LAND MARKET INSTITUTIONS AND AGRICULTURAL PRODUCTIVITY IN UKRAINE

by

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Abstract

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Ukraine's agriculture increasingly contributes to global food security. However, there is a significant untapped agricultural production and export potential with the country. Weak land governance and institutions, including the moratorium on farmland sales, are generally recognized as the major source of a significant agricultural productivity gap in Ukraine. In this thesis we match a rich farm-level accounting data with a unique set of land governance indicators to measure the role of land institutions in enhancing agriculture productivity. Controlling for farm specific characteristics, land institutions turned out to have quite sizable impact on productivity.

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GLOSSARY

GDP – Gross domestic product

SSSU – State Statistics Service of Ukraine

TFP – Total factor productivity

LGI – Land Governance indicators

Chapter 1

INTRODUCTION

Traditionally, development economists viewed economic growth as depending on capital accumulation (human capital accumulation) or technological improvement and did not take into account concepts of institutions and property rights development. New institutional economists started treating institutions in more detail, claiming that the way they change has long-term impacts on economic outcomes (Ostrom, 1990). They defined institutions as "rules of the game in a society, or more formally, are the humanly devised constraints that shape human interaction… [which] structure incentives in human exchange, whether political, social, or economic" (North, 1990), and placed property rights in the heart of this definition. According to the Coase theorem (Coase, 1960), property rights allocation does not matter only in transaction costless world with perfect information. Otherwise, property rights engender residual control rights for the owner (Hart 1995), which affect her decision to invest or even keep property rights in the future.

Property rights for land have historically played a crucial role in the establishment and development of society, especially agrarian (Deininger, 1998), which could be explained through several channels, including:

- Population levels remained very low, and almost everyone had access to land use. When population growth exceeded the technology of cultivating, arable land became scarce, and land property rights were established by society.
- Early societies cultivated their land by the whole group (because of lacking technology), which led to different land tenure systems.

Thus, property rights for land and land tenure system became a part of land institutions. In this work, we will understand by land institutions rules and structures that regulate land use and decisions concerning property rights for land.

In the literature it was shown (Deininger et al., 2014) that better land institutions, in particular, which lead to the higher security of land property rights, are important, among other things, to provide incentives for investment and efficiency-enhancing land transfers. This in turn positively affects agricultural development and productivity growth, which is achieved through at least three channels: i) incentives or motivation to make land investments; ii) the scope for transferring land to more productive users and taking up non-agricultural employment; iii) the ability to use the land as collateral for credit.

However, in the literature (Easterly, 2010), there exists a critique that institutions are not something that is directly exposed. They grow and develop independently and are challenging to measure and evaluate them. For instance, former Soviet Union countries tried to establish a new capitalist system instead of socialism by policy decisions and laws and mostly failed. China, on the other hand, on its path from socialism showed tremendous progress in the development of many capitalist institutions. Therefore, there is a need in addressing a problem of evaluating and measurement of land institutions and their impacts on economic growth.

Land institutions are a part of a broader concept of land governance (Deininger 2011), which encompasses government actions and decisions related to land markets and land use in order to prevent distortions and market failures. Land governance includes, besides land institutions, i) land use planning and taxation (to avoid negative externalities, allow provision of services at low cost, and support effective decentralization); ii) unambiguous identification and efficient management of state land; iii) accessibility of information on land ownership (e.g., cadaster); iv) ability of interested parties to access institutions with clear, well-defined mandates (Deininger et al., 2014). Therefore, land governance is easier to measure and evaluate than land institutions, so it can be used as a proxy to establish the relationship between institutions and growth.

Despite land governance impacts are found controversial on a number of occasions, policymakers should take into account the long-term nature of land interventions and their effect on overall development (World Bank, 2003). Also, agricultural development and land governance give large impact to welfare (mainly, rural) and equity concerns through the redistribution and reallocation channels.

There can be distinguished several important aspects on why Ukraine's case is important in this context:

- Ukraine's agricultural productivity remains very low in comparison to the levels observed in the developed countries (Nivievskyi, 2011). For example, Ukraine's value added per hectare of arable land was USD 413 in 2014, compared to USD 1,135 in the US and USD 2,445 in France (Nivievskyi, 2017). This is especially striking given the fact that a third of the most productive soils in the world (black soils) is located in Ukraine. In addition, about 71% of Ukrainian territory (42.7 mln. ha) is classified as agricultural lands. Weak land governance is considered to be one of the critical reasons that preclude the realization of Ukraine's agricultural comparative advantage and its attractiveness for outside investment in agriculture and beyond (Deininger and Nizalov, 2016).

- Ukraine is becoming one of the major global exporters of agricultural outputs and is called as a "breadbasket" of Europe (Bezlepkina, van Berkum, and Rau, 2013). Thus, the quality of land governance in Ukraine has far-reaching implications for global food security.

- Since 2015, Ukraine is undertaking enormous and unique efforts to implement a Land Governance Monitoring system as a part of national agricultural reform , which allows for a regular and automatic collecting, processing, and publishing of administrative data as well as

> more than 140 indicators from multiple state agencies on the current condition of land governance in Ukraine. The monitoring system is implemented at the city, rayon (district), and oblast (region) levels.

The evidence of the impact of poor land governance on agricultural productivity in Ukraine is scarce in economic literature, which calls for the development of a model that would explain the relationship between land governance and agricultural productivity. Nizalov et al. (2015) tried to explain inefficient crop planting by the insecurity of property rights and uncertainty about future regulations of land rental markets, but they did not build a general model due to lack of data.

In this work, the main research question is whether land governance measured by indicators pertaining to institutional development have a significant positive impact on agricultural productive outcomes in Ukraine.

The main contribution of this research to the expanding collection of academic research on land governance is to check empirically model of relationships between the development of land governance and the agricultural productivity and try to explain the possible cause-effect relationship.

Empirical findings suggest that better governance indicators engender significant positive association with agricultural productivity growth. Ceteris paribus: coefficients on indicators associated with good governance (decreasing information asymmetry, increasing property rights security, increasing land formalization, etc.) are positive; while for indicators associated with bad governance (increasing transaction costs, the higher number of legal disputes, etc.) coefficients are negative.

The rest of this thesis is structured as follows. Chapter 2 presents the literature review, which discusses the most important theoretical and empirical studies on land market institutions, land governance, and their relation to agricultural performance. Chapter 3 describes the methodology, which consists of two principal parts, obtaining productivity figures for different regions in Ukraine and using panel data for Land Governance indicators to build a model. Chapter 4 is about data description and data processing for this research. Chapter 5 presents results from the key model built to analyze whether the research hypothesis is correct, how large they in magnitude, and their interpretation. Finally, Chapter 6 provides the main conclusions made from the empirical results.

C h a p t e r 2

LITERATURE REVIEW

This section is divided into two parts. First, we analyze the theoretical studies discussing the nature of institutions, governance, and their impacts on production and investment. Then we look at the empirical studies that investigate whether there is evidence for such impacts at cross-country level and in particular (mostly, developing) countries. We analyze the conclusions drawn by economists and based on this evidence try to understand, which key features are essential in Ukrainian case.

In particular, in theoretical studies, charitable institutions are usually associated with a higher level of property rights establishing and their security. Different models have been developed in the literature ((Grossman and Hart, 1986), (Hart and Moore, 1990)), which are based on a single-input stochastic output approach. Within these models, property rights are measured as probabilities of income losses or capital expropriation, etc., and establish government constraint of owner behavior. For instance, Besley (1995) shows impressive outcomes of such a model, i.e., that income, investment, and labor are strictly decreasing as such probability increases, and when insecure asset is involved in production process, the resource constraint (for labor) becomes not binding, thus creating the necessity to protect property using resources (diverting them from production and turning them into underinvestment). Furthermore, insecure property rights impede land trade and resource reallocation, which lead to decreasing efficiency and productivity.

Recent views on such findings are summarized by Besley and Ghatak (2010). In their paper, authors also pointed to endogenous property rights and the importance of tenant behavior regulation. They construct subgame perfect equilibrium for different types of inefficient state (with a low level of institutions), including predator (strong), anarchic, and ineffective (weak). Predator state behavior is similar to the bandit, who wants to collect every possible surplus. The anarchic state has power spread between different "state agents" and fails to internalize the effect of its expropriation decision (tax collecting, for example) on others. Ineffective state underinvests in public goods such as court system, administration, etc. For all such types, the calculated payoff for agents and state are much lower and create disincentives for investment. The lower investment, again, negatively affects productivity. Within rental land markets, as was shown, this one-sided protection of an owner (landlord) turns into inefficient outcome, while increasing in land use rights of the tenant could give productivity growth.

On the other hand, there exist opposing views on the development of land institutions. Economists claimed (Andolfatto, 2002) that sufficient commitment between government and agents could be achieved only with imperfect information, which is reduced due to institutional improvement. The author posits that perfect information associated with a high level of transparency of land titling on the land market leads to myopic transactions and negative social impacts.

Another thing, which is important to consider, is the difference in approaches to definitions of institutions, their determinants, and impacts. Easterly (2008), without questioning the fact of a positive institutional impact, analyzed two conceptually different views on their nature, namely, "bottom-up" and "top down." According to the "top-down" view, institutions highly depend on authority decisions and formalized laws, which makes them manageable by the government. "Bottom-up" supporters claimed that it is not true, and institutions grow in their natural way. In support of this idea, references on studies were provided, which also show the negligible effect of land governance. Therefore, even without challenging the theoretical approach to the positive influence of institutions, in reality, there could be a lack of pieces of evidence in its favor.

Thus, it is essential to investigate, whether the theory described above is relevant in practice. According to Pande and Udry (2005), there exists a large number of papers, which evaluate positive impacts of institutional development on national welfare and economic growth at the cross-country level. The most famous is research done by Acemoglu, Johnson, and Robinson (2001). They, using OLS regression with the cross-country evidence for 126 countries in 1984-1997, tried to explain what factors incentivize government to establish long-run institutions. The key findings show that settler mortality (a proxy for weak property rights and expropriation risk) is associated with a reduction of growth.

Another interesting finding is cross-country analysis based on the data for 172 countries from the World Bank's Doing Business Web conducted by Besley (2010) to support his theoretical findings described above. The author showed that more easy procedure for registering the property under the law correlates with higher income per capita and higher economic development.

There is a large body of research about African countries, their land governance reforms and impacts on agricultural performance, which show some controversial results. In Kenya, after implementing land registration system and land titles, agricultural performance did not change. Place and Migot-Adholla (1998) analyzed, using the household and plot data in four Kenyan sites, that land titling gave no effect on perceived land rights of farmers, credit use and terms, crop yields, or concentration of land holdings. However, the authors concluded that initially people have demand for titling only for ensuring their current status, which potentially affects the outcomes of such improvements.

One of the most successful results was obtained in Ethiopia. Deininger, Ali, and Alemu (2011), applying the difference-in-difference approach to the data from a panel survey of rural households conducted in 1999, 2002, 2004, and 2007, were able to show that introduction of program for enforcing land property right led to a statistically significant increase in land investment and land rental market participation.

Land Governance Assessment Framework (LGAF), which was developed by World Bank and partner institutions and applied in many countries around the world, showed that for such developing countries as African ones, increase in land governance did not affect productivity growth so much. Analyzing the set of 10 African countries and comparing them with Asian and South American ones, Deininger, Hilhost, and Songwe (2014) tried to explain such discrepancies by the incompleteness of implementation and proposed to increase spending on computers. Considering Rwanda as a country with the high value of the agricultural sector, Ali, Deininger, and Ronchi (2018) found that land fragmentation led to economically (or even statistically) insignificant results on technical efficiency, and tried to explain it by gender inequality

An interesting finding, which supports the theory, was reported by Banerjee and Ghatak (1997). They found that tenancy registration fixed an upper ceiling for rental land, which was implemented at the district level in West Bengal (India), achieved its goals, that is, protecting tenants from being evicted and led to significant productivity growth of nearly 40%. On the other hand, authors claim that costs of implementing such governance "need to be considered in making an assessment of the economic benefits from such a measure, and that tenancy reform may not have been the only alternative available."

Considering Ukrainian case, we could mention the findings of Nizalov et al. (2015) about crop agricultural sector. They, using long farm-level panel (2002-2012) estimated probability of investment into crops, which are less capital intensive and found that uncertainty, regarding the future regulation of the land rental market, positively affect such a probability. Then they conclude that such a bias creates inefficient land use, and crop sector does not achieve its potential growth rate.

As we can see, the question regarding land institutions and agricultural development has its supporters and opponents. The theory suggests, except some extensions, that security of property rights, availability of information about land markets have to positively affect resource reallocation, investment decisions and, thus, productivity growth. However, among empirical studies, there exists a discussion about the reality of land governance impacts. Cross-country evidence shows a highly significant effect of institutions and governance on economic development and welfare, especially for developing countries with agrarian systems. However, the results of some of the studies show that these impacts are at least insignificant, or even ambiguous. For some studies, it was evaluated that the cost of land formalizing could potentially exceed benefits for society at the current point of their state development. But still, authors claim that outcomes depend on specific country's circumstances, and historical society path should be taken into consideration. So, the economic and welfare influence on good land governance is not straightforward and should be evaluated for Ukraine.

Chapter 3

METHODOLOGY

The whole modeling exercise in this paper is executed in two stages. In the first stage, we use the farm-level data to estimate a production function and obtain farm-level total factor productivity (TFP) estimates. In the second stage, we regress farm-level productivity scores on a set of Land Governance indicators and farm-level control variables.

3.1 Estimating production function

Using semi-parametric approach developed by Levinsohn and Petrin (2003) and extended by Ackerberg, Caves and Frazer (2006), we assume Cobb-Douglas specification of a production function and estimate farm-level TFPs in the following way:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \beta_a a_{it} + v_{it} + u_{it}^q, \qquad (1)$$

where the y_{it} is the output for each firm *i* at period *t*, k_{it} is the logarithm of capital, l_{it} is the logarithm of labor, m_{it} is the logarithm of material costs, a_{it} is the logarithm of land, and $\omega_{it} = \beta_0 + v_{it}$ is logarithm of farm-level TFP. Levinsohn and Petrin (2003) allows to correct for a potential endogeneity problem stemming from simultaneity and sample selection. More specifically farm-level TFPs and choices of inputs by each farm are likely to be correlated, i.e. $\mathrm{E}\left[k_{it}, l_{it}, m_{it}, a_{it} \mid \omega_{it}\right] > 0$; in other words, each specific farm has some predetermined view on their productivity, so it chooses level of capital, labor, materials (oil, fertilizers, etc.), and land in accordance to these beliefs. Sample selection might come from the fact that in the dataset, we observe only those farms, which survived in the industry, and do not observe farms, which decided to leave the market. However, leaving the market is probably affected by self-observed farm productivity.

3.2 Estimating the Role of Land Governance Indicators

Finally, we merge TFP estimates with a set of land governance indicators and farm-level controls to estimate the following model:

$$\begin{aligned} \ln TFP_{it} = \delta_0 + \delta_{TFP_{t-1}} \ln TFP_{it-1} + \delta_A A_{it} + \delta_{Asq} A_{it}^2 + \delta_{HHI} \ln HHI_{gt} + \\ \delta_{CI} CI_{it} + \delta_{CIsq} CI_{it}^2 + \boldsymbol{\delta}_F \mathbf{F}_{gt} + \boldsymbol{\delta}_I \mathbf{I}_{gt} + \boldsymbol{\delta}_T \mathbf{T}_{gt} + \boldsymbol{\delta}_F \mathbf{R}_{gt} + \varepsilon_{it}, \end{aligned} \qquad (2)$$

where $\mathbf{F}_{gt}$, $\mathbf{I}_{gt}$, $\mathbf{T}_{gt}$, $\mathbf{R}_{gt}$ are land institutions characteristics, all in logs (at rayon level *g*), for which selected land governance indicators are available (we describe them below in more details); variables controlling for various farms specific heterogeneity are the following: A_{it} is land (proxy for farm sizes), HHI_{gt} is Herfindahl-Hirschman Index for a land market (a proxy for a competitive environment, calculated using information about land, which is operated by farms in particular rayon *g*), CI_{it} is capital intensity.

We include lagged variable of TFP in (2) to allow for persistence of results. Also, it possibly helps to deal with endogeneity problem. Such a problem is possible, because some big farm could potentially affect level of institutions in particular rayon.

In order to make some robustness check of the results we decide to substitute TFP with some proxy – technical efficiency (TE_{it}). Technical efficiency TE_{it} usually proxies the level of managerial efforts (Minviel and Latruffe, 2017) and the farm-level scores were obtained using order-alpha nonparametric partial frontier method at 95% level (Daraio and Simar, 2007). Then, we run the following model:

$$\ln TE_{it} = \delta_0 + +\delta_A A_{it} + \delta_{Asq} A_{it}^2 + \delta_{HHI} \ln HHI_{gt} + \delta_{CI} CI_{it} + \\ \delta_{CIsq} CI_{it}^2 + \boldsymbol{\delta}_F \mathbf{F}_{gt} + \boldsymbol{\delta}_I \mathbf{I}_{gt} + \boldsymbol{\delta}_T \mathbf{T}_{gt} + \boldsymbol{\delta}_F \mathbf{R}_{gt} + \varepsilon_{it}, \quad (3)$$

where all variables are the same as in (2), but we don't include the lag of technical efficiency in the model.

Below we build upon the Land Governance Assessment Framework (Deininger et al., 2012), we motivate and describe land institution variables used in the second stage regression. For more detailed description of the land indicators data refer to Nizalov et al. (2016).

Land governance indicators are grouped in four categories:

1) $\mathbf{F}_{gt}$ stands for a set of indicators characterizing the level the formalization of land tenure and land parcels. In particular:

   a) *share of arable land in private and state ownership*, registered in cadaster (with assigned cadastral number) is an indicator of security of property rights and an impact factor for market activity and for increasing productivity of land use. As a rule, a land without clear demarcation is highly vulnerable to encroachment by outsiders, which often leads to conflicts, and reduces the incentive to invest and thus improve productivity.

   b) *number of cadastral errors*; similar to the indicator above, it indicates the level of security of property rights, for the errors create uncertainties with respect to property rights, thus also reducing the incentives to invest and upgrade productivity;

   c) *share of arable land with the normative monetary value attached*; the general idea is that if a land plot has a normative (administrative) value (for fiscal purposes), this implies that the plot is registered at least in the cadaster and the rights are formalized.

d) *number of taxpayers;* the logic here is that higher number of officially registered taxpayers implies less informality in operations or higher level of land rights formalization.

2) $\mathbf{I}_{gt}$ stands for a set of indicators characterizing the level of information accessibility for interested parties about land ownership and land parcels. In particular:

a) *average time which is needed to register land parcel in cadaster.* (the expected sign is negative – increases transaction costs, information asymmetry);

This indicator shows the efficiency of land institutions, i.e. level of time transaction costs the system inflicts on land users and owners.

3) $\mathbf{T}_{gt}$ stands for a set of indicators characterizing the level of trust in land institutions (due to drawbacks in regulatory and legal environment, or an under-developed conflict resolution system). In particular:

a) *number of land-related civil cases.* It is difficult to assess the direction of the impact, because if the trust is low, then a lot of cases are settled unofficially and unofficial settlement negatively affects TFP (Deininger, Hilhost and Songwe, 2014);

b) *number of land-related administrative cases.* If people sue land authorities in court, this implies that state land-administrative bodies behave as predators and their decisions generally negatively affect the performance of farms in their constituent areas.

4) $\mathbf{R}_{gt}$ stands for a *number of rent transactions* (expected sign is positive – higher level of transaction means efficient resource reallocation, which affect TFP). This indicator demonstrates local land market

characteristics, market capacity and flexibility, and they are the most sensitive markers of changes. In more flexible the markets (or more liquid), investors are more likely to invest because of the higher security to their investments.

The estimation results and different model specification is provided in corresponding Chapter. Also, we provide a comparison between impact of land institutions and other farm-specific features. Since statistically significant signs do not reflect economic significance, we need to estimate approximately the impact of TFP improvement in revenues in comparison with government spending on land reform and additional cost-benefit analysis in needed as further policy research on this topic.

We use clustered errors at rayon level, because institutional features do not have variation of these variables in particular rayon for all farms.

C h a p t e r   4

DATA DESCRIPTION

First wave of Land Governance Monitoring data[1] consists of 140 indicators for 564 rayons and cities of Ukraine for 2014-2015 years (Donbass region and Crimea are not available). For research, it was decided to choose reasonable set of them and construct variables, descriptive statistics of which and reasonable definitions are given in Table 1. Here I provide some steps of obtaining such variables, which are used in model of equation (2):

- Numbers of cadastral errors – obtained by dividing total number of cadastral errors by number of hectares with this errors in particular rayon;
- Share of arable land in private ownership, registered in cadaster – obtained by dividing the number of arable hectares in private ownership in by total number of arable hectares in particular rayon;
- Share of arable land in state ownership, registered in cadaster – obtained by dividing the number of arable hectares in private ownership in by total number of arable hectares in particular rayon;
- Share of arable land, for which the normative monetary valuation of land is carried out – obtained by dividing the number of arable hectares, which have normative value by total number of arable hectares in particular rayon;
- Number of taxpayers – measured as number of taxpayers per 1,000 landowners in particular rayon;
- Average time which is needed to register land parcel in cadaster – expressed in days and averaged using quarterly data for particular year;

[1] http://www.kse.org.ua/uk/research-policy/land/governance-monitoring/database-2014-2015/

- Number of civil cases – obtained by official statistics and expressed as number per 10 thsd of landowners and land users in particular district;
- Number of administrative cases – obtained by official statistics and expressed as number per 10 thsd of landowners and land users in particular district;
- Number of rent transactions – expressed as number of rental transactions per 1,000 landowners and land users in particular rayon.

Farm level TFP scores were calculated using an unbalanced panel of the farm-level accounting data (50 SG form), provided by the State Statistics Service of Ukraine. The dataset provides a detailed information on farm inputs and costs, output revenues for crops and livestock production, as well as value of land and labor units. We considered only crop farms and chose the following variables to estimate (1):

- k_{it} : we use depreciation for a capital;
- l_{it} : labor input was included as an average number of workers per year;
- m_{it} : variable inputs were included as an aggregate of annual costs of oil, fuel, energy, fertilizers, and spare parts;
- a_{it} : land was included as the area of agricultural land cultivated by a farm.

The original farm-level data set consists of unbalanced panel of more than 4,000 unique farm legal entities (80,838 observations for 2007-2014 years). Descriptive statistic for variables above provided in Table 2.

As we can see from this table, most of the variables have 0`s minimum, pretty small mean and large maximum values. The corresponding Figure 1 show that they have actually right-skewed distribution which we need to deal with.

Table 1. Descriptive statistics for Land Governance indicators data for 2014 year

Variable	Mean	Standard Deviation	Minimum	Maximum
Numbers of cadastral errors, error per ha	1.838	5.348	0.000	105.708
Share of land in private ownership, percent	71.671	21.939	7.829	100.000
Share of land in state ownership, percent	21.336	18.281	0.034	100.000
Share of arable land, normative valued, percent	28.802	33.429	2.694	100.000
Number of taxpayers, per 1,000 of landowners	402.546	285.609	0.000	1134.827
Average registration time, days	1.589	2.718	0.006	34.259
Number of civil cases, per 10,000 of landowners and land users	5.626	6.274	0.000	24.961
Number of administrative cases, per 10,000 of landowners and land users	0.828	1.326	0.000	5.307
Number of rent transactions, per 1,000 of landowners and land users	35.853	34.236	0.000	109.951

We have constructed main farm specific control variables (HHI, CI) and proxies for TFP (TE) such as:

- *Herfindahl-Hirschman Index* (HHI) was obtained by rayon level as the level of concentration of land in particular rayon;
- *capital intensity* (CI) was obtained as labor cost to capital ratio;
- *farm sizes* was proxied by *total land*, which specific farm is operated;
- *technical efficiency scores* was calculated as order-alpha nonparametric partial frontier at 95 % level. The details on description of the control variables is available in the Appendix.

Table 2. Descriptive statistics for farm-level accounting data for 2007-2015 years (before preprocessing)

Variable	Mean	Standard Deviation	Minimum	Maximum
Total revenue, thous. UAH	10001.450	46448.080	0.000	7238831.000
Value-added revenue, thous. UAH	5503.996	36513.880	-2139882.000	6236961.000
Total material costs, thous. UAH	4102.031	17271.020	0.000	2173338.000
Labor costs, thous. UAH	656.752	10288.830	0.000	2642958.000
Capital, thous. UAH	539.823	3493.023	0.000	642900.000
Workers	40.224	96.470	1.000	5683.000
Total land, ha	2079.461	5242.903	1.000	773568.000

For estimation approach and for obtaining more precise and consistent results this data was processed in following steps:

1) We considered only necessary variables and create value-added output in monetary terms (by subtracting from monetary revenues all material costs, including oil costs, fertilizers costs, fuel costs, etc.);

2) Then, we dropped *outliers* and strange farms. We considered them as:

   a) firms which are higher than 99th percentile by revenue per ha of land;

   b) firms which are higher than 99th percentile by material costs, labor and salary;

   c) firms which report 0`s or less in revenues, land, labor, labor costs and capital;

   d) firms which are very small (which report labor less than 10 workers).

3) We deflate each monetary variable by appropriate industry deflator for each particular year[2];

4) Finally, we removed *not lasting firms* (with age less than 3 years and gaps in reported statistics) in order to deal with selection bias in our estimation approach. We also removed all observations from 2015 year because of new system of encoding from the State Statistic Committee of Ukraine (SSSU).

The descriptive statistics of cleaned data, which now consists of 28,441 observations of 4383 firms is provided in Table 3. Interesting that for some variables variation decreases (Total revenue)or remains unchanged. For almost all variables, mean values do not change so much.

[2] http://www.ukrstat.gov.ua/operativ/operativ2017/ct/icsh/xls/icsh2017_u.zip

Table 3. Descriptive statistics for farm-level accounting data for 2007-2015 years (after cleaning)

Variable	Mean	Standard Deviation	Minimum	Maximum
Total revenue, thous. UAH	11561.780	29525.740	0.400	1497667.000
Value-added revenue, thous. UAH	6090.807	22537.990	-2139882.000	1011528.000
Total material costs, thous. UAH	5470.973	17424.990	0.000	2173338.000
Labor costs, thous. UAH	989.462	14403.590	0.500	2642958.000
Capital, thous. UAH	707.261	3130.134	0.100	467576.500
Workers	62.635	120.321	10.000	5683.000
Total land, ha	3090.303	5536.793	3.000	319716.000

Also, we analyze the distribution of variables after cleaning the data and see that natural logarithm of them (necessary for estimation of final equation (2)) have close to standard normal distribution (see the histograms in Appendix). The corresponding descriptive statistics of logarithms of the farm data is provided in Table 4.

After the calculation of logarithm of TFP as residuals of production function and they are normally distributed around the mean (see the distribution of log(TFP) in Appendix).

Table 4. Descriptive statistics for farm-level accounting data in logarithms (after cleaning)

Variable	Mean	Standard Deviation	Minimum	Maximum
Log (Total revenue)	8.128	1.102	-1.660	12.295
Log (Value-added revenue)	7.477	1.237	-2.341	12.263
Log (Total material costs)	7.466	0.975	-0.999	10.606
Log (Labor costs)	5.742	0.897	-1.212	8.074
Log (Capital)	5.063	1.409	-2.676	9.257
Log (Workers)	3.622	0.680	2.303	5.781
Log (Total land)	7.576	0.766	1.099	12.675

C h a p t e r 5

RESULTS

After calculation of production function for all available farm level data we obtain estimated coefficients presented in Table 4. All coefficients of production function are statistically significant at 0.1% level. Also, production function exhibit constant returns to scale.

Table 5. Estimation results for production function with 100 bootstrap replications

Variable	Coefficient
l_{it} (labor)	0.237***
	(0.004)
k_{it} (capital)	0.211***
	(0.010)
a_{it} (land)	0.546***
	(0.007)

*** p<0.001, ** p<0.01, * p<0.05

The second stage model (equation (2)) estimates are presented in the Tables 6-7. We consider all institutional features ($\mathbf{F}_{gt}$, $\mathbf{I}_{gt}$, $\mathbf{T}_{gt}$, $\mathbf{R}_{gt}$) separately (Table 6) and in one equation in logs and also add a column with such a specification of model in standardized values to compare the weight of each of the explanatory variables on productivity (Table 7). The models presented in the Table 6-7 is a cross section regression for 2014 year, for this is the only time overlap of the farm-level and Land Monitoring datasets available. We matched farm-level TFPs and controls for 2014 with rayon level land institutions indicators for that year and estimated the second stage model, considered clustered standard errors.

Also, in Table 6 logarithm of TFP is our dependent variable (from equation (2)). In Table 7 first two columns represents equation (2) (OLS for all features and standardized variables) and the last two columns represents equation (3) with the same explanatory variables.

As we can see, land governance indicators of $\mathbf{F}_{gt}$ almost all (except share of land with normative monetary valuation) are insignificant. For $\mathbf{I}_{gt}$ and $\mathbf{T}_{gt}$ we have marginally significant coefficients and for $\mathbf{R}_{gt}$ – insignificant. After this, we analyze LGI for multicollinearity in the corresponding correlation matrix in Appendix. Here we see, that here we do not have any problem with multicollinearity, so we decide to add all institutional features in one line in order to handle omitted variable bias. This turns in quite interesting results – 4 out of 9 indicators are significant at least at 10 % level. Therefore, the last specification was chosen to estimate actual contribution to the TFP of each of the variables – farm-specific and institutional factors, and to check the model with TE as dependent variable (estimating of (3)).

Interesting that lagged TFP turns to be insignificant, which could be explained by the fact that productivity of farm is not a self-driven process.

One thing, which we should mentioned before further analysis of results is that all farm-specific variables have almost the same values and level of significance in all four regressions and in the last full-model specification of (2).

Unfortunately, direct indicators of formalization (shares of land, officially registered in state cadaster) are insignificant in this specification. This could be explained by very low speed of fulfillment cadaster with data and therefore the impact of such a change are very low at this stage of land governance development.

Table 6. Estimation results for the second stage model separately for all LGI

Variable	OLS (2) ($\mathbf{F}_{gt}$)	OLS (2) ($\mathbf{I}_{gt}$)	OLS (2) ($\mathbf{T}_{gt}$)	OLS (2) ($\mathbf{R}_{gt}$)
Lag of log(TFP)	0.003	0.005	-0.004	-0.004
	(0.018)	(0.018)	(0.018)	(0.018)
Total land	5.47e-05***	5.12e-05***	5.14e-05***	5.07e-05***
	(9.51e-06)	(9.46e-06)	(9.54e-06)	(9.53e-06)
Total land squared	-1.93e-10***	-1.83e-10***	-1.84e-10***	-1.82e-10***
	(2.94e-11)	(2.93e-11)	(2.95e-11)	(2.95e-11)
Log(HHI)	-0.082**	-0.032	-0.027	-0.024
	(0.042)	(0.040)	(0.040)	(0.041)
Capital intensity	-0.007	-0.007	-0.007	-0.007
	(0.010)	(0.010)	(0.010)	(0.010)
Capital intensity squared	3.99e-05	4.02e-05	4.54e-05	4.25e-05
	(4.93e-05)	(4.99e-05)	(4.97e-05)	(5.00e-05)
Log(# of cadastral errors)	-0.089 (0.077)	–	–	–
Log(Share of registered state land)	-0.014 (0.030)	–	–	–
Log(Share of registered private land)	-0.042 (0.094)	–	–	–
Log(share of land with normative valuation)	0.173** (0.040)	–	–	–
Log(# of taxpayers)	0.011 (0.035)	–	–	–
Log(Average registration time)	–	-0.051* (0.031)	–	–
Log(# of civil cases)	–	–	0.062* (0.028)	–
Log(# of administrative cases)	–	–	-0.035 (0.056)	–
Log(# of rent transactions)	–	–	–	0.012 (0.020)
Constant	0.953**	1.338***	1.228***	1.276***
	(0.426)	(0.090)	(0.097)	(0.101)
R-sq.	0.026	0.017	0.018	0.016
N of observations	2,957	2,957	2,957	2,957

*** p<0.01, ** p<0.05, * p<0.10

Table 7. Estimation results for the second stage model (2) and (3) for all features and standardized variables

Variable	OLS (2) all features	Standardized variables (2)	OLS (3) all features	Standardized variables (3)
Lag of TFP	0.003	0.003	–	–
	(0.018)	(0.017)		
Total land	5.54e-05***	0.360***	1.14e-04***	1.046***
	(9.42e-06)	(0.061)	(6.90e-06)	(0.063)
Total land squared	-1.96e-10***	-0.007***	-3.54e-10***	-0.019***
	(2.92e-11)	(0.001)	(2.14e-11)	(0.001)
Log(HHI)	-0.086**	-0.060**	-0.100***	-0.098***
	(0.042)	(0.029)	(0.029)	(0.028)
Capital intensity	-0.006	-0.025	0.032***	0.196***
	(0.010)	(0.043)	(0.010)	(0.060)
Capital intensity	3.47e-05	0.001	-1.45e-04***	-0.003***
squared	(4.92e-05)	(0.001)	(4.83e-05)	(0.001)
Log(# of cadastral	-0.045	-0.016	-0.120*	-0.059*
errors)	(0.080)	(0.028)	(0.070)	(0.034)
Log(Share of registered	-0.027	-0.024	-0.022	-0.027
state land)	(0.029)	(0.025)	(0.022)	(0.026)
Log(Share of registered	-0.055	-0.015	0.081	0.032
private land)	(0.096)	(0.027)	(0.074)	(0.029)
Log(share of land with normative monetary valuation)	0.186***	0.123***	0.135***	0.126***
	(0.041)	(0.027)	(0.030)	(0.028)
Log(# of taxpayers)	0.025	0.020	0.018	0.020
	(0.038)	(0.030)	(0.022)	(0.025)
Log(Average time for registration of land in cadaster)	-0.053*	-0.039*	-0.006	-0.006
	(0.029)	(0.022)	(0.020)	(0.021)
Log(# of civil cases)	0.045*	0.040*	0.045**	0.057**
	(0.027)	(0.023)	(0.018)	(0.022)
Log(# of administrative	-0.054	-0.027	-0.050	-0.034
cases)	(0.059)	(0.029)	(0.038)	(0.026)
Log(# of rent	0.038*	0.045*	0.016	0.027
transactions)	(0.023)	(0.026)	(0.016)	(0.027)
Constant	0 .767*	0.002	-1.276***	0.016
	(0.435)	(0.024)	(0.346)	(0.022)
R-sq.	0.031	0.031	0.151	0.151
N of observations	2,957	2,957	3,379	3,379

*** p<0.01, ** p<0.05, * p<0.10

The empirical results above reveal interesting information about the role of land institutions. For the visual inspection and clarification of key insights we construct special diagram (Figure 1). First of all, it demonstrates that farm specific characteristic (in particular, size of a farm) plays a much bigger role in explaining farms TFPs rather than land institutions and environment variables. Interestingly, that capital intensity contribution in (2) is small and insignificant, while in (3) it very significant and exhibit negative non-linear relationship between better managerial efforts and capital intensive production. In (2), statistically (if we account for standard errors), the effect of farm size is the same, and it is also non-linear, reflecting diminishing returns to scale. The turning point for the land is about 6,000 ha.

Land institutions and market structure variables turned out to have a much lower impact, if significant. For example, a variable that reflects a more competitive environment (HHI) is negative and statistically significant at 5% level – the same as many institutional features. Half of the institutional variables are insignificant, but here we see some good insights is those, which are significant. Virtually all variables that proxy security of land property rights turned out to be statistically insignificant, except the share of land, for which the normative monetary valuation of the land is carried out. This particular feature is very statistically significant (at 1% level) and positively contributes to TFP the biggest share among all LGI. We can see that an increase in formalization of land rights positively affect land tenure security, which positively associated with a higher level of TFP.

The efficiency and level of trust to land institutions does have a significant role in farms' productivity. The average time which is needed to register land parcel in cadaster is negatively and marginally significantly associated with farms' productivity levels TFP, i.e., higher transaction costs for farmers associated with the interactions with the land state institutions do reduce farms' productivity. This implies that less administrative burden of land institutions would positively reflect on agricultural productivity. Higher number of civil cases is positively associated (at 10%) with higher level of

TFP, which supports our hypothesis about positive impact of level of trust to institutions. The same is right about our proxy for efficient reallocation of resources (in particular, land) – number of rent transactions, which are positively associated with higher TFP. Thus, it gives us a good signal about the necessity of land market improvement (both sales and rental).

Finally, we can summarize that combined effect of 1% improvements of all four LGI variables give additional 0.247% boost in farms' productivity. It is quite robust effect, while we compare it to the effect on technical efficiency (0.183%) and implies that institutions matter.

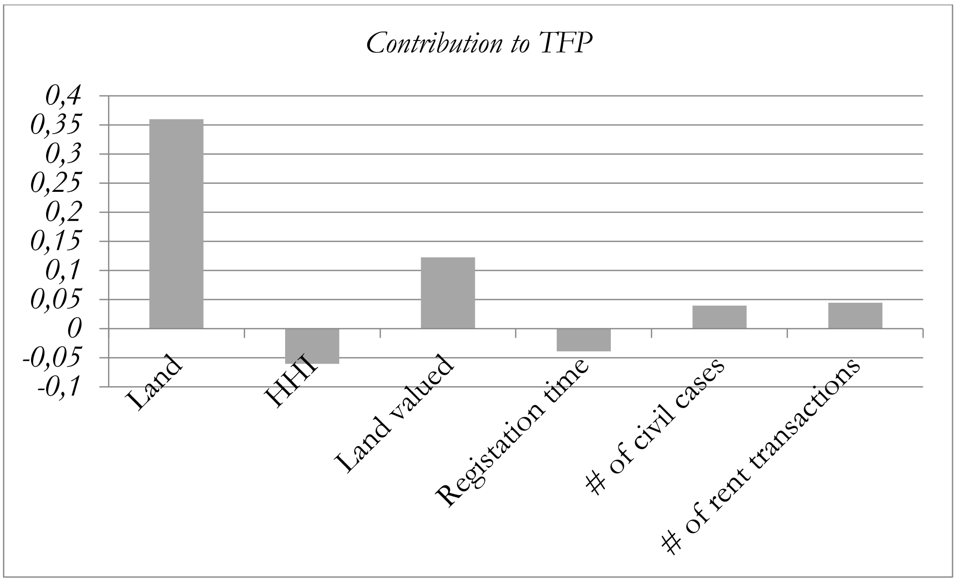

Figure 1. Contribution to TFP of farm specific features and institutional factors.

Chapter 6

CONCLUSIONS

Ukraine's agriculture increasingly contributes to the Ukrainian economy as well as to global food security. Its share in Ukraine's GDP increased to 14% in 2016, and its share in export revenues exceeded 40% in 2017. Ukraine's share in global exports of some agricultural commodities also increased quite dramatically. Over the last 16 years, Ukraine's share in global exports of grains increased from a meager 1% (2002/04 MY) to 17% (2018/19MY) for corn and from 4% to 9.2% for wheat. Despite such a superior growth, agricultural productivity in Ukraine remains just a fraction of its potential, so there is a significant untapped agricultural production and export potential with the country.

Weak land governance and institutions, including the moratorium on farmland sales, are generally recognized as the major source of a significant agricultural productivity gap in Ukraine (Deininger and Nizalov, 2016). In this thesis, we match a rich farm-level accounting data with a unique set of land governance indicators to measure the role of land institutions in enhancing agriculture productivity.

The empirical results revealed that, first of all, farm-specific characteristic (farm size) and competitive environment (HHI) play a much more prominent role in explaining farms TFPs than LGI. Nevertheless, land institutions turned out to have lower but still quite sizable significant impact. Virtually almost all institutional features have significant association with TFP at some level. Proxy for security of land property rights (share of land, for which the normative monetary valuation of the land is carried out) turned out to be statistically significant at 1% level and give the largest contribution to TFP among land institutions.

The efficiency of land institutions does have a significant role in farms' productivity. We see that average time which is needed to register land parcel in cadaster is negatively and significantly (at 5% level) associated with farms' productivity levels TFP.

Variable which imply the level of trust for institutions (number of civil cases) is marginally significant and its impact is interesting – we see that initial hypothesis was true about its positive association with higher productivity outcomes in different districts.

Last but not least, improvements in the land market (both rental and sales) are a necessary step in TFP growth – we see that higher number in the rental transaction is positively associated with higher farm performance. That gives us a signal about reducing competitiveness is some rayons, where rental contracts are signed for extended, and land users do not compete for a contract. Overall, institutional factors give smaller, but comparable to farm-specific characteristics and competitive environment.

A further step would include extending the farm-level analysis to include 2015 and 2016 years into the analysis so that the second stage model would turn into a panel data model to handle the endogeneity better.

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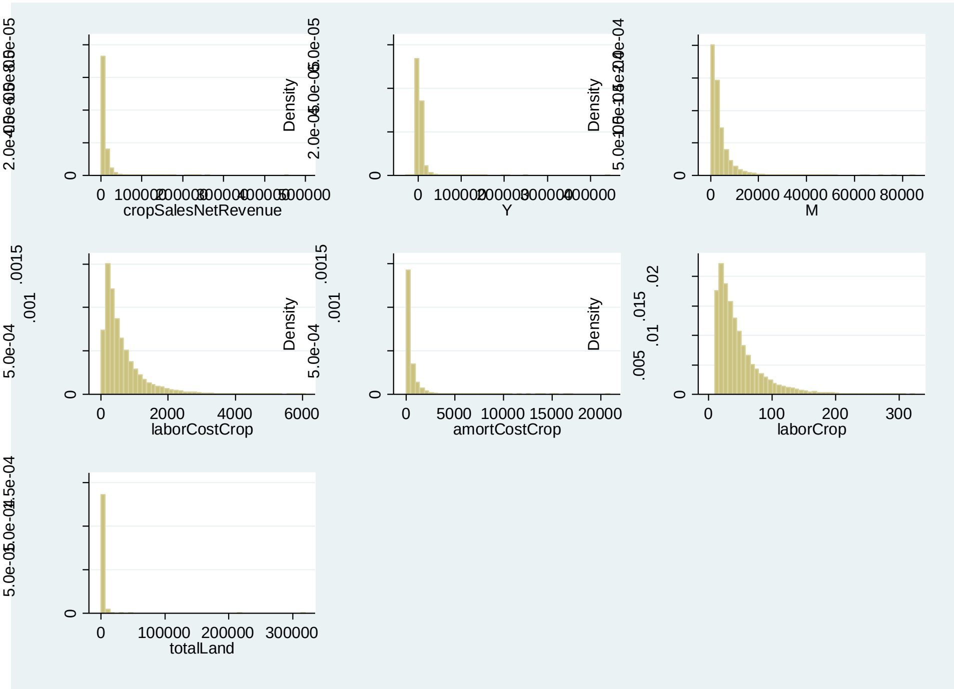

Figure 2. Distribution of farm variables from SSSU data after preprocessing

Source: Own estimation

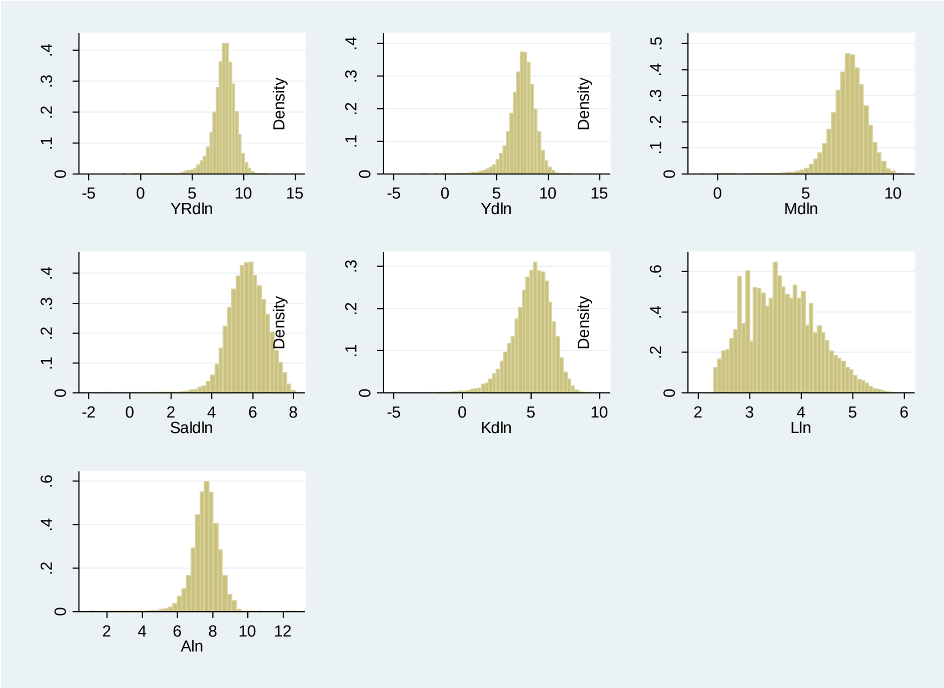

Figure 3. Distribution of log of farm variables from SSSU data after preprocessing

Source: Own estimation

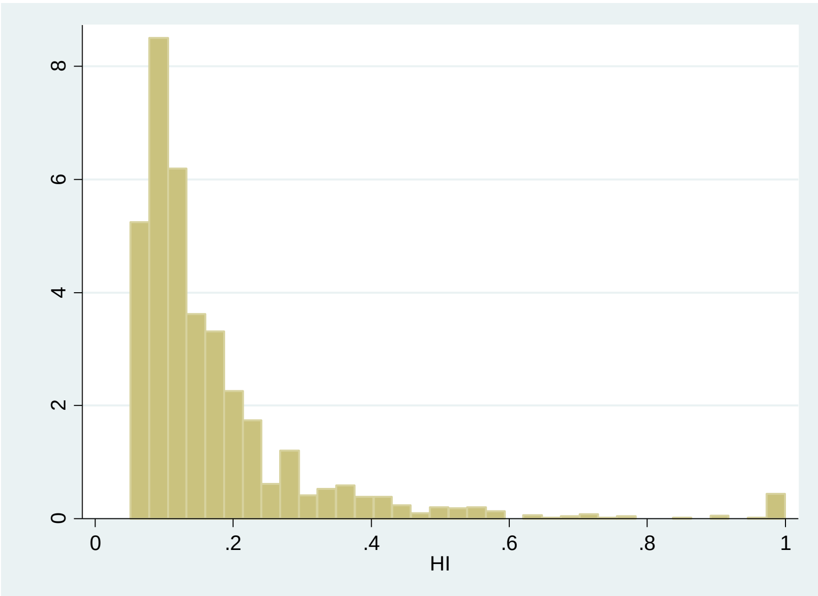

Figure 4. Distribution of Herfindahl-Hirschman Index

Source: Own estimation

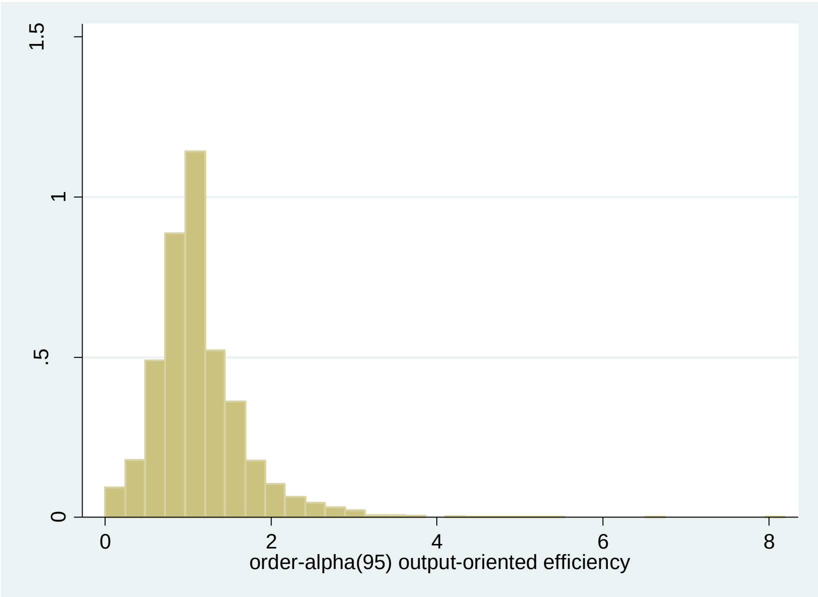

Figure 5. Distribution of order-alpha technical efficiency

Source: Own estimation

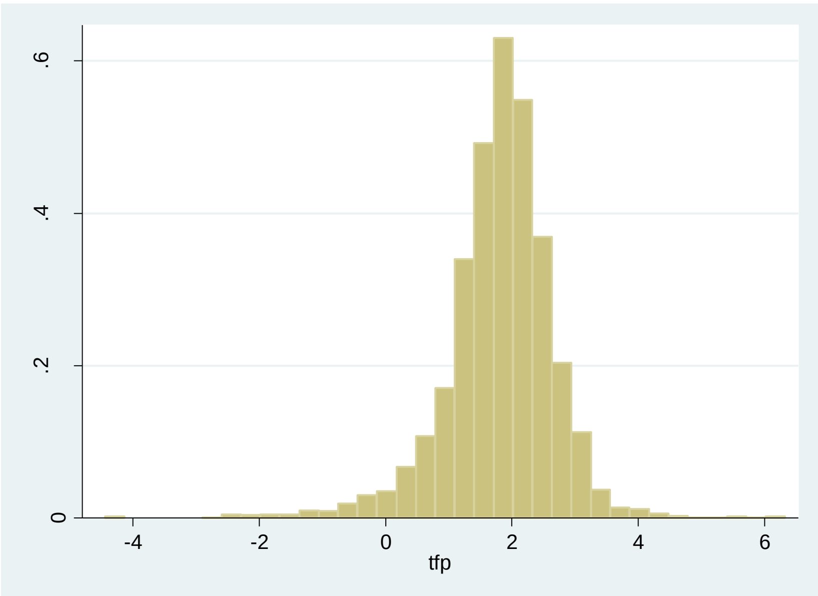

Figure 5. Distribution TFP, in log

Source: Own estimation

Table 8. Descriptive statistics for control variables for TFP

Variable	Mean	Standard Deviation	Minimum	Maximum
Herfindahl-Hirschman Index	0.178	0.158	0.051	1.000
Ln(Herfindahl-Hirschman Index)	-1.952	0.609	-2.975	0.000
Order-alpha efficiency	1.132	0.588	0.004	8.193
Ln(order-alpha efficiency)	-0.012	0.602	-5.55	2.103
Capital intensity	4.176	14.114	0.029	272.857

Table 9. Correlation matrix between LGI

	lnErrors	lnState Land	lnPrivate Land	lnValued	lnTax payers	lnReg Time	lnCivil Cases	lnAdmin Cases	lnRents
lnErrors	1.000								
lnState Land	-0.180	1.000							
lnPrivate Land	0.035	0.271	1.000						
lnValued	0.457	-0.186	0.045	1.000					
lnTax payers	0.090	0.069	0.081	0.022	1.000				
lnReg Time	0.118	-0.176	0.044	0.044	0.100	1.000			
lnCivil Cases	0.093	-0.041	0.129	0.198	0.138	0.022	1.000		
lnAdmin Cases	0.228	-0.115	0.153	0.277	0.160	0.162	0.259	1.000	
lnRents	-0.283	0.159	0.132	-0.314	-0.186	-0.120	-0.130	-0.262	1.000