

FACTORS INFLUENCING THE PUBLIC PROCUREMENT EFFICIENCY:  
THE EFFECT OF E-AUCTIONS PROCEDURES IN UKRAINE

by

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Abstract

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This thesis investigates the effect of use the competitive procedure in public procurement. The Ukrainian government believed that the auction provides the lowest cost of procurement in comparison with other methods of placing contracts, however, leaving the alternative of non-competitive procedures. In this thesis, using the data on almost 8,479 contracts for the purchase of fuel (gasoline, diesel fuel, gas) in the regions of Ukraine from 2015 to 2017 I show that for the procurement of a simple homogeneous product this assumption is fair. The results demonstrate that contracts with a larger number of participants in the auction and a larger volume are characterized by a lower level of prices. In accordance with the results of previous studies based on data from other countries, my analysis showed that fuel prices in the public procurement system ProZorro in Ukraine decrease with the consolidation of contracts. The impact of competition in the auction (measured by number of participants) is represented by a quadratic function: additional bidders less effect on the price level. My analysis also revealed significant differences between the competitive procedure and reporting on the contract, which should be subject of additional studies along with study the influence of the size and type of the institutions on the efficiency of procurement.

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## GLOSSARY

**E-procurement (electronic procurement)** – the purchasing and sale of supplies, work, and services through the web-platforms as well as other information and networking systems.

**ProZorro** – the electronic public procurement system designed and implemented in Ukrainian.

**CPV (Common Procurement Vocabulary)** – a unified classification system for public procurement aimed at standardizing the references used by contracting authorities and entities to describe contracts.

**Estimated Value** – initial price of the tender at which the procedures starts.

**Contract Price** – final price of the tender at which the procedure completes.

**Procedure of reporting the contract** – subthreshold (less expensive than UAH 200,000) non-competitive procurement procedure that requests from the buyer's side reporting on the purchases were made.

**Subthreshold purchase procedure** – subthreshold (less expensive than UAH 200,000) competitive procurement procedure of the three stage Dutch auction.

## *Chapter 1*

### INTRODUCTION

The optimization of the procurement process is a broad area for study and is of interest to researchers in many scientific fields. Reforming the process of public procurement is extremely important, as through the public procurement procedure about one billion hryvnias of budgetary funds are spent annually, 20% of which, according to the Ministry of Economic Development, disappear due to inefficient organization of the procedure.

The public procurement sector has not only an economic impact. In recent years public procurement has played a broader social and political role, in particular, through the emergence of sustainable procurement. Regions can use their purchasing power to promote social, industrial and environmental policies and encourage growth that is more inclusive. For example, policymakers responsible for public procurement can influence business practices by requiring that the purchased goods and services comply with specific environmental standards (for example, the use of renewable energy sources or recycled materials) or serve as a response to social issues (such as, for example, as gender equality or non-discrimination against minorities in the workplace).

In order to ensure transparency and proper management of the systems of public procurement need to find a balance between several objectives, including the promotion of efficiency, increased competition among suppliers from the private sector, and promoting the adoption of high standards of equality to ensure fairness and transparency. Overall, the public procurement system needs to instill in people the confidence that the government provides public service legal, not just makes public officials richer and promote narrow private interests.



This research work is based on the study of the multistage buyer's e-procurement auction system. In developing countries a considerable amount of public funds is paid for the institute of public procurement. OECD estimations show the share of government procurement as about 20% of GDP<sup>1</sup>, which simultaneously constitutes a big proportion of public spending. A possible increase of efficiency in the process of the contracting, which would lead to the reduction of winning prices of individual contracts, while maintaining the defined quality level of the required purchases, could thus bring a considerable cost savings, decrease pressure on budgets, and exclude operational losses. The use of information and communication technologies (e-procurement, electronic auctions, etc.) is one of the ways, which has been discussed in recent years in the world, and which is expected to be highly efficient. The expected impacts on the winning prices are often rather high (10%), however, they are not based on the empirical analyses. The aim of this thesis is to investigate, based on an analysis of the data gathered in Ukrainian regions, the factors that influence the efficiency of the competitive contracting and then test hypotheses on the positive effect of using the electronic auction for final prices of the public contracts. The use of electronic instruments in public procurement has a number of important advantages, such as: significant savings for all direct participants – customers, suppliers, regulatory authorities; simplification and shortening of the procurement process; reducing red tape; increase transparency; increase in the innovation component in the procurement; new business opportunities by improving the access for participants, including small and medium enterprises on the market of public procurement.

The actuality of the study consists of the empirical confirmation of the effectiveness of the use of competitive auctions in comparison with the purchase reporting procedures, implying the absence of competition and direct contract

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<sup>1</sup> <https://data.oecd.org>

for the purchase of goods and services. My work illustrates the effect of using e-auctions and will indicate changes in budgetary savings according to the particular procedure.

The research divided into several parts. The first one includes a theoretical discussion on the described in the literature factors, which influence the efficiency of the institute of public contracts including potential positive impacts of implementing the electronic contracting and the electronic auction. The second part formulates hypotheses, which constitute the subject of testing based on the theoretical discussion. The third part describes a data file, which acquired for testing the hypotheses by a direct data collection. The next part introduces results of the executed regression analyses. The last chapter concludes the results obtained and formulates several economic and policy recommendations observing respecting of which could lead to an efficiency increase of the institute of public procurement.

## *Chapter 2*

### LITERATURE REVIEW

#### 2.1 Theoretical evidence

The main purpose of public procurement is to ensure the provision of the procurement of works, services and goods for state and municipal needs. In scientific literature, the concept of public procurement received adequate attention (Bertok, 2005).

The concept of "public procurement" could be considered in two meanings. The author shows the direction in which the confirmed activity is a practical term that is used solely for equal cooperation of interaction of the state customer with the contractors and suppliers. As well, government procurement in economic theory very similar to its legal interpretation, and is defined as "the part produced in the country or abroad of goods and services procured by the government, state bodies at the expense of the state budget".

I think that the state and municipal procurement should be considered as a tool, which realizes the state and municipal order, since the formation of state order can be implemented only by means of procurement. Therefore, in my own opinion we can say that it is possible to include public procurement in public procurement, since public order can exist without procurement, if it is designed, but not implemented, and no purchase order cannot exist.

Therefore, public procurement must be called the process of acquisition by the state in the person of authorized bodies for state and municipal needs of goods, works and services by any means. An important fact is the use of the acquired

goods only meet the needs of the state and not for commercial purposes (Croom and Brandon-Jones, 2005).

The objects of economic regulation – all areas of the industry, as well as the situation and the phenomenon of social-economic life of the country, where have arisen or may arise difficulties. The problems not resolved automatically or resolved in the distant future, while fast solution to these problems is necessary for the normal functioning of the economy and maintain social stability.

Economic regulation is provided by various methods (economic, administrative, administrative-economic, technical methods, forms and ways). The spectrum of applied methods of economic regulation is constantly expanding. This is due to two factors: constant growth of scales, complication of structure of economy and the need to anticipate and respond adequately to the actions of many difficulties (Singer et al., 2009).

Moreover, the response to changes in the economic situation should be more dominant. In this regard, it is important to find the solution to two problems:

- finding the most successful and reasonable combinations of applied methods of the influence,
- consideration of possible negative consequences in the related fields of economy.

The companies should reduce the cost of their components, materials and services suppliers with the lowest cost suppliers to remain competitive in the market. One way to do this is through the migration of procurement activities in a network known as e-procurement. Many authors have defined e-procurement. Scientists have identified e-procurement as “Internet purchasing system that offers electronic purchase order processing and expansion of administrative

functions for customers, suppliers or the suppliers of goods and services by electronic means, usually over the Internet.” (Croom and Brandon-Jones, 2005) Basically, e-procurement can be defined as “the use of Internet technologies in the procurement process”. Although the term e-procurement has a much narrower scope. While e-shopping is simply a transaction provided in the electronic environment, e-procurement can be viewed more wide as complex solution that integrates and streamlines many procurement processes throughout the organization. E-procurement is a broad term that includes several elements, including electronic ordering, electronic biddings, purchasing cards, reverse auctions, and integrated automatic procurement systems (Soudry, 2004). E-procurement has recently been getting a lot of attention from business, industry and government; it is reported to be a powerful tool for increasing efficiency and effectiveness, and quality service to its adopters and their application in our time, inevitable in the manufacturing sector and the service sector, not in private but in the public sector. Companies have come into e-procurement platforms, where transactions are carried out efficiently and more fairly. In the literature underlines the many benefits of migration of procurement activities to the network. This new process is expected to benefit all aspects of procurement, including selection, bidding, payment, regulation, and inventory processes. Operational and economic efficiency are considered the main advantage of electronic procurement. Electronic based purchasing is also considered to offer the opportunity for the development of effective short- and long-term strategic approaches, processes improvement and budget control, as well as reducing transaction costs and red tape, thus leading to more efficient supply markets and increase the firm's competitive advantage (Eadie, Perera and Heaney, 2010). In addition, e-procurement offers buyers and sellers a new form of communication and facilitates the bidding documents, increasing transparency and accountability of operations. Increased internal customer satisfaction is also benefits associated

with e-procurement. Scholars argue that the introduction of e-procurement initiatives could improve the professionalism and perception of procurement professionals. Finally, e-procurement applications have a positive impact on the participants satisfaction, formality, and public relationships (Dewett and Jones, 2001).

Almost all developed countries have already made some steps in the direction of the transition to electronic public procurement. In particular, announcements contests procurement and tender documents are now generally available on the Internet. At the same time, speaking about e-support subsequent stages of the competition, it should be noted that the achieved results here I have quite a wide variation. So, in Mexico in 2005, nearly fifty percent of public procurement fully implemented electronically, in Germany only less than five percent. Further in the field of electronic competitive bidding for state needs left Australia<sup>2</sup>, Canada<sup>3</sup>, Mexico, Denmark, USA (MacDonald, Handy and Plato, 2002).

For example, in Australia in the national strategic program of automation of all technological stages of the competition embodied for the supply of goods for state needs. There is publication of information on auction on the web-portal, where arranged to receive from suppliers of electronic applications for participation in the competition. Functioning information and referral system, a roster of suppliers, are published in the Internet legislation and other documents relating to electronic auctions. There are means of electronic registration, tracking and payment of contracts.

It should be noted work in the field of national legislation. The first problem, more general, crucial for national e-procurement, is the legal framework of

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<sup>2</sup> [www.apcc.gov.au](http://www.apcc.gov.au)

<sup>3</sup> [buyandsell.gc.ca](http://buyandsell.gc.ca)

electronic documents and electronic payments. The second problem, more private, but not least, is the adjustment of the regulatory framework that supports the actual public procurement procedure.

The creation of a system of electronic public procurement is a time consuming and labor intensive, requiring careful planning, clear allocation of separate stages. As the first such stage, the implementation of which would bring tangible practical benefits, everywhere was the selected organization web publication of notices about public procurement tenders and tender documentation.

The benefits of receiving via the Internet bids from suppliers are not so obvious. In addition, it requires a more profound legal and algorithmic study. Why online applications are laid usually in the later rounds.

In each of the countries-leaders opened the national server of public procurement, which allowed us to consolidate all related to public procurement information: regulatory legal acts and market overviews to specific notices about contests and information about buyers and suppliers (Iimi, 2006).

Despite certain common features, there are none of the leaders did not go the way of borrowing. They created an independent national system of electronic public procurement, largely characterized in terms of algorithms and in terms of the overall design. The reason is, apparently, primarily in the specifics of national legislation in the field of public procurement, as well as the reluctance to make a very significant component of the national economy dependent on external factors.

The theoretical background analyzed before beginning work on the thesis describes possible ways of analyzing the effectiveness of the procedure of e-auction. These studies were conducted in the European Union and have empirical

evidence of the hypotheses. In addition to the proposed models, I have used approaches that take into account various factors influencing the efficiency of procurement.



## 2.2 Empirical evidence

I have read discusses on the factors influencing the efficiency of public procurement competitive tendering carried out through e-auctions. The article tests from the point of view of their influence on the efficiency of public procurement in conditions of the Czech Republic and in the framework of tenders for the construction work (Pavel and Sicakova-Beblava, 2013). They also use quantitative methods to analyse factors that may affect the openness of procedures, types of procurement regulation. It's interesting and possible for implementation in Ukraine (also post-soviet Eastern Europe), but first paper begins with a theoretical discussion about the factors affecting efficiency of the procurement, including the potential impact of electronic procurement and electronic trading. Formulated hypotheses are the base of used in my thesis. The following part presents the regression analysis, which become the prototype of the model that I suppose to use. I am providing it below and shows that the indirect percentage ratio between the number of submitted bids and the winning price. The article concludes that the use of electronic auctions brings an indirect impact on the winning price and suppose that it applicable for Ukraine. So, it looks like following regression model:

$$\begin{aligned} Price = \beta_0 + \beta_1 Bid + \beta_2 Bid^2 + \beta_3 ELAu + \beta_4 ExFi + \beta_5 BuWo \\ + \beta_6 LoCo + \beta_7 MeCo + \varepsilon \end{aligned} \quad (1)$$

Where:

- *Price* – the winning price as a percentage of expected prices, demand is the number of bids,
- *ELAu* – the use of electronic auction,

- *ExFi* – the organization of competitive procedures for foreign firm,
- *BuWo* – the contract for construction work,
- *LoCo* – a contract under the small contract size regime,
- *MeCo* – a contract below the threshold regime and  $\varepsilon$ -the difference between actual and expected value.

In addition, authors investigate the consequences of using or not using an electronic auction method of procurement, compares the level of competition in all government procurement of identical goods among member of the EU during the same period, and makes a request of how auctions affect competitiveness in public procurement. It was conducted in compliance with the number of proposals and the ratio of the value of the contract at the estimated cost of procurement. Authors used data from the EU open data portal for on public procurement for pharmaceutical products. Their first model shows overall effect of the method of electronic auction on competitiveness. On the other hand, the second model presented is that the method of electronic auction is decreasing the number of offers in the procurement. In the article noticed that second method increases the attractiveness of the procurement, but this extends the process. Since KSE Research Department works on the data about Ukrainian pharmacy procurement, first suggested model's specific design could be applicable for my thesis.

Other article focuses on e-procurement implementation process (Singer et al., 2009). Such a process is defined as the way new technologies are absorbed by organizations and become a part of their lives. The article presents an overview of e-procurement literature. In addition to the definitions presented in the review tools for procurement and different approaches for the analysis of e-procurement. It will consider changes in the Italian public sector that is similar to Ukraine. The research focused on the process of implementing e-procurement

systems in Italy-public-health system (Raffa and Esposito, 2006). This work aims to identify the set of conditions under which different e-procurement forms seem appropriate in different purchasing and organizational settings (ProZorro, ProZorro Sales) according to my motivation list.

According to the Law of Ukraine "On public procurement", type of procurement process is determined according to the threshold value of the purchased item, which is determined by the annual plan. Defined value thresholds differ depending on the nature of the subject of procurement (division for works, goods and services) and type of customer carries on activities in individual areas of management using of Subthreshold procurement described in the Order State Enterprise "Zovnishtorhvydav Ukraine" from 13.04.2016, №35<sup>4</sup>. Features of implementation of purchases for ensuring defence requirements are established by a separate law – the law of Ukraine "On peculiarities of procurement of goods, works and services for safeguarding needs of defense". In the end, I have used the combined and adjusted for Ukraine approach for further calculations.

The e-procurement has become an integral part in any developed business, but today this technology is sometimes seen as a new and incomprehensible. Most of the difficulties associated with electronic procurement, are rooted in problems with understanding relationships and mechanisms of choosing a contractor on the Internet. These problems can be aggregated into several groups:

- problems with the understanding of the essence electronic forms of procurement,
- problems with the use of electronic document management,
- problems with the understanding of the status and necessity of the electronic signature,

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<sup>4</sup> [http://www.poltavaculture.gov.ua/images/documentation/orders/2016/nakaz\\_35.pdf](http://www.poltavaculture.gov.ua/images/documentation/orders/2016/nakaz_35.pdf)

- problems with the understanding of the status and mechanism of e-marketplace,
- problems with the understanding of the mechanism and possibilities of open and closed form of submission of bids in e-procurement.<sup>5</sup>

Problems with the understanding of the essence e-forms are reduced to two extremes – either e-procurement is perceived as a specific, isolated, like no new method of procurement or e-procurement is called procurement in the classical paper form with minimal use of electronic means. Both of these approaches are wrong.

First, it is worth considering the distinction between the method of procurement and form of procurement. At present, there are only two forms of procurement: e-procurement, which provides full interaction between customer and supplier on the Internet for the orderly rules from the moment of the announcement prior to publication of results, and the traditional, often called paper, in which such interaction is not provided. The manner of purchases, in contrast to the forms of procurement do not define the mode of interaction between customer and suppliers, and the principle of selection of the winner of procurement and the mechanism of such choice. Currently in Ukraine in electronic form are implemented all the possible ways of purchasing it directly regulated trades (which are implemented in the form of tenders or auctions), and non-trade procurement methods (procurement reporting), which is governed by general civil law rules on contract.

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<sup>5</sup> [http://cep.kse.org.ua/assets/img/articles/Prozorro\\_report\\_ua.pdf](http://cep.kse.org.ua/assets/img/articles/Prozorro_report_ua.pdf)

## *Chapter 3*

### METHODOLOGY

The concept of public procurement in comparison with the concept of government procurement is an all-embracing one, since it expands the range of entities that through procurement activities ensure the needs of the state or a territorial community. E-procurement in Ukraine covers a substantial part of the life cycle of the procurement, including the identification of needs and planning, market analysis and monitoring of performance of the contract (payment and delivery) that occur outside the system. ProZorro does not contain information about the budget, justification of losses, price per unit, and information about the quality of goods/services/works.

On the technical side, structure of the ProZorro – hierarchical. A central database contains all data for the procurement of state-owned companies, and several sites that provide users of services on the organization and participation in tenders.

The organizers ProZorro expect that the government purchases as before will be held on the principle of reverse auction, i.e. the winner is the provider that will offer a lower price. In some cases, allowed to apply the procedure of the report on the contract.

According to the law, there are several procedures of procurement – competitive dialogue and negotiation procedure. They are used in case if the customer cannot determine the necessary technical, qualitative characteristics (specifications) of the work or to determine the type of service. Alternatively, if the subject of procurement is advisory, legal services, information systems development,

software products, perform development work, definition of requirements, execution of which requires negotiation.

To participate in tenders can all providers registered at any of the web-portals. According to the Law of Ukraine "On public procurement", the qualification for compliance is only the supplier-the winner (the principle of post).

Based on the methodology of existing sources and the analysis highlights a number of factors that affect public procurement system and are particularly important for private companies. Data aimed at meeting the informational, analytical and political stakeholders.

The analysis of the public procurement procedures will help on the example of a particular category the legislature and state agencies participating in the bidding for procurement to identify areas where change requested. Agreed and objective data on public procurement to provide the necessary information for decision-making by state bodies that seek to promote more effective, comprehensive and open system of public procurement. The study will also stimulate implementation of reforms by analysing the critical factors of competitiveness. Finally, it will be guidance for daily use practices in the area of procurement.

Private companies involved in public procurement, as well as those who refused to participate in the auction due to shortcomings in public procurement systems, will also find this work useful. Data will allow assessing the procurement system of a particular country. The movement towards a more transparent and efficient systems will strengthen private sector confidence and thus will give a new impetus to the participation in the auction while ensuring fair competition.

Finally, representatives of the academic and research community will be able to use the data of the comparative analysis of public procurement systems to obtain

better information on the systems of procurement and to conduct their own research. This initiative can become the main driving force in the global debate on the impact of legislation and administrative practices on competition and its relevance for economic development. The questions posed and developed methods have a high potential for increased use of the global aspect of the study.

Assuming the approaches of foreign colleagues and comparing the existing information on the procurement in Ukraine, I have decided to focus on some particular product category because of the heterogeneity of goods in the environment of the e-procurement system ProZorro. Defining a homogeneous category helps me to provide clear results on the stage of estimating the effects, but on the other hand, such results cannot be applied to other categories. However, such problems are related in the most to the non-unified contract form and participant's individual measurement of the procurement subject.

The focus of analysis is on the bidding stage and stage of tendering (choice of the procedure) within the procurement process. Consultations with experts in the field of public procurement revealed the following: the main obstacles in the way providers are found at these stages and are for transaction costs and lack of information. Moreover, the stage before the auction (in particular, procurement planning, needs assessment and preparation of documents – the factors directly influencing the choice of procedure) and the stage of bidding are affected by the corruption. For example, at the stage before bidding the transparency and accessibility of the needs assessment, procurement plan and specifications make them less susceptible to fraud. At the stage of bidding due to the transparency of the award process, criteria for selection of successful bidder the price offered by that provider, etc., it becomes harder to hide the fraud in determining the winner of the auction. In these reasons, the stage of execution of a procurement contract is not measured in the present project.

Based on the analysis of the available literature I have formulated the following hypotheses:

1. The use of the e-auction leads to an increase of the number of participants.
2. The final price decreases alongside with the increase of the number of participants.
3. The use of the e-auction through the increase in the competitiveness leads to a higher economy than in the case of using the reporting procedure.
4. The procurement deals made after the introducing the obligatory participation in the ProZorro has higher economy rate.

The main subjects of the research are the influence of the open auction use, the number of bidders in such particular tender auction, and the fact that ProZorro become obligatory on decreasing in the final price of the deal. For estimating, the proposed impacts two models were designed based on existing methods of estimating the effect of introduction e-auction procurement systems.

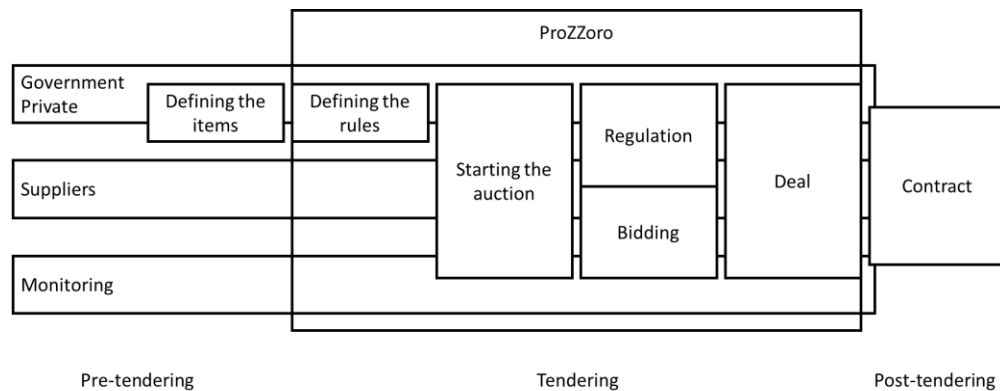


Figure 1: Subthreshold purchase procedure (auction) (graphic interpretation)



These methods should be adjusted to reflect the fact that in contrast to the examined approaches, my thesis compares not just two periods with different treatments, but two different procedures taking place simultaneously.

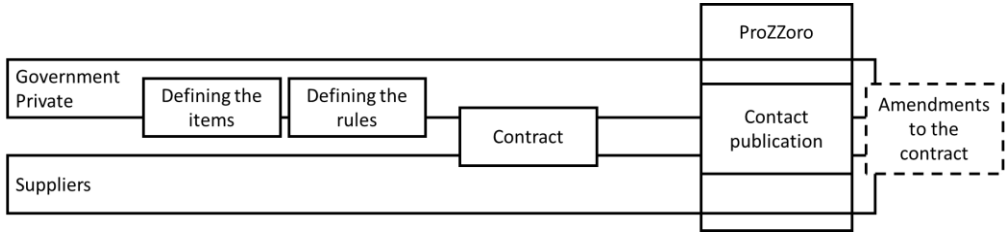


Figure 2: Procedure of reporting the contract (non-competitive) (graphic interpretation)

The existence of an alternative auction procedure is due to not only the heritage architecture of rules of public procurement in previous years, but the presence of the exception for the urgent concluding the contract. Procedure of reporting the contract is used in the case when the buyer is limited in time and does not have to wait until the expiry time of the auction. As a rule, organizations performing purchases using this procedure, don't usually report about the number of applying participants. Given the low percentage of saving or the lack of it when using this procedure, I assumed that it is not competitive. This assumption is made to contrast when compared with the Subthreshold procurement procedure that complies with the principle of open competitive electronic auction. The same assumption is based on the fact that the cost of purchasing the rational behavior of bidders should be evaluated and questioned the need for certain purchases, while urgent purchase shows the irrational behavior of participants and their tendency to the intentional avoidance of the open procedure of the auction. However, it should also be noted that conditions of the procurement (thresholds, procedures) can vary depending on the type of a customer. The definition of

customer types is described in the Law of Ukraine "On public procurement" (article 1). Both procedures are used in the same categories with a maximum amount of the procurement contract, UAH 200,000 and regulated by the Law of Ukraine "On public procurement" (Law № 922) from 10.12.2016 №922-19<sup>6</sup> and the Decree of State Enterprise "Zovnishtorhvydav Ukraine" from 13.04.2016 №35.

In addition will be used the variable separating the periods before and after the adoption of the law on the mandatory use of ProZorro in public procurement. Dummy variable should show the result of the forced use of the system, ProZorro.

The number of bidders in my assumption should have a positive impact on the level of savings in procurement and has a hyperbolic relationship with the dependent variable.

In addition to the main effects, the presence of which is indicated in the hypotheses needs to be used some explanatory variables that must influence the final level of prices of the tender in comparison with initial. The use of the initial valuable should handle with the economies of scale, which means big savings for large prices of tenders. The number of units of product in the tender serves the same purpose, but abstracted from the average price of the product. Product type and region of the tender organizer is used to control the potential differences in the environment of public procurement that directly depend on them.

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<sup>6</sup> <http://zakon2.rada.gov.ua/laws/show/ru/922-19>

First suggested model:

$$\begin{aligned} \text{Price Savings} = & \beta_0 + \beta_1 N + \beta_2 N^2 + \beta_3 \text{Estimated Value} + \\ & \beta_4 \text{Duration} + \beta_5 \text{Amount of Product} + \beta_6 \text{Procedure} + \\ & \beta_7 \text{Type of Product} + \beta_8 \text{Region} + \varepsilon \end{aligned} \quad (2)$$

$$\text{Price Savings} = \frac{\text{Estimated Value} - \text{Contract Price}}{\text{Estimated Value}} \quad (3)$$

- $N$  – number of bidders,
- *Estimated Value* – the starting price (price cap) of some particular tender; measure of the size of the tender,
- *Contract Price* – the price at which the tender was closed,
- *Duration* – time between the tender initialization and closing,
- *Amount of Product* – number of the homogeneous units in the tender request,
- *Procedure* – use of the competitive e-auction in the ProZorro environment (Procedure of reporting the contract=0, Subthreshold purchase procedure=1) (binary var),
- *Type of Product* – particular homogeneous subcategory in given CPV,
- *Region* – the particular digital code that describes location of the tender creator.

Since I have observed the differences in the economy among the regions (Figure 6), it is rescannable to use control variables for the each of them.

Second suggested model (difference-in-difference):

$$\begin{aligned}
 \text{Price Savings} = & \beta_0 + \beta_1 N + \beta_2 N^2 \\
 & + \beta_3 \text{Estiamted Value} + \beta_4 \text{Duration} \\
 & + \beta_5 \text{Amount of Product} + \beta_6 \text{Procedure} \\
 & + \beta_7 \text{Obligatory} + \beta_8 \text{Procedure} \\
 & * \text{Obligatory} + \beta_9 \text{Type of Product} \\
 & + \beta_{10} \text{Region} + \varepsilon
 \end{aligned} \tag{4}$$

$$\text{Price Savings} = \frac{\text{Estiamted Value} - \text{Contract Price}}{\text{Estimated Value}} \tag{3}$$

- $N$  – number of bidders,
- *Estimated Value* – the starting price (price cap) of some particular tender; measure of the size of the tender,
- *Contract Price* – the price at which the tender was closed,
- *Duration* – time between the tender initialization and closing,
- *Amount of Product* – number of the homogeneous units in the tender request,
- *Procedure* – use of the competitive e-auction in the ProZorro environment (Procedure of reporting the contract=0, Subthreshold purchase procedure=1) (binary var),
- *Obligatory* – indicator of deals that were made the mandatory participation in the ProZorro (binary var),
- *Procedure\*Obligatory* – use of the competitive e-auction in the ProZorro environment after becoming of the participation mandatory,
- *Type of Product* – particular homogeneous subcategory in given CPV,

- *Region* – the particular digital code that describes location of the tender creator.

A substantive constraint lies in the fact that private values are limited in scope. They do not measure the full range of factors affecting the public procurement system this particular economy. With regard to methodological limitations, it is worth noting that in the comparative analysis of public procurement systems not studied the performance of companies or suppliers.

In a comparative analysis of systems of public procurement not assessed the regulatory framework for the prevention of fraud and corruption. Some questions indicated a desire to assess the obligation of officials responsible for procurement to report the suspicion of fraud. However, carried out at the pilot stage, the analysis does not provide a wide coverage of the problem. It is also important to note that the study does not take into account corruption and the impact it can have on the number of procedures, time or cost. The fact that these factors are not the result of bribery or fraud is part of the assumptions.

When interpreting data, readers should keep in mind that private values are based on hypothetical assumptions, obtained by the analysis of specific situations involving the comparability of data.

The values contained in the analyses represent the indicators through which attempts to capture important aspects of the quality and effectiveness of procurement systems faced by the business community in different regions. Understanding the breadth of data is fundamental to their interpretation. In the pilot phase, the project is limited in scope for reasons of a practical nature.

As a result, the project is carried out analysis of the efficiency of public procurement as a government instrument for the reinforcement of public policy

objectives such as sustainable growth or budgetary efficiency. However, it is worth noting that private values capture the aspects/characteristics of the procurement systems, which represent obvious benefits for the state in the long term. After all, the simplification of the procurement process for bidders and the restoration of confidence in the systems of procurement can enhance competition and allow the state to obtain the best ratio of price and quality for state funds.

## *Chapter 4*

### DATA DESCRIPTION

In the preparation of the assumptions obtained by the analysis of specific situations, I was guided by several objectives. The first task is to ensure comparability. Thus, when it comes to public procurement, the industry chosen for analysis of specific situations should have the less specific rules of a labor safety, safety precautions or regulations on national security. A particular challenge is the mapping of the procurement of goods and services subject to strict regulation, since industry regulations often take precedence over the rules of public procurement.

The second objective of the underlying project case studies is to collect data about the effectiveness of the system. The procuring entity is the organization of local rather than national scale, and the typical bidders are local, small, and medium enterprises, wishing to participate in the auction held at the local level. Thus, from the analysis of specific situations automatically excluded large and complex projects relating to commodities and infrastructure, to submit bids in respect of which only a few companies.

Data were obtained from practicing professionals who brought to the cause a vast array of knowledge related to public procurement systems. This includes lawyers with extensive professional experience advising clients on laws and regulations in the field of public procurement, the suppliers from the private sector participating in public bidding, government officials familiar with the applicable procurement practices, as well as consultants and scientists.

The source of the data is the ProZorro BI service. I have full set of the data on the e-procurement for 2015-2017 years. There are 559,955 observations now. Among all the given procurement procedures 2 were chosen, each of them should describe the behavior of the participants and economy due to existence or absence of the competitiveness.

To prove the formulated hypotheses, I need to use data on the government purchases through different procedures available in ProZorro. The particular category of procurement in the environment of the system - CPV 09000000-0, which implies a generalized category of procurement of fuel. The problem that I have faced was that many of the participants could not specify the category directly. I have gathered all the available data with the word “БЕНЗИН” in the field with product specifications. As the result, I have 8,479 observations in both categories of procedures: Procedure of reporting the contract and Subthreshold procurement (three stage Dutch auction). Among them, there are 4,522 unique buyers (tender creators) and only 586 unique sellers. Therefore, we can see that on this particular market exists nine times demanders then suppliers.

Table 1: E-procurement in the Ukrainian Fuel Purchases

Procedure	Number of Tenders
Procedure of reporting the contract (non-competitive)	3,276
Subthreshold purchase procedure (competitive)	5,181

For creation of the dependent variable I've used Initial and Final Prices:

$$Price\ Savings = \frac{Estimated\ Value - Contract\ Price}{Estimated\ Value} \quad (3)$$



Created variable represents the rate of economy on each tender. In the table below I've added the description of the new variable.

Table 2: Price economy (variable that describe the economy rate) description

Procedure of reporting the contract					
Variable	Obs	Mean	Std. Dev.	Min	Max
Price Savings	3,276	.0063921	.0597277	0	1
Subthreshold purchase procedure					
Variable	Obs	Mean	Std. Dev.	Min	Max
Price Savings	5,181	.0382318	.0497876	0	.8517544

One of the problems with the data besides the misspecification was the fact that all the types of fuel including diesel, gasoline A-92 etc. were traded in most cases as the bundles. To handle with it dummy was created for each of the types of gasoline and then combined them into variable  $Y$ , which describes tenders with single type of gasoline or merged one.

Table 3: Intersection of the auction and mandatory participation

Procedure	Obligatory participation		Total
	0	1	
0	25	3,251	3,276
1	1,274	3,907	5,181
Total	1,299	7,158	8,479

On the graph below the comparison of the initial and final prices of the tenders is provided. It also brightly indicates the increasing in the number of the set auctions and growth of the average prices of the tenders. Interesting, that growth begun before the August 1, 2016.

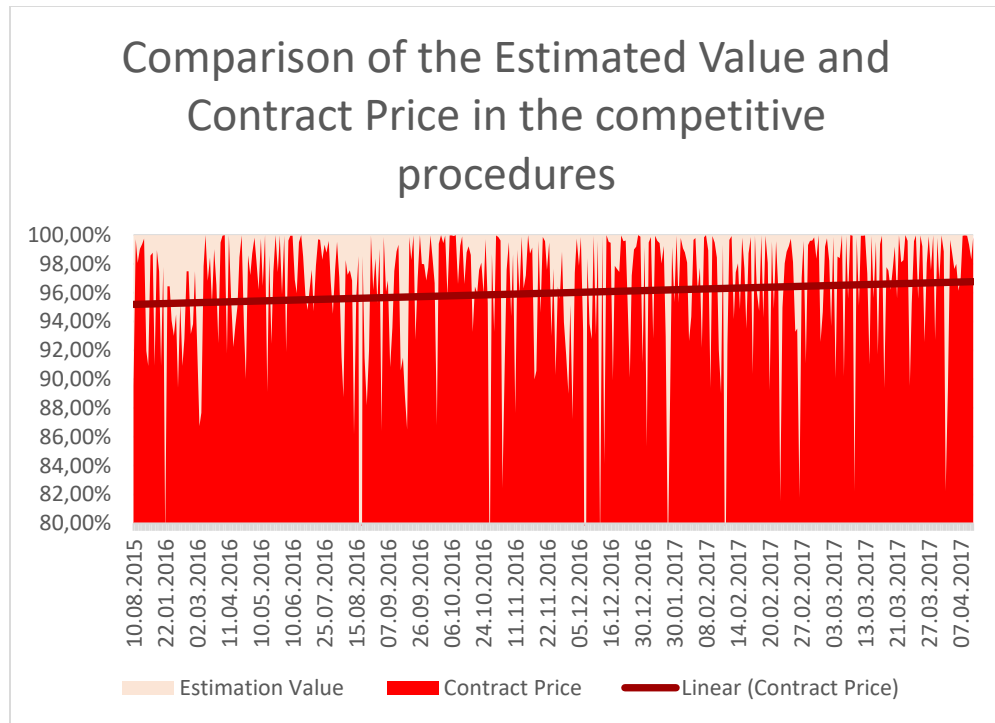


Figure 3: Comparison of the Estimated Value and Contract Price in the competitive procedures

As we can see, the level of the savings in average has tend to decrease with the time that is described by the linear trend line on the graph. The gaps in the graph show the economy that equals more than 20%. The procurement deals are irregular with time gaps and several contracts on the same date, but that fact doesn't distorts the true line of the trend. In addition, I should notice that there is triple less tender deals before the August 2016 and that explains the horizontal axe's scale of the graph.

On the graph below the logarithms of the prices are compared: deviations from the trend to left mean the economy on the tenders prices.

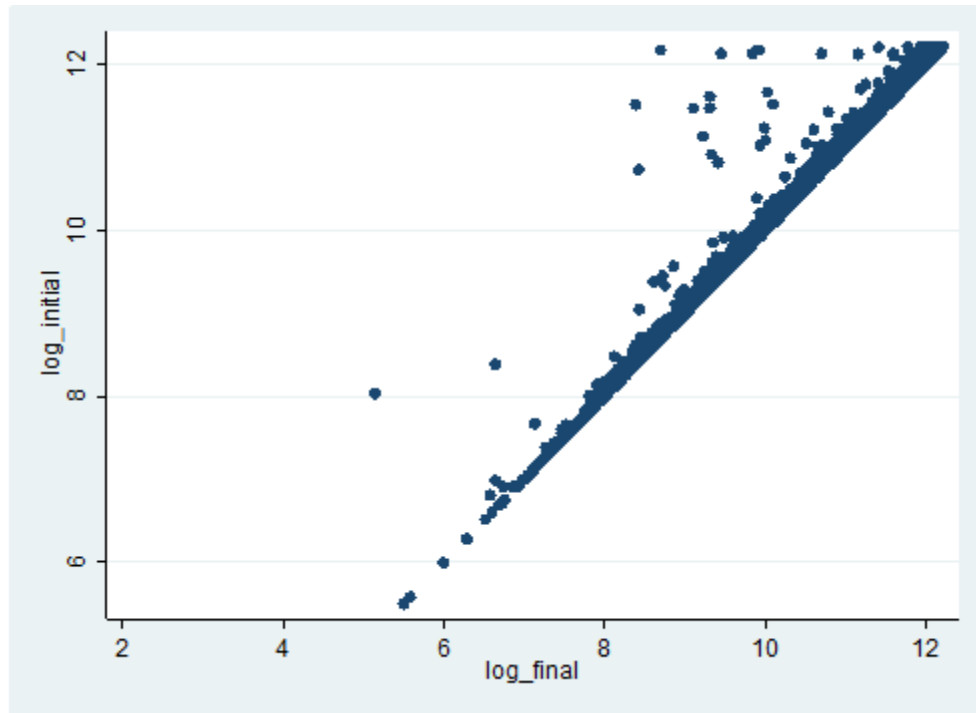


Figure 4: Relations between Estimated Value and Contract Price

On the graph above it is obvious to conduct that with the increase of the price of the tender difference between Estimated Value and Contract Price has tend to increase. This fact could be explained by the existence of the fixed costs in the contracts that increase price of the small contracts significantly, but with the increase of the number of the liters would be consumed open the ways for saving and Contract Price decrease.

Table 4: Summary statistics

Variable	Mean	Std. Dev.	Min	Max
Estimated Value of the Tender	51388.71	55738.08	245.03	200000
Contract Price of the Tender	49886.83	54273.48	210	200000
Number of Participants	1.403689	.7686352	1	9
Amount of Liters	2283.823	2484.232	1	21000
Price Savings	.025898	.0560422	0	.50235
Average Price per liter	21.72431	2.548042	8.064075	31.585

The table above describes main variable that were used in the estimations. Maximum values of the Estimated Value and Contract Price show the cap of the subthreshold procurement procedure requirements. Maximum number of the participants equal 9 gives me a reason to try to investigate the parabolic relation between the savings and the number of bidders in the auction with the negative marginal effect opposite to the logarithmic relation.

Amount of Liters shows the average capacity of the each tender that lies between the 1 liter and 21,000 liters.

Price Savings shows the average percentage decrease of the Estimated Value during the process of the procurement.

Average Price per liter describes the average price among all the types of fuel, but further in the estimations it would be controlled by the categories.

## *Chapter 5*

### EMPIRICAL RESULTS

#### 5.1 Estimation results

In first regression, I've used suggested OLS model. The regression was built with control on the regions of the participants (buyers) but since coefficients on those variables is not sufficient for my research; they are not included into the table with results. For the same reason indicators for the each type of the fuel were used (A-92, A-95, diesel, liquid gas, mix category). Base category related to type of the product describes gasoline with marker A-92.

First suggested model (eq. 2) include the variables that should have positive impact on the price savings, except the squared number of participants. Estimated Value used for the control of the size of the contract since the positive relation between the initial price and savings was observed. What about the duration of the tender – it is reasonable to assume that with the longer tender terms there arise more opportunities for the sellers to offer the lower price due to market price fluctuations, etc. Amount of Product should explain the difference in the economy that caused by the scale of the contract same as Estimated Value. It is not related to the prices differences between fuel types, so it could express the technological issues and difficulties related to the transportation features, etc. which are peculiar for the particular fuel marks or types. However, the correlation equal .7437 between them is observed.

Table 5: Simple OLS (with amount of goods)

	Price Savings
<i>Number of Participants</i>	0.038 (4.97)**
<i>Number of Participants (squared)</i>	-0.003 (2.58)*
<i>Estimated Value</i>	0.017 (2.36)*
<i>Duration</i>	-0.000 (1.71)
<i>Amount of Liters</i>	-0.000 (1.15)
<i>Procedure</i>	0.014 (3.91)**
<i>_cons</i>	-0.017 (0.94)
R <sup>2</sup>	0.15
N	8,479

\*  $p < 0.05$ ; \*\*  $p < 0.01$

With the given results, I can conclude that there are positive coefficients on the variables that describe the competitiveness of the tender procedure and its size. Such results were expected since foreign researchers' results were studied. You can see that on average competitive procurement procedure saves by 1.4% more budgetary recourses than non-competitive procedure. In addition, I have observed the evidence of the parabolic relation between the Price Savings and the number of the participants that tell about the existence of the negative marginal effect of the number of the participants –growth in the number of bidders could neutralize the effect of the competitiveness.

Since the coefficient at the variable that describes amount of the liters become insignificant, we could try to exclude it from the regression.

$$Price\ Savings = \beta_0 + \beta_1 N + \beta_2 N^2 + \beta_3 Estimated\ Value + \beta_4 Procedure + \beta_5 Type\ of\ Product + \beta_6 Region + \varepsilon \quad (5)$$

Table 6: Simple OLS (without amount of goods)

	Price Savings
<i>Number of Participants</i>	0.038 (4.99)**
<i>Number of Participants (squared)</i>	-0.003 (2.61)*
<i>Estimated Value</i>	0.010 (5.09)**
<i>Procedure</i>	0.014 (3.98)**
<i>_cons</i>	-0.016 (0.91)
R <sup>2</sup>	0.14
N	8,479

\*  $p < 0.05$ ; \*\*  $p < 0.01$

The key coefficients have not change, but the effect of each UAH 100 000 now become smaller, it has decreased from the 1.7% to 1%.

In third regression, I've used suggested difference-in-difference model. Base category describes gasoline with marker A-92. The regression was built with control on the regions of the participants (buyers) but since coefficients on those variables is not sufficient for my research; they are not included into the table with results. The variable *Procedure\*Obligatory* describes the intersection of the *Procedure*=1 for the Subthreshold competitive procedure and *Obligatory*=1 for the period when ProZorro became mandatory procurement environment (after August 1, 2016). Regardless to the incomparable numbers of the observations in the created intersections, it is important to investigate the effect of these variables because they shows the changes with the length of time:

$$\begin{aligned}
\text{Price Savings} = & \beta_0 + \beta_1 N + \beta_2 N^2 + \beta_3 \text{Estimated Value} \\
& + \beta_4 \text{Procedure} + \beta_5 \text{Obligatory} + \beta_6 \text{Procedure} \\
& * \text{Obligatory} + \beta_7 \text{Type of Product} + \beta_8 \text{Region} + \varepsilon
\end{aligned} \tag{6}$$

Table 7: Difference-in-difference

	Price Savings
<i>Number of Participants</i>	0.038 (5.02)**
<i>Number of Participants (squared)</i>	-0.003 (2.62)*
<i>Estimated Value</i>	0.010 (5.06)**
<i>Procedure</i>	0.022 (9.71)**
<i>Obligatory</i>	0.010 (3.04)**
<i>Procedure*Obligatory</i>	-0.008 (2.11)*
<i>_cons</i>	-0.026 (1.58)
R <sup>2</sup>	0.14
N	8,479

\*  $p < 0.05$ ; \*\*  $p < 0.01$

Regardless to the significant coefficients on the added variables, difference-in-difference could not be used as the final result of my research due to small number of the Procedures of reporting the contract before the participation in the ProZorro environment become obligatory (Table 3). So I interpret the results of the first suggested regression to describe the effect of the competitive procedures in my research.



## 5.2 Discussion of the results

In both regressions, only two variables are economically significant: the number of the participants, that indicates the competitiveness of the auction and the sort of the procedure, which also indicates the ability of the procurement procedure to be competitive. Such result shows the importance of the competitiveness and openness of the procurement auctions for the rate of the economy compare to the procedures that just report on the contracts. The R-squared is pretty low and this could be related to the big number of the observations.

Overall, three of four hypotheses faced no contradictions according to the coefficients in the results:

- the use of the e-auction leads to an increase of the number of the participants,
- the final price decreases alongside with an increase of the number of the participants,
- the use of the e-auction through increase in the competitiveness leads to higher economy than in the case of use of the reporting procedure.

Fourth hypothesis was declined since the sign of the coefficient that represents activity of the organizations after mandatory participation in ProZorro is negative: the procurement deals made after the introduction of the obligatory participation in the ProZorro has lower economy rate.

I have made an interesting observation, which demonstrates the negative effect on savings from mandatory use of ProZorro and Subthreshold procurements compared to the previous period. This fact can demonstrate that prior to August 2016, the majority of participants in the procedure used it just to save funds. On the contrary, with the advent of new buyers that may not be interested in budget

savings, the prices reduction in tenders is relatively decreased. The level of savings also could be affected by the increase in the number of tenders, which attracted a lot of intermediaries who cannot offer low prices when they have higher cost than direct sellers. In general, the estimation results had been expected, and clearly demonstrate the effect of the use of competitive procedures. But since the base category contains incomparable number of observations (Table 3), such result cannot be interpreted. For the further investigation of such effect other goods with bigger number of observation should be analyzed. In addition, it was proven that duration of the tender has statistically significant effect on the savings of funds.

## *Chapter 6*

### CONCLUSION

There is necessary to provide accountability and transparency of public procuring entities that ensures the proper expenditure of funds for efficient public procurement. The use of the e-auctions hinders the risk of corruption and creates equal conditions for suppliers. This ensures the adoption by the government structures fair and cost-effective solutions in the awarding of contracts.

As a result of the estimation provided, each participant in the tender increases the level of savings by 3.8% with a marginal effect equal to (.3)%, so each additional participant decreases the rate of the savings. It has also proven the positive effect of the application of subthreshold purchase procedure, even with one participant. The value of the contract (each UAH 100,000) increases the savings by 1.7% on average.

There was observed the decrease in the savings rate after the introduction of the obligatory participation. Since the base category does not give the opportunity for the reasonable comparison (Table 3), such result could be explained by the participants' qualification growth due to experience; the average prices per liter set in the tenders less deviate from the average prices on the fuel in Ukraine in general (Figure 5).

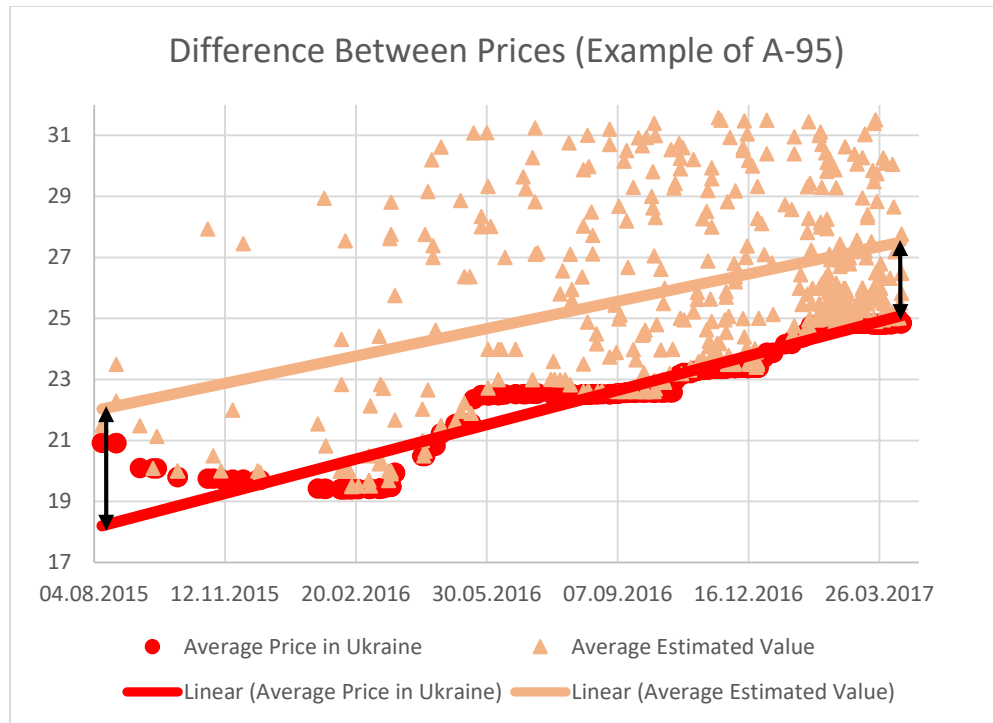


Figure 5: Average prices

The implementation of sufficient and regular of internal control is crucial for the improvement of the accountability and transparency in the public procurement process. Monitoring of the internal control system contributes significantly to the protection of the integrity, honesty and accountability of procurement procedures. Effective internal controls in the environment of ProZorro are critical to ensure the achievement of efficiency goals. Financial control mechanisms, internal audit and control mechanisms from the management help to monitor the operation of the procurement system to ensure compliance with laws and regulations and the submission of reliable reporting. The control allows determining whether the chain of responsibility clear and adequately implemented given the power of different levels for the approval of spending and of other key stages of the procurement.

Table 8: Pros and cons matrix

	Subthreshold purchase procedure	Reporting on the contract procedure
Time	Time consuming activity with the obligatory requirements; the duration before the successful auction could be long	Almost immediate purchase of the goods
Price	During the auction Estimated Value could be significantly decreased due to competitiveness of the sellers	Most of the cases it is contract with particular seller (without alternatives) with price close or equal the nominal one

Too strict rules-based approach (assuming the competitive subthreshold purchase procedure), which restricts the freedom of action of government officials, can deprive them of the flexibility needed to achieve the best result, but still provides better savings rate. On the contrary, risk-based (assuming the reporting on the contract procedure) approach seems a more appropriate measure to find the balance between mechanisms of accountability and oversight in procurement, however, gives almost zero savings rate because of the absence of the competition.

In conclusion, I should note the inefficiency of the reporting procedure in the system ProZorro in particular cases as a result of its insolvency compared to competitive procedure. The advantage lies in the possibility of urgent procurement may not be included in several procurement categories, including fuel: this kind of procurement can be planned in advance and be included in the budget of the organization conducting the tender. Such exogenous (for the ProZorro) factors affect the efficiency of the public procurement sufficiently and should be regulated

or even avoided by the governmental authorities. Otherwise, suffers not only the financial burden on certain auctions but also the transparency of procurement.

The further development of the thesis is possible in the direction of the research of the optimal number of participants in competitive procedures, investigating the external factors, and analysis of the influencing the sort (it's size, structure etc.) of the institution that place the tender on the efficiency of the public procurement.

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#### REGULATORY ACTS

- The Law of Ukraine "On public procurement" (Law № 922) from 10.12.2016 № 922-19
- Decree of the Cabinet of Ministers "The order of operation of the electronic system of procurement and authorization of the electronic platforms" from 24.02.2016, № 166
- Order of Ministry of Economic Development "The procedure for determining the subject of procurement" from 17.03.2016, № 454
- Order of Goscomecologiya "State classifier of products and services DK 016:2010" from 11.10.2010, № 457
- Order of Ministry of Economic Development "The national classifier of Ukraine "Unified procurement dictionary" DK 021:2015" from 23.12.2015, № 1749

Order of Ministry of Economic Development "Regulations on the tender Committee or the authorized person (persons)" from 30.03.2016, № 557

Order of the Ministry of Economic Development "On approval of forms of documents in public procurement" from 22.03.2016, № 490

The order of subthreshold procurements approved by the order of SE "Zovnishtorhvydav Ukraine" from 13.04.2016, № 35

#### WEB-SOURCES

<http://bi.prozorro.org/>

<http://zakon2.rada.gov.ua/laws/show/ru/922-19>

<http://www.ua-tenders.com/legislation/orders/248043/>

<http://cep.kse.org.ua/scheme/index.html>

[http://cep.kse.org.ua/assets/img/articles/Prozorro\\_report\\_ua.pdf](http://cep.kse.org.ua/assets/img/articles/Prozorro_report_ua.pdf)

<http://neftemarket.net/retail-market/65-values-of-average-retail-prices-of-petroleum-products-in-ukraine-and-their-dynamics>

APPENDIX A

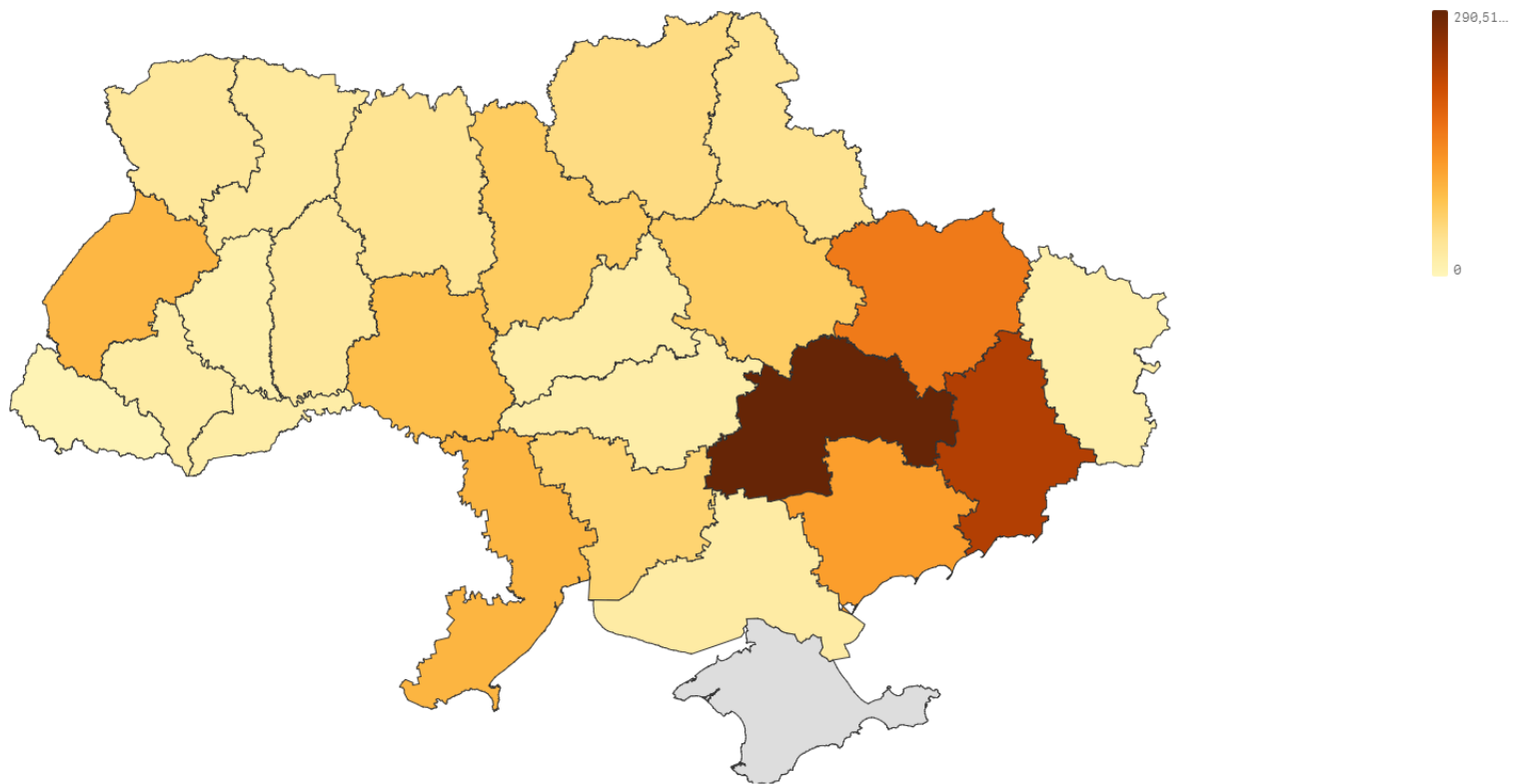


Figure 6: Level of the economy in the subthreshold procedures by the regions

APPENDIX B

Table 9: Estimations results

	<i>Price Savings</i>	<i>Price Savings</i>	<i>Price Savings</i>	<i>Price Savings</i>
<i>Number of Participants</i>	0.0377 (4.99)***	0.0377 (4.98)***	0.0377 (5.02)***	0.0379 (4.99)***
<i>Number of Participants (squared)</i>	-0.00299 (-2.61)*	-0.00299 (-2.60)*	-0.00297 (-2.62)*	-0.00298 (-2.59)*
<i>Estimated Value</i>	0.00968 (5.09)***	0.0172 (2.36)*	0.00961 (5.06)***	0.0170 (2.34)*
<i>Procedure</i>	0.0135 (3.98)***	0.0135 (3.97)***	0.0217 (9.71)***	0.0149 (3.84)***
<i>Duration</i>				-0.0000506 (-1.70)
<i>Mandatory Participation</i>			0.0101 (3.04)**	
<i>Procedure and Mandatory Participation</i>			-0.00789 (-2.11)*	
<i>Amount of Liters</i>		-0.00000167 (-1.15)		-0.00000165 (-1.15)
<i>Average Price in Ukraine</i>				0.000618

Table 9: Estimations results (continued)

				(0.77)
<i>_cons</i>	-0.0162	-0.0165	-0.0260	-0.0289
	(-0.91)	(-0.93)	(-1.58)	(-1.32)
R <sup>2</sup>	0.14	0.14	0.14	0.14
N	8479	8479	8479	8479

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t-statistics in parentheses: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

APPENDIX C

Table 10: Estimations results (ii)

	<i>Price Savings</i>	<i>Price Savings</i>	<i>Price Savings</i>
<i>Number of Participants</i>	0.0379 (5.01)***	0.0378 (4.99)***	0.0378 (5.01)***
<i>Number of Participants (squared)</i>	-0.00297 (-2.59)*	-0.00298 (-2.59)*	-0.00298 (-2.59)*
<i>Estimated Value</i>	0.00948 (5.10)***	0.0170 (2.35)*	0.00961 (5.04)***
<i>Procedure</i>	0.0151 (3.92)***	0.0229 (9.93)***	0.0227 (9.89)***
<i>Duration</i>	-0.0000532 (-1.78)	-0.0000508 (-1.69)	-0.0000526 (-1.77)
<i>Mandatory Participation</i>		0.00928 (2.31)*	0.0101 (3.08)**
<i>Procedure and Mandatory Participation</i>		-0.00807 (-2.18)*	-0.00773 (-2.06)*
<i>Amount of Liters</i>		-0.00000165 (-1.15)	
<i>Average Price in Ukraine</i>	0.000794	0.000309	

Table 10: Estimations results (ii) (continued)

	(1.00)	(0.32)	
<i>_cons</i>	-0.0321	-0.0319	-0.0263
	(-1.48)	(-1.47)	(-1.60)
$R^2$	0.14	0.14	0.14
$N$	8479	8479	8479

---

t-statistics in parentheses: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$