime – ceased to exist. Given the importance of VAT and FAT in Ukrainian agricultural support system some background information on the nature of these tax systems is provided below.

VAT is one of the oldest and most stable in the design of implementation Ukrainian taxes. Starting from its implementation in 1992 and till today main VAT rate remains unchanged on the level of 20% of goods/services' price net of VAT. Final price for almost all goods and services sold/provided in Ukraine must include 20% VAT. This tax is administrated by producers but the tax burden of VAT is imposed on consumers for whom all prices are increased by 20%. The most interesting moment with VAT administration is that only net tax obligations are payable to the budget. This derives from the fact that every company is a consumer of some goods and services itself that usually takes the form of production inputs. But VAT is designed in a way that only consumers of the final goods/services should be real taxpayers. Thus, any VAT paid by a producer to a supplier as a part of the production process is deductible from VAT obligations of that producers that constitute 20% of its taxable sales.

Under the VAT design it is assumed that a company's sales should usually exceed its input purchases, but sometimes the opposite happens. Years of low sales and intense investments and/or production may result in negative VAT obligations. In this case government must reimburse the difference to such company under the general VAT system.

In 1999 Ukrainian government allowed agricultural producers to retain VAT generated from sales of agricultural products on their own special accounts. This meant that VAT was still included in agricultural goods' prices but producers were allowed not to transfer 20% of taxable revenue to the budget but to use the accumulated liquidity for their own productional needs and to reimburse input VAT. The VAT accumulation system was designed in a way that, at the same time, agricultural producers were not allowed to reimburse VAT losses referred to in the previous paragraph in case their VAT obligations were lower than VAT paid with costs of inputs. Thus, VAT accumulation system is beneficial only in the case of moderate/low costs and high sales. Capital investments or improvement of production technology that usually require significant resources and time would lead to losses from VAT accumulation system use at least in the short run. Therefore, VAT accumulation system was criticized as discouraging from investments and productivity improvements (Betliy 2014).

Fixed agricultural tax was introduced almost simultaneously with VAT accumulation regime, in 1999 and, unlike VAT accumulation, FAT benefit is still available for farms in 2022. FAT was designed in a way that agricultural producers which revenue was generated by agricultural production by at least 50% (starting from 2005 – at least 75%) are eligible to pay fixed single tax instead of profit tax, land tax, water use rent and, in different years, many other taxes. Until 2005 agricultural producers were exempt from 12 taxes, in the period 2005 – 2010 – 6-7 taxes, later – 4 taxes: profit tax, land tax, water use rent and personal income tax (for small farmers).

FAT was transformed into single tax in 2015 but preserved the beneficial mechanism. FAT is defined as a rate of less than 1% multiplied by normative value of farmland measured in UAH/hectare. Thus, tax burden on agricultural producers does not depend neither on their income, nor profitability, but on the size, type and location of land which they use. Obviously, crop production requires more land to generate the same income than, for instance, poultry production. Therefore, tax burden is distributed unproportionally between different types of agricultural producers. Table 1 generalizes the main characteristics of the tax benefits described above.

Till 2016 agricultural sector was the largest beneficiary of tax exemptions in Ukraine (Marchak and Markuts 2020) until in 2017 when the agricultural VAT accumulation system was eliminated. Besides VAT, fixed agricultural tax is broadly applied in Ukrainian agriculture. As of 01.01.2021 46 720 agricultural companies were under single tax, 32 285 of which were under the fourth group of the single tax (FAT successor) and 64 422 companies had agricultural business operations under the general tax system according to State Tax Service of Ukraine. Given the fact that eligibility to FAT requires at least 75% of output to be generated by agricultural products and other requirements we assume that most companies eligible for FAT choose it. Under FAT an agricultural producer was eligible to pay around USD 0.8/ha per year until 2015, and as a result of a rise of the normative value of agricultural land this tax increased to approximately

USD 10/ha in 2015, which is still around 4 times lower than 18% of corporate income tax (Nivievskyi 2020, Samusenko 2015).

Table 1. Tax benefit systems design

	VAT accumulation	Fixed Agricultural Tax
Period of implementation	1999 - 2016	1999 - now
Benefits	VAT payments due on agricultural goods and services are retained by producers	Flat rate instead of profit tax, land tax, water use rent etc. List of other exemptions differed.
Costs	Producers are not eligible to tax credit reimbursement in case VAT paid to suppliers exceeds the accumulated VAT payments	USD 1 - 10/ha/year (equals normative monetary valuation of agricultural land in a given year *x* FAT rate)

Source: Data definitions and sources for Ukraine, OECD; Tax Code of Ukraine; Law on VAT, Law on FAT

The research objective of this thesis is to estimate which impact tax benefits for agricultural sector had on productivity growth of Ukrainian farms based on the empirical evidence of the last decades. The main research question may be formulated as follows: do tax benefits promote productivity growth of Ukrainian agricultural producers?

There has been only one research dedicated to the tax benefits' effects on productivity in Ukrainian agriculture (Nivievskyi 2017) which findings are based on Divisia TFP estimation and gross tax benefits estimation approach. This thesis contributes to the investigation of the topic by carrying out the different approach to the estimation of tax benefits. First, in this thesis the estimated costs of using tax breaks are also taken into account. Second, benefits due to exemption from land tax within the FAT system were included into FAT benefit estimation model. Also, a different approach, namely, translog production frontier with non-constant and non-neutral technological change, was used for TFP estimation.

The findings of this thesis can be useful for policymakers and their advisors who search for improving effectiveness of the system of agricultural support as well as everyone interested in agricultural and/or fiscal policy analysis.

The rest of this work is structured in the following way. Chapter 2 presents an overview of the relevant academic literature on tax incentives effectiveness in terms of productivity growth, output or investment growth. An overview of the basic theoretical framework that is going to be used in the thesis is given in Chapter 3, as well as methodological approach to estimating TFP, output growth etc. In Chapter 4, a description of the data used is provided. Chapter 5 will provide obtained empirical results. Chapter 6 will conclude the thesis with summarizing discussion, stressing on the implementation issues of the policy design options argued for in the work.

Chapter 2

LITERATURE REVIEW

The impact of tax incentives on productivity is not covered in recent empirical studies very well, unlike the effect of explicit subsidies. Meta-analysis of the empirical literature on the relationship between the direct subsidies and technical efficiency show an ambiguous result: a half of the models analyzed find a significant negative effect of subsidies on technical efficiency and the rest show positive or insignificant effect (Minviel and Latruffe 2016). Some theoretical papers find that the sign of the effect of agricultural support from government in form of subsidies on efficiency is difficult to determine theoretically because human factor takes place. Some farm managers run their enterprises in a more relaxed and, thus, less efficient manner as a result of subsidies but some do not (Martin 1978; Martin and Page 1983; Serra et al. 2008). In particular, Martin (1978) used the concept of "managerial leisure" to control for managerial effort to explore the relationship between changes in public policy and X-inefficiency (that is technical inefficiency indicator showing how far a farm's technology is from the most efficient resource use technologies in the sample).

Van Der Veen et al. (2007) found that competitive position of domestic agriculture is supported if the tax burden is low comparing to other countries and innovation and investments are supported by the government (2007). According to the World Bank's empirical research (Sebastian 2013) tax incentives are 8 times more effective in countries with strong investment climate than in countries with weak investment climate (which Ukraine is referred to) in terms of attracting FDI. Descriptive study on tax benefits conducted by the Center of Public Finance and Governance at KSE suggests that tax incentives in Ukraine are costly to budget, distorting to taxation system and ineffective in general (Marchak and Markuts 2020).

Zhu and Lansink (2010) analyze the impacts of Common Agricultural Policy reforms, particularly subsidies on technical efficiency of crop farms based on data of farms producing crops in the European Union countries. The research results show that crop subsidies as a share of total subsidies affect technical efficiency negatively in Germany, but have positive impact in Sweden and no effect in the Netherlands. When total subsidies are considered as shares in total farm revenues they affect technical efficiency in all three countries negatively, that is consistent with income and insurance effects.

Study on dairy farms from nine western European countries shows that agricultural subsidies may have positive, null, or negative effect on technical efficiency, which depends on the country under consideration (Latruffe at al. 2016). Stochastic production frontier approach is used to estimate farms' technical efficiency in the research as well as in this thesis. The main difference in methodology of our and the abovementioned papers is that Latruffe at al. use Cobb-Douglas functional form of production function in stochastic frontier analysis while translog production function is chosen for this thesis work (see Chapter 3). The EU Common Agricultural Policy was reformed in 2003 so that farms were able to obtain governmental support regardless on their output amount. Before 2003 the Common Agricultural Policy provided support based on production level and/or type. The authors of the paper on European diary farms find that this policy shift resulted in subsidies effects on technical efficiency became much weaker and often different in sign compared to the pre-reform support policy approach effects.

Some research papers studying the EU Common Agricultural Policy effects on productivity (Latruffe and Desjeux 2016, Latruffe et al. 2017) applied nonparametric DEA method to estimate technical efficiency score at the first stage of estimation and then regress the obtained technical efficiency score on the level of subsidies related to a size variable on the second stage of estimation. Laure Latruffe et al. (2017) find that the sign of impact of subsidies on technical efficiency differs depending on whether environmental outputs are taken into consideration in the efficiency estimation. Similar to this thesis (see Chapter 3) Latruffe and Desjeux (2016) decompose productivity change into technical efficiency change and technological change to obtain dependent variables for second-stage regressions with governmental subsidies level being the main explanatory variable.

Technical efficiency analysis for Turkish sunflower farms finds, in particular, that higher level of education of farmers, older age, more years of experience in agriculture and larger farm size are associated with lower technical efficiency. On the contrary, more intensive usage of borrowed capital and higher number of family members tend to have positive effect on technical efficiency (Külekçi 2010).

Mayrand at al. (2003) find that higher agricultural subsidies lead to more intensive agricultural production in countries which are OECD members and, at the same time, slow technological development that have negative environmental outcomes. The authors of the study argue that subsidies disincentivize farms from seeking for more environmentally-efficient production techniques and cause reduced diversification of production.

Yongzheng and Jie (2019) used difference-in-difference (DID) approach to learn the effects on capital investments and TFP growth caused by VAT tax incentives in China. TFP was estimated using the Solow residual from the ordinary least squares (OLS) regression approach which is run industry-by-industry and based on firm-level data. Under the design of the new Chinese VAT system, the purchase of fixed assets could be deducted from final product sales while calculating a firm's

VAT liability. The reform started in 2004 and lasted to its nationwide adoption for all industries in 2009.

The abovementioned academic paper by Yongzheng and Jie is based on firm-level panel dataset that covers a full range of sectors (including agriculture, mining, manufacturing, building, and service sectors) in the economy. Gradual implementation of the reform made possible separating treatment and control groups for DID approach and verifying the results with Placebo tests. The estimation results have evidenced effectiveness of the new VAT policy. Due to this reform investment by the treated firms relative to the control firms was increased by as high as 38.4 percent, and productivity was improved by 8.9 percent.

As declared by Ron Durst and James Monke (2001) the US federal tax breaks contribute to greater farm output and lower prices as well as growing number of farms. However, the effect of the tax breaks on productivity growth is not covered by the paper.

The most relevant to this thesis in terms of research question paper is on the impact of tax exemptions on agricultural productivity growth in Ukraine (Nivievskyi 2017). TFP was calculated via Divisia Index formally written as (1):

$$TFP = \sum_{k=1}^{K} sk * x\dot{k} - \sum_{m=1}^{M} rm * y\dot{m} \tag{1}$$

where s_k indicates the cost share of input x_k , and r_m stands for the revenue share of output y_m.

The paper shows that the impact of VAT benefits on productivity growth is positive for livestock farms and negative for crop farms, but tend to be supportive for productivity growth of perennial crops producers. FAT benefit turned out to be more effective in terms of productivity growth support for small farmers and crop producers. On the contrary, poultry farms show decreasing productivity growth as a result of FAT system use. Overall, the author describes VAT and FAT as inefficient and undermining productivity convergence processes in agriculture.

Thus, the existing research base shows that the effectiveness of agricultural support by, among other tools, tax incentives heavily depends on the country economic environment peculiarities and a specific policy design. This thesis contributes to the literature by finding if there is any evidence of lowering input use efficiency growth by tax benefits in Ukraine and which factors may influence this or the opposite effect.

Chapter 3

METHODOLOGY

The main hypothesis of this work is that tax benefits discourage agricultural enterprises from significant efforts to increase productivity. Thus, this paper is dedicated to analyze policy efficiency in terms of growth of resource use effectiveness in Ukrainian agriculture.

In order to test the aforementioned hypothesis, we use OLS estimation of models with the following specifications that are similar to specifications used in many other academic papers studying governmental supports effects on firms' productivity changes (Latruffe at al. 2016, Nivievskyi 2017, Yongzheng and Jie 2019):

$$\Delta TFP_{it} = \gamma_0 + a_1 VAT\_bt_{it} + a_2 VAT\_bt_{it-1} + a_3 FAT\_bt_{it} + a_4 FAT\_bt_{it-1} + a_5 farmsize_{it} + a_6 y.crop_{it} + a_7 sug\_beet_{it} + a_8 poultry_{it} + a_9 diary_{it} + a_{10} pork_{it} + a_t year_{it} + \varepsilon_{it} \quad (2)$$

$$\Delta TE_{it} = \alpha_0 + b_1 VAT\_bt_{it} + b_2 VAT\_bt_{it-1} + b_3 FAT\_bt_{it} + b4FAT\_bt_{it-1} + b_5 farmsize_{it} + b_6 y.crop_{it} + b_7 sug\_beet_{it} + b_8 poultry_{it} + b_9 diary_{it} + b_{10} pork_{it} + b_t year_{it} + \xi_{it} \quad (3)$$

$$\Delta T_{it} = \varphi_0 + c_1 VAT\_bt_{it} + c_2 VAT\_bt_{it-1} + c_3 FAT\_bt_{it} + c_4 FAT\_bt_{it-1} + c_5 farmsize_{it} + c_6 y.crop_{it} + c_7 sug\_beet_{it} + c_8 poultry_{it} + c_9 diary_{it} + c_{10} pork_{it} + c_t year_{it} + \varrho_{it} \quad (4)$$

where the dependent variables are total factor productivity change ΔTFP, technical efficiency change ΔTE and technological change ΔT. The main explanatory variables are as follows: VAT_bt_{it} stands for total benefit of a farm due to VAT accumulation, FAT_bt_{it} is total benefit due to FAT. Tax variables are taken both contemporaneously and with one lag to analyze causation relation between productivity growth and tax benefits. The rest of the variables are taken to control for other factors which could have impact on productivity growth. $farmsize_{it}$ is size of a farm (area of land in hectares in farm's use is used as a proxy). $y.crop_{it}$ is the share of farm's revenue generated by crop production, sug_beet_{it}, $poultry_{it}$, $diary_{it}$ and $pork_{it}$ are dummy variables indicating that sugar beet/chicken milk/pork generates at least 30% of a farm's revenue. These specialization variables were chosen based on considerations of data availability for the whole period of 1995 – 2014 and on the fact that crop and livestock production are very different in terms of land use and production process, so their differences must be controlled for in the model. $year_{it}$ is a dummy variable to fix effects particular to the whole system in a given year (e. g. political, weather or macroeconomic shocks). We also consider extended specification with one more explanatory variable – subsidies via budgetary outlays for the period 2004 – 2016 (data for direct government support is available only since 2004).

Estimation of the dependent variables is the most sophisticated part of this work which deserves special attention.

Academic literature related to productivity analysis show a variety of methods used to estimate TFP. One of the common approaches was developed by Robert M. Solow (1957) the idea of which is to extract output variation that is not explained by measurable inputs like labor, materials and capital etc. from a Cobb-Douglas production function, and to consider the production function residuals to be explained by technical change. This approach was used, for instance, to estimate tax incentives effects on productivity in China (Yongzheng and Jie 2019). The algorithm of this approach is intuitive and relatively easy to reproduce. However, there are some drawbacks. First, the production function residuals may not necessarily be mostly explained by technical change which is assumed by

Solow residual approach. Second, this approach requires assumption of constant returns to scale that is not always the case.

Another widely used approach is Approximate Divisia Index of Total Factor Productivity referred to in equation (1) and used to estimate the impact of tax exemptions on agricultural productivity growth in Ukraine (Nivievskyi 2017). The main issue with this method is to find relevant cost and revenue shares. In order to make this thesis complementary to the paper mentioned herein the approach used in this work is different from Divisia Index.

Data Envelopment Analysis is a relatively new and commonly used approach to estimate firms' efficiency developed by Charnes, Cooper, and Rhodes (1978) based on the earlier work of Farrell (1957). The idea is to measure the efficiency of a decision-making unit relative to similar decision-making units in order to estimate a "best practice" frontier (Cooper, Seiford and Zhu 2011).

In this work stochastic frontier production function model (Aigner, Lovell and Schmidt 1977 and Meeusen and van den Broeck 1977) is followed to estimate the TFP change. This approach appeared to be the most relevant to this research because other methods were rejected for different reasons. Solow residual approach works properly when production function reveals constant returns to scale, but both Cobb-Douglas and translog production functions estimated on the dataset studied in this thesis showed decreasing returns to scale that resulted in residuals being extremely highs on average and thus not plausible. Data Envelopment Analysis estimation approach suggested in Henningsen (2019) turned out to work properly on smaller datasets than one used in this thesis (over 150 000 observation), so we have met technical difficulties in application of DEA in this research in practice. Divisia Index method is covered in the academic paper written my thesis advisor (Nivievskyi 2017). Given this paper in based on the same dataset as my thesis application of the same method of TFP estimation would make this work less valuable in terms of contribution to the existing knowledge. Thus, SFA approach appeared to work best for this thesis. Similarly to TFP decomposition considered in Guyomard et al. (2006) TFP change is defined as follows:

$$\Delta TFP \approx \Delta TE + \Delta T \tag{5}$$

Translog production frontier with non-constant and non-neutral technological change has proved to be the best specification for the production function among other forms covered by Henningsen (2019) which recommendations we followed for the purposes of TFP change estimation. This specification was chosen by comparing it with OLS translog production function and Cobb-Douglas production function specifications with likelihood-ratio tests (LRT). LRT have shown that the additional variables included in the chosen specification compared to other specifications are jointly significant at 1% level, so they make the model more accurate which is significant enough to cover the drawback of additional complexity of the model. Technical efficiency estimation with stochastic frontier translog production function is widely used in academic literature dedicated to productivity analysis (Covaci and Sojkova 2006, Rivera at al. 2008, Baten et al. 2009, Umar et al. 2017).

Equation for production function:

$$\begin{aligned}output_{it} = {} & \mu_0 + \alpha_1 labor_{it} + \alpha_2 material_{it} + \alpha_3 energy_{it} + \alpha_4 land_{it} + \alpha_5 capital_{it} + \\ & \alpha_6(0.5*labor_{it})\hat{}2 + \alpha_7(0.5*material_{it)}\hat{}2) + \alpha_8(0.5*energy_{it)}\hat{}2) + \\ & \alpha_9(0.5*land_{it)}\hat{}2) + \alpha_{10}(0.5*capital_{it)}\hat{}2) + \alpha_{11} labor_{it}*material_{it} + \\ & \alpha_{12} labor_{it}*energy_{it} + \alpha_{13} labor_{it}*land_{it} + \alpha_{14} labor_{it}*capital_{it} + \\ & \alpha_{15} material_{it}*energy_{it} + \alpha_{16} material_{it}*land_{it} + \alpha_{17} material_{it}*capital_{it} + \\ & \alpha_{18} energy_{it}*capital_{it} + \alpha_{19} energy_{it}*capital_{it} + \alpha_{20} land_{it}*capital_{it} + \alpha_{21} year_{it} + \\ & \alpha_{22} year_{it} * labor_{it} + \alpha_{23} year_{it} * material_{it} + \alpha_{24} year_{it} * energy_{it} + \\ & \alpha_{25} year_{it} * land_{it} + \alpha_{26} year_{it} * capital_{it} + \alpha_{27} 0.5 * year_{it}\hat{}2 + \varepsilon_{it}\end{aligned} \tag{6}$$

where $output_{it}$ stands for total revenue of a farm i in year t, $labor_{it}$ is costs of labor employed by a farm, $material_{it}$ is the sum of expenditures for seeds, feeds, ferilizers and other agricultural production materials, $energy_{it}$ is total costs of fuel and electricity, $land_{it}$ is the area of agricultural land used by a farm measured in hectares, $capital_{it}$ includes amortization deductions and costs of repair and construction materials. All variables except time variables are taken in log-linear form and all monetary variables are adjusted on inflation.

Stochastic frontier analysis allows to estimate individual technical efficiency scores directly from the production function. This score shows the level of technical efficiency of an individual firm compared the most efficient firms in the same sample in terms of use of inputs. If score is equal to one the corresponding firm processes inputs if the most efficient way; score equal close to zero means that the corresponding firm is able to produce much less output from the same combination of inputs then its peers. Technical efficiency change is calculated as TE of a firm in the current period minus TE of the same farm in the previous period.

Technological change is also derived from (6) with the following equation:

$$\Delta T_{it} = atLabor * labor_{it} + atMaterial * material_{it} + atEnergy * energy_{it} + atLand * land_{it} + atCapital * capital_{it} + att*year_{it} \tag{7}$$

where at_0 is the coefficient of $year_{it}$, atLabor is the coefficient of $year_{it}* labor_{it}$, atMaterial is the coefficient of $year_{it}* material_{it}$, atEnergy is the coefficient of $year_{it}*energy_{it}$, atLand is the coefficient of $year_{it}*land_{it}$, atCapital is the coefficient of $year_{it}*capital_{it}$, att is the coefficient of $0.5 * year_{it}$^2 estimated in equation (6).

Total VAT agricultural benefit (VAT_bt_{it}) is estimated as the amount of money farms were able to save (or to lose) due to VAT accumulation regime. Equation for agricultural VAT benefit:

$$VAT\_bt_{it} = VAT\_rate_{it}*(output_{it} - tax\_inputs_{it}) \tag{8}$$

where VAT_rate_{it} is 20% for the period of VAT accumulation implementation (1999 – 2016) and 0% before 1999 when farmers were under the general VAT system; tax_inputs_{it} is costs of all inputs usually subject to VAT: energy, materials and outsource services.

FAT benefit is calculated as an amount of tax estimated to be due to the budget under a general tax system decreased by the estimated amount of tax due under the FAT system.

Equation for FAT benefit:

$$FAT\_bt_{it} = PT\_rate_{it}*Profit_{it} + LTrillya\_rate_{it}*Rillya_{it} + LTother\_rate_{it}*OtherLand_{it} - FATrillya\_rate_{it}*Rillya_{it} - FATother\_rate_{it}*OtherLand_{it} \tag{9}$$

where PT_rate_{it} is profit tax rate effective in years when agricultural enterprises were exempt from profit tax (1992 – 1997, 1999 – now). $Profit_{it}$ is farm's profit calculated as total revenue generated by both crop and livestock production decreased by the amount of total farm's costs. $LTrillya\_rate_{it}$ is land tax flat rate set per hectare of arable land and $Rillya_{it}$ is the area of arable land used by a farm. $LTother\_rate_{it}$ is the average rate for other than arable types of land (perennial plantations, hay-fields, pastures land of water fund) weighted for structure of types of agricultural lands in Ukraine and $OtherLand_{it}$ is area of farm's land that is not arable.

Other kinds of taxes that the fixed tax system exempted farms from, including water use fee, are not included in the equation (9) because the list of the other taxes/fees under exemption changed over the period of FAT implementation and many of those taxes are supposed to be paid by only some of farms, for example, fee for the acquisition of a trade patent for commercial activities or fee for conducting certain types of business activities. Despite the fact that farms using the FAT system have been exempt from water use rent since 1999 we do not include this benefit into FAT benefit variable because the dataset does not contain information about water use by farms and estimation based on the reported production volumes would have been too inaccurate. Therefore, the real FAT benefit is higher than the estimated with the equation (9).

The hypothesis tested with the methodology described above is that tax benefits that had been provided to agricultural producers in Ukraine in 1995 – 2016 were designed in a way that does not stimulate productivity growth. On the contrary, the tax benefits even could have the opposite effect of disincentivizing from management efforts directed at seeking for ways to improve technology applied and technical efficiency.

Chapter 4

DATA

The empirical models described above are estimated based on highly disaggregated Ukrainian-wide farm-level data that span from 1995 through 2016 and demonstrate the dynamics output and input measures of farm performance in detail. The data are coming from the 50-sg forms provided by the State Statistics Service of Ukraine. These data represent an unbalanced panel with information about 30 833 unique agricultural enterprises, making a total of 213 443 observations for the period 1995 - 2016. Data from 50-sg form for 2017 – 2020 are also available, but individual farms performance for all years starting from 2015 is not comparable with data for the period 1995 – 2014 due to non-transitivity of farms' identifiers. Transitivity of farm identifiers is crucial for this work so that it is possible to analyze progress in production on a farm level. Thus, all empirical analysis was carried out by using the sample of 1995 – 2014.

State Tax Service statistics shows that 32 695 agricultural producers used fourth group of single tax system at the end of 2015. This tax system is a direct successor of FAT being implemented in 1999 – 2014 and transformed to single tax without much changes. The number provided by the State Tax Service almost coincides with the number of unique farms from 50-sg dataset. That is evidence for common knowledge that most Ukrainian agricultural producers use FAT if they are eligible for this system.

Before proceeding to empirical models' estimation 50-sg form data were prepared in accordance with the following steps:

1. All monetary variables were adjusted on inflation with 2016 price level taken as a base;

2. All crop producers' observations with no reported land were removed from the working sample;
3. All observations with zero or negative input costs were removed from the dataset;
4. Observations for years with non-transitive farm identifiers, that are 2006, 2015 and 2016, were removed from the sample;
5. All farms represented in the dataset less than twice were removed from the dataset.

The cleaning procedure has resulted in reduction of the sample to 153 999 observations that is 81% of all observations for the selected years with transitive farm identifiers before data cleaning (188 998 observations in the population). In order to calculate productivity changes it was necessary for each farm to appear in the sample at least twice. This has led to all farms who reported in only one year in the period 1995 – 2014 drop from the sample. That could result in a selection bias because the least successful farms which were not able to survive at least one year on the market were not included in the estimation. The potential implications of this for our results could be overestimated positive association between tax benefit amount and productivity growth that is likely to correlate positively with farms' survival probability.

Table 2. Descriptive statistics of variables

Variable	Mean	Standard Deviation	Minimum	Maximum
TFP change	0.07	0.14	-0.92	1.11
TE	0.60	0.14	0.0003	0.97
TE change	-0.01	0.13	-0.93	9.94
Technological change	0.07	0.02	-0.14	0.32
agVATbt, UAH mn	0.55	8.24	-1041	536
FAT_bt, UAH mn	0.39	3.67	-21	466
farmsize, ha	2 188	3 347	0	319 716
crop revenue share	0.73	0.28	0	1
shugar beet	0.38	0.49	0	1
poultry	0.004	0.06	0	1
pork	0.01	0.08	0	1
diary	0.48	0.50	0	1

Source: 50-sg firm-level dataset, SSSU

Technical efficiency score shows that 90% of sample farms were below 76% of the maximum technical efficiency observed in this sample with no visible efficiency convergence which is seen from boxplot on Figure 3. Inefficiency scores do not converge to the mean efficiency and the corridor of outliers does not become narrower. Also, slight negative trend for an average technical inefficiency score for the Ukrainian agricultural industry is observed (see Figure 3) with mean technical inefficiency score change equal -0,01.

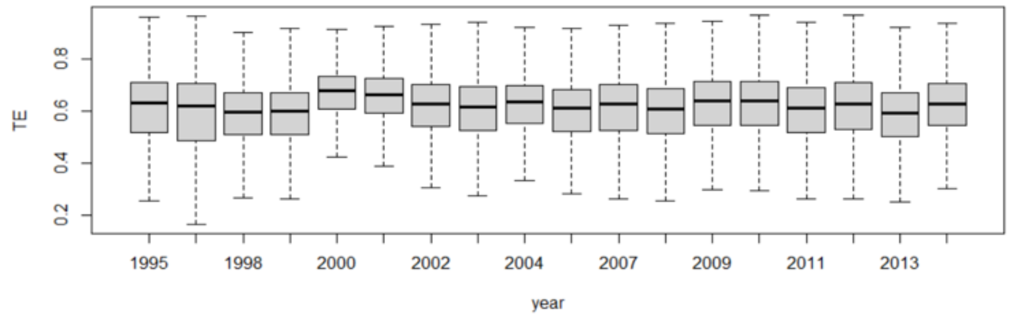

Figure 3. Technical Efficiency Score Distribution

Contrary to technical efficiency change, technological change constituted 7% per year on average (see Table 2). According to productivity variables estimated from SFA, technological change component of TFP change was responsible for the overall productivity growth in Ukrainian agriculture over the period of 1995 – 2016.

All variables are taken or estimated from 50-sg form data except tax rates for VAT and FAT benefits. To obtain tax rates and normative monetary evaluation of agricultural lands necessary for estimation of tax benefits we analyzed Ukrainian tax legislation changes since 1995 including Law on Value Added Tax, Law on Fixed Agricultural Tax, Law on Profit Tax, Tax Code, Resolution of the Cabinet of Ministers on the Methodology of normative monetary valuation of agricultural lands and settlements, State Tax Service newsletters on normative evaluation of farmland index coefficients.

As Table 2 shows, there are negative tax benefit observations. According to the 50-sg dataset about 25% of VAT benefit observations are negative that is in line with the argument against this agricultural support tool that this tax benefit is actually lossmaking for those who invest a lot and has not very high sales revenues in the same period stated in the introductory chapter. This implication arises from the functional form of VAT benefit calculation and the policy design which benefit is defined as the difference between total sales and total costs for materials and services subject to VAT multiplied by constant coefficient of 20%.

At the same time, about 43% of the dataset observations is associated with negative estimated FAT benefit 53% of which occurred in 1998 - 2003. There are 2 main reasons for this: first, FAT benefit is underestimated as explained in the methodology chapter (most of tax exemptions under FAT system other than profit tax and land tax are too difficult to estimate); second, the problem of underreporting may take place. First issue implications for the estimation results in this thesis are ambiguous because there may be no essential bias in case if the portion of the FAT benefit is negligible. But if the underestimated amount of FAT is significant, we are likely to obtain estimation results according to which the effect of FAT benefits is stronger than in reality. The effect of underreporting is characterized by the feature that the higher revenue a farm reports, the higher tax benefits it is estimated to have. Therefore, it is possible that a farm with actual high revenues earned in the shadow market is considered in our sample as a farm with low income and low implicit benefits. However, this is not going to affect our estimation results much because the correlation coefficients of total revenues and TFP change, TE change and technological change are only 0.01, 0.04 and -0.19 correspondingly. The period of 1998 – 2003 was the time when tax system for agricultural sector changed rapidly. In 1998 there were no special tax benefits and this year was the only year in the history of independent Ukraine when farms were subject to profit tax. When FAT was introduced in 1999 it was presented as a temporary tax benefit program available until 2004. In 2003 the program was extended till 2010.

So, agricultural producers could consider underreporting of real revenues and profits as a safe strategy for the case tax burden design is changed again in a way that it depends on farms' performance. After early 2000-s FAT and VAT systems were gradually transformed into the long-term tax breaks for farms which agricultural producers accounted for in their decision making. Thus, incentives for underreporting were gradually reduced which is controlled for with year dummies.

It is worth mentioning that the scale of the estimated losses from FAT is much lower than benefits. About 60% of the negative FAT benefit observations report losses lower than 150 UAH thousand while 53% of observations with positive FAT benefit report benefits greater than 400 UAH thousand.

The tax benefits estimation results were compared to OECD data on agricultural support by countries adjusted on inflation with 2016 as a base (OECD PSE database 2021) (see Figure 4 and 5). The graph on Figure 5 presents total benefits (and losses) due to agricultural tax benefits in Ukraine for the whole sector (or 50-sg sample). VAT benefits obtained from 50-sg database is comparable with OECD data. Estimated agricultural VAT accumulation benefits almost replicate the corresponding line on the OECD graph. Very high VAT benefit value in 2015 explained by the good harvest and record high export of 33,5 million ton of grains in 2014/15 marketing year compared to the previous export record of 32,3 million ton of grains (Potikha 2015). Higher harvest, export and sales has resulted into greater VAT base and VAT amounts agricultural producers were able to accumulate on their special accounts.

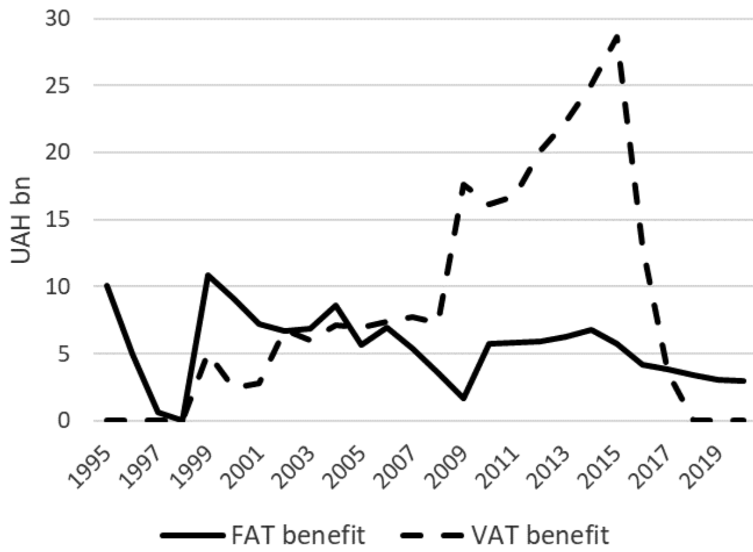

Figure 4. Estimated Tax Benefits. OECD data

Source: OECD PSE Database

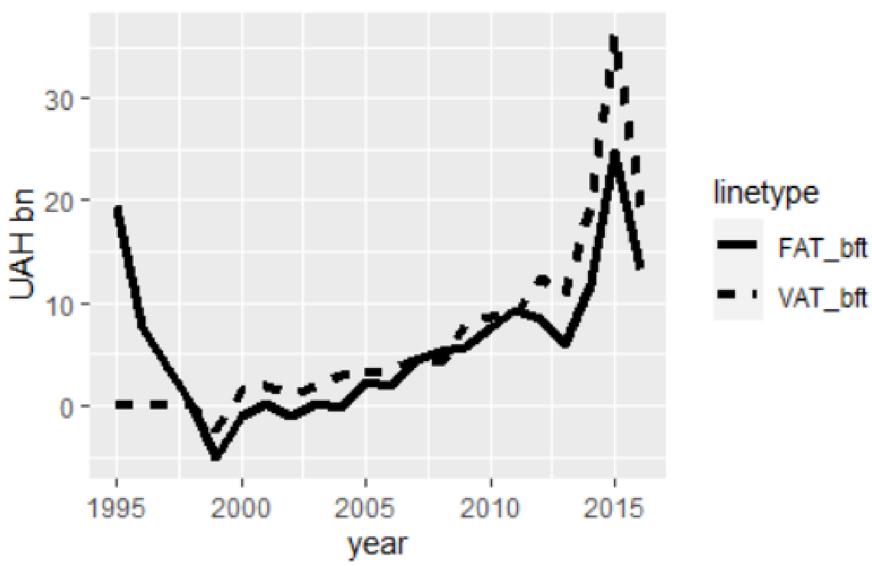

Figure 5. Estimated Tax Benefits. 50-sg data

Source: 50-sg State Statistics Service form

FAT benefits estimated from 50-sg form are less comparable with OECD estimations than VAT benefits despite the fact that methodology of FAT benefits estimation presented by OECD is very similar to the approach used in this thesis. OECD estimates of FAT benefits are the "values calculated by the Ukrainian Ministry of Agrarian Policy and Food representing the difference between the total amount of the fixed agricultural tax collected in a given year and the amount of taxes, fees and contributions which were replaced by the fixed agricultural tax", according to OECD Definitions and Sources book which complements the data on support to agriculture in Ukraine (OECD PSE Database 2021).

OECD FAT benefits are much higher than 50-sg based benefits for early years and much lower for the period after 2010. In fact, if we look at OECD reported FAT benefit prior to adjusting on inflation we see that the estimation results look artificial. OECD reported the same FAT benefits equal to exactly 1.4 UAH bn every year from 1999 to 2003 and in 2005. Starting from 2015 OECD FAT benefit estimation also is almost unchanged and equal to 4 UAH bn in 2015, 4.2UAH bn in 2016 and exactly 4.3 UAH bn each year in the period 2017 – 2020. However, in real agricultural economy, for example, production and farm's income change from year to year that implies that at least benefits from profit tax exemption portion of FAT benefit cannot be exactly the same every year. 2015 was the most successful year for agricultural producers in many years according to both 50-sg data and open-source agricultural statistics (Potikha 2015). However, OECD data show only tiny 0.2 UAH bn increase in FAT benefit in 2015 compared to 2014. Therefore, the conclusion can be made that OECD FAT benefit estimates are not very accurate.

The comparison of data used in this research with OECD data was important to verify if this thesis main explanatory variables' data are plausible and can be relied on at the estimation stage of the research. However, the OECD estimation result itself is questioned due to reasons described in the previous paragraph. Despite this, tax benefits estimated by OECD and in this research are comparable and even similar in case of agricultural VAT benefits and, thus, main explanatory variables data estimated with (8) and (9) can be used for the main models' estimation.

Chapter 5

ESTIMATION RESULTS

Total factor productivity change, technical efficiency change and technological change explaining models were estimated according to specifications (2), (3) and (4), respectively, using OLS estimating method. The main estimation results are presented on the Table 2. Translog production frontier with technological change function, which was used as the first stage of model estimation to obtain the dependent variables and specified in (6), was estimated using "frontier" package in R (Henningsen, 2019).

The estimation results presented in Table 3 below show that if we look at the contemporaneous effects, VAT benefit is associated positively with TFP change, TE change and technological change. More specifically, keeping other factors fixed, 10% increase in VAT accumulated in a given year is coincided on average with 3 p. p. increase in the total factor productivity growth and technical efficiency growth, and about 0.3 p. p. in technological growth in the same year. However, the same interrelationship changes its sign once we analyze VAT benefits with one-year lag. This intertemporal effect is more significant in our study because this thesis tries to find causal relationship between tax benefits and productivity growth. For example, 10% increase in VAT accumulated by a farm in the previous year is associated with 1.7 p. p. decline in both TE growth and TFP growth and has no effect on technological change.

Table 3. Farms' productivity growth models estimation results

	Dependent variable:		
	deltaTFP	deltaTE	deltaT
log(agVATbt)	0.327***	0.298***	0.029***
	(0.037)	(0.037)	(0.006)
log(Lag(agVATbt, -1))	-0.174***	-0.177***	0.003
	(0.037)	(0.037)	(0.006)
log(FAT_bt)	0.124***	0.155***	-0.031***
	(0.006)	(0.006)	(0.001)
log(Lag(FAT_bt, -1))	-0.084***	-0.073***	-0.011***
	(0.006)	(0.006)	(0.001)
log(farmsize)	0.005***	0.002***	0.002***
	(0.0003)	(0.0003)	(0.00004)
y.crop	-0.003***	-0.014***	0.011***
	(0.002)	(0.002)	(0.0003)
sug_beet	-0.008***	-0.007***	-0.002***
	(0.001)	(0.001)	(0.0001)
poultry	-0.058***	-0.043***	-0.015***
	(0.006)	(0.006)	(0.001)
diary	-0.027***	-0.024***	-0.002***
	(0.001)	(0.001)	(0.0002)
pork	-0.044***	-0.043***	-0.001*
	(0.004)	(0.004)	(0.001)
Year	Yes	Yes	Yes
Constant	-1.14***	-1.069***	-0.071*
	(0.289)	(0.285)	(0.044)

Table 3 – Continued

	Dependent variable:		
	deltaTFP	deltaTE	deltaT
Observations	153,993	153,993	153,993
R2	0.056	0.051	0.328
Adjusted R2	0.056	0.051	0.328
Residual Std. Error (df = 153965)	0.132	0.130	0.020
F Statistic (df = 24; 153965)	338.568***	308.026***	2,783.784***
Note:	*p<0.1; **p<0.05; ***p<0.01		

FAT benefit effect estimates give similar to VAT benefit picture with some exceptions, but they are less economically significant. FAT benefit increase by 10% in current year in associated with 1.2 p. p. increase in TFP change, 1.6 p. p. increase in TE change, but 0.3 p. p. decline in technological change. However, previous year FAT benefits' 10% increase is associated with 0.8 p. p. decrease in TFP growth, 0.7 p. p. decrease in TE growth, and 0.1 p. p. decrease in technological growth.

The estimation results also show that bigger farms tend to be characterized by slightly higher rates of TFP growth, technical efficiency growth and technological growth than smaller farms ceteris paribus. However, farm size effect is not very significant economically.

Keeping all other factors constant farm specialization in poultry, milk or pork production is associated with lower TFP, TE and technological change growth. If more than 30% of farm revenues are generated from poultry production this farm tends to have 0.6 p. p. lower TFP growth, 0.4 p. p. lower TE growth and 0.2 p. p. lower technological change growth with the fixed level of tax benefits. Effects of specialization in milk or pork production are similar to poultry production but are less economically significant. Livestock production is much less land-intensive than crops' production, and the estimation results show that productivity growth is lower for the livestock groups controlled for compared to crops producers keeping tax benefits constant. This makes sense because the system of agricultural support in Ukraine is much more beneficial to livestock producers, especially poultry producers, which do not need to use much more land than an average factory.

Effects of specialization on sugar beet production are statistically significant but negligible. Higher share of crops in the total output in also associated with lower productivity growth but, again, the effect is very small.

Year dummy variables are included into the model to control for time varying systematic effects. we do not include these 18 dummy estimates to the tables in this paper because they are not in a focus of this work.

Following the argument stated in the introductory chapter that FAT makes tax burden insignificant for livestock producers who need much less area of agricultural land for production than crops producers, the models specified in (2), (3) and (4) were estimated on a subset of the main dataset in which only those farm observations were included which revenue is generated by livestock production by at least 70%. Additionally, specification with direct budgetary outlays for livestock producers was estimated (fourth model from the left in Table 4) separately on a subset of 2004 – 2014 years that is the period for which data on this variable is available. The results obtained are presented in Table 4.

The result shows that only FAT benefit effects are statistically significant for TFP, TE and technological changes except for some positive contemporaneous association of VAT benefit with technological change. Although small, the effect of lagged FAT benefit is negative in all 4 equations. Contemporaneous FAT benefit effect is positive for TE growth, negative for technological change and neutral for TFP change.

Table 4. Farms' productivity growth models estimation results for livestock producers

	Dependent variable:			
	deltaTFP	deltaTE	deltaT	deltaTFP
log(agVATbt)	0.093	-0.021	0.072***	0.079
	(0.093)	(0.091)	(0.015)	(0.087)
log(Lag(agVATbt, -1))	-0.007	- 0.015	0.007	-0.058
	(0.092)	(0.090)	(0.015)	(0.085)
log(FAT_bt)	0.002	0.032***	-0.030***	0.019
	(0.015)	(0.015)	(0.002)	(0.015)
log(Lag(FAT_bt, -1))	-0.035***	-0.022***	-0.013***	-0.034**
	(0.015)	(0.015)	(0.002)	(0.015)
bdgt_outlay				0.0002
				(0.0002)
log(farmsize)	0.008***	0.002***	0.007***	0.003***
	(0.001)	(0.001)	(0.0001)	(0.001)
y.crop	-0.024	-0.022	-0.002	0.003
	(0.016)	(0.016)	(0.003)	0.019)
sug_beet	-0.066***	-0.063***	-0.004***	-0.066***
	(0.008)	(0.008)	(0.001)	(0.010)
poultry	-0.056***	-0.050***	-0.006***	-0.055***
	(0.008)	(0.008)	(0.001)	(0.008)
diary	0.034***	-0.034***	-0.0001	-0.018***
	(0.003)	(0.003)	(0.001)	(0.004)
pork	-0.030***	-0.039***	0.008***	-0.029***
	(0.006)	(0.006)	(0.001)	(0.006)
Year	Yes	Yes	Yes	Yes

Table 4 – continued

	Dependent variable:			
	deltaTFP	deltaTE	deltaT	deltaTFP
Constant	-0.476	-0.050	-0.426***	-0.057
	(0.464)	0.455)	(0.074)	(0.436)
Observations	15,048	15,048	15,048	8,639
R2	0.172	0.134	0.549	0.022
Adjusted R2	0.171	0.133	0.548	0.019
Residual Std. Error	0.146 (df = 15021)	0.143 (df = 15021)	0.023 (df = 15021)	0.137 (df = 8618)
F Statistic	120.061*** (df = 26; 15021)	89.487*** (df = 26; 15021)	703.385*** (df = 26; 15021)	9.542*** (df = 20; 8618)
Note:		*p<0.1; **p<0.05; ***p<0.01		

The estimated coefficient of variable bdgt_outlay, which stands for direct subsidies from the budget, is insignificant. This is explained by the fact that governmental support for agriculture by direct subsidies was not systematic and predictable. Thus, farmers were not able to make business decisions for next periods relying on expected direct subsidization from the government and adjust their production process correspondingly. On the contrary, FAT has been available for agricultural producers for more than 20 years without significant transformation and VAT accumulation system had been available for 18 years. This results in tax benefits have become a part of agricultural producers' business model.

Chapter 6

CONCLUSIONS AND POLICY RECOMENDATIONS

The point of interest of this research was to investigate how Ukrainian agricultural support system, that is based basically on tax benefits, relates to productivity growth in Ukrainian agricultural sector. For this purpose, two-stage analysis was performed. At the first stage we estimated total factor productivity growth and the elements of its decomposition, technical efficiency changes and technological change, with parametric stochastic frontier analysis. At the second stage we estimated impact of log-linearized tax benefits' volume on TFP, TE and technological changes controlling for farms' size, specialization and systematic shocks (with year dummies).

The estimated effects of tax benefits on productivity growth suggest that additional recourses saved due to exclusive for agricultural sector tax benefits clearly do not encourage agricultural producers to improve their productivity. On the contrary, 10% increase in both VAT and FAT tax benefits implicitly obtained in a given period is associated with 2.5 p. p. lower TFP growth in the next period on average for all farms, 3.1 p. p. lower TFP growth for poultry farms, 2.9 p. p. lower TFP growth for pork production farms and 2.8 p. p. lower TFP growth for dairy farms.

If we analyze the effects on a subset of livestock producers who benefit most from FAT system the results keep negative intertemporal effect for FAT benefits on productivity growth but VAT accumulation benefits are almost not associated with productivity growth for this subset of farmers. Given these results, the initial hypothesis that tax benefits in agriculture discourage farmers from pursuing higher productivity growth is not rejected.

The statement above is consistent with tax benefit policies' design description from Chapter 1. The main problem of VAT accumulation system that it was less profitable for those farms which bear greater production costs. Roughly speaking, to turn VAT benefit into real benefit a farm needed to refrain from significant investments into business. The main problem of FAT system is that it distorts tax burden allocation by pegging the taxes due to the budget to farmland area, that would obviously be different for e. g. poultry producers and wheat producers.

Another important finding is that supporting policy is unlikely to be effective if agents which this policy is targeted at do not perceive the policy as reliable enough to include expected benefits from that policy into economic planning. This common-sense conclusion is in line with evidence from Chapter 5 of no effect of direct budget subsidies for livestock producers on productivity growth.

In the end of 2021 Tax Code was amended in a way that at least partially eliminated the most obvious drawback of FAT system. FAT rate for poultry producers was established at the level 50 times higher than for crop producers. Although the design of the tax remained the same, the thesis provides supportive empirical evidence for such a decision.

However, in order to not just eliminate tax loopholes and inefficient policy, but to achieve productivity growth in agriculture, support policy should correspond with two main tasks:

1. To create environment for quality competition and growth;
2. To encourage productivity-gross oriented farmers' approach to conducting business.

Therefore, policy recommendations are the following.

1. Government should increase the share of industry supportive services in the agricultural support policy. Among such measures are providing access to high-end industry technology knowledge, improvement of inspection and control processes etc.;

2. Development and maintenance of agriculture infrastructure should be among the priorities of agricultural support policy. Among such measures are improvement of hydrological, storage, transport infrastructure etc.
3. Government should consider investment-stimulating program with clear time frames of implementation and requirements. It could be partial tax credits for investments that meet expected productivity growth effect requirements or direct partial subsidies for such investments.

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