STATE SUPPORT AND FARM STRUCTURES IN UKRAINE

by

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Abstract

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This thesis provides a farm-level analysis of the effect of state support on farm output shares dynamics in Ukraine in 2007-2014. The study uses descriptive methods, parametric regression analysis of production functions and cluster analysis. Investigated dataset contains broad accountant records of 10,529 Ukrainian agricultural firms. The analysis showed that state support policies in all cases have a positive impact on output share. We find evidence of selectivity in providing support. In particular, in three sectors out of six were found that larger farms will tend to receive more aid. Also, it is noticed that in livestock sectors, the highest support obtains on the average more consolidated sector. Coupled with the effect of support such situation may distort market incentives and lead to misallocation of outputs and inputs.

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GLOSSARY

SSSU. State Statistical Service of Ukraine

PSE. Producers Support Estimate

FAT. Fixed agricultural tax

MPS. Market price support

GATT. The General Agreement on Tariffs and Trade

SCT. Single commodity transfer

Chapter 1

INTRODUCTION

Historically the Ukrainian government tends to protect agricultural industry (Figure 1). The volume of support for the agricultural sector is growing year by year. According to the state statistics, by 2018 only direct payments reached 1% of GDP, while in 2017 it was approximately two times smaller - 0.43% of GDP. High dependence on climatic conditions and seasonality of production, slowing flows of working capital and profits instability make the issue of developing support policy to agri-businesses fundamental.

In our study, we aim to investigate the effect of state support on the agricultural farm structure. Also, it is interesting to know which farms are supported more: large, small, or support is given on an equal basis, and therefore, what is the impact. The central hypothesis is that state support distorts market competition, thus discriminating those, who receive it over others, making the market more concentrated. Moreover, we do suppose that benefits primarily go to large enterprises.

Most of the literature concerning the effect of subsidies on competition focused on a firm's productivity and efficiency, at the same time, the direct effect on the market structure has not been studied very well. Therefore, developing this issue, we intend to contribute to the academic literature. Ukraine becomes a good example for investigating since we obtain the extensive dataset based on the firm-level accounting data of agricultural enterprises. The dataset was accumulated by the State Statistical Service of Ukraine (SSSU) for 1995-2016 years. It contains a wide variety of firm-level indicators as well as the amount of government support, mainly represented by subsidies due to budgetary outlays and VAT. To widen the range of supporting

measures, we also consider OECD tables, namely PSE estimates, and World Commodity Outlook, to arrive at the agriculture industry growth index.

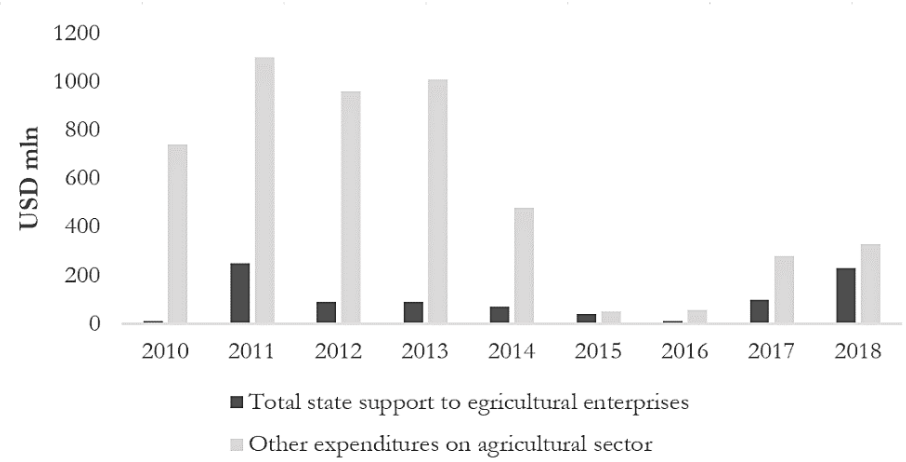

Figure 1. The amount of state support to agriculture in cost structure of the Ukrainian Ministry of Agrarian Policy and Food during 2010 – 2018 years

Source: ligazakon.ua

The analysis is based on the theoretical framework suggested by Buts and Jegers (2013) and Bezlepkina (2005). The latter author provides a detailed procedure for appropriate productivity model in case of specifics of the agricultural sector, while Buts and Jegers try to answer the same research question for Belgium firms in 541 industries.

Based on a firm's production, we obtain output shares and model the relationship between farms structure and state support using Cobb-Douglas production function.

Our investigation contributes to the literature in three major aspects. To the best of our knowledge, this is the first paper considering Ukrainian agricultural industry and second empirically studying the relationship between state support and market structure (in our case farm structure) in the foreign literature.

Moreover, the analysis would be interesting not only from the academic point of view but from the policy perspectives too. Based on our results, policymakers could consider the rationale for state support in other sectors in terms of market structure dynamics. Also, we aim to consider a wider circle of governmental support: apart from subsidies, we focus on preferential taxation measures specified in Ukraine and market price support.

Results show that state support per revenue positively influences farms structure in almost all sectors, which supports our central hypothesis. It is found that unit increase in weighted state support has a negligible effect on output share, while if we take extream value association becomes considerable. In particular, for the pork and dairy farming sector the output share might increase by .01%, where average output shares are .04% and .05% respectively. Also, it was noticed that big farms benefit more in terms of obtained support. Moreover, they pay less rental payments per hectare and could gain from its increase. The findings suggest that there are distortive effects in providing support and could be considered meanigful from policy perspective.

The rest of the paper is organized as follows. The following part describes major instruments of state support and the current Ukrainian agricultural market structure. In chapter 3, we briefly discuss the literature, which helps us better understand the underlying processes. In Chapter 4, we describe the methodology of our analysis with the theoretical framework, and in Chapter 5, we discuss the data. Chapter 6 gives us the results of the empirical estimation so that we should arrive at conclusions.

C h a p t e r 2

AGRICULTURAL INDUSTRY IN UKRAINE

2.1. State support instruments

Ukraine historically focuses on indirect support instruments, which mainly explained by the lack of financing direct outlays as well as the assumption of some policy makers that agriculture cannot be fully taxed. Only in recent years government reoriented towards direct support and implement changes in state aid policy. As a result, we can distinguish four main instruments of state support: direct payments in the form of direct subsidies, the single tax of the fourth group, special VAT refund regime (existed until 2017). Consider each of them in detail.

State support for the agricultural industry is defined by moderate levels of budgetary outlays and relatively strong tax benefits. Introduction of compensation for 30% of the cost of purchased domestic equipment coming into view as a first direct agricultural support in Ukraine. At the same time, the government provides additional payments for keeping the stock of meat and dairy cows, sheep, and goats. In 2004, the state introduced subsidies aimed to increase the heads of livestock sold to the processing enterprises and to compensate costs of fertilizers (lasted only one year). Subsequently, in 2006, production subsidies in crop production were introduced - budget payments per hectare of wheat, rape, and flax. The amount of state support for crop and livestock producers in 2006-2008 amounted to an average of 312-527 million USD, in 2009 support fell to 47 million USD, in 2010 - up to 12,6 million USD, for 2017 the government allocated about 240 million USD. Budget subsidies are considered as sector-specific, since they are aimed to support particular sub-sectors such as field crops, pigs, cattle, etc.

Among the tax benefits, there are two major sources: single tax of the fourth group and VAT exemption. They represent indirect support to agricultural businesses. The single tax of the fourth group (by 2015 - Fixed Agricultural Tax - FAT), presented in Figure 2, calculated and charged per unit of land and as a percentage of the normative monetary value of land. This tax was proposed and introduced in 1998 as a substitute for twelve other taxes. As for 2019, it replaces only three taxes - corporate tax, land tax, and a tax on special water use.

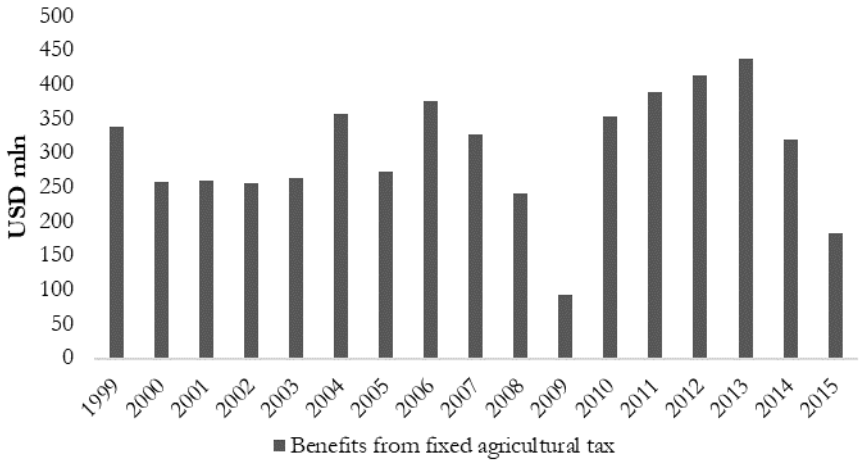

Figure 2. Benefits from fixed agricultural tax in 1995-2015 years.
Source: OECD tables

The greatest privilege of this tax is the permission not to pay a corporate tax, which at present accounts for 18% in Ukraine. Animal farming producers generally do not have such large fields as crop producers, therefore, benefit from extra resources. For comparison, the tax rate varies from 0.09 to 1% of the normative value of agricultural land, reliant on its type and location. Nivievskyi (2017) argues that in 2010, the average payment for such tax was

only 6 UAH per hectare of cultivated land or about 0.75 USD per hectare. In 2015, due to a significant increase in the normative value of land, FAT payments increased to approximately 200 UAH per hectare or about 9 USD per hectare. Comparing to profits needed to pay the amount of tax payed remains negligible. The latest data in OECD tables show that in 2015, the amount of support given by FAT was accounted for 183 million USD.

Another important source is benefits from VAT (Figure 3). The concept of a special VAT regime defined in the Tax Code and introduced in 1992. A resident, who conducts entrepreneurial activity in the field of agriculture, forestry, and fisheries and meets the criteria set out in paragraph 209.6 of this article (here and after agricultural enterprise), may choose a special tax regime. Thus, farmers could receive the compensation by the difference between the amount of VAT paid on the purchasing of production factors and the amount of VAT received on the sale of the final product.

The Tax Code determines that some positive difference between tax liability and tax credit redistributed as follows: for grains and technical crops 85% should be transferred to the state budget and rest 15% to the special accounts; for operations with livestock products – 20% transfer to the budget and 80% on the accounts; for other transactions with agricultural goods/services – 50% to the budget and 50% on accounts.

Accumulated resources on special accounts until 2008 could be used on purchasing of inputs. After 2009 producers use accumulated VAT to cover the VAT on purchased inputs and the remaining amount on other agricultural purposes.

Due to Ukrainian Ministry of Agrarian Policy and Food, both single tax of the fourth group and special VAT regime ensure around 50% of agrarians' total profitability.

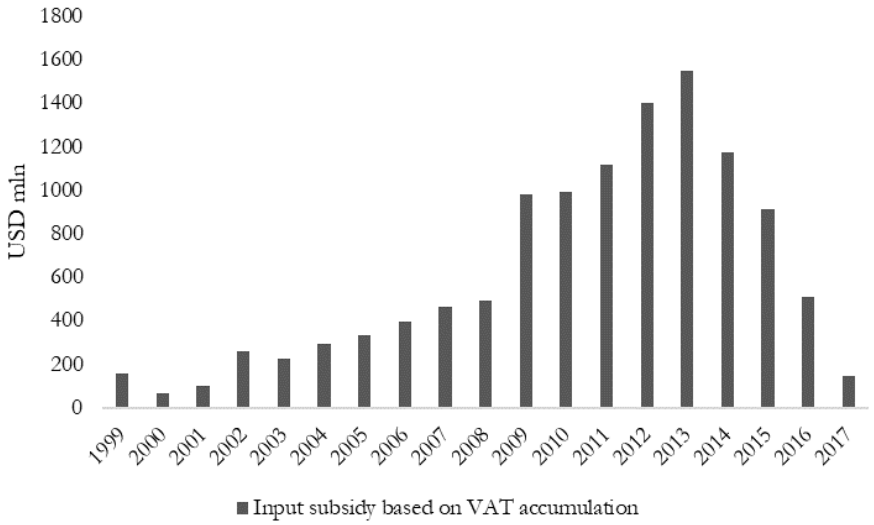

Figure 3. The amount of input subsidy based on VAT accumulation in 1999-2017 years.

Source: OECD tables

However, since January 1, 2017, this preferential treatment for agricultural producers was abolished and replaced by "Development Subsidy" with analogous realization.

2.2. Specifics of government support to agricultural sub-sectors

OECD provides substantial data on the amount of support to producers among agricultural sub-sectors. OECD Cookbook defines single commodity transfer (here and after SCT) as a percentage of support for a certain commodity. According to SCT (Figure 4), over the period 2004-2017 crop sector was highly taxed, whereas livestock production was in general supported. Poultry sector for the whole period was only supported and obtained the most significant amounts. Despite the highest margins, meaning high sector's profitability, in the agricultural industry, it continues receiving governmental support. However, in recent years' share of single commodity transfers in

industry revenues has decreased, compared to before-crisis times. The overall tendency is that market price support has the dominant weight in support estimate. Albeit, considering livestock sector, one might notice that direct payments also have a relatively high share. The most cumbersome case is the beef sector, which receives the highest amount of direct payments and at the same time is highly taxed, resulting in negative MPS.

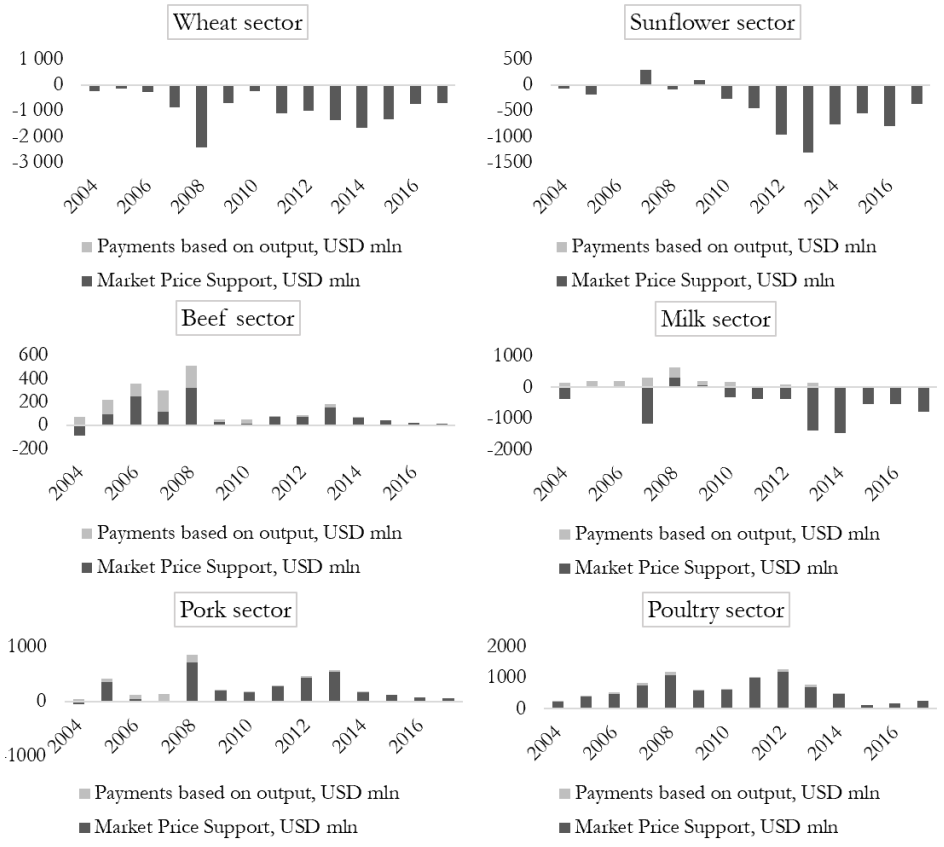

Figure 4. Single commodity transfer among the sectors during 1996-2017 years.

Note: Producer's single commodity transfer marked as a yellow line, while green and blu bars represent market price support and payments based on input respectively.
Source: OECD tables

On the contrary, considering crop sectors, we observe a growing burden of negative MPS. The most taxed within the sector is wheat production. According to food security issues (including, but not limited to), the government often introduces export restrictions (or implicit restrictions, resulting from the abolition of exporters VAT refund) that negatively affect domestic prices and result in lower revenues for crop producers. In 2018 export restriction was also introduced – the total amount to be exported from Ukraine is 16 mln tones – due to weather conditions and as a result – lower crop yield in MY18/19.

2.3. Structure of agricultural industry

State support also has not been equal among agricultural producers since 2000. In 2004 around 7% of subsidized farmers obtained almost 75% of all amount of livestock subsidies (Borodina, 2006). In 2005 around 15% of all dairy farms in Ukraine, which produce 56% of milk, received around 65% of subsidies provided for milk producers (Nivievskiy et.al., 2007). Such distribution of subsidies implies that not each firm obtains support, which affects a firm's performance and the industry structure.

Table 1 gives us an idea of how the evolution of the four largest players output share change between 2007 and 2014.

Four sectors show a decrease in concentration by four largest players, among which are primarily crop. The latter indicate slight changes in wheat and barley sectors, while rye, maize, sunflower, and oats ratios' dynamics experience moderate fluctuations. Considering livestock sectors concentration slightly fall and rise by around two percentage points in cattle and dairy sectors respectively, while the pork and poultry sectors experience a noticeable increase by around twelve and eight percentage points respectively.

Table 1. Top-4 market players in Ukraine agricultural industry by sectors in 2007 and 2014

Industry	CR4 (%), 2007	CR4 (%), 2014
Wheat	3.78	3.81
Barley	2.53	2.23
Rye	5.58	9.2
Maize	12.86	9.84
Oats	3.01	5.24
Sunflower	4.38	3.25
Cattle	8.99	6.24
Pork	12.62	24.59
Poultry	49.69	57.98
Dairy farming	4.48	6.18

Note: CR4, concentration level of top-4 firms in the industry. Higher ratio implies less competition in sub-sector, while small ratio vice versa. To be more precise, the value below 40% indicate competitive market, whereas above 40% reveal oligopoly. Calculations based on firm-level dataset provided by SSSU using output shares of the farms.
Source: Own calculations based on SSSU dataset

Chapter 3

LITERATURE REVIEW

A considerable body of literature has many examples of studies which investigate the impact of state support measures, mainly focusing on subsidies. However, there is a lack of studies that focus on the impact of state support on the domestic market structure. Therefore, we can consider such research as an additional contribution to academic literature.

The closest investigation was made by Buts and Jegers (2013), who studied the existence of subsidies, which distorted competition in 541 industries in Belgium. They choose the 2005 – 2008 period for the research of 13000 of Belgium firms, which pass on extensive annual reports. The authors focus on the joint impact of subsidies on the dependent variables, among which are market shares and concentration ratio. In the paper, they confirmed their central hypothesis that subsidies positively influenced the evolution of market share and concentration ratio.

Buts and Jegers (2013) also indicate a lack of literature. Nevertheless, there is a considerable part of the literature discussing the competitive effects provided by state support and the determinants of concentration, which we consider in the following parts.

4.1. Effects of state support on competition

The vast majority of scholars focused on how subsidies influence the international market. In particular, Brander et al. (1984) investigate export subsidies and their impact on international market share rivalry. In this

theoretical study, the export subsidy policy is considered as salvation from profit-shifting, an attractive instrument from the domestic point of view. The authors conclude that the subsidy policy will only be effective if one of the exporting countries uses such instrument in the oligopolistic market. Otherwise, no country will win (since the terms of trade worsen) and for all the best strategy will be a free market without government intervention. This situation is very similar to the prisoner's dilemma from the game theory approach. However, export subsidies could improve a relative position of the firm and the domestic welfare as a whole. This, in its turn, creates a room for cheating, since countries could agree on non-use of the subsidy tool and nobody will be confident in the final result. The regulation agreements, such as GATT, could help overcome it.

The other theoretical study is about the effect of the export subsidy on competitiveness in D. Collie et al. (1993). The paper, such as previous, based on Cournot duopoly model, but with some issues: completeness and incompleteness of information. The authors consider export subsidies as a signal of firm's competitiveness. So that with the existence of a subsidy, foreign players under incomplete information would form their beliefs about lower marginal costs of the domestic firm and therefore, about its higher output, which would result in lower output proposed by a foreign firm. This, in its turn, would form a basis for more substantial profits of domestic players.

Another branch of authors and international organizations contributed primarily to the empirical studies and investigated the effects of subsidies. In particular, their impact on total factor productivity (TFP) growth (Tan et al., 2013; Rizov et al., 2013) and product competitiveness (Latruffe, 2010).

Tan et al. (2013) investigate China cotton industry by using the Malmquist index of 2001 – 2010 period to measure the impact before and after implementing the subsidy. As a result, they arrive at a negative impact of subsidies on TFP growth. The main issue here is the government policy of providing subsidies

since they associated with the amount of acreage. This, in its turn, incentivize firms not to improve their productivity but expand sown areas. Other authors, Rizov et al. (2013), who investigate the impact of common agricultural policy on farm's TFP in EU-15 countries during 1990–2008 period also find same negative correlation among all countries before implementing the subsidies. When subsidies introduced, the result is ambiguous, however with several positive effects. The authors find that the existence of "coupled" subsidies (Amber Box[1]) distort farm's productivity, whereas policies with "decoupled" support (Green Box[2]) could positively influence productivity through credit channel and decreased risk aversion, which is consistent with the literature.

Latruffe (2010) provides a substantial amount of literature, which contributes to competitiveness, productivity, and efficiency in the agriculture and agri-food sectors. Among those papers related to competitiveness is the one provided by Nivievskyi et al. (2008), who used the farm-level data for the 2004-2005 period of dairy production in Ukraine. Authors find that received subsidies have a negative impact on the competitiveness of dairy farms. On the contrary, Bezlepkina et al. (2005) following a similar approach arrive at positive role of subsidies on Russian dairy farm's profits, which support their competitiveness by relieving financial constraints, investigating 1995-2001 period.

A separate cluster is composed of studies devoted to the impact of subsidies on R&D and the innovative activity of the firms. Clausen (2009) focused on the 1999-2001 period and based on several surveys (CIS3 and R&D survey) conducted in Norway. He empirically investigates how subsidies of two types (far or close to the market subsidies[3]) influence R&D activity. The results

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[1] Amber Box due to the WTO considered as a support instrument which distorts trade and production. Here we include market price support measures (export/import restrictions, intervention prices)

[2] Green Box considered as a support instrument which has a little or no effect on trade and production. Here we include decoupled income support, general services, payment for relief from natural disasters, and others.

[3] Projects which considered "far from the market" are actually uncertain and far from the commercialization of the product. Thus, further contributing to good personal and financing for the

showed that subsidies of the first type had a positive impact, mainly through a bigger amount of expenditures, whereas the second type substituted private R&D spending through decreasing budget attached to the development activities. Bronzini et al. (2014) prepared the other paper focused on Italian firms, which during 2005-2011 years participating (or not) in patent programs and therefore, may (might not) have innovations. They arrived at a positive impact of subsidies on patent activity, thus if firms received a subsidy, then the number of patents increased. Interestingly, such a positive effect is much more significant for small firms, rather than for large ones. The other finding is that subsidies increase the opportunity to receive a patent. However, such a result is weaker and also devoted to small firms.

4.2. Literature about determinants of market concentration

The struggle for a championship in the market has gradually become an essential component of the corporate management strategy. Questions regarding monopoly, oligopoly, and so on have been investigated many times in the developed countries, like the US and those of Europe. At the same time, a significant amount of literature is devoted to understanding the key drivers, performance, and consequences. Unfortunately, a common element is that no approach, which evaluated the impact of market variables, could thoroughly explain the process.

The concept about the market concentration, related theories existed a very long time and considered as an important part in today's world functioning. In 1982 Demzets concluded, that some firms on the market had intrinsic advantages, which allowed to stand out in the market. Among such advantages could be greater efficiency, lower costs, or merely the more competitive

research from the firm expected. On the contrary, "close to the market" projects considered as being at the stage of development or even commercialization (no research needed).

product. The evidence from the sugar industry in Czech Republic during 1989 – 1999 years (Bavorova, 2003) confirmed the hypothesis that increased concentration level resulted in higher competitiveness of the industry and therefore lower production costs and increased economy of scale. The concentration level is also an important measurement for the government, which decides about imperfectly competitive behavior (Bird, 1999).

On the other hand, concentration also has some determinants, which may influence its evolution. The critical role here sets up barriers for entry and exit (Wenders, 1971; Lipczynski and Wilson, 2001), other examples are market growth (Shepherd, 1964), regulation (Klapper et al., 2006), economies of scale (Miller, 2010), sunk costs (Kessides, 1990), market size (Neumann et al., 2001), research and advertising spending (Marcus, 1969; Mueller and Rogers, 1980; Ornstein and Lustgarten, 1978).

Ye et al. (2009) highlight that concentration now has many meanings, since we can understand it like a degree of market power, market efficiency, competitiveness or economic power. Such polysemy results in differences in measurement instruments. Ye et al. (2009) and Zhang (2014) highlight the usage of the most common indicators: concentration ratio, Herfindahl-Hirschman index, Lerner index, entropy, and Gini coefficient, however, consider it necessary to find an adequate improved single measure of concentration keeping all merits of previous indices and getting rid of demerits.

Summing up our brief overview of the literature, we see that there is only one article that most closely relates to our study. Therefore, we will base our analysis in association with the Buts and Jegers (2013) structure. Other papers mainly focused on theoretical or empirical investigation of the state support impact on competitiveness, international market, R&D, other internal firm's indicators. In addition, there is a branch of scholars that investigate the determinants of concentration level, which clearly define the current market structure.

Chapter 5

METHODOLOGY

In our study, we follow the methodology suggested by Buts and Jegers (2013) and Bezlepkina (2005). First one gives us an idea about variables of interest, whereas the latter provides the theoretical framework for estimation.

The literature commonly examines the effect of changes in policies and business environment on a firm's production using productivity model (Nickell et al., 1997). Where the relationship between production and inputs characterized by:

$$Q = A * F(X) \quad (1)$$

Q is an output of the firm; A stands for total factor productivity; F is production function; X is the vector inputs considered in the model.

Since such an approach is widely used in agricultural economics studies (Schnytzer et al., 2002; Macours et al., 2000), we decide to proceed with it using simple Cobb-Douglas production function. For that purpose, we measure farms structure through output share, unlike Buts and Jegers (2013) who consider revenues.

The central focus of the study is to model the effect of state support on the firm's performance, represented by output share. As it was mentioned before we consider four major flows of support: direct subsidies, benefits from single tax of the fourth group (previously FAT) and input subsidies based on VAT

accumulation. Information about the amount of direct subsidies presented in 50-th agricultural form, which is reported by each farm. As for the FAT and VAT benefits, we follow the O. Nivievskyi (2018) methodology. FAT benefits we measure as an amount of profit tax not paid to the state budget and VAT benefits as 20% (VAT rate in Ukraine) from sector's revenues. Profits we calculated as a difference between total revenue and total costs of the farm activity in a particular sector and in case of losses we set them equal to zero. The other indicator we include in state support is market price differential (here and after MPD), which indicates the difference between domestic and world prices (negative values stand for support of consumers and positive for producers) and presented in OECD tables for each sector of interest. To arrive at aggregate farm's support, we add all mentioned above streams.

To answer the question about the possible distortive selection policy of providing support the interaction terms of support and farms size considered. Similarly, to examine whether there is a difference in magnitude of rental payments depending on the farm's size, we also consider interaction term.

Assuming Cobb-Douglas specification, output shares for n farms and i sectors could be modeled:

$$Yint = \alpha SUP_{int}^{\beta sup} X_{int}^{\gamma x} Z_{int}^{\psi z} e_{int} \quad (2)$$

Where Y_{int} is an output share of farm n in sector i in year t; SUP_{nt} represent the aggregate value of direct subsidies benefits from single tax of the fourth group and VAT and market price differential for farm n in sector i in year t; X_{nt} are productive inputs for farm n in sector i in year t; Z_{nt} is the vector of other control variables for farm n in sector i and at time t; T represent the time dimension, and e_{nt} is an error term which accounts for random shocks.

We might expect to include aggregate support weighted by revenue to arrive at a more comparable estimate (Sedik et al.,1999; Voigt et al., 2001).

Among the inputs, we consider land, capital, labor, materials heads of livestock as standard variables for agricultural production function (Bezlepkina, 2005). In our case, land size and heads of livestock could be good proxies for the farm size, which we might expect to enter in the model as a quadratic term due to possible U-shaped relationship. Also, we consider rental payments to account for barriers to entry (McKee et al., 2018). Here we might expect to weight it by total agricultural land in use to arrive at payments per hectare. We hypothesize other farms' output to impact the n-th farm output share at year t, thus include the residual output in the model. In Z_{nt} vector, we also include industry growth suggested by Buts and Jegers, 2013.

We also want to account for potential heterogeneity thus expect to include in the model: year dummies to capture climatic changes and policy shocks; a dummy for obtaining direct subsidy (subsidy = 1 if farm obtains subsidy in year t, otherwise subsidy = 0) to capture potential corruption effects. In practice, industries with concentrated market power could promote protectionist lobbying (Peltzman, 1976; Stigler, 1971). Thus, we want to test, whether the situation of obtaining subsidy is linked to corruption (e.g., the change in office in power might influence farm's position on the market and possibility of receiving direct support).

As a result, the parameters α, β, γ, and ψ need be estimated, and αn stands for farm-specific effect (e. g. soil quality, management, climate, location).

Considering possible signs of parameters, due to the nature of particular sectors, we need to look at them separately. Since grains sectors are primarily taxed rather than supported, we might expect a negative sign of aggregate support. Whereas in livestock sectors the opposite. We might expect growth in output if the size of the farm increase, but in case of output share, the effect

could be ambiguous. In terms of capital and labor, grains sector usually more labor intensive (thus the sign on labor might be positive) while livestock capital intensive. So, we can expect positive signs of labor for grains sectors and capital for livestock sectors. Increase in rental payments indicate increasing barriers to entry, thus small farms might exit the sector and others output shares increase. Alternatively, no one exit the market and no one entry, so the output shares remain the same. Fluctuations in industry growth might directly affect the dynamics of output shares. The effect of residual output on farm structures we expect to be detrimental since its increase will indicate a decline in i-th farm output and therefore output share.

Chapter 6

DATA DESCRIPTION

To conduct the analysis, we will use farm-level data of unbalanced panel over the 1996-2016 period, which is collected by SSSU. The data represented by the 50th agricultural form and is highly preferable, since it contains all details about farms` activities. It covers various firm accounting data on revenue and costs structure, as well as information about the volume of production, inputs, and state support.

The representativeness of the dataset was noted in the agricultural policy report done by Graubner et al. (2018). The authors highlight that as for the period 2008-2013, SSSU yearbooks states that the panel covers between 85 to 91% of crop production variables through the observation period. In our study, we extrapolate such an assessment on other years of interest.

The raw dataset contains 51,671 unique agricultural farms with 212,279 observations for 1995-2016 years. Since the paper focuses only on Ukrainian farms, we understand that somewhat neglected the effect of international trade on market concentration. Also, we use data provided by SSSU (inflation indices), OECD tables (market price differential), and World Commodity Outlook (industry growth).

The dataset contains several limitations. Firstly, as for the period 1995-2000, there was no unified reporting system, so the data could have some gaps and be inconsistent due to changes in currency and form of ownership. Moreover, for the 1997 year, we have no observations at all. Therefore, the period up to 2000 is not preferable for analysis. Secondly, there is a problem with transitivity over the data. Unfortunately, the years 2006, 2015, 2016 fully contains firms

which appear in dataset only once (rarely twice). Since we expect to estimate the effect of support in dynamics using lagged variables, we need to get rid of those firms. Thirdly, there are some underreporting in the amount of land and heads of livestock, for instance, they recorded as zeros, while a farm has positive output and revenue. Since farms show dynamics in the amount of land and heads, we could not imply here imputation technique or take an average, so we drop them. The same thing we observe between revenue and output. There are some cases when either output equals to zero, and revenue is positive, or farm has some output while revenue equals zero. Such a situation can be explained by sales of inventories and/or non-willingness to sale yield. Since we use revenues in the calculation of support, we decided to eliminate those farms from the sample. Also, at the step of calculating support per revenue, we face the problem of revenue underreporting (incomparable records of revenue within a farm). We could not say that all of them consciously or unconsciously underreport, however usage of such variables in the model might bias the results. To make the estimates more efficient, we eliminate first and last percentile in support per revenue estimate from the analysis. Finally, direct support becomes available for farms only from 2004 for livestock and from 2006 for crop production. Taking into consideration above mentioned limitation, we clean the data and conclude to restrict dataset to 2007-2014 years.

After correcting, we arrive at the unbalanced panel, which contains 11,640 farms and 57,956 observations.

To make sub-samples more homogeneous, we focus on 10 sub-sectors – cereals (wheat, maize, barley, oats, rye), sunflower, cattle, pork, poultry, dairy farming, since they represent the largest shares in crop and livestock sectors. The other reason is absence of direct to the other sub-sectors available in dataset.

All monetary values are measured in thousands of hryvnas and corrected for inflation by prices with 2007 as a base year. Among them are aggregate support,

labor costs, depreciation (which is used as a proxy to capital (Bezlepkina, 2005)), direct material costs (seeds, fuel, fertilizers) and rental payments. Physical output and incremental livestock weight are measured in tones. The price index for crop production (SSSU) were used to deflate crops' support and revenues and livestock price index to deflate livestock support and revenues; wage index was used to deflate labor costs, and all other monetary values were deflated by CPI (SSSU). Dynamics of indices are presented in Appendix A.

Calculated output shares may vary between $1/n$ (where n is the number of farms; indicating equal shares) and 100% in case of monopoly. Looking for descriptive statistics (see Table 2), we see that across the panel maximum value of output share is presented in the poultry sector – 53.1%. Other sectors show much lower market shares. Cereals, sunflower, cattle, and dairy sectors could be considered competitive since the maximum share does not exceed 10%. At the same time, the pork sector almost achieves 11% level. On average farms in Ukrainian sectors show small market shares, in particular less than 1%, which is represented by mean values.

Table 2. Summary statistics of output shares among sub-sectors of Ukrainian agriculture, %

Variable	Observations	Mean	Std. Dev.	Min	Max
OS Cereals	53369	.0149	.0320	1.83e-07	1.528
OS Sunflower	38409	.0208	.0376	.000013	1.355
OS Cattle	16754	.0477	.1033	.000067	3.469
OS Pork	18540	.0431	.2560	.000033	10.695
OS Poutlry	1694	.4723	2.008	.000084	53.096
OS Dairy farming	15135	.0529	.1068	4.56e-06	2.674

Note: here we include only those observations which represents active farms on the market, so that their output share is greater than zero.
Source: Own calculations based on SSSU dataset

If we consider core variables, Table 3 represents their descriptive statistics. We see that aggregated support is on average negative for cereals sectors and for dairy-farming sector, which is in line with OECD data presented in Chapter 2. However, designed dataset suggests positive average values for the sunflower sector. The presence of negative values explained by the dominant effect of differences between world and domestic prices, therefore such sectors are rather taxed than supported. Livestock sectors on average show positive support, where cattle and pork have less than million and poultry receives around 4 million hryvnas. Highest support, as well as highest taxation is given to cereal sector – around 725 and 680 million hryvnas respectively. The poultry sector also receives considerable amount of support – around 524 million hryvnas. More detailed information about the distribution of support between sectors by years can be seen in Appendix B.

Table 3. Summary statistics of aggregate support for 2004-2014 years, thsd UAH

Variable	Mean	Std. Dev.	Min	Max
State support Cereals	-1231.36	7753.70	-678713.3	725376.3
State support Sunflower	458.87	2521.95	-95849.45	73201.21
State support Cattle	318.79	770.87	.0805	21429.97
State support Pork	814.84	6053.86	-230.45	343470
State support Poultry	3778.32	18541.65	.5885	523805.7
State support Dairy farming	-31.064	1847.54	-54816.05	34714.82

Note: State support includes MPD, tax benefits in form of single tax of the fourth group and VAT, and direct subsidies measured. here we include only those observations which represents active farms on the market, so that their output share is greater than zero.
Source: own calculations based on SSSU dataset

Before we proceed to more formal analysis, we report a figures that show the relationship between farms' output shares and aggregate support provided to them. Notice, detailed graphs on the association between support and output shares of wheat, barley, maize, rye and oats sectors provided in Appendix C. Obtained associations give us an idea about expected signs on government support regardless concrete sectors.

As we can see, Figure 5 and Figure 6 present positive relation between output shares of highlighted sectors and received support, therefore we can expect that the increase of support will positively influence farm's market position in all sectors.

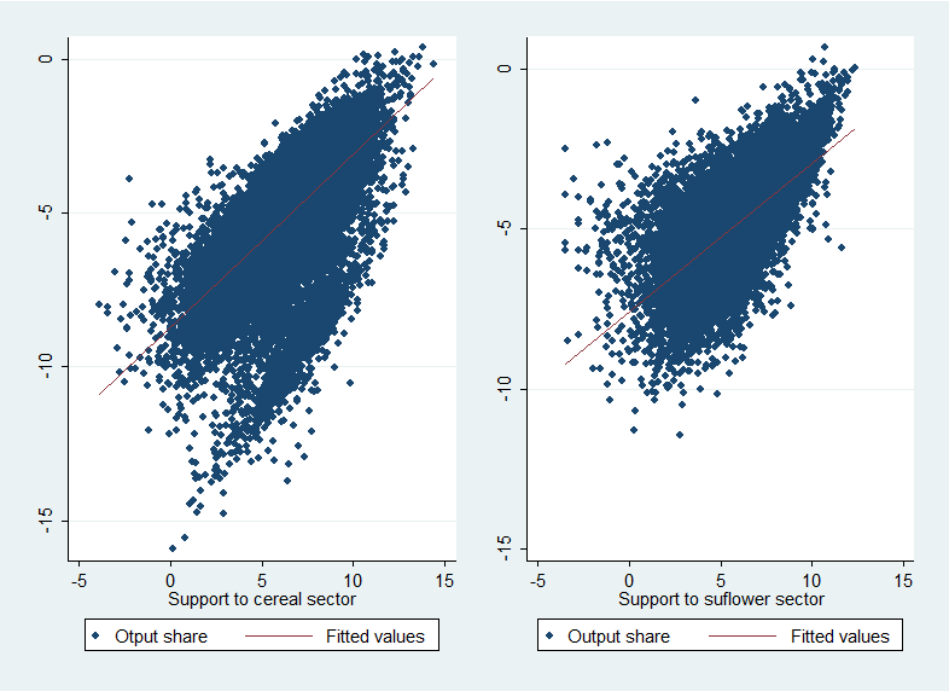

Figure 5. Relationship between aggregate support and output share among crop sectors during 2004 – 2014 years.

Note: y-axis represented by output share in logs; x-axis represented by aggregate support in logs.
Source: own estimations based on SSSU dataset

n order to arrive at more comparable estimates, we weight agricultural support by revenues. As it was mentioned at the beginning of that chapter, here we face the problem of miss recordings and try to minimize the potential biases by percentiles elimination. In each sector, we consider dropping first or last percentile (or both), except for dairy-farming and poultry sectors. In dairy farming and poultry sectors, we have specific right tails and drop either a half of last percentile or 4 last percentiles. Finally, we arrive at the distributions (Appendix D), where the median value for sectors are in line with OECD tables.

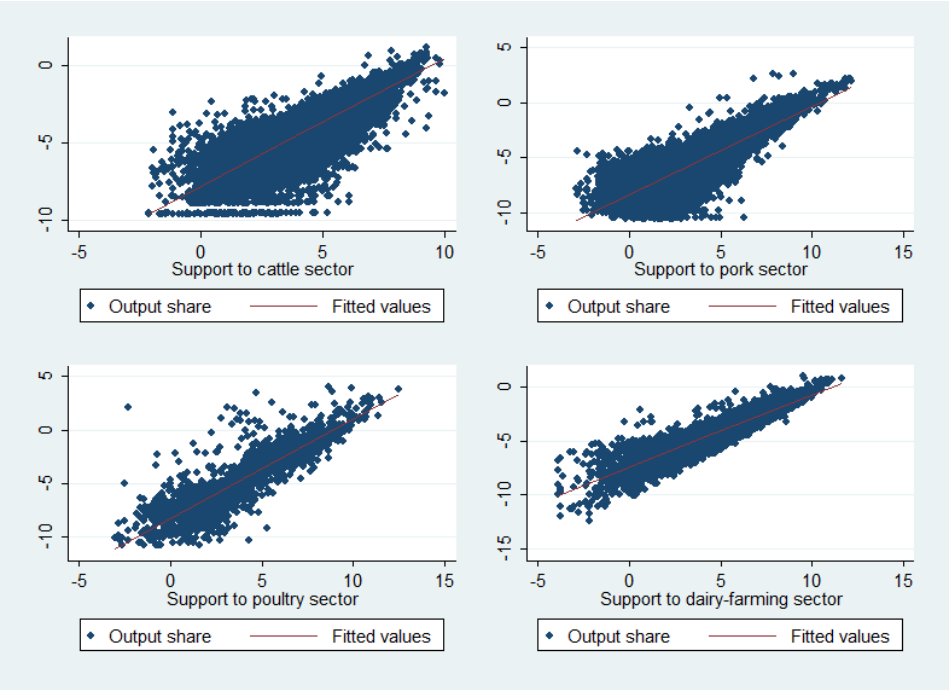

Figure 6. Relationship between aggregate support and output share among livestock and dairy sectors during 2004 – 2014 years.

Note: y-axis repreented by output share in logs; x-axis represented by aggregate support in logs.
Source: own estimations based on SSSU dataset

Through out years on the median value of support to cereal sector reaches - 28% of farms revenues, while in sunflower sector it is 11%. As for the livestock sectors, in cattle and pork support reflects median values of 23% and 37%. Poultry and dairy farming sectors experience the highest and lowest median support per revenue, respectively – 80% and 6%. Other control variables are also calculated for each sector separately, and the information on descriptive statistics provided in Appendix E.

To control for time- and farm-specific variable, we expect to use one-way fixed effect panel regression model (Baltagi, 2005).

The problem linked to reverse causality of state support (mainly subsidies) is widely discussed in the literature. In particular, support could be given to worse farms or accumulated by high-performers. Following Bezlepkina (2005) suggestion, such a problem could be handled by introducing instrumental variable – lagged support. The other reason for the inclusion of lagged support is that usually, it takes time, especially for farms in crop sector, for money to go into circulation and become noticeable on the activity.

Since we deal with unbalanced panel data we might face with some problems which may reduce the efficiency of our estimates. We might expect to observe groupwise heteroskedasticity since there are small and large farmers within the same group. One may use robust standard errors to control for heteroskedasticity. Also, the common problem for unbalanced panels we might face serial autocorrelation. However, due to small time span, the presence of serial correlation should not noise the estimates substantially. Coupled presence of mentioned problems may be resolved by employing robust Driscoll-Kraay standard errors (Hoechle, 2007). Such an approach uses nonparametric technique and apply Newey-West type correction to arrive at consistent estimator of covariance matrix independently of cross-sectional N.

Chapter 7

EMPIRICAL RESULTS

Production function was estimated using the sample of 57,956 observations during 2007 – 2014 years. Hausman test suggests using fixed effects model in favor of random effects (the null hypothesis of choosing random effects was rejected at 1% level). As a result, in line with the literature on agricultural economics, production function was estimated using one-way fixed effects. To deal with heteroskedasticity and serial autocorrelation, we apply Driscoll-Kraay standard errors. The year effects were found to be highly statistically significant for all sectors. The coefficients on cross-terms for crop and livestock sectors are highly significant for cereals, sunflower and dairy farming sectors at least at .01 level, in other cases it depends. Industry growth was omitted from all regressions due to collinearity. Possible explanation here is that we include dummy variables for years, which resembles industry trend. The results of the model for crop and livestock sectors are presented in Appendix F.

The central focus of the study was to indicate the relationship between the farm's output share and provided support. If the relationship exists, we are interested in its magnitude. We expect that due to vulnerability of the sectors climatic conditions, lack of liquidity and profits instability, state support might positively affect present farm structure.

Table 4 gives us an idea on how core variable support (lagged by one year) affect farm's output share (reduced table of empirical results). We did not find that higher lags have significant power, thus conclude that for support it takes one year to have an effect, at least on output share. Such fact supports our prior expectations described in the methodology. In cereal and sunflower sectors, the cumulative effect of the increase in weighted support by 1% associated with an

increase in output share of the average-sized farm by .000015% and 6.69e-06% respectively.

Table 4. Reduced table of estimated results from fixed effect model

	Dependent variable in %		
	Cereals output share	Sunflower output share	Cattle output share
L1. Support	2.16e-06***	2.50e-06***	-2.10e-06
	(5.40)	(3.15)	(-1.12)
(Land|Head) *Support	1.33e-08***	1.19e-08***	-4.31e-9
	(66.51)	(17.55)	(-1.38)
	Pork output share	Poultry output share	Dairy-farming output share
L1. Support	1.22e-05***	2.96e-05	3.00e-05***
	(3.53)	(0.24)	(7.51)
(Land|Head) *Support	-2.73e-9	6.88e-10	3.95e-07***
	(-1.53)	(1.34)	(24.36)

Note: In parentheses t-statistics, * p<0.1, ** p<0.05, *** p<0.01
Source: own estimations based on SSSU dataset

Interestingly, in case of livestock sectors, support has a larger effect if it is given to, on average, more consolidated sector. The cumulative effect of 1% increase in support per revenue for pork and dairy farming sectors is associated with acceleration of farm's output share (head of livestock at means) by 1.15e-05% and 5.47e-05% respectively. While the respective average output shares are .04% and .05%. T-test rejects the hypothesis of joint insignificance of support and head of livestock, so we combine its effect with support for the pork sector. It turns out to be that for cattle and poultry sectors, there is no significant association between weighted state support and output share.

Considering the maximum value for weighted support 1293% (pork sector) and 138% (dairy farming sector) and average output share .04% (pork) and .05% (dairy farming), makes the result of increase in output share by .01% (for both sectors) quite considerable. For comparison, in crop sectors the result equals .001% (cereals) and .01% (sunflower), while average output shares are .015% and .021% respectively. This, in its turn, suggests that the outcome is meaningful for all sectors.

Coefficients on cross-terms show that there is a complementarity between land/heads of livestock and support in period t for almost all sectors. It partially confirms our hypothesis about the importance of the size of the farm in receiving support. In Table 2, we might see that increase in farm size by 1 ha (head of livestock) reinforces the effect of support by 1.33e-08% (cereals), 1.19e-08% (sunflower), 3.95e-07% (dairy farming). Interaction term on land|heads of livestock and rental payments demonstrates that for sunflower, pork and dairy farming smaller farms pay more for the used land (for cereals and cattle the effect is opposite, whereas for poultry turns to be insignificant). Here lower price for larger farms might be explained by scaling.

The effect of farm size suggests a U-shaped relationship for cattle and poultry sectors, while for cereals, sunflower and pork sectors it is inverse. In dairy farming, the relationship is increasing, which indicates higher output shares for larger farms. For instance, 10,000 additional hectares of land in (for example) sunflower sector is associated with an increase in output share by .82%, while same amount but heads of livestock might bring to farmers' output shares in cattle and pork sectors - .04% and .12% respectively. Combined effect of size suggests positive relation to output share almost in all sectors. We found that increase in size by 10,000 units (ha or heads of livestock) associated with output share acceleration by .02% (cereals), .78% (sunflower), -.02% (cattle), .09% (pork), -.01%(poultry), .06% (dairy farming). Negative signs in cattle and poultry sectors might be due to inability of average farm to compete in scaling with enormous players.

Rental payments positively influence output shares, which confirms the reason for their presence in the model – a barrier of entry. Thus, an increase in rental payment by 1 unit per hectare in, for example, cereal sector lead to increase in farm's output shares by .0003%. Higher rental payments per hectare will either force some farms to exit the market or serve as a barrier to new players, or both. Coupled with result obtained on interaction term (Size*Rental payments), we can state that increase in rental payments per hectare could be associated with strengthening the farmer's positions. Albeit, the effect is opposite in the cattle sector and insignificant for the poultry sector.

Farm's inputs characteristics found to be significant at .01 level almost in all sectors. However, in more than half cases, they show negative association with output share. This, in its turn, suggests a thought that if increased inputs upsurge one's physical output, it might be the case when it does not boost the farm's position in the market. Increase in residual output (statistically significant at .01 level) shows negative impact on output share in all sectors and is in line with our prior expectations.

Dummy for a subsidy, which serves as an indicator for possible corruption, is found to be highly significant. It shows negative association for cereals, cattle, and dairy farming sectors, while for pork sector the sign on coefficient is positive. In latter case the effect suggests that obtaining subsidy matters in terms of farm's position on the market. For the negative effects, there are several explanations. Bezlepkina (2005) mentions that the presence of negative sign on subsidy could characterize Kornai-type subsidies, which are granted to the sector low-performers (Kornai, 2001). The other explanation provided by Sedik (1999) and Voigt et al. (2001): subsidies may reduce incentives of farmers to improve the efficiency and increase output. If it is noticed that those farms continue obtaining support, this might be the indicator of the weak response of received aid in all forms may characterize distortive features of state support.

Significant coefficients on year effects, ceteris paribus, suggest good and bad environmental and macroeconomic conditions resulted in an increase or decrease of output shares. The coefficients on sunflower, pork and dairy farming sectors suggest an only positive association, while cereal sectors show the opposite.

Chapter 7

CONCLUSIONS

In our paper, we apply Cobb-Douglas production function to estimate the relationship between state support and farm structures based on their output shares. The study examined broad farm-level accounting data in the agricultural industry and was the first considered such a research question in Ukraine. Dataset used for estimation contains the records about 11,640 farms (57,956 observations) over the period 2007-2014 and presented in the form of an unbalanced panel. The paper has also studied the relationship between farms' size and amount of obtained support.

The provided analysis suggests that on average Ukrainian farms feature low output shares. It indicates substantial heterogeneity of farms concerning their production performance. Since farms participate in many sectors simultaneously, we form distinct samples for each sector. Diversifying farm's activity, we can arrive at more homogeneous samples and "true" effect on the farm's position in the market.

The problem of endogeneity was solved by using an instrumental variable in the form of lagged value of support (Bezlepkina, 2005). Prior to the estimation of core model, we check an instrument to be reliable using Wooldridge (2012) approach. Test for endogeneity confirms the inclusion of constructed instrument. F-test for the final model shows that chosen specification of production function representative. According to adjusted R-squared, the explanatory power of model across sub-samples is in the range 78-99%. The reason for such high R-squared (cattle sector) is hidden in substantial effect of a trend in year effects since without them it declines to 55%. On average, the proportion of variables which are significantly different from zero at .05 level

is 85%. Year effects turn out to be significant across all sub-samples, while dummy for subsidy (an indicator of corruption features) shows significant and primarily negative result for four sectors.

Our study confirms central hypothesis about positive association between state support and output shares. All sectors show increase in next year output share by increasing state support. The existence of opposite dynamics may indicate the presence of support which is given to inefficient farms (Kornai-type) or that support disincentivize farmers to perform better. Albeit, we do not have such cases in our study.

In general, the cumulative effect of an increase in weighted support by 1% results in increase of next year output share by around .00001% on average for all sectors. Considering extreme values of support per revenue we arrive at quite noticeable effect on output shares – about .01% increase for sunflower, pork and dairy farming sectors. The effect is meaningful, taking into account the average size of the farm.

Combined effects of land|heads of livestock and support per revenue suggest that they are complements, i.e., with an increase of farm's size, the state support per revenue also increases. It indicates that larger farmers are associated with higher benefits. Albeit, for cattle, pork, and poultry such an effect found to be insignificant. Substitution effect was found between size and rental payments per hectare, i.e. for sunflower, cattle, and dairy farming sector, small farmers are discriminated by landowners and pay more. Designed dataset supports an idea that rental payments served as a barrier to entry (exception is cattle sector).

Combined farm's size effect in four sectors shows positive effect of scaling on output share. In cattle and poultry sectors, the association is negative, which can be explained by existence of enormous players, so that average farm could not gain from scaling.

Overall, the findings are in line with results provided by Buts and Jegers (2013) and suggests existing of distortive features of state support on farm structures in Ukraine.

Outcomes of the study might be interesting for policymakers. Results show a significant positive relationship between state support and next year output share. This provides an idea on consolidation of sector with an increase of state support. Also, in case of livestock sectors greater support is given to sector with greater maximum output share. It was found that larger farmers obtain greater support per unit of revenue. Therefore, in case of policy, it might be plausible to grant small farmers to counterbalance the weight of the large ones.

Considering further government policies concerning state support, studying the effect of state support on sector's concentration level could point an interesting result. This may give an idea about strengthen or weaken competition within the sector as a result of provided state support. Such an approach could be extrapolated to other industries of Ukraine, which have substantial amount of state support. This, in its turn, might help to increase the efficiency of state resources allocation and do not promote the emergence of monopolies.

In light of conclusion, we might say that the observed effects of state support on output shares need further research. We obtain insignificant result on cattle and poultry sectors, so such sectors might be considered separately to account for more specific factors. Also, one might look at support effect in detail using direct subsidies, tax benefits, and MPD separately, as well as other sectors might be taken into consideration.

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APPENDIX A

Dynamics of indices over the period 2007-2014

Table 5. Indices dynamics: crop, livestock, wage, CPI, industry growth indices

Index	2007	2008	2009	2010	2011	2012	2013	2014
Crop index	1	1.58	1.72	2.41	2.78	2.94	2.69	3.49
Livestock index	1	1.16	1.17	1.34	1.47	1.58	1.62	1.93
Wage index	1	1.47	1.65	2.00	2.53	2.86	3.19	3.49
CPI	1	1.25	1.45	1.59	1.71	1.73	1.72	1.93
Index of industry growth	0.85	0.99	0.93	1	1.09	1.04	0.96	0.94

Source: SSSU, World Commodity Outlook

APPENDIX B

Dynamics of support to sectors of interest over the period 2007-2014

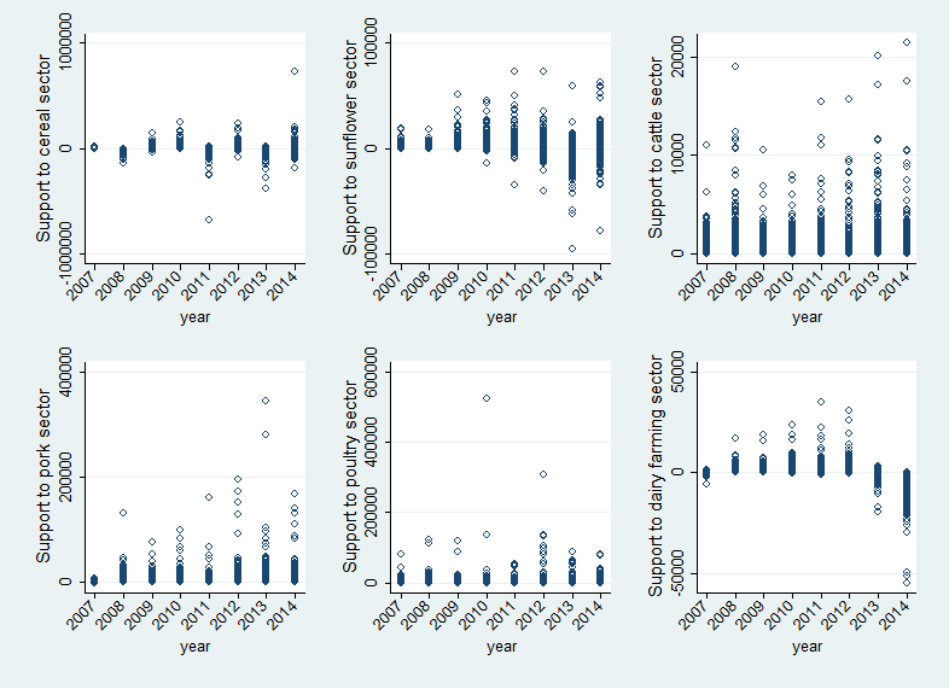

Figure 7. Sample distribution of received support by sector by year, thsd UAH

APPENDIX C

Relationship between cereal sectors output shares and support

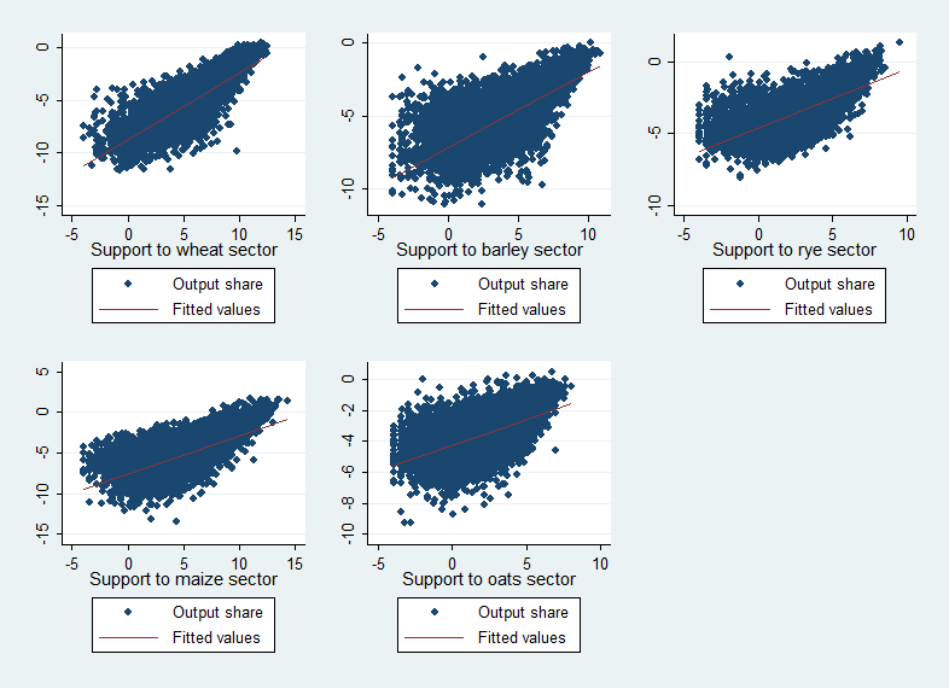

Figure 8. Relationship between support and output shares of wheat, barley, rye, maize and oats sectors.

Note: all variables are presented in logs
Source: own calculations based on SSSU dataset

APPENDIX D

Dynamics of weighed support by revenue over the period 2007-2014

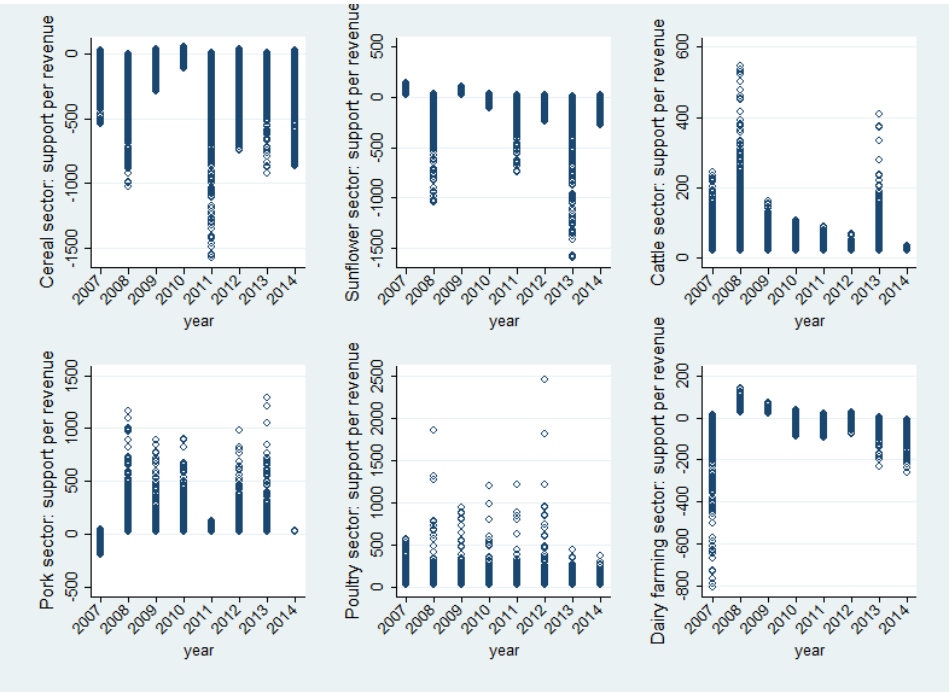

Figure 9. Sample distribution of weighted support by revenue in crop and livestock sectors by year, in %

APPENDIX E

Descriptive statistics of control variables by sectors

Table 6. Cereals sector: summary statistics of control variables for 2004-2014 years, thsd UAH

Variable	Mean	Std. Dev.	Min	Max
Land, ha	1088.95	2588.92	1	148529
Rental payments per hectare, thsd UAH	.6003	2.527	0	567.5
Amortization, thsd UAH	396.94	1286.81	.1	79633.16
Labor costs, thsd UAH	660.07	2153.34	.1	111934
Material costs, thsd UAH	5112.33	20849.34	.4	1613098
Residual output, tones	1.67e+09	3.33e+08	1.02e+09	2.15e+09

Source: own calculations based on SSSU dataset

Table 7. Sunflower sector: summary statistics of control variables for 2004-2014 years, thsd UAH

Variable	Mean	Std. Dev.	Min	Max
Land, ha	532.15	1465.81	1	182020
Rental payments per hectare, thsd UAH	.6625	2.951	0	567.5
Amortization, thsd UAH	204.73	536.42	.1	31187.99
Labor costs, thsd UAH	324.17	826.62	.1	72257.88
Material costs, thsd UAH	2341.59	6106.95	.6899	290490.7
Residual output, tones	4796319	1517380	2087689	7039590

Source: own calculations based on SSSU dataset

Appendix E Continued

Table 8. Cattle sector: summary statistics of control variables for 2004-2014 years, thsd UAH

Variable	Mean	Std. Dev.	Min	Max
Heads of livestock	394.72	671.09	1	16665
Rental payments per hectare, thsd UAH	.4655	.5388	0	2309004
Amortization, thsd UAH	69.53	235.79	.1	8647.23
Labor costs, thsd UAH	418.36	1089.53	.1	33876.59
Material costs, thsd UAH	1411.89	3660.19	.1252	102525.2
Residual output, tones	135491.4	8172.69	119854.8	148437.1

Source: own calculations based on SSSU dataset

Table 9. Pork sector: summary statistics of control variables for 2004-2014 years, thsd UAH

Variable	Mean	Std. Dev.	Min	Max
Heads of livestock	764.54	3522.58	1	137622
Rental payments per hectare, thsd UAH	.4909	.5593	0	23.57
Amortization, thsd UAH	137.64	1177.47	.1	47572.14
Labor costs, thsd UAH	325.24	1456.98	.1	93661.54
Material costs, thsd UAH	1955.21	12321.46	.2	626241.2
Residual output, tones	235518.2	49644.49	154955	301319.1

Source: own calculations based on SSSU dataset

Appendix E Continued

Table 10. Poultry sector: summary statistics of control variables for 2004-2014 years, thsd UAH

Variable	Mean	Std. Dev.	Min	Max
Heads of livestock	126048	486695.8	2	1.06e+07
Rental payments per hectare, thsd UAH	.3838	.5126	0	3.58
Amortization, thsd UAH	316.62	1429.13	.1	31557.52
Labor costs, thsd UAH	380.04	1073.94	.1468	20701.51
Material costs, thsd UAH	6307.83	32358.49	.1	1037584
Residual output, tones	83865.02	20006.58	40568	118717.3

Source: own calculations based on SSSU dataset

Table 11. Dairy farming sector: summary statistics of control variables for 2004-2014 years, thsd UAH

Variable	Mean	Std. Dev.	Min	Max
Heads of livestock	239.56	393.51	1	9880
Rental payments per hectare, thsd UAH	.4774	.5472	0	2309004
Amortization, thsd UAH	180.30	822.42	.1	30587.86
Labor costs, thsd UAH	998.05	2692.26	.1	92071.45
Material costs, thsd UAH	2681.23	7327.48	.1	245122.9
Residual output, tones	1828155	214306.6	1523454	2190688

Source: own calculations based on SSSU dataset

APPENDIX F

Estimation results from fixed effect model

Table 12. Estimation results from fixed effect model.

Explanatory variables	Dependent variable in %					
	Cereals output share	Sunflower output share	Cattle output share	Pork output share	Poultry output share	Dairy-farming output share
L1. Support	2.16e-06***	2.50e-06***	-2.10e-06	1.22e-05***	2.96e-05	3.00e-05***
	(5.40)	(3.15)	(-1.12)	(3.53)	(0.24)	(7.51)
(Land|Head) *Support	1.33e-08***	1.19e-08***	-4.31e-9	-2.73e-9	6.88e-10	3.95e-07***
	(66.51)	(17.55)	(-1.38)	(-1.53)	(1.34)	(24.36)
Land|Head	2.70e-06***	8.19e-05***	-3.96e-06***	1.07e-05***	-1.23e-06***	9.06e-06***
	(43.42)	(62.26)	(-12.17)	(29.73)	(-5.52)	(9.14)
Land|Head squared	-1.86e-13	-3.02e-11***	6.22e-11**	-3.68e-12	4.85e-13***	8.39e-10***
	(-0.46)	(-45.13)	(2.29)	(-1.55)	(5.57)	(6.58)
Land|Head *Rental payments	8.39e-08***	-5.77e-06***	3.27e-06***	-3.36e-06***	2.55e-08	-4.71e-06***
	(5.48)	(-75.62)	(22.93)	(-29.70)	(0.21)	(-12.47)
Rental payments	0.0003***	0.0031***	-0.0015***	0.0043***	0.0033	0.0008***
	(4.39)	(20.96)	(-9.53)	(7.27)	(0.08)	(3.48)
Depriciation	3.95e-07***	-7.37e-07***	2.95e-06***	-4.01e-06***	2.10e-05	5.78e-08
	(10.39)	(-5.20)	(8.34)	(-6.95)	(1.23)	(0.30)
Labor	-9.88e-9	-2.46e-06***	-2.44e-07***	-1.01e-05***	6.68e-05**	-1.87e-05***
	(-0.39)	(-25.55)	(-2.61)	(-23.87)	(2.35)	(-24.37)
Material costs	-1.06e-07***	-6.81e-07***	1.34e-06***	-3.45e-06***	4.65e-06***	-1.03e-06***
	(-35.78)	(-40.36)	(31.29)	(-40.23)	(2.63)	(-30.75)
Residual output	-4.83e-08***	-1.77e-05***	-7.54e-04***	-3.87e-04***	-0.0012***	-5.15e-05***
	(-317.80)	(-235.97)	(-730.93)	(-161.22)	(-25.65)	(-252.13)
Dummy subsidy	-0.0007***	-	-0.0009***	0.0052***	-0.0091	-0.0011***
	(-4.70)	-	(-7.14)	(6.81)	(-0.15)	(-4.75)

Table 12. Estimation results from fixed effect model. – Continued

Year effect 2009	-11.83***	2.639***	5.082***	5.079***	3.212***	10.59***
	(-317.83)	(235.72)	(731.14)	(161.28)	(23.85)	(252.04)
Year effect 2010	-34.32***	10.77***	-5.805***	20.94***	41.52***	11.49***
	(-317.81)	(235.84)	(-730.40)	(161.19)	(25.57)	(252.08)
Year effect 2011	-17.87***	29.96***	-5.711***	31.61***	-36.19***	15.73***
	(-317.81)	(235.91)	(-730.80)	(161.18)	(-25.51)	(252.05)
Year effect 2012	-37.91***	31.80***	-1.320***	34.85***	26.75***	25.96***
	(-317.81)	(235.89)	(-728.02)	(161.17)	(25.53)	(252.07)
Year effect 2013	-20.34***	60.66***	-4.792***	38.78***	8.891***	28.28***
	(-317.83)	(235.92)	(-731.83)	(161.17)	(25.35)	(252.13)
Year effect 2014	-9.845***	54.58***	-10.36***	41.38***	-5.492***	32.22***
	(-317.81)	(235.90)	(-731.32)	(161.18)	(-24.56)	(252.17)
_cons	103.8***	63.80***	102.9***	75.26***	84.93***	80.65***
	(317.81)	(236.02)	(730.92)	(161.22)	(25.67)	(252.20)
N	38698	27563	11285	12407	929	10355
R-sq	0.870	0.827	0.993	0.974	0.865	0.969
adj. R-sq	0.828	0.770	0.991	0.963	0.780	0.957
F-statistic	11514.77 (df=17; 29218)	6208.85 (df=16; 20751)	71122.04 (df=17; 8160)	19391.88 (df=17; 8821)	214.78 (df=17; 572)	13775.93 (df=17; 7528)

Note: State support is measured in %; land is measured in hectares; heads of livestock is measured in units; residual output is measured in tones; all other are monetary values are measured in thousands of UAH. T-statistics in parentheses * p<0.1, ** p<0.05, *** p<0.01

Source: own estimation based on SSSU dataset