THE EFFECT OF THE SHADOW MARKET ON AGRICULTURE AND RURAL DEVELOPMENT

by

Polina Kubakh

A thesis submitted in partial fulfillment of the requirements for the degree of

MA in Economic Analysis

Kyiv School of Economics

2021

Thesis Supervisor: Professor Oleg Nivievskyi

Approved by _____
Head of the KSE Defense Committee, Professor

_____

_____

_____

Date _____

Kyiv School of Economics

Abstract

THE EFFECT OF THE SHADOW MARKET ON AGRICULTURE AND RURAL DEVELOPMENT

by Polina Kubakh

Thesis Supervisor: Professor Oleg Nivievskyi

Agriculture and rural development are the topics of broad and current interest for researchers and policy makers. It is recognized as the main origin of economic stability and prosperity. Agriculture provides food, raw materials, employment opportunities for rural people, and an increase in output and productivity. However, the activity of many modern agricultural enterprises is safely hidden in the shadows. This thesis aims to assess the effect of the shadow agricultural market on agriculture and rural development using own constructed dataset spanning for 1995-2015 years. To conduct estimation, such approaches are employed: fixed effect panel regression and Heckman's two-step estimation procedure. Controlling for different economic and political indicators, shadow agricultural market appeared to have negative effect on agriculture and rural development, measured by agricultural TFP and expenditures on agricultural public goods. This thesis contributes to the development of the topic and fills the gap in the estimation process.

TABLE OF CONTENTS

TABLE OF CONTENTS — Continued

LIST OF FIGURES

Number *Page*

LIST OF TABLES

Number *Page*

ACKNOWLEDGEMENTS

I would like to express deep gratitude to my thesis supervisor Oleg Nivievskyi for supporting, guiding and motivating me during the process of writing my thesis. He shared valuable ideas and professional advice, which promoted bringing this work into life.

I would like to thank all KSE professors, who walked us through the incredible KSE way and gave us useful knowledge and skills. In particular, I am very grateful to the course instructors of the Research Workshop, who pushed us through the whole year and provided feedback that contributed to the accomplishment of this thesis.

I would like to express my sincere gratitude to Oleksandr Kravchenko for awarding me his scholarship for the master's studies. I am deeply appreciative of his support.

My separate words of gratitude are dedicated to my parents and boyfriend, who constantly encouraged and helped me to remain resistant and optimistic in the face of all difficulties.

GLOSSARY

ARD – Agriculture and Rural Development

UN – United Nations

SSSU – State Statistics Service of Ukraine

FAO – Food and Agriculture Organization of the United Nations

SDG – Sustainable Development Goals

GVA – Gross Value Added

IMF – International Monetary Fund

TFP – Total Factor Productivity

GRP – Gross Regional Product

GDPRD – Global Donor Platform for Rural Development

OECD – Organization for Economic Co-operation and Development

SPEED – Statistics on Public Expenditures for Economic Development

IEG – Independent Evaluation Group

GDP – Gross Domestic Product

CPI – Consumer Price Index

BE – Between Estimator

OLS – Ordinary Least Squares

GMM – Generalized Method of Moments

IV – Instrumental Variable

PPP – Purchasing Power Parity

USDA – U.S. Department of Agriculture

DFID – UK Department for International Development

OECD – The Organization for Economic Co-operation and Development

GSSE – General Services Support Estimate

PSE – Producer Support Estimate

Chapter 1

INTRODUCTION

Agriculture and rural development are the topics of broad and current interest during the discussions, conferences, meetings, and summits of the World Bank, FAO, UN, and many other world organizations. It is recognized as the main origin of economic stability and prosperity. Agriculture provides food, raw materials, employment opportunities for rural people, an increase in output and productivity. Therefore, agriculture and rural development is a part of most economic programs aimed at improving social welfare, quality of life and longevity, as well as reducing poverty.

According to the World Economic Situation and Prospects (WESP) report of the UN, Ukraine is an economy in transition, meaning that the issue of rural (30.53 %[1] of the population live in rural areas) and agricultural (around 18.2% and 44.7% of Labor Force are formally and informally employed in agriculture respectively[2]) development is important. Agriculture is the third sector in the economy after trade and manufacturing, generating 9% of the GVA in the GDP in 2019 (The World Bank). Therefore, promoting agriculture and rural development is an important national strategy. The results of development policy interventions can reduce poverty (23.1% earned less than the actual subsistence level in 2019 according to SSSU), which is still a huge problem in Ukraine; create jobs and means of subsistence for small farmers and their families. Moreover, such programs will have an effect on the whole economy and all people: well-being improvement, healthy life promotion and progress towards other SDGs. In this respect, agriculture and rural development are essential for the growth of a nation.

[1] The World Bank: https://data.worldbank.org/topic/agriculture-and-rural-development?locations=UA
[2] including forestry and fisheries, SSSU: http://www.ukrstat.gov.ua/

Figure 1 displays the percentage of rural to total population in Ukraine, Lower middle-income countries (Ukraine is included) and World. Ukraine has two times less percentage of people living in rural areas compared to the mean of countries with similar per capita real income. It is worth mentioning that in Lower-middle countries and World, the rural population growth is decreasing but positive while Ukraine has negative growth which is accelerating in absolute value over the considered period, 2010-2019. So, the rural population continues to increase at a slower rate in the mentioned groups of countries and fall at a faster rate in Ukraine. Around 75% of Ukrainians living in rural areas are over 60 and under 17 years of age, as economically active people migrate to cities.

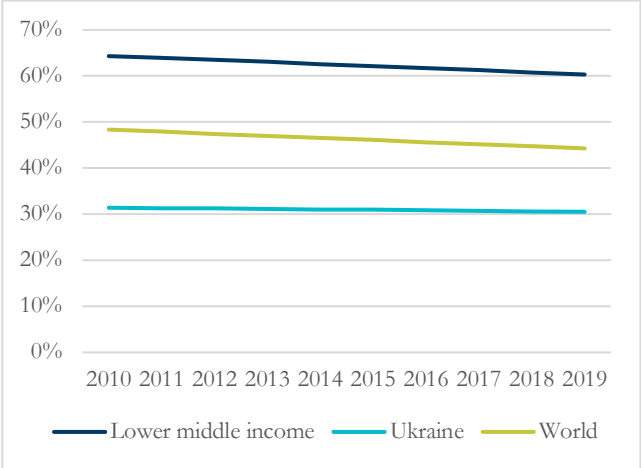

Figure 1. Rural population (% of the total population), 2010-2020
Source: The World Bank

The graph shows:

- the outflow of population from rural areas to cities continues
- no sufficient living and working conditions in the countryside
- a low level of development of rural areas

- since agriculture is labor-intensive, a decrease in labor results in a decrease in output

This negative demographic tendency in rural areas, permanent decrease in employment in agriculture and, consequently, a necessity for an active working population to support the agricultural sector, call for clearer policies and programs to respond (FAO 2012).

Such a situation is not acceptable and needs government intervention, which should be reasonable and justified. Ukraine has a lot of examples of ill-advised policies: grain export restrictions, cancelling VAT refund, interventions in prices, land moratorium and others. Such interventions create distortions to the market and welfare losses. So, any program should be critically analyzed and have examples of successful application. That's why ARD is an especially significant and important issue in the Ukrainian economy.

Ukraine is one of the top ten agricultural producing countries in the world[3] and top five agricultural exporters to EU[4]. Agriculture composes a significant part in the exports and it continues to enlarge its share. In 2012, agriculture constituted only 26.3% of exports while in 2019 the portion has increased to 44.3%[5]. Therefore, agriculture has become one of the key contributors to the budget[6]. However, the activity of many modern Ukrainian agricultural enterprises is securely hidden in the underground. The estimates are very rough and differ across sources. Some studies find that 25-30%[7] of the agricultural sector is concentrated in the shadows.

[3] Insider monkey: https://www.insidermonkey.com/blog/top-10-agricultural-producing-countries-in-the-world-885643/

[4] UKRINFORM: https://www.ukrinform.net/rubric-economy/3097548-ukraine-remains-among-top-five-agricultural-exporters-to-eu.html

[5] International Trade Administration: https://www.trade.gov/knowledge-product/ukraine-agricultural-sector

[6] Visnyk. Officially about taxes: http://www.visnuk.com.ua/uk/publication/100003680-de-pributki-mnozhatsya

[7] Agravery agricultural news agency: https://agravery.com/uk/posts/show/minekonomiki-vidhililo-proekt-kontrolu-tinovogo-oborotu-v-silskomu-gospodarstvi

The impact of the shadow economy is multidimensional, as the consequences of it could be observed on any level. On the macroeconomic level, it was established that the shadow economy does harm economic growth and hinders the improvement of living standards (Kelmanson et al. 2019). On the micro-level, it was found that the shadow economy reduces government revenues, which leads to under-provision or worse quality of public goods and services. Moreover, informal activities skew resource allocation away from efficiency, decrease human and physical capital accumulation, undermine productivity and potential output (Nivievskyi, Iavorskyi, and Donchenko 2020). In this research, we are aimed at testing the hypothesis about the negative effect of the shadow economy on the ARD, which will be represented and measured by agricultural TFP and government expenditures on public agricultural goods. However, we are aware of the unpredictable results since the shadow economy in the normal restrictions is not considered an absolute bad phenomenon. Sometimes, it is a refuge for small and medium enterprises during crises and financial unstable times. Also, some part of the shadow economy still generates budget revenues. For example, unofficial workers get their salaries in envelopes. Buying products in the supermarket, they pay VATs, which are collected by the government. Moreover, such workers can afford much more goods and services since they have more money than it is officially stated and pay more taxes. The unpredictable results could be found in the empirical studies, e.g., in paper of Elgin and Birinci (2016), where the shadow economy had a positive spillover effect on TFP growth and non-linear effect on GDP per capita growth.

Accounting for the shadow market effect, this thesis will contribute to the discussion of agricultural and rural development in Ukraine in the world as a whole as well as have policy implications. The relevance of the topic comes from the UN goals for sustainable development, World Bank programs and cooperation between the European Union and Ukraine. Moreover, estimating the effect of the shadow economy will help to answer such an important

question: how much benefit, as improvements in the economic indicators, on average, could be obtained if the country will reduce or tackle the shadow economy? Another implication is that the shadow economy can serve as an indicator of attitude and trust towards the government. If there is a huge trend of going into the informal sector, it means that some laws and rules don't work properly or economic agents disagree with them.

The thesis is structured in the following way. The second chapter presents an overview of existing studies and estimates of the shadow economy in Ukraine and in the world overall. The third chapter covers the review and the analysis of literature relevant to the discussed topic. The fourth chapter describes the methodology applied to the thesis. The fifth chapter is devoted to the data preparation and description used in the research. The subsequent chapter presents estimation results. The last chapter is devoted to conclusions as well as policy implications.

Chapter 2

SHADOW ECONOMY OVERVIEW

In this part of the thesis, we would like to make a review of existing studies and estimation of the shadow economy in Ukraine and in the world as a whole.

The Ministry for Development of Economy, Trade and Agriculture in Ukraine provide their estimation of the size of the shadow economy (Figure 2). According to them, the level of the shadow economy on the national level was 31% of the GDP while in the agricultural sector was registered about 26% during the 1st quarter in 2020.

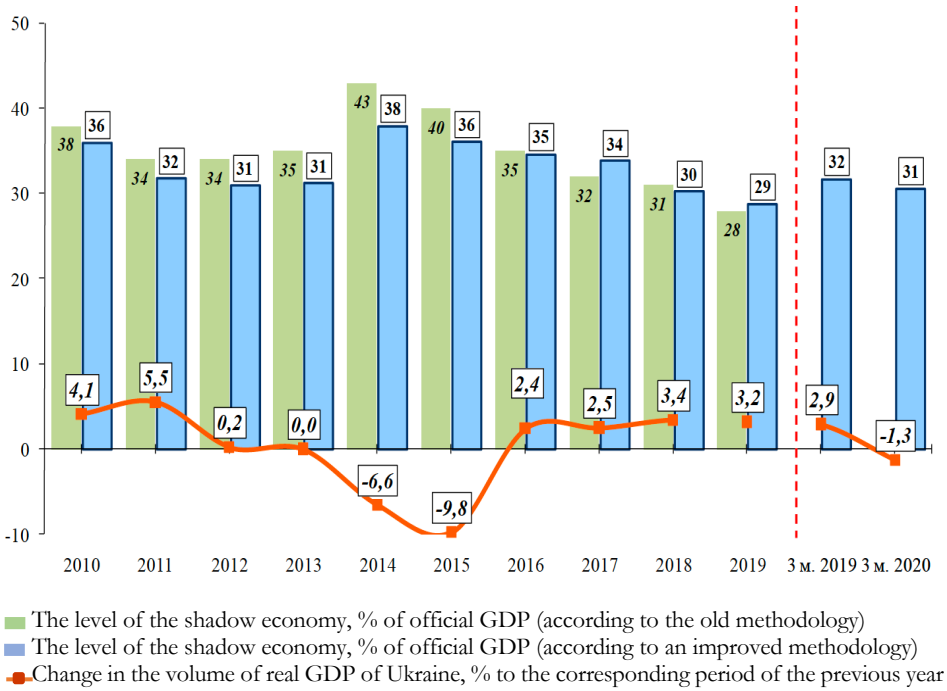

Figure 2. An integrated indicator of the level of the shadow economy in Ukraine (in% of official GDP) and growth/decline in real terms GDP (in % to the corresponding period of the previous year)
Source: Ministry for Development of Economy, Trade and Agriculture in Ukraine (2020)

Kyiv International Institute of Sociology (2019) estimated the size of the shadow economy in five regions of Ukraine using business survey data (Table 1). They found the shadow economy constituted 46.8% and 47.2% of the GDP in 2017 and 2018 respectively. They discovered that the size of the shadow economy is not uniformly distributed across the regions, ranging from 43.5% to 50.2%. In both years, the Southern region has the smallest size of the shadow economy across all regions. In 2018, the size of the informality increased in all regions except the North/Center.

Table 1. Size of shadow economy distributed by regions over 2017 and 2018

Year	South	West	East	North/Center	Kyiv City
2017	43.5%	43.5%	44.3%	50.2%	44.9%
2018	44.7%	47.6%	46.1%	45.9%	45.7%

Source: Kyiv International Institute of Sociology (2019)

Kyiv International Institute of Sociology (2019) also revealed that the major component of the shadow economy is Unreported business income (Figure 3). They advise not to punish the "law-breakers" but find approaches and ways of inviting business to work officially.

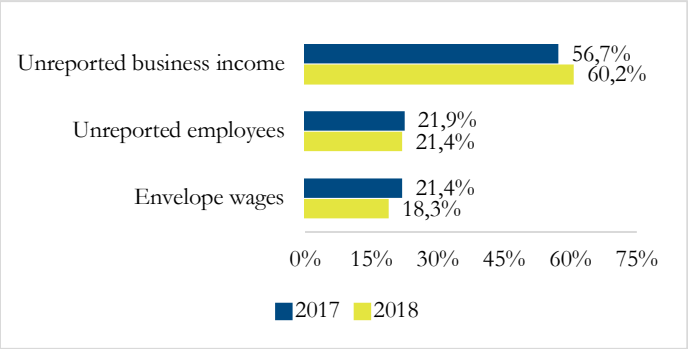

Figure 3. Components of the shadow economy, 2017-2018
Source: Kyiv International Institute of Sociology (2019)

Putnins and Sauka (2020) estimated the size of the shadow economy in Ukraine over the period of 2017-2018 using a new survey-based approach of measuring it elaborated by them in 2015. It consists of a survey of entrepreneurs who have information on the "envelope" wages, unofficial employment and underreported income. The questions were aimed at the activity of similar firms in the industry, not at the company itself. The process of selection answers had a lot of subtle nuances. Nonetheless, the results showed the size of the shadow economy in Ukraine was 38.5% and 38.2% of the GDP in 2017 and 2018 respectively.

According to worldwide country studies, there are two main sources with estimates of the shadow economy: Medina and Schneider (2018), Elgin and Oztunali (2012). Medina and Schneider estimated the size of the shadow economy for balanced 158-country panel data over the period 1991 and 2015 using MIMIC approach. On the contrary, Elgin assessed informality for unbalanced data of 161 countries over 1950-2009 via a two-sector dynamic general equilibrium model. The results differ a lot. As an example, we presented the estimates for Ukraine in Figure 4.

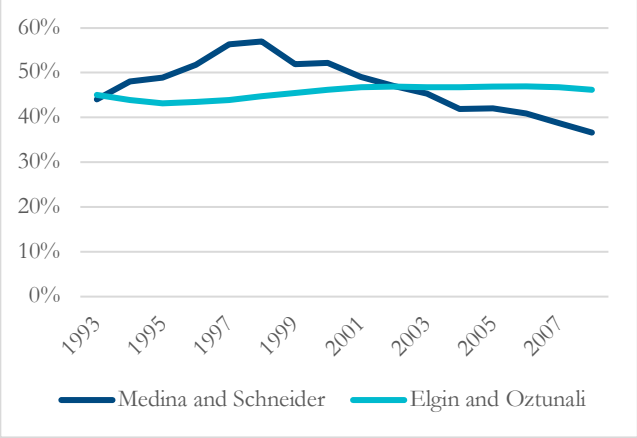

Figure 4. Size of the shadow economy in Ukraine according to two major databases
Source: Medina and Schneider (2018), Elgin and Oztunali (2012).

Medina and Schneider (2018) have conducted a research on the estimation of the shadow economy across countries. They revealed that the size of the shadow economy fluctuated in the range of 36% and 57% of official GDP with an average of 44.8% (Figure 5, Table 2). Roughly speaking, almost half of the Ukrainian economy is concentrated in the shadows according to the international evidence.

Table 2. Summary statistics of the shadow economy, % of official GDP

Country	Average	St.dev.	Median	Min	Max
Ukraine	44.80	5.59	42.90	36.65	57.00
World	32.28	2.45	33.13	28.25	35.62

Source: Medina and Schneider (2018)

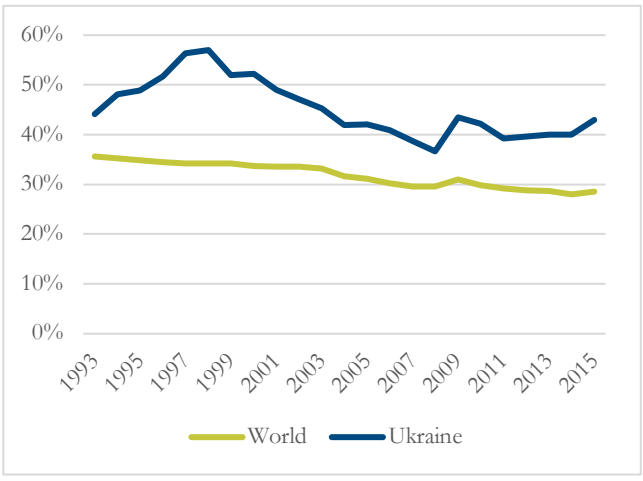

Figure 5. Size and development of the shadow economy of Ukraine
Source: Medina and Schneider (2018)

Summarizing, the studies are consistent in terms of the role and size of the shadow activities in Ukraine's economy. Researchers have revealed that shadow market occupies a considerable part of the Ukrainian economy. The lowest estimate was provided by the Ministry for Development of Economy, Trade and Agriculture in Ukraine – 31% while the highest one – by Kyiv International Institute of Sociology. The international evidence gravitates to Kyiv International Institute of Sociology estimates. The worldwide country studies use two country-wide datasets described above as interchangeable.

Chapter 3

LITERATURE REVIEW

3.1. Identifying and measuring agriculture and rural development

ARD is a topic receiving close review in national economic programs, as it is one of the ways of achieving Sustainable Development Goal 1, "ending poverty in all its forms everywhere"[8]. Therefore, the literature review mainly consists of the reports, documents, papers of the world organizations, who for the most part make research and contribute to the development of the topic.

The following groups of indicators are distinguished according to Global Donor Platform for Rural Development, Food and Agriculture Organization and World Bank (2008):

- Core ARD sector indicators
- Agribusiness and Market Development
- Community-based rural development
- Fisheries (aquaculture)
- Forestry
- Livestock
- Policies and institutions
- Research and extension
- Rural Finance
- Sustainable land and crop management
- Water resource management

[8] Sustainable Development Goals https://www.un.org/sustainabledevelopment/poverty/

Each group consists of its indicators, which help to monitor and evaluate the agriculture and rural development activities. Depending on the data, information and goals, each country chooses which indicators to use. To test the main hypothesis mentioned in the Introduction that the shadow economy leads to under-provision of public goods/services and undermines productivity, we will restrict our analysis to such two components in our research: expenditures on the public agri-good provision and agricultural Total Factor Productivity.

According to GDPRD, FAO and World Bank (2008), these two indicators are among the most representative for the level of ARD. So, public goods expenditures and output are the criteria for monitoring performance and the development of rural communities. Public goods expenditure show commitment to promoting agriculture and rural areas while productivity demonstrates the growth potential. These indicators are considered to be long-term outcomes, which will help us to catch the long-run effect in our empirical analysis.

Kelmanson et al (2019) claim that productivity is a good instrument in the evaluation of the level of development, which has a high correlation with taxes and demand for public goods. So, the authors confirm our assumptions that TFP and expenditures on the public good provision are appropriate proxies to measure ARD.

Productivity and public goods expenditures widely used in the analysis of the agriculture and rural development of countries since they are associated with living standards and economic growth. Productivity is the main driver of agricultural growth as well as an indicator of performance and competitiveness. Public goods expenditures play a key role in agricultural sector operation. In the report of FAO (2019), it was investigated that rural poverty exists in the territories where a large number of producers with low productivity and limited access to land and public goods.

3.2. Identifying and measuring the shadow economy

To the best of our knowledge, there are no many studies related to the shadow agricultural sector. Therefore, there is an obvious lack of specific methodological approaches for estimating the informal agricultural sector. While we do not have evidence on the size and effect of the shadow agri-market, there is more information available on the shadow economy overall. Thus, we would like to investigate the impact of the shadow economy in the literature in order to understand what effect the shadow agricultural market would have on our two variables of interest, agricultural TFP and expenditures on public goods provided by the government to the agricultural sector.

In this part of the thesis, we would like to give the definition of the shadow economy, make a review on the existing approaches of its size measuring and proceed with the methodology used for estimating the effect of it on agricultural and rural development.

We would like to begin with definition of shadow economy which will apply to our research. There are many different approaches of determining the shadow agricultural economy. Most researchers define the shadow economy mainly using OECD classification and findings of Schneider, one of the experts in this field.

While conducting the analysis of the size of the shadow economy, Kelmanson et al (2019), who made a contribution to the development of the topic of the shadow economy, used definitions suggested by Schneider (2014) and summarized as following: "the legal economic and productive activities that are deliberately hidden from official authorities".

In the research conducted by Putnins and Sauka (2020), they narrowed shadow economy to "legal production of goods and services produced by

registered firms that is deliberately concealed from public authorities", making reference to OECD (2002).

Using OECD (2002) framework of Non-Observed Economy, Nivievskyi, Iavorskyi, and Donchenko (2020) determined it as the following: shadow agricultural economy includes unreported activities from the manufacturing of legal goods and services and informal agricultural/rural sector surpassing the farmers' production for their final consumption. So, the shadow agricultural economy consists of three subsets of the NOE economy: T4, T5, and T7 (Figure 6). According to the OECD (2002), underground activities (T4 and T5) include underreporting incomes, tax evasion and not registering. Illegal activities (T7) consist of production and sale of goods and services prohibited by law. The latter sector is not registered at all.

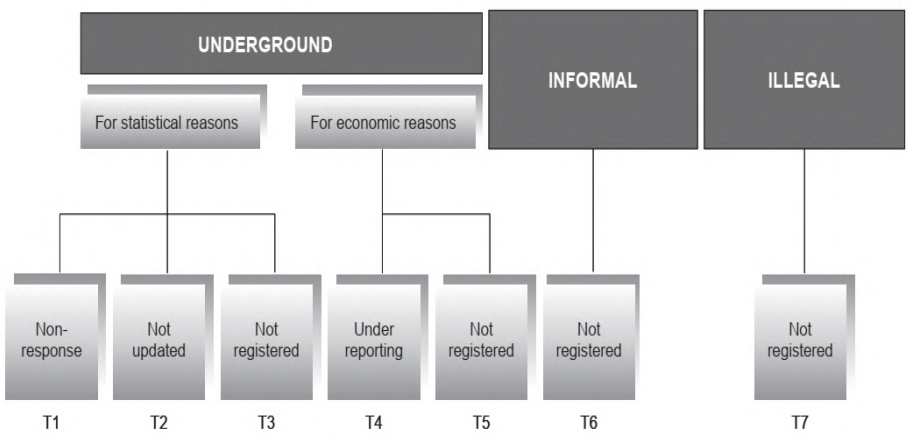

Figure 6. ISTAT Analytical Framework
Source: OECD (2002)

This definition is the most appropriate and will be adopted for the agricultural sector since we are going to focus on the size-oriented definition only.

To provide effective and efficient allocation of the resources, it is crucial for a country to evaluate the shadow economy and determine involved agents. However, it is a difficult task since economic actors don't want to be identified and conceal their activities.

According to the work of Medina and Schneider (2018), the shadow economy is measured in 6 ways:

1. The Discrepancy between National Expenditure and Income Statistics.

   It implies that the difference between national income and expenditure estimates is the size of the shadow economy. As a drawback, the main assumption is that measures of national expenditure are precise and do not correlate with the income factors.
2. The Discrepancy between the Official and Actual Labor Force.

   Assuming labor force participation unchanged, the decline in it means an increase in the informal sector. The assumption is very rough; therefore, this indicator is considered to be unreliable.
3. The Transaction Approach.

   Using the Fisher's equation $Money * Velocity = Prices * Transactions$ and assuming a constant relationship between money and value added (including informal), the equation can be rewritten in the following way: $Money * Velocity = k * (official\ GDP + shadow\ economy)$. The disadvantages of this method lie in the assumptions: k and velocity are assumed to be unchanged over time, which is not very realistic.
4. The Currency Demand Approach.

   It is supposed that underground transactions are taken in the form of cash, driving the demand for the currency. Tanzi (1980) proposed to estimate the size of the unofficial sector through a time-series model using macroeconomic indicators and factors inducing the switch to

informal activities. However, such a method has a lot of flaws, but the main one is hard underestimation.

5. The Physical Input (Electricity Consumption) Method
   The methodology of measuring the growth of the shadow economy, suggested by Kaufmann and Kaliberda (1996), lies in finding the difference between official GDP growth and electricity consumption growth. They believed that electricity consumption is the best indicator measuring both formal and informal activity since it was found empirically that electricity GDP elasticity is near one.
6. Multiple Indicators, Multiple Causes (MIMIC) approach
   The MIMIC model is considered to be one of the kinds of structural equation modeling. It includes establishing the relationship between observable causes (exogenous variables) and invisible effects of the shadow economy on macroeconomic indicators.
   The MIMIC approach is considered to be a powerful instrument in measuring the shadow economy, however, the only issue is the determination of true causes. As an advantage, the method allows to include any variables varying for regions (Kireenko and Nevzorova 2019).

Estimating the shadow economy can be done not only on country-level but also the region-level. Bilonizhko (2006) estimated the size of the shadow economy on oblast-level in Ukraine and Russia using the MIMIC approach. She used such causes: tax pressure, specialization of the region (industrial or agricultural), unemployment, criminality, number of small enterprises; and indicators of the shadow economy: real per capita Gross Regional Product and employment rate. The main findings in the studies:

- tax pressure, as well as region specialization, positively affects shadow economy
- unemployment negatively affects the informal sector

- the size of the shadow economy is similar across regions.

The similarity of the level of the shadow economy across regions is questionable. Komarova (2003) applied the Electricity consumption method across regions of Ukraine and Russia. She found diversity and great variability in the size of the shadow economy across regions.

So, the literature evidence sheds the light on the methods of the estimating the informality and allows us to use the estimates in our thesis.

3.3. The effect of the shadow market on agriculture and rural development

The discussion of the effect the shadow economy on agricultural and rural development can be found both in empirical and theoretical studies. The main research questions are how damaging the shadow economy is and whether underground activities impede agriculture and rural development as well as economic growth.

The empirical literature is mostly consistent on the negative relationship between the relative size of the shadow economy and its growth and productivity. We found this evidence in papers of Taymaz (2009), Hsieh and Klenow (2009), Kelmanson et al (2019) and other. As an exclusion, there is a study of Elgin and Birinci (2016), who found that the shadow economy had a positive effect on TFP growth and non-linear effect on GDP per capita growth.

Hoinaru et al (2020) analyzed the impact of the shadow economy and corruption on economic and sustainable development. The authors found that the increase in the size of the shadow economy is associated with a decrease in economic development (HDI) across all types of income groups. On average, one unit increase in the shadow market implies, a decrease in economic development by around 5%.

Taymaz (2009) analyzed the activities of Turkish firms and stated that informal firms are less productive since they hire less skilled labor and pay the workers less. The author found a huge difference in productivity between formal and informal firms. Also, the data showed an interesting pattern: more skilled workers moved to the official economy. The researcher concludes that a reduction of the shadow economy may increase productivity, but not all businesses will survive working officially.

Another point of view was suggested by Hsieh and Klenow (2009). They maintain that productivity is lowered due to the shadow economy as a result of the reallocation of resources towards the informal sector.

Despite defining the causes for the effect on productivity differently, the authors agreed on the negative effect of the shadow economy.

The opinion about negative effect is supported by another researchers. Using the World Bank firm survey data, Porta La and Shleifer (2008) noticed such pattern: firms operating unofficially were, on average, unproductive and labor-intensive. Moreover, such firms hired unskilled employees. They assert that the shadow economy supports many people but fades away when the country develops.

Kelmanson et al (2019) investigated the effect of the shadow economy on the productivity in Europe (including Eastern European countries) using fixed effect panel regression and revealed the negative relationship. Also, authors discovered that share of agriculture in GDP negatively correlates with the size of the shadow economy. So, they expect that increasing agriculture employment would decrease the size of the shadow economy.

The same negative effect on the provision of the public goods was found in the literature. Underground activities hinder proper taxes collection resulting in worsened government functioning and provision of public goods (Alvarez and Ruane 2019). Choi and Thum (2005) found that shadow activities kill

incentives to provide public goods and exacerbate the issue. Also, escaping into the informal sector turns out to be costly for those firms who receive the public good as an input for production.

The same results were obtained by Schneider (2000). He confirms that there is a negative effect of the shadow economy on the provision of public goods. The increase of the size of the shadow economy leads to less taxes collection by the government resulting in worsening the provision of public goods and development of the country.

Kelmanson et al (2019) summarized the consequences of the shadow economy existing: distortions on the market, reallocation of the resources, underreporting incomes, less budget earnings and, as a result, lower provision and access to public goods, which consists of education, healthcare, infrastructure, defense and other components. Lower quality of goods/services means weaker development of the country.

To sum everything up, the researchers are consistent with the effect of the shadow economy on agricultural and rural development. Imposing taxes on the farms, the government in return provides public goods, which foster productivity growth. Informal sector demotivates the government to help farmers by reducing the budget incomes. As a result, farmers are worse off as well as the state at all. Therefore, in our empirical analysis, we expect to obtain a negative sign of effects on agricultural productivity and public agricultural goods expenditures.

Chapter 4

METHODOLOGY

To the best of our knowledge, there are no available theoretical and empirical models on the effect of informal agricultural sector on agriculture and rural development. Therefore, this thesis will contribute to the development of the topic and fill the gap in the estimation process.

Based on the literature review on the relationship between productivity, public goods and the shadow economy overall, we would like to focus specifically only on the agricultural sector and outline two main hypotheses to be investigated in this research:

1. The shadow agricultural market negatively affects agricultural TFP in the country.
2. The informal agricultural sector leads to underprovision or worse quality of public goods and services provided by the government to the agricultural sector.

Concentrating on agricultural sector in our research, we would like to investigate the relationship between ARD indicators and shadow agricultural market. Our estimation strategy is the following:

1. We look for available empirical models on the effect of the shadow market on productivity and public goods.
2. We adapt existing models with respect to the agricultural sector.
3. We collect the data and define all variables: what each indicator means, in what database it could be found, how it is measured.
4. We convert the data in order to have the same base year across all variables.

5. We estimate two separate models, where the dependent variable is agricultural and rural development indicator: agricultural TFP and expenditures on public goods in agricultural sector.

Before proceeding with estimation methodologies, we would like to determine our main explanatory variable, shadow agricultural market: its measurement and data source.

4.1. Informal/Shadow agricultural sector identification

As was discussed in the Chapter 2, there are only several databases on the shadow economy over the Globe. Measuring shadow agricultural sector is even more difficult task. Since there are no accurate estimates for the informal agricultural sector, the proxy will be used. Shadow economy comes as one of the candidates. To check whether this variable will be a valid and good proxy, we collected available information on the measures of the informal agricultural sector (Table 3). Despite having short list of countries, data collected represent strong correlation of 0.948 between shadow economy and informal agricultural sector. To be a valid proxy, the variable should have high correlation with the variable of interest and this is what we have in our sample. Shadow economy validates assumption above and proves to be an appropriate proxy.

The estimates for the shadow economy will serve as proxy for the informal agricultural sector. The values of the informal sector from two databases mentioned above are similar. However, in Elgin's measurement, the estimates are smoothed, with no much variability and in most cases bear resemblance to linear trend. Therefore, we would draw attention on Schneider's database and will take it as the main data source for the size of the shadow economy. Instead, Elgin's results could be used in the robustness check.

Table 3. Comparison of the size of the shadow economy and informal agricultural sector

Country	Shadow economy, %	Informal agricultural sector, %
Italy	15	24.62
Poland	15	25.32
Germany	12	12.61
Spain	12	23.32
Turkey	20	29.77
Ukraine	30	47.20

Source: Schneider and Kearney (2013), Kyiv International Institute of Sociology (2019)

4.2. Modeling the effect of informal agricultural sector on agricultural TFP

We start our research from the modelling effect of the shadow agricultural sector on agricultural TFP. The baseline of our econometric model is taken from Elgin and Birinci (2016). The TFP growth is the outcome variable. The explanatory variables are GDP per capita, trade openness, government expenditure inflation, fiscal deficit, financial depth, corruption and law index.

The estimation is done for panel dataset of 161 countries over period of 1950 to 2010 by fixed effects estimator. We are going to use the similar to the paper procedure. Authors recognize a potential problem of endogeneity, therefore, they include important control variables, such as inflation, corruption, urbanization and so on. Authors explain that endogeneity could raise because of several potential problems:

- Measurement error. The informality estimates could be measured inaccurately since they come from two-sector dynamic general equilibrium model results from Elgin and Oztunali (2012).
- Omitted variables.

As a robustness check, they inspect the significance of the parameters by estimating using other estimators: between, pooled OLS and GMM. Also, they run several tests on endogeneity, multicollinearity and find no problems in the model.

We modified the model according to our research question. So, the main differences are the following:

- We adapt model to agricultural sector. Specifically, we consider variables of interest not on the whole economy level, but on the level of agricultural sector only.
- We take estimates from Schneider and Medina (2017).
- We keep control variables related to agricultural TFP from the paper of Elgin and Birinci (2016): trade openness, real GDP per capita, inflation, corruption. Inflation and trade openness are kept in the regression, as they are correlated with agricultural informality.
- We add other variables from papers studying the determinants of agricultural TFP: human capital, urbanization. (Liu et al., 2020)
- We add agricultural public expenditures variable since it is correlated with agricultural TFP.

The final specification is the following:

$$Agri\ TFP_{i,t} = \beta_0 + \beta_1 IS_{i,t} + \beta_2 IS_{i,t}^2 + \sum_k^n \beta_k X_{i,t} + \theta_i + \gamma_t + \varepsilon_{i,t} \quad (1)$$

$Agri\ TFP_{i,t}$ – agricultural TFP in country *i* and year *t*

$IS_{i,t}$ – informal sector size as % of GDP

$IS_{i,t}^2$ – quadratic term of the informal sector size as % of GDP to test a non-linear relationship.

$X_{i,t}$ – explanatory (control) variables: trade openness, real GDP per capita, inflation, corruption, human capital, urbanization and public expenditures on agriculture.

θ_i and γ_t – country and period fixed effects

$\varepsilon_{i,t}$ – error term.

We test the non-linearity of informal sector and TFP since the literature review has shown the non-linear relationship. Elgin and Birinci (2016) find quadratic term of the informal sector to be significant with a negative sign. In other works, such as Wu and Schneider (2019), the relationship between GDP growth and quadratic informal sector was tested. The results confirm the nonlinearity with positive sign. Despite GDP growth tested instead of agricultural TFP, we would take such outcomes into consideration these variables are interconnected. Agricultural TFP growth is not sufficient condition for economic growth, however, Gollin (2010) states that it is main source for economic development in majority of developing countries. So, we can expect significant but of different sign returns to the size of the informal sector.

4.3. Modeling the effect of informal agricultural sector on agricultural public goods expenditures

So far, we have not found a model in the empirical literature that was dealing with estimating the effect of the shadow agricultural market on government expenditures on agricultural public goods. Therefore, we adapt available models to our research question. The benchmark equation comes from the work of Lopez, Vinod and Wang (2008). The authors regress the share of government expenditures for public goods in total government expenditure

on growth of GDP per capita, total government consumption, taxes and total investment over GDP, inflation, lagged years of schooling, years of demographic stability, corruption, malaria ecological index and dummy variables for regions. They are aimed at testing the hypothesis that the composition of government expenditures promotes the economic growth and a decrease in inequality. We complete the model by introducing important variable, shadow market, and adapt to agricultural sector. Main changes to their framework:

- We use government expenditures on public goods in agriculture instead of the whole economy.
- We add the informal agricultural sector as a variable to the regression.
- We add urbanization (% of total population) as a control variable to keep differences in productivity and income between urban and rural areas, as was discussed in this paper as one of the model extensions.

The following framework is used:

$$Public\ goods\ in\ agriculture_{it} = \alpha + \beta_{sm} IS_{it} + \beta_z Z_{it} + \theta_i + \varepsilon_{it} \quad (2)$$

y_{it} – outcomes of interest of agriculture and rural development in the particular country and time period: public expenditures

IS_{it} – size of the informal agricultural sector in the particular country and time period

Z_{it} – set of time-variant exogenous variables: GDP per capita, inflation, urbanization, corruption, lagged human capital, trade openness.

θ_i – the unobserved, time-invariant error, which may be correlated with Z_{it}

ε_{it} – idiosyncratic time-variant errors.

Unfortunately, there is a problem of limited dependent variable due to peculiarities of OECD PSE database. OECD provides General Services Support Estimate (GSSE) only for 26 countries. Thus, instead of two-way fixed effects model, the estimation procedure will be done via Heckman model (1976).

Heckman's (1979) two-step estimation procedure includes two stages: estimating regression and selection equations. In the first stage, we estimate the probit model predicting the probability of data unit appearing in the sample. From the results, we get the inverse Mills ratio (transformation of the predicted values). In the second stage, we estimate the selection equation applying the ordinary least squares estimator to the model of interest including the inverse Mills ratio.

To have reliable estimates, Wooldridge (2015) recommends to include exclusion restriction: the variable that affects selecting procedure and has no effect on the dependent variable. The literature didn't show any variable for the General Services Support Estimate, therefore, we proceeded with our own reflections on the problem. We hypothesized that countries belonging to OECD membership has higher chance to have estimates in the database. Thus, we included in the dataset a dummy variable indicating 1 if country belongs to OECD list and 0 otherwise. The variable is time-variant since countries became OECD members in different years. As an additional exclusion restriction, we propose a variable that reflects competitiveness in the agricultural sector, since the OECD provides statistics for countries in which agriculture plays a significant role. Latruffe (2010) considers export indices as one of types of measurements for competitiveness. We chose export quantity index since it measures the change in the quantities of products traded relative to specific base period unit value. As alternatives, we will try Export Unit/Value Index and Export Value Index.

Chapter 5

DATA OVERVIEW

5.1. Data source and preparation

The data for this empirical analysis is worldwide country-level data over 1995-2015 years from several sources: USDA, the estimates of the shadow economy of Schneider and Medina (2017), World Bank, FAO, OECD, Harvard Dataverse, Transparency International and Human Development Data (Table 4).

The data preparation included merging databases by country and years. Therefore, data preparation was not without difficulties. Firstly, each variable had separate file (in some cases, several files, e.g., Public expenditures on agriculture and Corruption). Secondly, countries names were differently written in many sources, e.g.: Swaziland and Eswatini, Cote d'Ivoire and Côte d'Ivoire, United States of America and United States, Bahamas and Bahamas, The, and so on. Thirdly, some variables had different base year. For example, income level, represented by real GDP per capita, is measured in constant 2010 US$. Since most of our variables are evaluated in terms of 2005 year, we converted the data on real GDP per capita into international dollars, as was suggested by Liu et al (2020), using the GDP deflator time-series. Fourthly, each variable was measured in different range of time, so, there was a trade-off between adding additional variable and cutting dataset observations. The variable with the shortest time limits were corruption (data are available from 1995) and agricultural informal sector (data are available until 2015). The last obstacle was data inaccessibility for some countries. For the most part, statistics wasn't available for developing countries, situated in Africa and represented by small islands. For this reason, the special member state

territories weren't included in this study as well. Therefore, the final dataset consists of only 133 countries over the period of 1995 and 2015.

Table 4. Description of variables with data sources

Variables	Description of Variables and Source of Data
Agricultural TFP	Agricultural TFP indexes (base year 2005=100) over 1961-2016 from USDA.
Agricultural informal sector	Proxied by estimates of the shadow economy of Schneider and Medina (2017) over 1991-2015.
GDP per capita	GDP per capita (constant 2010 US$) over 1960-2019 from the World Bank (converted into 2005 international thousand dollars)
Inflation	Inflation, consumer prices (annual %) over 1960-2019 from WB.
Trade openness	Trade (% of GDP) over 1960-2019 from WB.
Urbanization	Urban population (% of total population) over 1960-2019 from WB.
Public expenditures on agriculture	Per capita agriculture expenditure in 2005 $PPP over 1980-2017 (2013-2017 are converted from 2010 to 2005), Statistics on Public Expenditures for Economic Development (SPEED) database.
Public goods in agriculture	General Service Support Estimate measured in millions of US$ and converted to real values from OECD PSE database.
Employment in agriculture	Number of people employed (in thousands) in agriculture from FAO.
Corruption	Corruption Perception Index over 1995-2020 from Transparency International.
Human capital	Mean years of schooling from Human Development Data (1990–2018) from the United Nations Development Program.

5.2. Data description

The dataset contains 2,793 observations for 133 countries across 21 years including some missed values (Table 5). The highest number of NAs is observed in corruption and public expenditures with 588 and 412 incomplete cases respectively. On the contrary, the shadow agricultural market and urbanization level have available information for the whole longitudinal data.

Table 5. Descriptive statistics of variables in the dataset

Statistic	N	Mean	Std. Dev.	Min	Max
Agricultural informal sector	2,793	31.26	12.55	7.96	71.95
TFP	2,779	101.50	19.79	57.11	515.98
Public expenditures on agriculture per capita	2,381	89.90	129.59	0.02	1,640.50
Expenditures on public agri-goods per agri-worker (K)	422	1.61	1.81	0.00	8.81
Inflation	2,579	9.14	36.11	-30.24	1,058.37
Trade openness	2,680	82.53	50.88	0.17	437.33
Corruption	2,205	42.83	23.87	1.00	99.40
Urbanization	2,793	57.33	23.11	7.21	100.00
GDP per capita (K)	2,782	11.64	16.91	0.09	94.44
Human capital	2,711	7.72	3.24	0.70	14.10

Source: USDA, World Bank, Harvard Dataverse, Transparency International, the databases of Schneider (2015)

According to Table 5, the mean of TFP index with base year of 2005 is 101.5. It means that, on average, TFP grew by 1.5% over the period of 1995 and 2015 relative to 2005 among considered countries. Singapore has the highest value of TFP index of 515.98 in 1995, while South Africa reached a minimum of 57.11 in 1995 among all states.

As for agricultural public expenditures, on average, countries spend around 90 $PPP per capita in a year. Some countries spend little money. The countries spending below 1 $PPP are situated in Africa: Democratic Republic of the Congo, Zambia, Zimbabwe, Malawi, Guinea-Bissau, Burundi, Liberia, Republic of the Congo, and Uganda. It can be explained by inability to pay for public goods, as these countries belong to low-income group[9]. Meanwhile, Qatar has the highest average expenditures on agricultural public goods of 1,640.5 $PPP. The reason for that might be the fact that Qatar is the richest country in the world, so they can afford larger amount of public goods and better quality of them. Moreover, since it is a resource-poor country with severe weather conditions, Qatar actively invests in high agricultural technologies and provides help to local farmers.

If we build the distribution variable, we will see that most variables have positively skewed distribution (Appendix A): TFP, public expenditures (PG), Inflation, trade openness (TO), Corruption (COR) and GDP. Some variables demonstrate multivariate distribution, such as informal agri-sector (IS), corruption, urbanization (URBAN) and human capital (HC). It is a sign of huge variability of values among countries implying heterogeneity.

A correlogram shows us that some variables are highly correlated with each other. The summary of the most correlated variables, where the threshold is the correlation coefficient is 0.5 in absolute terms (Table 6).

The high correlation between independent variables may result in multicollinearity, which hinders correct interpretation of the coefficients. Therefore, we will check such a problem in our final models. High collinearity should not exist for experimental variables of interest. In that case, even if multicollinearity is present in control variables, it could be neglected.

[9] List of Low-Income Countries is prepared by DFID (August of 2017). https://g2lm-lic.iza.org/call-phase-iv/list-of-lic/

Table 6. Summary of high correlated variables

Pair of variables	Correlation coefficient
Corruption and Informal sector	-0.59
Urbanization and Informal sector	-0.48
GDP and Informal sector	-0.62
GDP and Public expenditures	0.53
Urbanization and Corruption	0.55
GDP and Corruption	0.73
Human Capital and Corruption	0.56
GDP and Urbanization	0.61
Human Capital and Urbanization	0.69
Human Capital and GDP	0.60

The Figure 7 demonstrates how the average value of informal sector for 133 countries has changed over time. We can observe the trend is negatively sloped, meaning that there is a tendency for the decline in the size of the shadow agricultural market. However, we see some peak during 2009. It could be associated with the consequences of the global financial crisis when people had very strong motives to go into the shadows. Nevertheless, afterwards, the size is still falling.

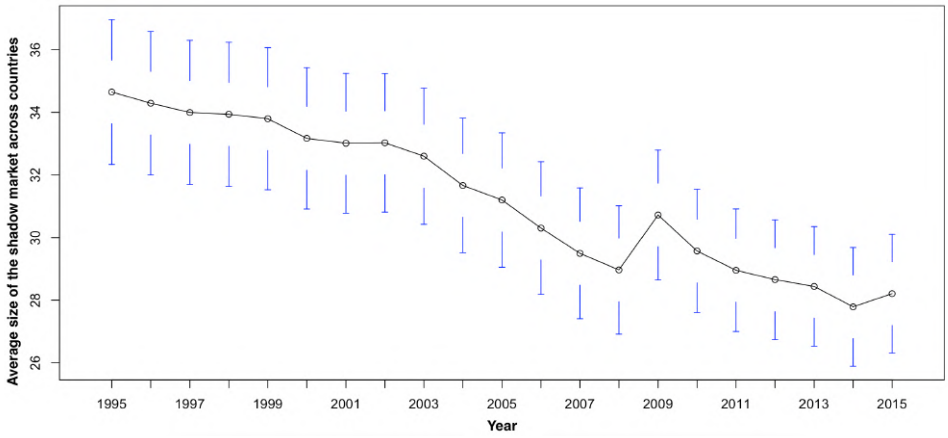

Figure 7. Heterogeneity in the informal agricultural sector across the years

Observing heterogeneity in Figure 7, the next interesting question would be how this heterogeneity could be distinguished across countries. To answer this question, we built a map with the average size of the shadow agricultural market (Figure 8). Territories with unavailable data are in white with no border edging. In the context of continents, South America, Africa and Australia have homogenous informality across belonging to them countries.

Among continents, Australia has the smallest size of the informal sector and forms 24.87% of the GDP. As a country, the average over period of 1995 and 2015 is 14.13%.

Considering the North America, the USA has the lowest level of 9.15% of the shadow economy. On average, the color intensifies from the North to the South, implying the increasing size of the shadow agricultural market. The maximum level of the informality is made by Guatemala with an average of 54.74%.

As for Africa, it has quite homogeneous color across countries, very dark, meaning that there is a high level of the shadow economy. To be more accurate, there is the highest level of the informality among continents with an average of 39.07%. The most "shadow" is concentrated in the center of the continent.

Europe has the increasing size of the shadow market from the East to the West. Including the Russian Federation, it has slightly higher size of the shadow economy, by 0.37%, than Australia and lower than the North America, which has the mean of 35.12% for its countries. Exclusive of Russia, allows Europe to have the smallest size of the informality across continents and makes 24.7% of the GDP. The smallest size of the shadow economy in the world is concentrated in Switzerland with an average of 8.89%.

Asia has the third position in the ascending order of the level of the informality, going after Europe and Australia. There are four countries with

standing out high values: Georgia – 64.87%, Azerbaijan – 52.19%, Myanmar – 51.39%, Thailand – 50.63%.

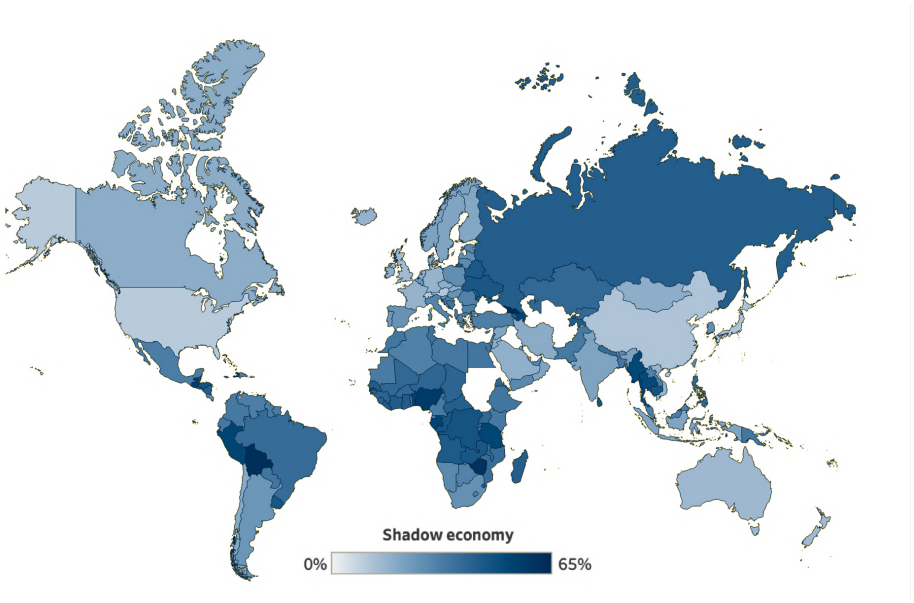

Figure 8. The shadow economy map
Source: own representation based on Schneider and Medina (2017)

Countries with less sizes of the shadow agricultural market have higher level of the GDP per capita (Figure 9). All high-income countries lie in the range of 9% and 33% of the informal agricultural market. The threshold is the Bahamas with 33% of the informality and $ 28.54K of the GDP per capita.

Having analyzed the high-income group, we cannot find any patterns in the scatter of public expenditures. At the minimum level of the informality, 9%, states have absolutely different values of public expenditures. For example, the USA has an average of 68 $PPP per capita while Switzerland has 13 times more. So, there is no consistent pattern in the forming public expenditures on agriculture.

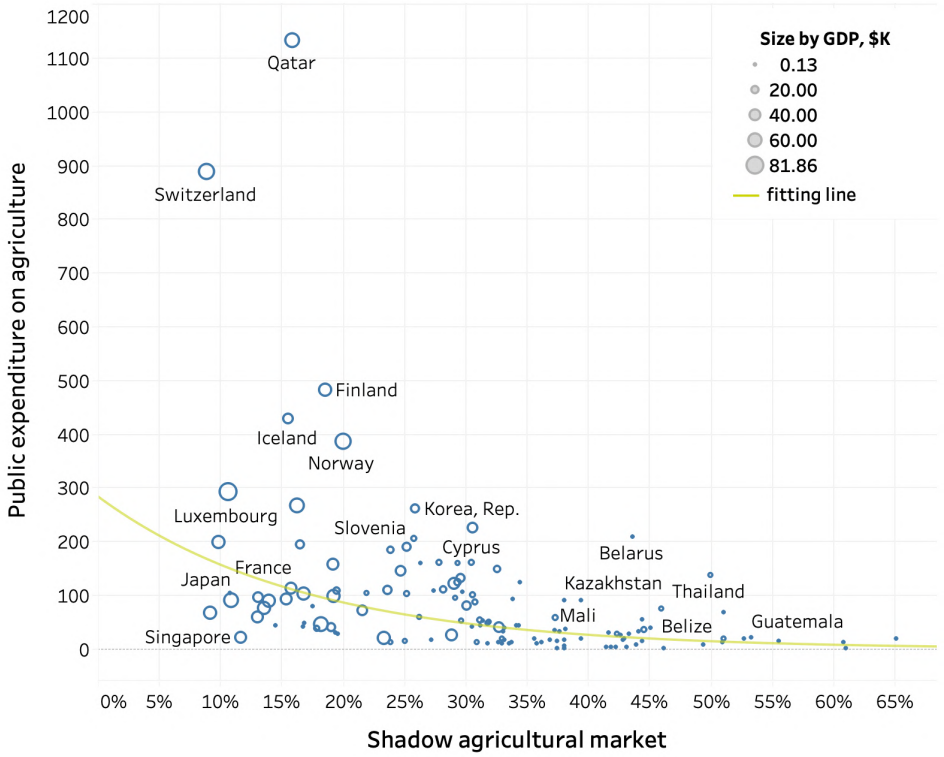

Figure 9. Bubble chart: Public expenditures on agriculture vs Shadow agricultural market
Source: own representation based on Schneider and Medina (2017) and SPEED (2019)

Countries with the size of the shadow agriculture greater than 33% have lower level of the GDP compared to predecessors. The variation of the per capita public expenditures on agriculture for such countries is smaller and reaches the maximum of 210 $PPP (case of Belarus). Ukraine is the one of countries belonging to this group. The average size of the informality and public expenditures on agriculture are 45% and 40 $PPP per capita respectively over the period of 1995 and 2015.

The most fitting line is the exponential one. It has the following form: $284.06 * e^{-0.059*IS}$. The equation describes the negative relationship between shadow agricultural market and agricultural public expenditures. On

average, if the agricultural informality increases by 1%, we'd expect agricultural public expenditures to decrease by 5.9%.

Summarizing all stated above, we can conclude that all distributions of dependent and control variables have skewed distribution and strong enough correlation with each other. The variables indicate heterogeneity. Thus, we will estimate the models using fixed-effects which can address heterogeneity.

Chapter 6

EMPIRICAL RESULTS

6.1. Shadow agricultural market and TFP estimation

As was suggested in Elgin and Birinci (2016), we will use a panel data model, fixed effects. We will follow the same approach in the estimation. Concretely, we will apply a fixed effects estimator to a panel dataset of 133 countries over period of 1995 to 2015 (21 years). The results are presented in Table 7.

To capture the size and sign of the effect, the authors include variable by variable in the regression in order to check robustness to inclusion different control variables (Appendix B).

Including variable by variable in the regression, we can see that the estimated coefficient of the linear term for the informal agricultural sector is negative. So, we confirm our hypothesis that the shadow agricultural market negatively affects agricultural TFP in the country. At the same time, the squared term is positive, meaning that we have decreasing returns to the shadow agricultural market. So, initially, TFP decreases with an increase in the agricultural informality, the marginal effect is decreasing and then at some point, TFP benefits from being in the shadows. These data seem to show a combination of a negative linear and a U-shaped quadratic trend. The signs of the effects are robust to the inclusion of various control variables in the regression. On average per country, when there is no shadow market, TFP index decreases by 2.58% over time for an additional 1% of shadow market.

Table 7. Estimation results for time FE model for agricultural TFP

	Agri-TFP
Informal agri-sector	-2.574***
	(0.569)
(Informal agri-sector)^2	0.019***
	(0.007)
Trade openness	-0.036
	(0.031)
Agri-public expenditures	-0.016**
	(0.007)
GDP per ca	-0.925***
	(0.231)
Inflation	-0.080**
	(0.039)
Corruption	-0.005
	(0.032)
Urbanization	1.760***
	(0.194)
Human capital	1.738**
	(0.835)
Observations	1,724
R2	0.166
Adjusted R2	0.098
F Statistic	35.325***
	df = 9; 1593

Standard errors in parentheses: *p<0.1; **p<0.05; ***p<0.01

The main result of Elgin and Birinci (2016) was that the shadow economy had a positive spillover effect on TFP growth on the whole economy level despite the fact that the majority of worldwide country studies found negative relationship using different models. Our results gravitate to the majority of the international findings.

Trade openness and corruption don't explain the changes in TFP. The same results were obtained by Elgin and Birinci (2016).

Human capital and urbanization positively correlate with agricultural TFP, meaning that capital formation makes significant contributions to the agricultural TFP and there is a rational reallocation of agricultural labor input to urban areas Liu et al (2020).

GDP per capita is significant and negatively correlated with agricultural TFP, indicating that higher income levels are associated with a lower level in agricultural TFP. The results are consistent with the findings of Liu et al (2020). This finding indicates that the agricultural productivity is lagged behind economic development.

Another result from the regression is that a smaller amount of government public spending on agriculture is associated with a higher agricultural TFP. The same findings were obtained by Elgin and Birinci (2016). Such result is not surprising and could be found in the literature. Public expenditures on agriculture consist of two main parts: expenditures on private (direct subsidies to products and producers) and public goods (R&D, education, infrastructure and so on). Private goods have negative effect on the agricultural sector. Thus, having negative effect of the agricultural public expenditures means that the share of private goods prevails or has stronger effect in the structure of the public expenditures on agriculture. It is a sign for policy makers to react since reallocation of public expenditure from private to public goods foster sustainable growth and development, as was discussed in of Lopez, Vinod and Wang (2008).

We also followed the robustness check procedure, suggested by Elgin and Birinci (2016): the between estimator and the GMM estimator. However, due to data peculiarities, namely, an inconsistent number of missing values in observations, we came up with a very short sample consisting of 122 instead of 1,724 observations in the regression output. Therefore, we couldn't rely on estimates.

We didn't run pooled OLS since it does not consider heterogeneity across countries or across years, which we actually observed in the Data Overview chapter in Figure 7. The results wouldn't make any sense. To be on the safe side, we ran pooled OLS and tested for fixed effects. The null-hypothesis is that OLS is better than fixed effects regression. The p-value is less than 2.2e-16, so we reject the null-hypothesis and accept the alternative, which means that fixed-effects model is preferred.

The last robustness check was done using random effects model because there is no guarantee that we included enough variables in the regression that explain the differences between the countries, which could affect the agricultural TFP. Then, we ran the Hausman test to decide between fixed or random effects, where the null hypothesis is that the preferred model is random effects. We reject the null-hypothesis and accept the alternative that fixed effects model is better with the p-value of less than 2.2e-16.

So, we confirm our hypothesis and obtained results have consistent effects with the paper of Elgin and Birinci (2016).

6.2. Shadow agricultural market and expenditures on public goods in agriculture estimation

Based on the described in the previous chapters theoretical and methodological background, we empirically test the research hypothesis that shadow agricultural market negatively affects expenditures on public goods in agriculture.

The results of two stages of the Heckman model are represented in Table 8. In the selection equation, OECD-variable is significant among our two exclusion restrictions. It is not surprising since the correlation coefficient between this variable and artificial variable reflecting sample selection is 0.331.

Table 8. Estimation results of Heckman model for agricultural public goods

	Probit selection equation	Outcome equation
	Expenditures on public goods per agri-worker, US$ K	
Shadow agri-market	-0.037***	-0.044*
	(0.005)	(0.025)
GDP per ca	-0.013***	0.043***
	(0.004)	(0.008)
Inflation	0.007**	0.010
	(0.005)	(0.009)
Urbanization	0.018***	0.019
	(0.003)	(0.016)
Trade openness	-0.014***	-0.019**
	(0.001)	(0.009)
Lagged human capital	0.133***	0.172**
	(0.021)	(0.082)
Corruption	-0.003	-0.011**
	(0.002)	(0.004)
OECD	0.227*	
	(0.117)	
Export quantity index	0.001	
	(0.001)	
Constant	-0.910***	-0.766
	(0.271)	(1.612)
Observations	1,997	
rho	0.639	
Inverse Mills Ratio	0.878 (0.921)	
Multiple R-Squared	0.5352	
Adjusted R-Squared	0.5252	

Standard errors in parentheses: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

So, indeed countries belonging to OECD membership correlate with presence of estimates in the database. More interestingly, the export quantity index does not explain the sample selection. The correlation index appeared

to be -0.04. We also tried other indices presented in the FAO database in order to find more exclusions restrictions: Export Unit/Value Index and Export Value Index. Unfortunately, they didn't work as well since they produce similar behavior over time as the export quantity index, which has no correlation. However, the sufficient condition is to have at least one non-zero variable in the selection, which is not present in the outcome equation. According to Certo et al (2016), Heckman model produces unbiased coefficient estimates, even when exclusion restrictions are weak. So, having significant coefficient of the exclusion restriction and following previous studies, we are confident in the model and are on the safe side.

The estimation results confirm our hypothesis by a negative sign of the shadow agricultural market. The interpretation of the results is not straightforward as in case of OLS. Following Greene (2002), we re-estimate the coefficients to correctly interpret the results. On average, an increase in shadow agri-market by 1% is associated with a decrease in expenditures on public goods per agri-worker by $18.47. If we compare the results obtained by OLS (Appendix C), we would observe the moderate difference in the coefficients, so OLS estimates may not be too biased. However, the biggest difference, almost in 2 times, occurs exactly in the variable of interest, shadow agri-market. So, indeed we had a selection problem and Heckman model helped to correct the coefficients. The Inverse Mills Ratio has a small t-statistic (0.953), so we fail to reject the null-hypothesis that rho-coefficient is 0. It means that errors in the sample selection and regression equations are uncorrelated. So, instead of two stages we could run only OLS. However, insignificant Inverse Mills Ratio doesn't imply that the errors are uncorrelated, it is only about the fact that the data is consistent with no selection. In fact, the lack of data impedes detecting sample selection problem. We have estimates for 26 countries instead of 133. The small sample could be the reason why the Inverse Mills Ratio is insignificant (Certo et al., 2016). Moreover, there is a big difference in the coefficients of our variable of

interest compared to OLS results. So, we would rely on estimates provided by Heckman model. However, both regressions confirm the negative effect of the shadow agricultural market.

Almost all variables are significant, except for urbanization and inflation. Corruption negatively affects the expenditures on public goods in agriculture., which is logical. The signs of the coefficients coincide with the estimates in the Lopez, Vinod and Wang (2008). In our research, lagged human capital appeared to be significant. That is only one difference with the results of the benchmark model. The authors explain that despite the overall improvement in the average years of schooling, expenditures on education increased. Many countries still need to spend a lot on education quality.

To summarize, in both models with different dependent variables standing for agriculture and rural development, we proved that there is a negative effect of the shadow agricultural market on the agriculture and rural development. We also checked for different lagged variables in order to get interesting results. However, they appeared unnecessary since the effects of the variables were insignificant. So, the models are robust to the inclusion of different variables.

Chapter 7

CONCLUSIONS AND POLICY IMPLICATIONS

Agriculture and rural development are the topics of broad and current interest for researchers and policy makers. It is one of the core pillars promoting rural development. Many researchers in their papers and articles have shown the importance of public expenditures in agricultural sector. However, the informal activities reduce the positive long-run effects from these investments.

In this thesis, we estimated the effect of the agricultural informality on agriculture and rural development, measured by agricultural TFP and public goods expenditures on agriculture. Using own constructed dataset spanning for 1995-2015 years, the estimation was done through fixed effect panel regression and Heckman's two-step estimation procedure. Controlling for different economic and political indicators, shadow agricultural market appeared to have negative effect on agriculture and rural development, so we managed to confirm two hypotheses for the research: agricultural informality leads to under-provision and worse quality of public goods and services as well as it undermines productivity and potential output.

The shadow agricultural market is an obstacle on the way to potential growth and development. We demonstrated the detrimental effect informality has on agriculture and rural development. Every additional 1% increase in the shadow agricultural market, on average, is associated with a decrease in expenditures on public goods per agricultural worker by $18 and 2%-fall in the agricultural TFP. Therefore, it is necessary to develop relevant policy implications from this analysis.

There is a good sign for the decline of the shadow economy over time, which can serve as an indicator of attitude and trust towards the government. The

decrease implies that laws work in the right direction. However, despite the tendency for the decline in the size of the shadow market, it still has a huge size and comprises significant part of the GDP. So, the government should take measures to reduce the size of the informal agricultural market, taking into account the damage calculated in models. The solution lies in regulating and administrating taxes and revenues so that laws and rules work properly and economic agents have no incentives to go into the shadows.

There is also another additional policy implication related to agricultural expenditures, which consist of expenditures on private and public goods. The estimation results suggest that government public spending on agriculture negatively affects agriculture TFP. This means that private goods have a stronger and negative effect on agricultural TFP compared to the public goods. Provision of public goods and services is considered to be the most efficient method of agricultural spending. Public expenditure on public goods promotes development and fosters sustainable growth. Thus, government should focus their expenditures on public goods and other sources of market failures, such as externalities, since they provide positive effects for the agricultural sector.

WORKS CITED

Alvarez, Jorge, and Cian Ruane. 2019. "Informality and Aggregate Productivity: The Case of Mexico." Working Paper No. 19/257. International Monetary Fund. November.

Certo, S. Trevis, John R. Busenbark, Hyun-soo Woo, and Matthew Semadeni. 2016. "Sample selection bias and Heckman models in strategic management research". *Strategic Management Journal* 37 (13): 2639–2657.

Elgin, Ceyhun, and Oguz Oztunali. 2012. "Shadow economies around the world: model-based estimates." Bogazici University Department of Economics Working Papers, 5.

Elgin, Ceyhun, and Serdar Birinci. 2016. "Growth and informality: a comprehensive panel data analysis." *Journal of applied economics,* Vol XIX, No. 2 (November 2016): 271-292.

FAO. 2012. "Assessment of the Agriculture and Rural Development Sectors in the Eastern Partnership countries." The European Union's Neighbourhood Programme. Ukraine.

GDPRD, World Bank and FAO of the United Nations. 2008. *Tracking results in agriculture and rural development in less-than-ideal conditions: A sourcebook of indicators for monitoring and evaluation.* World Bank Other Operational Studies 6200, The World Bank.

Gollin, Douglas. 2010. "Chapter 73 Agricultural Productivity and Economic Growth." In *Handbook of agricultural economics,* vol. 4, 3825-3866.

Greene, Williams H. 2005. *Econometric analysis*. Fifth edition. New York University.

Heckman, J. J. 1976. "The Common Structure of Statistical Models of Truncation, Sample Selection, and Limited Dependent Variables and a Simple Estimator for Such Models." *Annals of Economic and Social Measurement* 5: 475–492.

Hoinaru, Razvan, Daniel Buda, Sorin Nicolae Borlea, Viorela Ligia Văidean, and Monica Violeta. 2020. "The Impact of Corruption and Shadow Economy on the Economic and Sustainable Development. Do They "Sand the Wheels" or "Grease the Wheels"?" *Sustainability* vol. 12(2): pages 1-27.

Kaufmann, Daniel, and Aleksander Kaliberda. 1996. "Integrating the Unofficial Economy into the Dynamics of Post-Socialist Economies: A Framework of Analysis and Evidence." The World Bank, Policy Research Working Paper 1691.

Kelmanson, Ben, Koralai Kirabaev, Leandro Medina, Borislava Mircheva, and Jason Weiss. 2019. "Explaining the Shadow Economy in Europe: Size, Causes and Policy Options." Working Paper No. 19/278. International Monetary Fund. December 13.

Kirchgaessner, Gebhard. 2016. "On estimating the size of the shadow economy". *German Economic Review* 18/1: 99-111.

Komarova, T. 2003. Hidden economy in Russian Regions. MA Thesis. New Economic School.

Kyiv International Institute of Sociology. 2019. "Press releases and reports. Shadow economies in Ukraine. Results of the 2019 survey." European Commission. Accessed December 14. https://www.kiis.com.ua/?lang=eng&cat=reports&id=897

Latruffe, Laure. 2010. "Competitiveness, Productivity and Efficiency in the Agricultural and Agri-Food Sectors" OECD Food, Agriculture and Fisheries Working Papers, No. 30, OECD Publishing. http://dx.doi.org/10.1787/5km91nkdt6d6-en

Liu, Jianxu, Mengjiao Wang, Li Yang, Sanzidur Rahman and Songsak Sriboonchitta. 2020. "Agricultural Productivity Growth and Its Determinants in South and Southeast Asian Countries." *Sustainability* 12(12): 4981.

Lopez, Ramon E., Thomas Vinod, and Wang Yan. 2008. "The Quality of Growth: Fiscal Policies for Better Results". IEG Working Paper 2008/6. Washington, DC.

Medina, Leandro, and Friedrich Schneider. 2018. "Shadow Economies Around the World: What Did We Learn Over the Last 20 Years?" Working Paper No. 18/17. International Monetary Fund. January 24.

Nivievskyi, O., P. Iavorskyi, and O. Donchenko. 2020. "Assessing the Role of Small Farmers and Households in Agriculture and Rural Economy and Measures to Support Their Sustainable Development". Kyiv School of Economics.

OECD. 2002. *Measuring the Non-Observed Economy: A Handbook*. Paris. https://www.oecd.org/sdd/na/1963116.pdf

Porta, Rafael La, and Andrei Shleifer. 2008. "The unofficial economy and economic development." *Brookings Papers on Economic Activity* 2008: 275-352.

Putnins Talis J., and Arnis Sauka. 2020. "The Shadow Economy in Russia: New Estimates and Comparisons with Nearby Countries." Policy Brief Series. The Forum for Research on Eastern Europe and Emerging Economies (FREE Network). March.

Schneider, Friedrich. 2000. "Illegal activities but still value added ones (?): size, causes and measurement of shadow economies all over the world." CESifo Working Paper Series No 305. June.

Schneider, Friedrich. 2014. "The shadow economy: an essay".

Schneider, F., and Kearney, A. T. 2013. "The shadow economy in Europe".

Schneider, Friedrich, and Leandro Medina. 2017. "Shadow economies around the world: New results for 158 countries over 1991-2015". Working Paper No. 1710, Johannes Kepler University of Linz.

SSSU. 2020. State Statistics Service of Ukraine. Accessed December 12, 2020. http://www.ukrstat.gov.ua

Tanzi, Vito. 1980. "The underground economy in the United States: estimates and implications". *Banca Nazionale del Lavoro* 32: 427-453.

Taymaz, Erol. 2009. "Informality and Productivity: Productivity Differentials between Formal and Informal Firms in Turkey". ERC Working Papers in Economics 09/01. March

Wooldridge, M. Jeffrey. 2015. *Introductory Econometrics: A Modern. Approach.* Sixth Edition. Boston: Cengage Learning, 789.

Wu, Dong Frank and Friedrich Schneider. 2019. "Nonlinearity Between the Shadow Economy and Level of Development". Working Paper No. 19(48):1. International Monetary Fund. March.

APPENDIX A

DISTRIBUTIONS AND SCATTERPLOTS OF DATASET VARIABLES

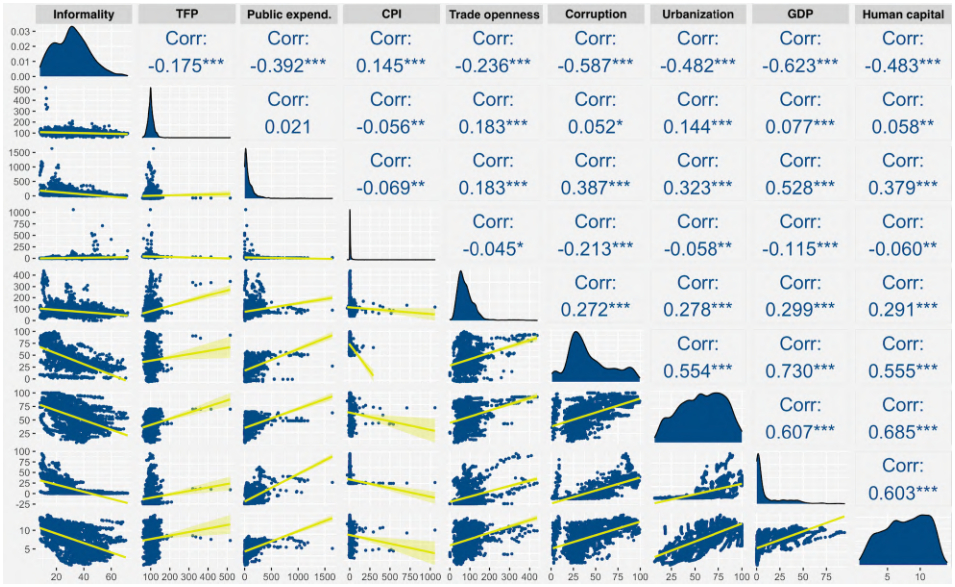

Figure 10. Correlogram with distributions and scatterplots of dataset variables

APPENDIX B

INCLUSION OF VARIOUS CONTROL VARIABLES IN THE REGRESSION FOR AGRI-TFP

Table 9. Estimation results for time FE model for agricultural TFP

	(1)	(2)	(3)	(4)	(5)
Informal agri-sector	-1.751***	-2.226***	-2.514***	-2.914***	-3.139***
	(0.086)	(0.328)	(0.349)	(0.418)	(0.454)
(Informal agri-sector)^2		0.006	0.010**	0.015***	0.017***
		(0.004)	(0.004)	(0.005)	(0.006)
Trade openness			-0.041*	-0.069***	-0.067***
			(0.022)	(0.024)	(0.024)
Agri-public expenditures				-0.010	-0.012*
				(0.007)	(0.007)
GDP per ca					-0.237
					(0.187)
Inflation					
Corruption					
Urbanization					
Human capital					
Observations	2,779	2,779	2,666	2,281	2,281
R2	0.136	0.136	0.129	0.106	0.106
Adjusted R2	0.092	0.093	0.083	0.051	0.051
F Statistic	415.027***	208.739***	125.252***	63.380***	51.042***
	df = 1;	df = 2;	df = 3;	df = 4;	df = 5;
	2645	2644	2532	2148	2147

Standard errors in parentheses: *p<0.1; **p<0.05; ***p<0.01

Table 9. - continued

	(6)	(7)	(8)	(9)
Informal agri-sector	-3.355***	-3.861***	-3.012***	-2.574***
	(0.478)	(0.558)	(0.545)	(0.569)
(Informal agri-sector)^2	0.020***	0.027***	0.024***	0.019***
	(0.006)	(0.007)	(0.007)	(0.007)
Trade openness	-0.053**	-0.036	-0.033	-0.036
	(0.026)	(0.032)	(0.030)	(0.031)
Agri-public expenditures	-0.014**	-0.014*	-0.018**	-0.016**
	(0.007)	(0.008)	(0.007)	(0.007)
GDP per ca	-0.403**	-0.421*	-0.758***	-0.925***
	(0.201)	(0.218)	(0.213)	(0.231)
Inflation	(0.011)	(0.040)	(0.039)	-0.080**
	-0.020*	-0.124***	-0.092**	(0.039)
Corruption		0.021	-0.006	-0.005
		(0.033)	(0.032)	(0.032)
Urbanization			1.878***	1.760***
			(0.177)	(0.194)
Human capital				1.738**
				(0.835)
Observations	2,132	1,732	1,732	1,724
R2	0.106	0.104	0.163	0.166
Adjusted R2	0.049	0.033	0.096	0.098
F Statistic	39.552***	26.600***	39.055***	35.325***
	df = 6;	df = 7;	df = 8;	df = 9;

Standard errors in parentheses: *p<0.1; **p<0.05; ***p<0.01

APPENDIX C

COMPARISON OF THE OLS AND HECKMAN RESULTS

Table 10. Estimation results OLS and Heckman model for agricultural public goods

	Expenditures on public goods per agri-worker, US$ K	
	selection	*OLS*
Shadow agri-market	-0.044*	-0.023**
	(0.025)	(0.009)
GDP	0.043***	0.048***
	(0.008)	(0.005)
Inflation	0.010	0.004
	(0.009)	(0.006)
Urbanization	0.019	0.006
	(0.016)	(0.006)
Trade openness	-0.019**	-0.010***
	(0.009)	(0.003)
Lagged human capital	0.172**	0.113***
	(0.082)	(0.040)
Corruption	-0.011**	-0.010**
	(0.004)	(0.004)
Constant	-0.766	0.560
	(1.612)	(0.511)
Observations	1,997	380
R^2		0.536
Adjusted R^2		0.527
rho	0.639	
Inverse Mills Ratio	0.878 (0.921)	
Residual Std. Error		1.183 (df = 372)
F Statistic		61.393*** (df = 7; 372)

Standard errors in parentheses: *p<0.1; **p<0.05; ***p<0.01