PROCUREMENT PERIL: EXAMINING THE NEXUS BETWEEN THE CONTRACT SCALE AND CORRUPTION VULNERABILITY

Insights from Government Contracting in Kazakhstan

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AUTHOR'S DECLARATION

I, the undersigned, AIZADA OMEN, hereby declare that I am the sole author of this thesis. To the best of my knowledge this thesis contains no material previously published by any other person except where due acknowledgement has been made. This thesis contains no material which has been accepted as part of the requirements of any other academic degree or non-degree program, in English or in any other language.

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ABSTRACT

This thesis is dedicated to examining the relationship between contract magnitudes and corruption risk indicators within Kazakhstan's public procurement system. The study aims to contribute to public policy by offering detailed and nuanced empirical insights on the strength and direction of the relationship between the government contracting scales, determined by both the price and implementation duration aspects, and four prominent integrity risk indicators: the use of non-open procedures, advertisement period length, submitted bid counts, and relative price increases. The study employs logistic and linear regression models to determine the combinations of contract price and duration levels most vulnerable to these corruption risks. Key findings of the study include that larger contracts exhibit stronger inclinations towards the use of open procedures and longer advertisement periods. However, the positive effects of contract durations on the likelihood of an open procedure are mitigated by the prices of the contracts, and vice versa. Furthermore, contracts with larger budgets are at greater risk of relative price increases when their duration is short. The risk of a small count of submitted bids significantly increases as the implementation extends for longer periods for contracts with bigger budgets and "approaching bidders" procurement procedures, whereas for contracts acquired via open and competitive dialogue procedures, contract magnitudes do not significantly impact the bidding behavior.

ACKNOWLEDGEMENTS

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I extend my appreciation to the faculty members of the Department of Public Policy at the Central European University for helping me develop a solid understanding of public policy processes and equipping me with the skills to analyze them. Specifically, I would like to thank Professor Anand Murugesan and Professor Mihály Fazekas for their instruction of quantitative skills, which were essential in conducting the analytical component of this research.

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INTRODUCTION

Have you ever wondered what factors elevate the chances of corruption in government contracting, and what role does the size of the contracts play in this? Most people might, with a good reason, assume that large-scale contracts are more susceptible to corrupt practices, even if only because they involve higher financial stakes. And yet, the corruption risks associated with low-profile, smaller-scale contracts should not be underestimated, as those oftentimes fly under the radar and enjoy much less scrutiny over them, making it easier to covert corruption. Put differently, the relationship between the size of contracts and corruption risks is not so readily apparent. Hence, engaging in empirical studies aimed at investigating the interplay between those variables becomes essential from both theoretical and practical policymaking perspectives.

The thesis is dedicated to examining the nexus between the scale of public procurement contracts and the vulnerability to corruption in Kazakhstan. The research aims to identify the strength and direction of the relationship between these variables using statistical methods on procurement data scrapped from Kazakhstan's official public procurement portal. As such, the paper aims to elucidate the question, "To what extent does the scale of public procurement contracts influence the vulnerability to corruption in Kazakhstan?" The significance of the study lies in its contribution to the expansion of our understanding of the intricate dynamics between the magnitude of public procurement contracts and the propensity for corruption, thereby widening the existing body of knowledge on corruption risks in public procurement by offering empirical insights derived from a thorough quantitative analysis of procurement data. The findings of this study serve the purpose of informing and facilitating anti-corruption efforts, promoting integrity and transparency standards in procurement processes, and ultimately fostering good governance practices by means of corruption risk management.

The relevance of the research inquiry stems from the immense importance of public procurement in proper government functioning, its vital role in the provision of public services, and the expansion of social welfare. Government purchases account for a huge chunk of government spending, not only in Kazakhstan, where, according to the OECD report (2019), they account for a staggering 43% of all government expenditures, but also ubiquitously across the globe (p. 9). Public procurement, in other words, constitutes a critical policy area both economically and socially. Naturally, because of its great importance in government operations and the high financial ramifications at stake, various legal and institutional frameworks were developed, and regulations and procedures were established to ensure the fairness and integrity of the procurement processes. Notwithstanding these efforts, however, corruption in government contracting remains a pervasive issue and a great concern, as it entails numerous negative repercussions, including misallocation of taxpayers' money, distortion of competition in the market, erosion of public trust in the government, delays, and inefficiency in the delivery of public services, and more. Corruption in public procurement, in other words, is not only economically costly but also bears social costs, as it gets reflected in the low quality of public services and substandard infrastructure projects, which can potentially pose a threat to public health. Ultimately, all these societal costs are most heavily borne by the most vulnerable strata of the population, who most rely on public services.

Therefore, the question of combating corruption in public procurement is critical for ensuring efficient allocation of public funds, advancing social welfare in the country, and safeguarding fair competition in the market. To best optimize corruption risk management and design effective evidence-based institutional reforms that enhance integrity and transparency in procurement procedures, it is vital to have a firm understanding of the interplay between policy-relevant variables, like the scale of government contracting, and different corruption risk indicators. This paper focuses on two primary dimensions of the government contracting

magnitude: monetary and temporal aspects. Those are measured in contract prices and the duration of the implementation phase from the date of the contract's signature until its completion. The study aims to determine the combinations of contract size levels that are more likely to be associated with four different corruption risk indicators, most often analyzed in integrity assessments of public procurement processes. These indicators include the use of non-open procedure types, the number of submitted bids, the length of the advertisement period, and the relative price increase of the purchased service or supply item. It must be noted that the corruption risk indicators used in this study serve the purpose of signaling potential risks of corruption but shall not be interpreted as definitive evidence that the corruption incidence took place in those specific tenders.

A single-case focus of this research offers both advantages and limitations at the same time. Naturally, the generalizability of findings derived from a single case study is inherently limited due to the unique context and characteristics specific to that case, such as institutional and legal frameworks and political, economic, and cultural aspects present in Kazakhstan, which can affect both the corruption risks and the magnitudes of the contracts, and that vary from country to country. And yet, single-case studies, especially when researching a complex phenomenon like corruption in public procurement and the intricate interplay of various policy-relevant variables, are particularly useful, as they yield rich and nuanced insights derived through extensive analysis. Moreover, while a data-driven examination of the nexus between contract scales and corruption risks in public procurement might not be a groundbreaking novel approach in academia on a global scale, this paper represents a pioneering effort to extensively analyze the relationship between contract magnitudes and corruption risks in Kazakhstan's public procurement using various statistical models. As such, this paper seeks to produce an in-depth analysis of the procurement perils within Kazakhstan, a country notoriously known for its pervasive corruption, yet where no prior data-driven studies specifically examining the

relationship between the contract scales and the aforementioned corruption risk indicators have been conducted.

The subsequent parts of the thesis will be organized into five main chapters. First, the literature review will provide an overview of the institutional and legal framework of public procurement in Kazakhstan and delve into the corruption risks surrounding public procurement. Following that, in the chapter dedicated to research design, the selection and operationalization of independent and dependent variables utilized in the study and the overall analytical setup of the study will be laid out. The chapter on research design will also elucidate the quantitative methods and models used in the analysis and address ethical considerations associated with this study. In the next two chapters that follow, the results and empirics derived from the research and data analysis will be presented and extensively discussed. Finally, in the concluding chapter of the thesis, the key findings of the study will be encapsulated, and the broader implications of the empirical insights derived from this study, their significance and contribution to the discourse of corruption risks in public procurement, as well as any potential limitations associated with this study, will be delineated.

LITERATURE REVIEW

This chapter of the thesis deals with a review of the literature consulted during the course of the study. First, the specific characteristics of Kazakhstan's public procurement system, including the procurement methods in use, the stages of the procurement cycle, the bid evaluation criteria, the main principles guiding the procurement processes, and some of the challenges and limitations of the current arrangements will be thoroughly delineated. Following that, the corruption risk indicators associated with public procurement and their operationalization in quantitative analysis will be outlined. This comprehensive review of the relevant literature will inform the research hypotheses tested within the study.

Public Procurement System in Kazakhstan

Before delving into the literature on the topic of corruption in public procurement and building the theoretical framework, it is important to grasp the legal particularities, stages, and main regulatory principles of the procurement process in Kazakhstan and understand the existing procurement system. The primary source consulted to get an overarching overview of Kazakhstan's procurement system is the Organization for Economic Co-operation and Development's (OECD) report from 2019 (which is fitting to the tendering years under analysis) that reviews the procurement system and changes it went through in recent years.

The Institutional and Legal Framework

According to the OECD (2019) report, public procurement accounts for a staggering 43% of all government expenditures in Kazakhstan (p. 9). As such, government contracting constitutes a large market in the country, which in recent years has undergone many important reforms and modernization efforts that aim to enhance the effectiveness, fairness, and integrity

of the procurement processes. The most notable of these reform initiatives was the launch of the e-procurement system in 2016. The data analyzed in this study comes directly from the national e-procurement portal, where, since its introduction, tenders have been published on a regular basis. As important as these reforms are, the OECD warns that such **frequent changes might increase the likelihood and frequency of mistakes made by procurement practitioners during the recurrent transition and adaptation stages** (p. 12). According to the OECD (2019), the procurement system can be regarded as decentralized, but since 2018, efforts for a more centralized system have been made, including the introduction of "central procurement bodies" as single organizers (p. 20). Moreover, the contracting bodies in Kazakhstan are legally obliged to include their procured goods and services in their annual, publicly available procurement plans (p. 14).

The eight main principles guiding the procurement processes in the country emphasize the importance of **procedure openness, fair completion, equal opportunities to bidders, efficient money allocation, prevention of corruption, respect for intellectual property of procured goods and services, encouragement of technologically advanced products, and support for local suppliers.** The aforementioned recommendations are mostly in congruence with the OECD recommendations, with the exception of the principle of supporting domestic supplies if it harms access for international suppliers (p. 18).

Main Procurement Procedure Types

There are five main methods of procurement in use in the country. These include **competitive tenders (open procedure), auctions, requests for quotations, direct awards, and the purchases at the commodity exchanges** (p. 13). Four of those (excluding the purchases at the commodity exchanges, which are exempted from being published electronically) are present in the data analyzed in the study. The public procurement laws and

regulations in Kazakhstan do not prescribe the use of a particular method of procurement; instead, the **contracting authorities are free to choose the procedure type they deem most appropriate for each tender**. In contrast, most of the OECD member states and EU states prioritize the use of competitive tenders, i.e., open procedure types, as a default procurement method (p. 14).

Open tenders are characterized by a regular competitive procedure, which includes the pre-qualification and contract awarding stages. The pre-qualification stage is also present in the auctions; however, within this procedure type, the bid prices only decrease during the bidding process. The request for quotations procedure type is only applicable to standardized goods and services, the price of which does not exceed 10,100,000 tenge, or 24,836 euros. Finally, the direct awards, or procurement from a single source, can only take place after at least two failed attempts of an open, competitive tender (p. 44).

Procurement Cycle and Evaluation Criteria

The public procurement cycle consists of five main phases: **the planning and budgeting stage, the preparation of the tendering documents by the buyers, including the technical requirements, the publication of tender announcement on the e-procurement system, and the bid submission stage, which is followed by the bid evaluation and the contract implementation stages** (p. 38).

The OECD (2019) reports that Kazakhstan's contracting authorities conduct **limited market analysis**, which is usually limited to finding the required supply and researching the conditions, such as price and required time frames, needed for its acquisition. They pay **inadequate attention to developing appropriate technical specifications**, and because the drafting of these technical specifications is almost solely the responsibility of the contracting authorities themselves, many local suppliers complain that, due to either incomplete or

inadequate technical specifications, they adjudge that they cannot comply with the published requirements and abstain from submitting their bids (p. 43). And this in turn results in a lack of submitted bids, which deem the open tenders to be "failed" and, as such, to be re-published and re-conducted as direct awards due to failed procurement attempts. **As such, a lack of technical expertise among the local buyers, who are almost exclusively responsible for developing technical specifications, might lead to failed tenders and their re-publication as direct awards.**

The average length of the advertisement period in Kazakhstan is 16 days for open tenders and 15.5 days for tenders using the request for quotation type of procurement, which is just above the legally required minimum of 15 days (p. 45). This means that **most buyers in Kazakhstan use the advertisement periods close to those minimally required by the law.** During the fourth stage of the procurement process, when bids are evaluated, the commission, which includes the members of the contracting authority, conducts the initial evaluations within a 10-day window, after which the results of their initial evaluations are published online on the national portal. Subsequently, the participating suppliers have three days to re-submit the lacking documentation and revise their bids, leaving the bid prices unchanged. Then, the responsible committee members re-evaluate the bids again within a 5-day window and single out the **valid bids, which are then automatically evaluated by the e-procurement system based on the best offered (the lowest) price, considering the "conditional discounts" to select the winning bid.** Suppliers then have five days to appeal the contract awarding decision (p. 45). The conditional discounts increase the chances of winning for bidders with the relevant expertise, exceptional quality offers, environmental accreditations, and certificates proving the compliance with certain national technical standards (p. 48).

Corruption Risks in Public Procurement

This study examines the effects of different contract size levels on corruption risks in Kazakhstan's public procurement system. On the whole, a considerable body of literature on the topic suggests that the more complex and extended procurement contracts are more vulnerable to corrupt practices, as they typically require the participation of many stakeholders and heightened levels of information asymmetry, which can facilitate efforts to obscure inflated prices, delays in delivery, and the sub-standard quality of purchased goods and services (Golden & Picci, 2005; Kenny, 2007). Furthermore, the higher financial stakes normally associated with larger-scale contracts offer attractive and lucrative opportunities for opportunistic behaviour (Rose-Ackerman, 1999). Nonetheless, smaller-scale, short-term procurement contracts, due to their lower visibility and reduced public attention, often enjoy limited oversight over them and fly under the radar, which also facilitates attempts to covert corrupt practices. Moreover, because smaller-scale contracts are typically less encumbered by statutory procedural obligations, there is more avenue for corrupt practices (Ticha, Nowak, & Mrnova, 2019). In other words, the relationship between contract size and corruption risks is not so readily apparent.

This paper focuses on four distinct corruption risk indicators: the use of non-open procedure types, the length of the advertisement period, the count of submitted bids per tender, and the relative price increase. One of the foundational integrity principles to safeguard the public procurement system from corruption is the use of fair and open competition to acquire supplies and services. The use of open procedure in public procurement is needed to ensure that tenders are awarded to suppliers offering goods and services with the best available quality in the market for the fairest prices (Kostyo, 2006). Conversely, **non-open procedures are associated with higher risks of corruption**, as the limited competition involved in these types of procurement methods results in a smaller count of valid submitted bids per tender, thereby

increasing the chances of single bids. Additionally, such procurement methods are known to **increase the winner's contract share in the buyer's total spending, as non-open procedure types allow buyers to repeatedly award tenders for their preferred suppliers** (Fazekas, Tóth, & King, 2016, p. 379). As such, the use of non-open procedure types can signal a conscious effort to restrict competition (Fazekas & Kocsis, 2020, p. 159).

The length of the advertisement period is another important indicator, which can signal integrity issues within the procurement process. To be more precise, **short advertisement periods are linked to elevated corruption likelihood**, as the competitiveness of such tenders is limited. Short periods of advertisement restrict the suppliers, who might not have enough time to prepare and submit all the required documents and conduct proper cost evaluations before the indicated deadline. As such, some **favoured contractors with insider information about the forthcoming tenders, which have not been announced on the official portal, might unfairly benefit from these short advertisement periods to beat their competitors** (Horn et al., 2021, p. 8).

The number of submitted bids per tender is also an important integrity risk indicator, which can be used as a corruption risk proxy. Because tenders receiving only a small number of valid bids, particularly those with the instances of single-bidding could signal increased risks of corruption, favouritism, collusion, and bias. And while small count of recorded bids and even single-bidding do not always serve as a definitive evidence of corrupt practices, **in the cases when single-bidding is repeatedly and extensively takes place, it can be indicative of corruption and restricted access to tenders** (Fazekas & Kocsis, 2020, p. 158). Moreover, a small bid count results in less competitive pressure on prices, resulting in higher costs, and as noted by Titl (2023), **single-bidding, in particular, leads to significant inefficiencies in the market**.

Finally, the relative price increase, which is referred to as cost overruns in some literature, measures the deviation of the final contract price from the estimated costs of the purchased supply or service in percentage terms, is another significant indicator of potential corruption in government contracting. The findings by Singh (2011) suggest that **contracts with bigger budgets and longer durations have significantly higher cost overruns**.

Research Hypotheses

In the study I hypothesize the following:

I. Larger-scale contracts (both in terms of price and duration), being subject to more stringent statutory procedural obligations, are more likely to be acquired via open procurement procedure.

II. For the same reason, I expect larger-scale contracts to also entail longer advertisement periods compared to smaller-scale contracts.

III. I hypothesize that larger-scale contracts will attract a higher count of bids, as they garner greater publicity and involve higher revenue potentials.

IV. Lastly, I expect larger-scale contracts to exhibit higher relative price increases, given the findings of the previous studies by Singh (2011), which suggest a positive correlation between contract scale and cost overruns.

RESEARCH DESIGN

This section of the thesis is dedicated to describing the data source used in the study, providing an overview on the selection and operationalization of the variables used in the analysis; laying out the methodological framework that guided the analysis; and detailing the ethical considerations associated with the study.

Data Source Description

The data analyzed in this paper was collected by means of web scrapping of the official procurement portal of Kazakhstan, accessible at https://www.goszakup.gov.kz/, and encompasses tenders published on the portal since 2016, that is, the earliest available contracts published on the national portal, until 2019.

The dataset used in the analysis was carefully cleaned and filtered to include awarded contracts with available contract prices, a critical variable for the analysis, which is used for the development of both dependent and independent variables. The finalized version of the dataset contains 99,885 published tenders awarded in Kazakhstan from 2016 to 2019. The bar chart in Figure 1 demonstrates the distribution of the awarded contracts per tender year and reveals a substantial disparity across these years. A markedly low number of awarded contracts in 2016, only a little over one thousand, could be explained by the fact that in this year a transition into online publication of tenders began in Kazakhstan. In that year, a vast majority of the published tenders did not include information about the final contract prices. In years that follow, we observe that the number of awarded contracts with available contract prices is significantly greater; although in 2018, again, a great portion of the published tenders lacked the final contract prices. It is important to note that this observation about a great portion of published tenders missing final contract prices, in itself, signals major transparency issues that exist within

Kazakhstan's national procurement system. These major gaps, undoubtedly, warrant detailed scrutiny, however, this study primarily focuses on integrity risks indicators and their relation to the procurement contracts' magnitudes, rather than on the transparency deficiencies, hence these data gaps within Kazakhstan's procurement system fall outside the scope this paper.

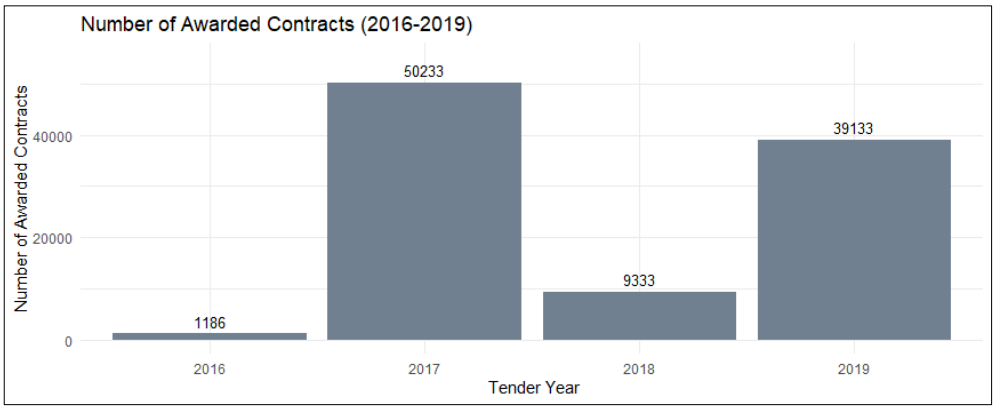

Figure 1. *Number of Awarded Contracts per Tender Year*

Furthermore, the number of buyers and bidders across these years varies greatly as well (see Figure 2). While some in some years, the number of participating bidders exceeded the number of participating buyers, like in 2017 and 2019; the opposite was true for 2016 and 2018, where the buyers participating in the procurement processes surpassed the number of bidders.

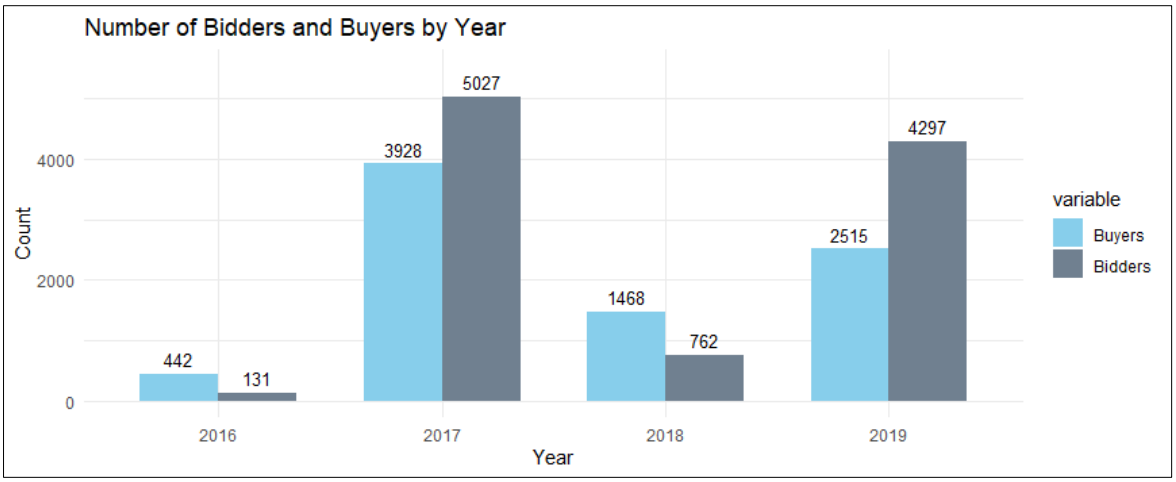

Figure 2. *Number of Buyers and Bidders by Tender Year*

The cleaned and finalized dataset includes the awarded tenders within 17 largest cities of Kazakhstan, including the three cities of the republican significance (Astana, Almaty, and Shymkent) and the administrative centers of the country's 14 principal provinces. The Figure 2 clearly illustrates that the most tendering activity in the country between 2016 and 2019, not surprisingly, took place in the capital city Astana, and the country's largest urban center Almaty. Followed by Karaganda, the administrative center of Kazakhstan's largest region.

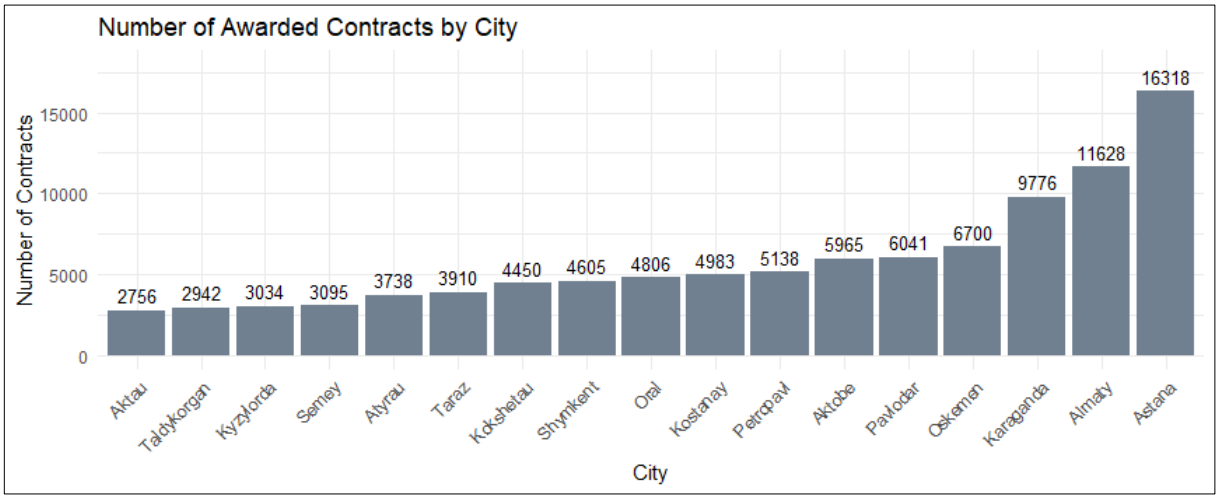

Figure 3. *Number of Awarded Contracts by City (2016–2019)*

Selection and Operationalization of the Variables

To analyze the relationship between public procurement contract size and corruption risk indicators, two primary sets of variables were included in the analysis. The first set of variables pertains to the contract size and encompasses both the monetary and temporal (duration of the implementation) aspects of the contracts. These are the independent variables of the study. The second set of variables, which act as the dependent or outcome variables, relate to different corruption risk indicators. The selection and operationalization of the dependent variables follow the theoretical framework, which was delineated in the concluding section of the literature review chapter and are informed by an extensive review of the literature on the corruption risks in public procurement procedures. Both independent and dependent variables

used in the analysis were developed directly from the original data: the calculation and operationalization of these variables will be explained in great detail in this section.

Independent Variables (Contract Scale)

In addition to the original variables present in the dataset, including the tender year, the contract estimated and final prices, the national procurement procedure types, the unique identifiers for tender, buyer, and bidder IDs, and others; I have developed nine additional variables to better understand and capture the strength and the direction of the relationship between the contract magnitude and different corruption risk indicators, or so-called red flags.

To estimate the size of procurement contracts, I focused on two primary aspects of the contract magnitude: duration and monetary value. Contract duration encompasses the implementation period, i.e., the period from the date of contract signature until the date of contract completion. First, I calculated and created a continuous variable for the contract duration, which I then categorized into ten intervals, ensuring that the number of observations in each interval is balanced. Following that, I created another variable with five simplified levels, to estimate the contract scale by the aspect of duration. These simplified levels allow us to identify broader trends and facilitate the interpretation of the findings. Hence, this variable will be one of the two primary predictor variables used in the study. Below I provide a more detailed overview of these variables:

a. **Contract duration:** This is a continuous variable, measured in the number of days. To develop this variable, I first converted the original variables ‘lot_contractsignaturedate’ (the date when the contract was signed) and ‘lot_contractcompletiondate’ (the date when the contract was completed) into the date format to ensure accurate calculations. Then, I calculated the difference between them, subtracting the contract signature date from the contract completion date. Importantly, around a quarter (24.4%) of contracts

under analysis lack contract completion dates, making it impossible to calculate the duration of those contracts. This variable is not directly used in the analysis as an independent variable per se, but rather it is used to code the next two variables.

b. Contract duration category: This a categorical variable, which categorizes the preceding continuous variable into ten intervals, each containing approximately 10% of the observations in the data, to ensure a balanced distribution of observations across different intervals. Put differently, I transformed the continuous variable into a categorical one by splitting the date into deciles with approximately same frequency (see Figure 4). The contracts with missing completion dates, for which the contract duration could not be determined, were assigned into a separate category, "Missing Values," to avoid data omission.

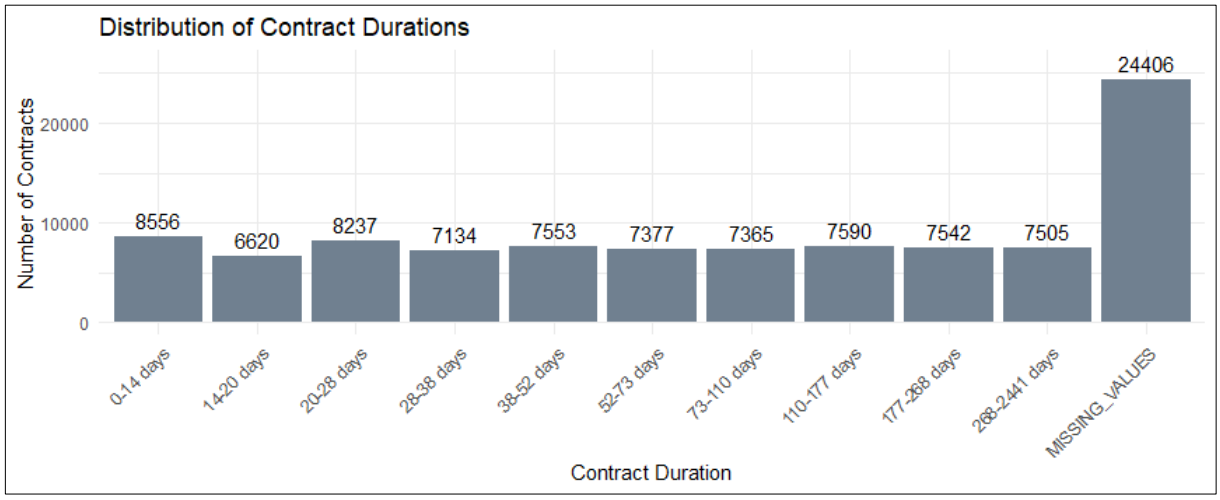

Figure 4. *Distribution of Contract Durations (2016–2019)*

c. Contract scale (duration aspect): The contract duration categories were further grouped into five simplified levels to make interpretations of the findings more digestible and compressible. The levels included in this variable include: "very short" for contracts with the duration up to twenty days; "short" for contracts with the duration from 21 to 38 days; "moderate" level includes contracts lasting from 39 up to 73 days;

"long" level includes contracts with the duration from 74 to 177 days; and finally, the contracts with the duration exceeding 177 days are labeled as "very long" contracts.

Another important aspect of the size of the procurement contracts is the monetary value. To incorporate this aspect, I used the original variable representing the aggregated contract price by the winning supplier, i.e., the final contract price. Similar to the approach used for the creation of the contract duration levels, I have created two additional variables. The first categorical variable categorizes the contract prices into ten intervals of approximately same size (see Figure 5), while the second variable further groups those intervals into five simplified levels that represent the contract size by the aspect of monetary value. These price levels, along with the aforementioned duration levels, are used as primary predictor variables in the study. Below is a more detailed breakdown of these variables:

d. Contract price category: The original continuous variable, representing the final contract prices was transformed into a categorical variable with ten intervals, each containing around 10% of the awarded contracts to ensure a balanced distribution (see Figure 5).

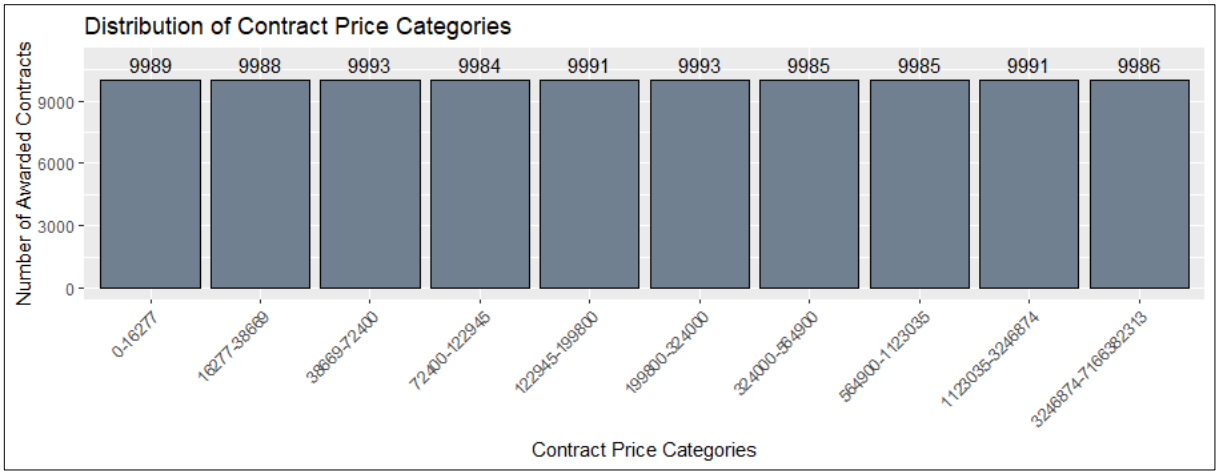

Figure 5. *Distribution of Contract Prices (2016–2019)*

e. **Contract scale (price aspect):** This variable was coded using the contract price categories. It contains five levels, which describe the price aspect of the contract scale. The contracts with the price up to 38,700 tenge, which is the equivalent of approximately 80 euros based on the most recent exchange rates at the time of writing, are labeled as "micro" contracts; while contracts with the price range from 38,700 to 123,000 tenge (80 – 255 euros) are labeled as "small" scale contracts; the contracts with prices above 123,000, but below 324,000 tenge (255 – 673 euros) are regarded as "medium" scale contracts; the "large" scale contracts have prices ranging from 324,000 to 1,123,000 tenge (673 – 2,335 euros); finally the "mega" scale contracts have prices exceeding 1,123,000 tenge, up to 7,166,382,313 tenge (around 14,913,241 euros), which is the most expensive contract in the data under analysis, and pertains to the construction of a power transmission line and two substations as part of the construction of the external infrastructure of the Caspian Energy Hub.

Dependent Variables (Corruption Risk Indicators)

As for the outcome variables, this study analyzes the effect of contract size on four different corruption risk indicators: for four of those indicators I developed new variables, and for the last indicator (the number of submitted bids) I use the original variable, 'tender_recordedbidscount.' As was noted in the introduction chapter, these variables indicate the *risk* of potential corruption, but they do not constitute definitive evidence that corruption actually took place in those tenders. The selection and operationalization of these dependent variables is informed by literature and in particular by the ProACT Procurement Anticorruption and Transparency platform's methods paper. Below I provide a more detailed breakdown of the outcome variables I developed:

f. **Open procedure:** This is a binary variable, which takes the value '0' for the contracts awarded using non-open procedure types; and the value '1' for contracts awarded using open procedure type. It is coded using the original variable 'tender_proceduretype.'

g. **Advertisement period:** This is a continuous variable, representing the number of days between the publication of the first call for tenders and the bid submission deadline. It is calculated by converting the relevant variables ('tender_biddeadline' and 'tender_publications_firstcallfortenderdate') into the date format and subtracting the date of publication of the first call for tenders from date of the bid submission deadline.

h. **Relative price increase (%):** This is a continuous variable that measures a deviation of the final contract price from the estimated costs of the purchased supply or service in percentage terms. The variable calculates the difference between the final contract value and the estimated lot price as a ratio of the estimated lot price, using the formula below:

$$\left[\frac{bid\_contractprice - lot\_estimatedprice}{lot_{estimatedprice}}\right] \times 100$$

i. **Count of Submitted bids:** This continuous dependent variable already exists in the original dataset, as 'tender_recordedbidscount.' As established in the literature review, tenders with small count of submitted bids, especially those with single-bidding, are in greater risk of corruption. The original dataset contained many tenders with single-bidding; however, these tenders lack the final contract prices, which is a critical variable for this study. Hence, when a filter was applied to select awarded tenders with available contract prices, only the tenders with at least two submitted bids remained. And while two submitted bids do not always definitively constitute a major corruption red flag, examining the relationship between the contract size and the number of submitted bids, particularly for tenders with open procedure, allows us to determine if larger scale contracts attract more bids.

Methodological Framework

In this study, the examination of the procurement risks in Kazakhstan will be carried out using a combination of various statistical models, which aim to identify the strength and direction of the relationship between the size of the contact and four different integrity risk indicators: the use of non-open procedure types, the length of the advertisement period, the number of submitted bids per tender, and the relative price increase of the purchased supply or service. Given the relatively narrow temporal scope present in the data (2016–2019), tenders within these years will be analyzed collectively. Such a comprehensive analysis offers several advantages. Firstly, it enlarges the sample size used in the statistical models, thereby allowing for more precise estimates, and enhancing the reliability of the results. Secondly, analyzing all the tenders from these four years available in the data jointly results in a more holistic examination, which facilitates the identification of the general trends and patterns in the country's public procurement procedures.

The choice of statistical methods and models used in the study is guided by the primary objectives of the research and the nature of the variables under analysis. The two predictor, or independent variables, used in the study are factor variables, meaning that the categorical variables pertaining to contract price and implementation duration intervals are stored in five distinct levels (as explained in detail in the previous section 'Selection and Operationalization of the Variables'). The study examines both the individual effects of different levels of contract duration and price and the synergistic effects of various combinations of contract price and duration levels. Three of the outcome, or dependent variables, used in the study are numeric continuous variables (the length of the advertisement period, relative price increase, and the count of recorded bids). To analyze those continuous variables, I employed linear regression models. Linear regression analyses are particularly useful to identify the strength, i.e., magnitude, and direction of the relationship between the two analyzed variables. To

complement the regression analysis, I generated the effect and heat map plot visuals using specific packages within the statistical software R. The effect map effectively visualizes how changes in the predictor variables affect the outcome variable, plotting the predicted values from the regression model. This facilitates the intractability of the regression results and eases the identification of general trends. Similarly, the heat map also uses the fitted regression model to visualize the predicted values of the outcome variable. The color gradient of the heat map effectively illustrates the magnitude of the predicted outcomes, thereby depicting the overarching patterns.

The fourth outcome variable, related to the use of non-open procedure types, is a binary variable. As the first level of analysis, aimed at examining the effect of contract magnitude on the procurement procedure type, I generated a flat contingency table, which reveals the frequency distribution of tenders acquired via open and non-open procedures for each combination of contract size and price levels. This is done to get an overview of which combinations of contract price and implementation duration levels tend to involve open procurement procedures and which ones, in contrast, are more likely to be associated with non-open procedures. Additionally, I conducted the chi-square test of independence on the contingency table to identify whether there exists a statistically significant association between contract size and the procurement procedure type. Then, I computed the standardized residuals from the chi-square test to determine the combination of contract price and duration that contributes the most to the chi-square test statistic and, thereby, the observed frequencies that deviate the most from the expected frequencies under the assumption of independence. Finally, I analyzed the relationship using the logistic regression model, which, along with the main effects of contract price and duration levels, also included the interaction terms between these different levels of the predictor variable to determine the likelihood of an open procedure among different combinations of contract price and duration.

Ethical Considerations

I would like to conclude the research design chapter by addressing the ethical considerations associated with this study. By its nature, my quantitative research entails practically no ethical or confidentiality concerns, as the study leverages data scraped from an open data source that is readily available to the public. In other words, my research utilizes government contracting data, which, according to legal norms, must be accessible to public scrutiny. Moreover, I abstained from using any personal or contact information of buyers and bidders, such as their names, addresses, phone numbers, and email addresses (which are nonetheless published on the portal), as these details are extraneous to the objectives of the research that aims to produce empirical insights by examining the relationship between policy relevant variables and corruption risks rather than conducting exhaustive investigations of Kazakhstani buyers and suppliers' backgrounds. As such, the research respects and upholds ethical considerations, and the study incurs no ethical or confidentiality concerns.

EMPIRICS, FINDINGS AND DISCUSSION OF THE RESULTS

This chapter will present the results of the quantitative analysis, aimed at examining the relationship between different levels of contract size and five distinct corruption risk indicators: the use of non-open procedure types, the length of the advertisement period, the relative price increase of the purchased service or supply item, the number of submitted bids, and the supplier's contract share in buyers total annual spending.

Procedure Openness

As the first step to analyze the relationship between the contract size and the openness of the procurement procedure, I created a contingency table in R, which demonstrates a multivariate frequency distribution of all the combinations of contract duration and price levels, and the procurement procedure openness.

By carefully examining the counts for the binary outcome variable on Table 1 (where '0' represents non-open procedure, and '1' represents open procedure), we find that the highest number of contracts procured using open procedure, belong to the largest-scale category, both in terms of contracts' duration and price. In other words, contracts with the longest duration and with the highest prices, where the implementation duration is over 178 days and the price exceeds 1,123,000 tenge, predominantly were procured using open procedure (2,313 contracts). The second highest count of open procedure type (1,277 contracts) correspond to the contracts with long duration (74 – 177 days) and a mega-scale price level (of value over 1,123,000 tenge). Finally, contracts with moderate duration (39 – 73 days) and again with a mega-scale price, had the third highest number of openly procured contracts. From this we can infer that **larger scale contracts, especially those with mega-scale prices and long or very long durations, had the greatest number of contracts procured using open procedure type** in Kazakhstani tenders

between 2016 and 2019. We also find that non-open procedure types are mainly prevalent among the smallest-scale contracts, both in terms of duration and price. As such, the highest number of non-open tenders (4,862) took place in contracts with very short duration (less 21 days) and micro-scale prices (not exceeding 38,700 tenge); in contracts with short duration and small-scale prices, i.e., with the implementation duration of less than 39 days and the price of maximum 123,000 tenge (3,989 tenders); and in contracts with very short duration and small-scale prices (3,892 tenders). From this we can conclude that **smaller scale contracts, particularly those with very short duration and micro or small-scale prices, had the greatest number of contracts procured using non-open procedure types** in Kazakhstani tender between 2016 and 2019.

Table 1. *Frequency Distribution of the Contract Size Levels and Open Procedure Type*

	0	1
Very Short - Micro	4862	10
Very Short - Small	3892	36
Very Short - Medium	3284	54
Very Short - Large	2142	94
Very Short - Mega	558	244
Short - Micro	3890	35
Short - Small	3989	48
Short - Medium	3249	79
Short - Large	2303	276
Short - Mega	1030	472
Moderate - Micro	3536	25
Moderate - Small	3293	91
Moderate - Medium	3266	99
Moderate - Large	2390	317
Moderate - Mega	1187	726
Long - Micro	2883	59
Long - Small	2921	118
Long - Medium	2786	323
Long - Large	2782	512
Long - Mega	1294	1277
Very Long - Micro	2352	17
Very Long - Small	2474	52
Very Long - Medium	2659	206
Very Long - Large	2781	709
Very Long - Mega	1484	2313

As a succeeding step in the analysis, I performed the chi-square test of independence that revealed **a very low p-value (less than 0.00000000000000022),** which indicates that there exists a strong association between the variables under analysis, and that certain combinations of contract duration and price levels are more likely to be associated with open procurement procedure than others. As such, a very low p-value in the chi-square test of independence suggests that the observed frequency distribution we see in contingency table (Table 1), is

considerably different from the frequencies we would expect if the variables were independent of each other. I, then, calculated the Pearson standardized residuals to identify the combinations of contract price and duration levels, the observed frequencies of which deviate the most from the expected frequencies under the assumption of independence, and thereby contribute the most to the chi-square statistic. Positive residuals on Table 2 signal that the observed frequencies of these combinations of contract price and duration levels are higher than would expected under the assumption of independence, while negative residuals signal that the observed frequencies of these combinations of contract price and duration levels are lower than would expected.

Table 2. *Standardized Residuals (Contract Size Levels and Open Procedure Type)*

	0	1
Very Short - Micro	7.87178204	-22.56023770
Very Short - Small	6.59602192	-18.90395616
Very Short - Medium	5.65140539	-16.19671994
Very Short - Large	3.33017289	-9.54415299
Very Short - Mega	-5.87000665	16.82322311
Short - Micro	6.60994327	-18.94385422
Short - Small	6.50353422	-18.63888981
Short - Medium	5.18098155	-14.84850250
Short - Large	0.08150133	-0.23357981
Short - Mega	-8.44396960	24.20010621
Moderate - Micro	6.41586376	-18.38762950
Moderate - Small	5.03011147	-14.41611441
Moderate - Medium	4.86057716	-13.93023532
Moderate - Large	-0.47226735	1.35350085
Moderate - Mega	-12.55262046	35.97534841
Long - Micro	5.08287686	-14.56733807
Long - Small	4.06983102	-11.66398596
Long - Medium	0.27410882	-0.78558579
Long - Large	-2.85093882	8.17068577
Long - Mega	-20.84537654	59.74208225
Very Long - Micro	5.22499408	-14.97464079
Very Long - Small	4.68153329	-13.41710218
Very Long - Medium	2.07664045	-5.95157511
Very Long - Large	-5.92018979	16.96704614
Very Long - Mega	-32.67277864	93.63898152

A careful simultaneous examination of the positive and negative residuals in Table 2 helped me identify the specific combinations of contract price and duration levels that are most likely to involve open procurement procedures and the combinations that, in contrast, are least likely to involve open procurement procedures. For example, for the contracts of the largest scale, i.e., with the combination of a very long duration and a mega-scale price, we can observe a very high positive residual (93.64) in column 3 and a very low negative residual (-32.67) in column 2, meaning that this specific combination of the contract size is the most likely to have an open procurement procedure. The large magnitudes of both positive and negative residuals suggest that the observed frequencies of both open and non-open procedures for contracts of this size are significantly different than would be expected if there were no association between the contract size and the openness of the procurement procedure. Similarly, contracts with long duration and mega-scale prices also have a very high positive residual (59.74) for open procedures and a very low negative residual (-20.85) for non-open procedures, as well as contracts with moderate duration and mega-scale prices, implying that contracts of this size predominantly have open procurement procedures. This further consolidates our findings that **larger-scale contracts, particularly in terms of their price and pretty much irrespective of their duration, but especially so for contracts with longer duration, are more likely to involve open procurement procedures in Kazakhstani tenders**. Table 2 also reveals the contracts, which predominantly involve non-open procedure types. These include the smallest-scale contracts, the contracts with the combination of short duration and micro-scale prices (no longer than 39 days in terms of implementation and contract price not exceeding 38,700 tenge), and the combination of very short duration and small-scale prices (implementation of a maximum 20 days and a maximum a maximum price of 123,000 tenge). As such, we again see that **smaller-scale procurement contracts are more likely to involve non-open procedure types in Kazakhstan**.

Next, to complement the insights derived from the analysis of the contingency table, I run logistic regressions using different contract size levels as the predictor variables and a binary variable indicating the openness of the procedure as an outcome variable. The logistic regression results in Table 3 reveal the main effects of different contract size levels on the likelihood of procedure openness (taking the very short duration and micro-scale prices as a reference category). Table 3 clearly demonstrates that **as contracts become longer in duration, the likelihood of the procedure being open increases, and as the contracts become more expensive, the probability of the open procedure also increases**. This validates the insights derived from the analysis of the cross-tabulation, further consolidating our findings on the effects of contract size on the openness of the tendering procedure in Kazakhstan. Notably, all the coefficients are positive and statistically significant; however, the **effect of the contract prices on the openness of the procurement procedure is greater than that of the contract duration**.

Table 3. *Logistic Regression Results (Procedure Openness)*

Logistic Regression Results

Effect of Contract Scale on Open Procurement Procedure

Predictor	Coefficient	Standard Error	Z Value	P-value	Significance
(Intercept)	-5.5834089	0.09532655	-58.571395	0.000	***
contract_scale_durationshort	0.4634019	0.06335417	7.314466	0.000	***
contract_scale_durationmoderate	0.7045477	0.06085211	11.578031	0.000	***
contract_scale_durationlong	1.2765600	0.05758167	22.169557	0.000	***
contract_scale_durationvery long	1.4785487	0.05636655	26.230959	0.000	***
contract_scale_pricesmall	0.8776841	0.09949404	8.821474	0.000	***
contract_scale_pricemedium	1.7041385	0.09122988	18.679610	0.000	***
contract_scale_pricelarge	2.7415163	0.08694056	31.533225	0.000	***
contract_scale_pricemega	4.4394144	0.08568169	51.812872	0.000	***

To get a bigger picture of how the effects of one predictor variable (contract price levels) on the outcome variable (the procedure openness) change at different levels of the second

predictor variable (contract duration levels), I conducted another logistic regression, which, apart from the main effects of the individual levels of contract duration and price levels, also incorporates the interaction terms between these two predictor variables. This makes it possible to determine whether the combined effects of contract price and duration levels augment or reduce the likelihood of open procedures in Kazakhstani tenders. Looking at the interaction terms in Table 4, we notice that for almost all combinations, the coefficients are negative. This implies that for most combinations of contract duration and price levels, the probability of an open procedure is reduced when we consider their joint effect instead of the individual effects of these predictor variables. In other words, **the positive effects of contract durations on the likelihood of an open procedure are mitigated by the prices of the contracts, and vice versa**.

Table 4. *Logistic Regression Results (Procedure Openness) including the interaction terms*

Logistic Regression Results

Effect of Contract Scale on Open Procurement Procedure

Predictor	Coefficient	Standard Error	Z Value	P-value	Significance
(Intercept)	-6.18661963	0.3164063	-19.55276803	0.000	***
contract_scale_durationshort	1.47580326	0.3590842	4.10990860	0.000	***
contract_scale_durationmoderate	1.23474403	0.3746942	3.29533766	0.001	***
contract_scale_durationlong	2.29757038	0.3426499	6.70529924	0.000	***
contract_scale_durationvery long	1.25681167	0.3992013	3.14831568	0.002	**
contract_scale_pricesmall	1.50346013	0.3579772	4.19987666	0.000	***
contract_scale_pricemedium	2.07878621	0.3448710	6.02772146	0.000	***
contract_scale_pricelarge	3.06041916	0.3334938	9.17683959	0.000	***
contract_scale_pricemega	5.35942889	0.3255817	16.46108767	0.000	***
contract_scale_durationshort:contract_scale_pricesmall	-1.21273859	0.4219718	-2.87398016	0.004	**
contract_scale_durationmoderate:contract_scale_pricesmall	-0.14027930	0.4239377	-0.33089604	0.741	
contract_scale_durationlong:contract_scale_pricesmall	-0.82340755	0.3927603	-2.09646351	0.036	*
contract_scale_durationvery long:contract_scale_pricesmall	-0.43600000	0.4550070	-0.95822705	0.338	
contract_scale_durationshort:contract_scale_pricemedium	-1.08462452	0.4009121	-2.70539237	0.007	**
contract_scale_durationmoderate:contract_scale_pricemedium	-0.62311203	0.4118568	-1.51293384	0.130	
contract_scale_durationlong:contract_scale_pricemedium	-0.34444679	0.3737471	-0.92160382	0.357	
contract_scale_durationvery long:contract_scale_pricemedium	0.29319253	0.4282699	0.68459751	0.494	
contract_scale_durationshort:contract_scale_pricelarge	-0.47116982	0.3796104	-1.24119328	0.215	
contract_scale_durationmoderate:contract_scale_pricelarge	-0.12869044	0.3937942	-0.32679613	0.744	
contract_scale_durationlong:contract_scale_pricelarge	-0.86397066	0.3616998	-2.38864044	0.017	*
contract_scale_durationvery long:contract_scale_pricelarge	0.50267847	0.4150143	1.21123181	0.226	
contract_scale_durationshort:contract_scale_pricemega	-1.42894762	0.3713778	-3.84769277	0.000	***
contract_scale_durationmoderate:contract_scale_pricemega	-0.89918768	0.3853649	-2.33334079	0.020	*
contract_scale_durationlong:contract_scale_pricemega	-1.48360426	0.3533488	-4.19869678	0.000	***
contract_scale_durationvery long:contract_scale_pricemega	0.01418331	0.4078705	0.03477405	0.972	

As can be seen from Table 4, seven of the sixteen interaction terms are statistically significant and thus warrant closer scrutiny. For example, the contracts belonging to the most expensive category with both long and short durations have statistically significant negative coefficients of -1.48 and -1.43, respectively. This implies that the odds of open procedure for contracts with the highest-level prices coupled with either long or short implementation durations are significantly reduced compared to the baseline levels (contracts with very short

duration and micro-scale prices). To improve the interpretability of the findings, let's convert the log-odds from Table 4 for these two combinations of contract duration and price levels to the odds ratios using the exponential function. As such, using the calculator, we find that the log-odds coefficient of -1.48 is equal to exp (-1.48) ≈ 0.23 in odds ratio terms, and the log-odds coefficient of -1.43 is equal to exp (-1.43) ≈ 0.24 in odds ratio terms. This means that the likelihood of an open procedure is reduced by 0.23 and 0.24 times when contracts with mega-scale prices have long and short durations, respectively, compared to the baseline levels with the shortest duration and lowest price level. Put differently, **for contracts with the highest price level coupled with long and short durations, the probability of an open procurement procedure reduces by 77% and 76%, respectively**. Furthermore, Table 4 reveals that **as the duration of the contracts with small and medium-scale prices decreases, the likelihood of the open procedure also decreases.** Another important observation that can be made from the regression results is the fact that all the coefficients for contracts with very long duration are positive and statistically significant (the only exception is the combination with small-scale prices, where the coefficient is negative but still not statistically significant), which suggests that **contract prices exhibit little influence on the odds of open procedure for contracts with very long duration.**

Length of the Advertisement Period

The second corruption risk indicator that I analyzed pertains to the length of the advertisement period. This indicator is crucial for corruption risk assessment, as short advertisement period in public procurement signals heightened potential risk of corruption, because it can be indicative of the presence of unfair competition conditions. To analyze the relationship between different levels of contract size and this corruption red flag, I employed linear regression analysis using the continuous variable, representing the number of days of the advertisement period.

The results of the linear regression are summarized in Table 5. The table contains both the main, i.e., the individual effects of the varying levels of contract duration and value, and the interaction terms, i.e., the combined effects of different combinations of contract duration and price levels, taking the smallest-scale contracts with combination of very short duration and micro-scale prices as the baseline level. As we can see by looking at the main effects, **as the duration of contract increases, the length of the advertisement period also increases**. The **contract with a long implementation duration are the most likely to have the longest periods of advertisement**, compared to contracts with other duration levels. Moreover, **as the monetary value of contracts increases, the length of the advisement period also progressively increases**, making contracts with the highest level of price (mega-scale) the most likely to have the longest advertisement period.

Now, to analyze the combined effects, I examined and interpreted the interaction terms in Table 5. As can be observed for contracts with small-scale prices (in the range of 38,000 – 123.000 tenge), none of the coefficients of the interaction terms with different levels of duration are statistically significant, meaning that the effect of small-scale prices on the length of the advertisement period does not significantly change as the duration of such contracts increases. As per contracts with medium-scale prices (123,000 – 324,000 tenge), as they become larger in terms of their implementation duration, the advertisement period for them also increases significantly. The advertisement period for contracts with large-scale prices (324,000 – 1,123,000 tenge) progressively increases as the duration of such contracts increases. The same is true for the most expensive contracts; as their implementation increases, the advertisement period also steadily increases. Notably, the highest amplifying effect on increasing the length of the advertisement period is seen when contracts with the highest-level prices (mega) are paired with the highest-level durations (very long), meaning that contracts with longer durations and higher prices significantly increase the length of the advertisement period in Kazakhstani

tenders.

Table 5. *Regression Results (Contract Size Levels and Advertisement Length)*

Regression Results

Effect of Contract Scale on Advertisement Period Length

Predictor	Coefficient	Standard Error	Z Value	P-value	Significance
(Intercept)	8.17159278	0.06358586	128.5127362	0.000	***
contract_scale_durationshort	0.17286582	0.09519366	1.8159385	0.069	
contract_scale_durationmoderate	0.12719970	0.09785108	1.2999315	0.194	
contract_scale_durationlong	0.38177228	0.10362771	3.6840751	0.000	***
contract_scale_durationvery long	0.29738148	0.11116736	2.6750791	0.007	**
contract_scale_pricesmall	0.12321374	0.09517352	1.2946221	0.195	
contract_scale_pricemedium	0.38173257	0.09972154	3.8279853	0.000	***
contract_scale_pricelarge	0.43574175	0.11337005	3.8435348	0.000	***
contract_scale_pricemega	4.14386857	0.16912898	24.5012333	0.000	***
contract_scale_durationshort:contract_scale_pricesmall	-0.09858639	0.13768118	-0.7160484	0.474	
contract_scale_durationmoderate:contract_scale_pricesmall	0.16901033	0.14286594	1.1829995	0.237	
contract_scale_durationlong:contract_scale_pricesmall	0.14013722	0.14911530	0.9397911	0.347	
contract_scale_durationvery long:contract_scale_pricesmall	0.07685397	0.15865444	0.4844111	0.628	
contract_scale_durationshort:contract_scale_pricemedium	-0.16278973	0.14450609	-1.1265250	0.260	
contract_scale_durationmoderate:contract_scale_pricemedium	-0.02465580	0.14604770	-0.1688202	0.866	
contract_scale_durationlong:contract_scale_pricemedium	0.87127098	0.15157776	5.7480134	0.000	***
contract_scale_durationvery long:contract_scale_pricemedium	0.59257416	0.15853989	3.7376976	0.000	***
contract_scale_durationshort:contract_scale_pricelarge	1.02553831	0.15971660	6.4209874	0.000	***
contract_scale_durationmoderate:contract_scale_pricelarge	1.17422085	0.16019125	7.3301187	0.000	***
contract_scale_durationlong:contract_scale_pricelarge	1.44380151	0.15977597	9.0364122	0.000	***
contract_scale_durationvery long:contract_scale_pricelarge	2.28353615	0.16374369	13.9457962	0.000	***
contract_scale_durationshort:contract_scale_pricemega	0.43311091	0.21618970	2.0033837	0.045	*
contract_scale_durationmoderate:contract_scale_pricemega	0.92325636	0.21079219	4.3799363	0.000	***
contract_scale_durationlong:contract_scale_pricemega	2.65438053	0.20727246	12.8062383	0.000	***
contract_scale_durationvery long:contract_scale_pricemega	4.31920880	0.20520109	21.0486643	0.000	***

To effectively visualize the visualize the relationship between different levels of contract size and the length of the advertisement period, I created two different plots in R, which make it easier to visually identify any patterns and trends in the data. The effect plot on Figure 6 displays the relationship between different levels of contract duration and price, and the length of the advertisement period as it is predicted by the linear regression model. As can be observed from the graph, the relationship between the contract magnitude, considering both the price and

duration aspects together, and the length of the advertisement period is almost linear. **The bigger the scale of the contract, both in terms of implementation duration and monetary value, the longer is the advertisement period.**

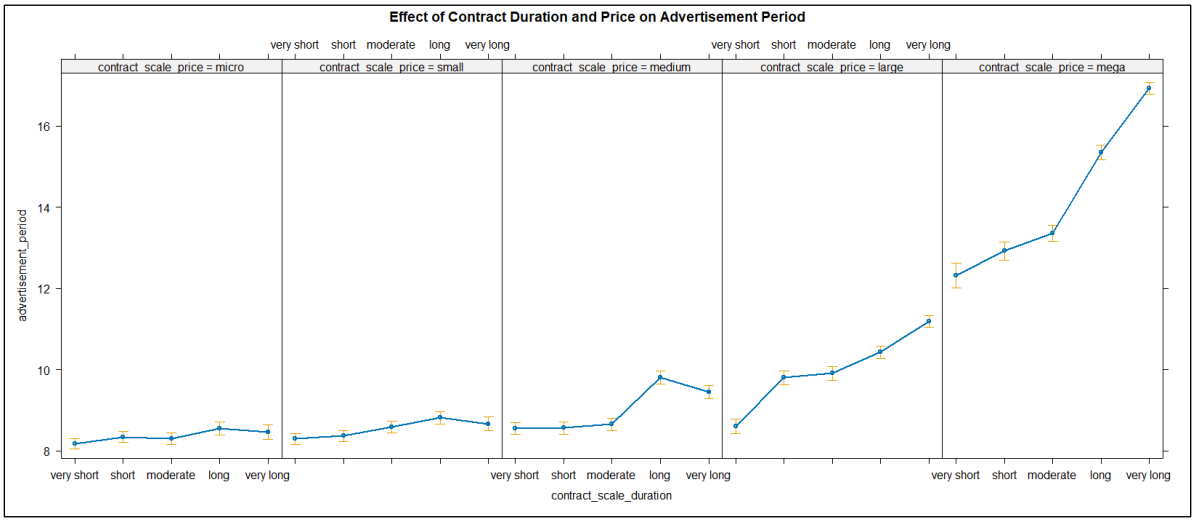

Figure 6. *The Effect Plot of Contract Size Levels on Length of Advertisement Period*

In addition to the effect plot on Figure 6, I created a heat map plot (see Figure 7 below), which displays the predicted advertisement length for different combinations of contract price and duration levels. The more saturated the "pink" color of the cell is, the longer is the advertisement period for the corresponding combination of contract price and duration is. Conversely, cells of "blue" color indicate shorter advertisement periods for that combination of contract sizes. As can be observed by the pattern of colors on the heat map in Figure 7, **there is a clear trend in data: the bigger the scale of the contract, both in terms and duration, the longer is the predicted advertisement period**.

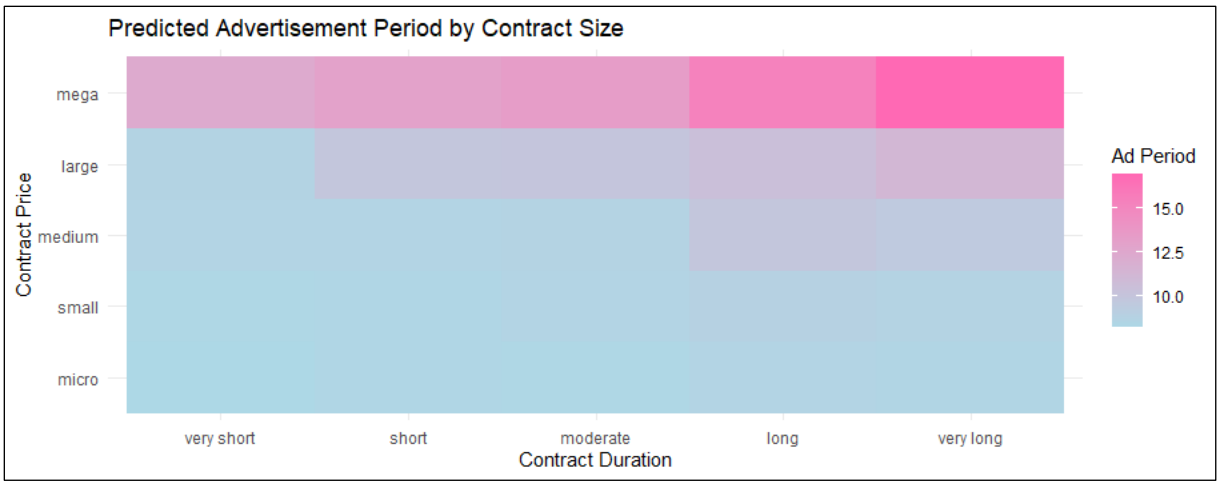

Figure 7. *The Heat Map of Contract Size Levels and Predicted Advertisement Period*

Relative Price Increase

Another important integrity indicator relates to the relative price increase of the purchased supply or service. This indicator is sometimes also referred to as a cost overrun in the literature. To analyze the effects of contract size on this corruption red flag, I utilized the linear regression model.

The results of the linear regression are summarized in Table 6 (the smallest scale contracts, those with the shortest duration, and the lowest costs are taken as the reference category). As can be observed from the main or individual effects of the first predictor variable (contract duration), there are no statistically significant coefficients, meaning that the duration of the contract alone does not significantly affect the relative price increases. However, the individual effects of the second predictor variable (contract price) are all positive and statistically significant. This means that as contracts become more expensive, the risk of increase in relative prices heightens steadily as well.

***Table 6**. Regression Results (Contract Size Levels and Relative Price Increase)*

Regression Results

Effect of Contract Scale on Relative Price Increase

Predictor	Coefficient	Standard Error	Z Value	P-value	Significance
(Intercept)	178.06192	105.2711	1.69146017	0.091	
contract_scale_durationshort	-27.04351	157.6002	-0.17159564	0.864	
contract_scale_durationmoderate	-15.68287	162.0129	-0.09680015	0.923	
contract_scale_durationlong	41.41867	171.5634	0.24141906	0.809	
contract_scale_durationvery long	-67.20881	184.0458	-0.36517430	0.715	
contract_scale_pricesmall	732.35480	157.5669	4.64789875	0.000	***
contract_scale_pricemedium	3383.28223	165.0964	20.49276408	0.000	***
contract_scale_pricelarge	3524.49180	187.6926	18.77800370	0.000	***
contract_scale_pricemega	3960.38584	280.0056	14.14395099	0.000	***
contract_scale_durationshort:contract_scale_pricesmall	611.98867	227.9414	2.68485038	0.007	**
contract_scale_durationmoderate:contract_scale_pricesmall	-347.83770	236.5342	-1.47055980	0.141	
contract_scale_durationlong:contract_scale_pricesmall	-464.73445	246.8715	-1.88249548	0.060	
contract_scale_durationvery long:contract_scale_pricesmall	-600.22002	262.6642	-2.28512267	0.022	*
contract_scale_durationshort:contract_scale_pricemedium	-1154.79341	239.2406	-4.82691234	0.000	***
contract_scale_durationmoderate:contract_scale_pricemedium	-2608.55398	241.8016	-10.78799091	0.000	***
contract_scale_durationlong:contract_scale_pricemedium	-2674.87311	250.9483	-10.65906180	0.000	***
contract_scale_durationvery long:contract_scale_pricemedium	-2546.36698	262.4746	-9.70138445	0.000	***
contract_scale_durationshort:contract_scale_pricelarge	1375.97410	264.4227	5.20369052	0.000	***
contract_scale_durationmoderate:contract_scale_pricelarge	-2968.73892	265.2166	-11.19364031	0.000	***
contract_scale_durationlong:contract_scale_pricelarge	-1835.75888	264.5210	-6.93993574	0.000	***
contract_scale_durationvery long:contract_scale_pricelarge	-2509.71654	271.0899	-9.25787615	0.000	***
contract_scale_durationshort:contract_scale_pricemega	787.21255	357.9181	2.19942060	0.028	*
contract_scale_durationmoderate:contract_scale_pricemega	-1376.38711	348.9883	-3.94393510	0.000	***
contract_scale_durationlong:contract_scale_pricemega	-2932.60122	343.1550	-8.54599585	0.000	***
contract_scale_durationvery long:contract_scale_pricemega	-234.72227	339.7257	-0.69091704	0.490	

If we look at the coefficients of the interaction terms more closely, we notice that **for low-cost contracts, the percentage of relative price increase declines as the implementation duration of such contracts increases**. The same is true for contracts with **medium-scale prices, as their duration increases, the relative price increase again decrease**. However, for contracts with higher prices (large and mega scale prices) the trend is not so straightforward.

To ease the detection of the combinations of contract duration and price levels that have the highest and lowest risks of relative price increases, I created the effect plot (refer to Figure 8). By analyzing the effect plot below, and the coefficients of the interaction terms on Table 6 concurrently, we can infer that for contracts with large-scale prices, as the duration level changes from short to moderate, the cost overrun dramatically decreases (from 1375.97 to -2968.73). In other words, for contracts with large-scale prices (324,000 – 1,123,000 tenge), the relative price increases are the lowest when their implementation duration is moderate (39 – 73 days), and the highest when their implementation duration is short (21 – 38 days). **Put differently, contracts with large-scale price level are at greater risk of the relative price increases, when their duration is short.** Similarly, if we analyze the peak and the trough for contracts with the biggest budget on Figure 8, we can infer that **the contracts with the biggest budget are at their lowest risk of the relative price increase when their duration is long, and at their highest risk of the relative price increase when their duration is short.** However, interestingly enough, we can observe from the Figure 8 below that for **contracts with the biggest budget, as implementation duration increases from long to very long level, the risk of cost overrun considerably heightens as well**.

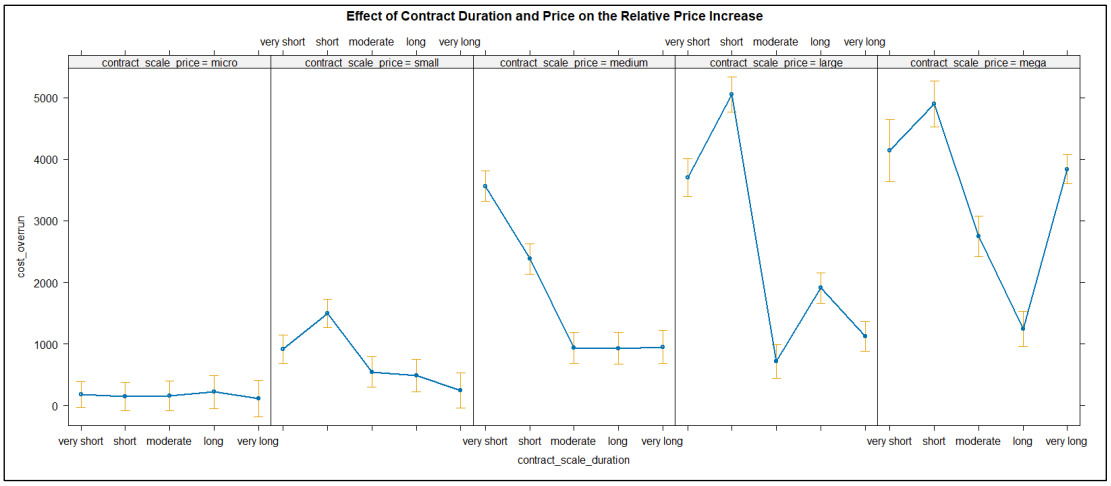

Figure 8. *The Effect Plot of Contract Size Levels on the Relative Price Increase*

To complement the effect plot, I created a heat map plot, which illustrates the predicted relative price increases for different combinations of contract price and duration levels (see Figure 9). The heat map makes the spotting of patterns and trends in the data even simpler. A more saturated pink cells indicate the higher the relative price increase for the corresponding contract price and duration levels. As can be seen, **the contracts at the biggest peril for this integrity risk indicator, are the contracts involving high financial costs and short or very short implementation duration periods**. Whereas **contracts with longer duration, especially those with lower budgets, are at lower risk of the relative price increase**. However, there is exceptions to that rule: **when the contract prices involved are huge, the risk of the relative price increase is high, even when the implementation durations are long**.

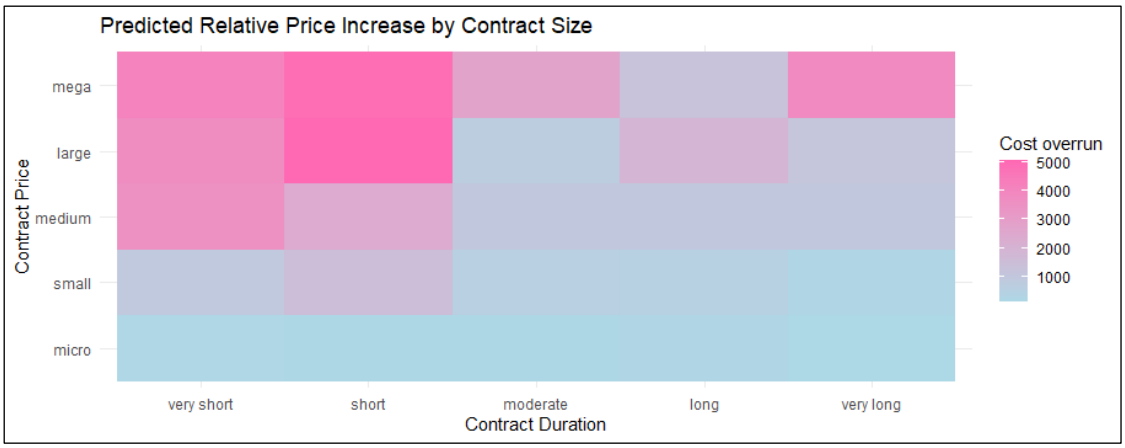

Figure 9. *The Heat Map of Contract Size Levels and Predicted Relative Price Increase*

Number of Submitted Bids

The final integrity risk indicator analyzed in this study pertains to the number of submitted bids. Because the number of submitted bids is directly related to the procurement procedure type and its specific features, I have analyzed this risk indicator individually for each procurement procedure type that is present in the data, using a linear regression model. These include the “approaching bidders” procedure type (83,794 tenders), the “open” procedure type

(15,719 tenders), and the "competitive dialogue" procedure type (159 tenders). Both the lowest number and the most frequent number of submitted bids across these procedure types are two recorded bids per tender. However, as can be observed from Figure 10, the highest number of submitted bids across these procedure types differs considerably.

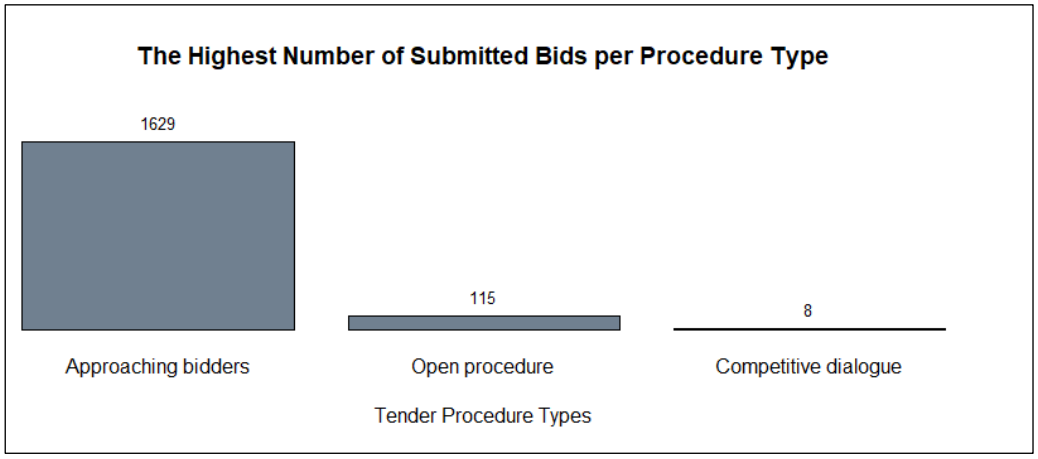

Figure 10. *The Highest Number of Submitted Bids per Procedure Type*

Approaching Bidders

By looking at the individual effects of contract size aspects in Table 7, we can infer **that as contracts with the 'approaching bidders' type of procurement procedure become longer in implementation duration, the number of submitted bids significantly decreases**. Interestingly enough, the opposite is true when we consider the price aspect of the contracts' size. **The higher the cost of the contracts with the 'approaching bidders' type of procurement procedure, the greater the number of submitted bids.** Notably, all the coefficients of the main effects of the contract prices on the number of submitted bids are statistically significant, meaning that **contract prices alone have a considerable impact on the number of submitted bids** for tenders with the 'approaching bidders' type of procurement procedure.

Table 7. *Regression: Contract Size vs. Bids, Approaching Bidders*

Regression Results

Effect of Contract Scale on Number of Submitted Bids for Approaching Bidders Type

Predictor	Coefficient	Standard Error	Z Value	P-value	Significance
(Intercept)	47.124254	1.760007	26.7750379	0.000	***
contract_scale_durationshort	1.083715	2.639784	0.4105316	0.681	
contract_scale_durationmoderate	-3.491440	2.712414	-1.2872077	0.198	
contract_scale_durationlong	-3.861681	2.884528	-1.3387565	0.181	
contract_scale_durationvery long	-8.416346	3.082150	-2.7306742	0.006	**
contract_scale_pricesmall	32.273946	2.639784	12.2259787	0.000	***
contract_scale_pricemedium	56.288929	2.773544	20.2949490	0.000	***
contract_scale_pricelarge	53.065530	3.186479	16.6533443	0.000	***
contract_scale_pricemega	143.960891	5.511425	26.1204500	0.000	***
contract_scale_durationshort:contract_scale_pricesmall	3.749220	3.822835	0.9807434	0.327	
contract_scale_durationmoderate:contract_scale_pricesmall	-12.380941	3.975174	-3.1145659	0.002	**
contract_scale_durationlong:contract_scale_pricesmall	-18.139602	4.165097	-4.3551451	0.000	***
contract_scale_durationvery long:contract_scale_pricesmall	-16.772073	4.410986	-3.8023406	0.000	***
contract_scale_durationshort:contract_scale_pricemedium	-6.152580	4.025016	-1.5285851	0.126	
contract_scale_durationmoderate:contract_scale_pricemedium	-16.386981	4.069879	-4.0264048	0.000	***
contract_scale_durationlong:contract_scale_pricemedium	-29.781746	4.280657	-6.9572838	0.000	***
contract_scale_durationvery long:contract_scale_pricemedium	-24.795780	4.446855	-5.5760265	0.000	***
contract_scale_durationshort:contract_scale_pricelarge	28.856727	4.536811	6.3605754	0.000	***
contract_scale_durationmoderate:contract_scale_pricelarge	-15.725656	4.554110	-3.4530693	0.001	***
contract_scale_durationlong:contract_scale_pricelarge	-15.446112	4.561853	-3.3859293	0.001	***
contract_scale_durationvery long:contract_scale_pricelarge	-14.671793	4.696932	-3.1236969	0.002	**
contract_scale_durationshort:contract_scale_pricemega	-40.797972	7.018487	-5.8129302	0.000	***
contract_scale_durationmoderate:contract_scale_pricemega	-87.516580	6.916080	-12.6540722	0.000	***
contract_scale_durationlong:contract_scale_pricemega	-85.406142	6.888760	-12.3978970	0.000	***
contract_scale_durationvery long:contract_scale_pricemega	-106.201102	6.881275	-15.4333464	0.000	***

However, the interaction terms between different contract prices and duration levels provide more nuanced insights. To ease the interpretation and enhance the comprehension of how different combinations of contract price and duration levels affect the number of submitted bids, it is worthwhile to analyze the coefficients of the interaction terms in Table 7 and the effect plot in Figure 11 simultaneously. The first insight we can infer is the fact that for the contracts with the lowest budget (micro-scale prices), the number of submitted bids per tender

slightly decreases as their implementation duration increases. However, these reductions are generally not significant, meaning that **the duration exhibits limited influence on the number of submitted bids for contracts with the lowest budget allocation and the 'approaching bidders' procedure type**. As for the contracts with small-scale prices, as shown in Table 7, the coefficients are negative and statistically significant for combinations with longer duration periods. As such, **as the implementation duration becomes longer, the number of submitted bids decreases for contracts with small-scale prices and the 'approaching bidders' procedure type.**

This trend is generally true for contracts with bigger budgets as well. Particularly, **for contracts with the biggest budget allocation (mega-scale prices), the reduction in the number of submitted bids as the implementation duration becomes longer is the most readily apparent**, according to statistically significant negative coefficients of great magnitude in Table 7, and the sharply plummeting graph in Figure 11. As such, **for contracts with bigger budgets (medium, large, and mega-scale prices), the risks associated with a small number of submitted bids significantly increase as their implementation duration extends for longer periods.**

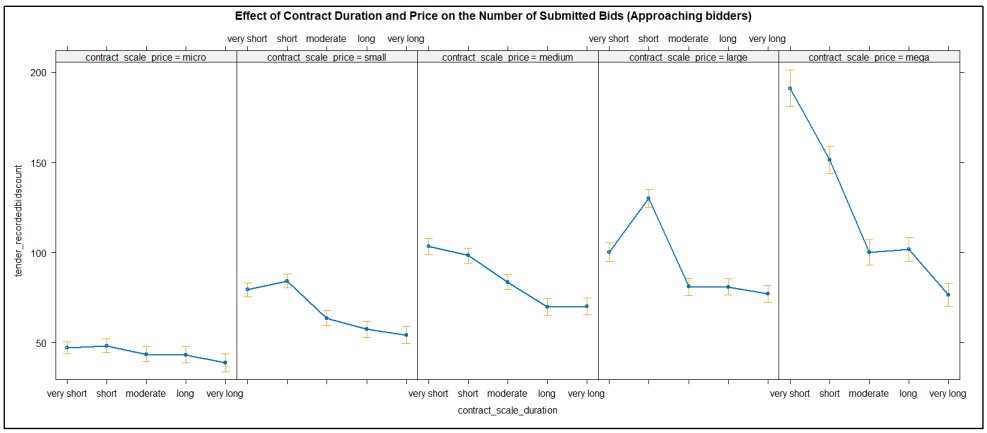

Figure 11. *Effect Plot: Contract Size vs. Bids - Approaching Bidders*

The heat map in Figure 12 below depicts the predicted number of submitted bids for each combination of contract price and duration levels. The more saturated pink the cell color is, the higher the number of submitted bids for that combination of contract size and duration. As can be observed, **the highest count of recorded bids corresponds to contracts involving very short durations and mega-scale prices**. However, as the duration of such contracts with mega-scale extends to longer periods, we see the shade of colors gradually fading, suggesting that the number of recorded bids decreases. Overall, we see **the most saturated pink clusters (contracts with a higher count of recorded bids) are around contracts with shorter durations and higher prices**. However, as the duration extends and the price level subsides, the count of recorded bids progressively declines.

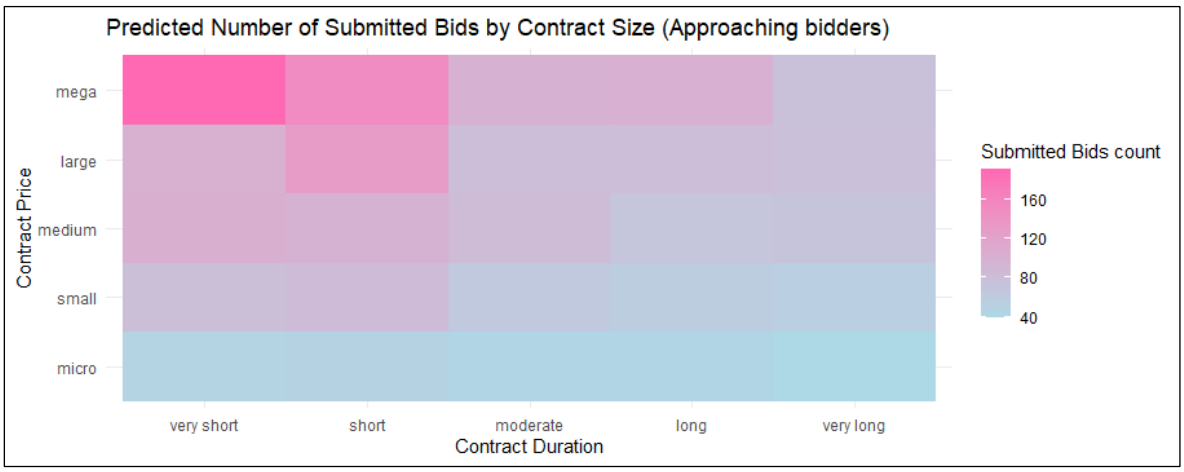

Figure 12. *Heat Map: Size & Predicted Bids - Approaching Bidders*

Open Procedure

The regression analysis, examining the relationship between contract size and the number of submitted bids for tenders involving open procedure types, produced a negligible amount of statistically significant coefficients, with only the intercept coefficient reaching a conventionally accepted significance level of $p < 0.05$ (see Table 8). This means that **for**

tenders involving open procurement procedures, both contract duration and price do not significantly impact the bidding behavior.

Table 8. *Regression: Contract Size vs. Bids, Open Procedure*

Regression Results

Effect of Contract Scale on Number of Submitted Bids for Open Procedure Type

Predictor	Coefficient	Standard Error	Z Value	P-value	Significance
(Intercept)	9.60000000	2.220133	4.32406539	0.000	***
contract_scale_durationshort	-5.31428571	2.517394	-2.11102650	0.035	*
contract_scale_durationmoderate	-4.24000000	2.626897	-1.61407183	0.107	
contract_scale_durationlong	-3.63389831	2.400919	-1.51354469	0.130	
contract_scale_durationvery long	-1.36470588	2.797927	-0.48775605	0.626	
contract_scale_pricesmall	-3.26666667	2.509612	-1.30166185	0.193	
contract_scale_pricemedium	-2.00740741	2.416975	-0.83054551	0.406	
contract_scale_pricelarge	-1.74893617	2.335241	-0.74893174	0.454	
contract_scale_pricemega	-3.42786885	2.265171	-1.51329387	0.130	
contract_scale_durationshort:contract_scale_pricesmall	3.71011905	2.955217	1.25544706	0.209	
contract_scale_durationmoderate:contract_scale_pricesmall	4.93963370	2.968400	1.66407289	0.096	
contract_scale_durationlong:contract_scale_pricesmall	3.31751412	2.747961	1.20726409	0.227	
contract_scale_durationvery long:contract_scale_pricesmall	2.99291101	3.185191	0.93963308	0.347	
contract_scale_durationshort:contract_scale_pricemedium	3.65840198	2.806060	1.30375051	0.192	
contract_scale_durationmoderate:contract_scale_pricemedium	2.68781145	2.882922	0.93232189	0.351	
contract_scale_durationlong:contract_scale_pricemedium	0.99796206	2.613386	0.38186548	0.703	
contract_scale_durationvery long:contract_scale_pricemedium	0.50997737	2.996739	0.17017745	0.865	
contract_scale_durationshort:contract_scale_pricelarge	5.61539580	2.653341	2.11634878	0.034	*
contract_scale_durationmoderate:contract_scale_pricelarge	2.81164910	2.753259	1.02120759	0.307	
contract_scale_durationlong:contract_scale_pricelarge	2.80431885	2.526864	1.10980199	0.267	
contract_scale_durationvery long:contract_scale_pricelarge	-0.07592071	2.902116	-0.02616047	0.979	
contract_scale_durationshort:contract_scale_pricemega	5.34130711	2.577539	2.07225051	0.038	*
contract_scale_durationmoderate:contract_scale_pricemega	4.96318566	2.677776	1.85347276	0.064	
contract_scale_durationlong:contract_scale_pricemega	5.27460976	2.450514	2.15245046	0.031	*
contract_scale_durationvery long:contract_scale_pricemega	2.93014499	2.837554	1.03263048	0.302	

To complement the results of the regression analysis, the effect plot and heat were produced to display the direction of the relationship between the contract size levels and the count of recorded bids per tender. The effect plot in Figure 13 reveals great uncertainty, as reflected in the wide confidence intervals. Moreover, neither the effect plot on Figure 13 nor the heat map

on Figure 14 below reveal any discernible patterns or trends, as was the case with the predicted bidding behavior for tenders involving the "approaching bidders" type of procurement procedure. This implies that for contracts procured through an open procedure, there is no regular, consistent relationship between the size of contracts, considering both the individual and combined effects of contract implementation duration and price levels. Hence, **contract duration and price levels do not have a significant impact on bidding behavior in the context of contracts acquired via an open procedure.**

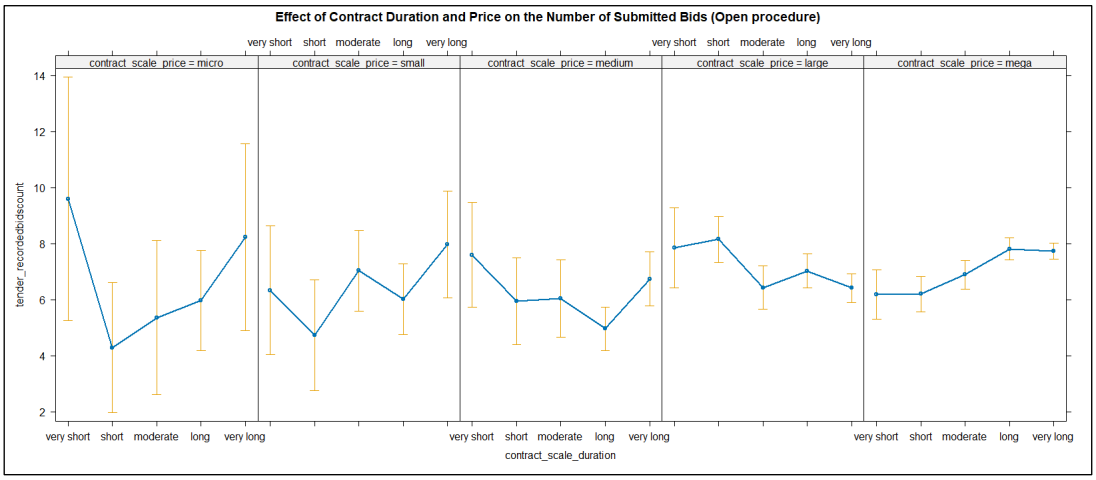

Figure 13. *Effect Plot: Contract Size vs. Bids - Open Procedure*

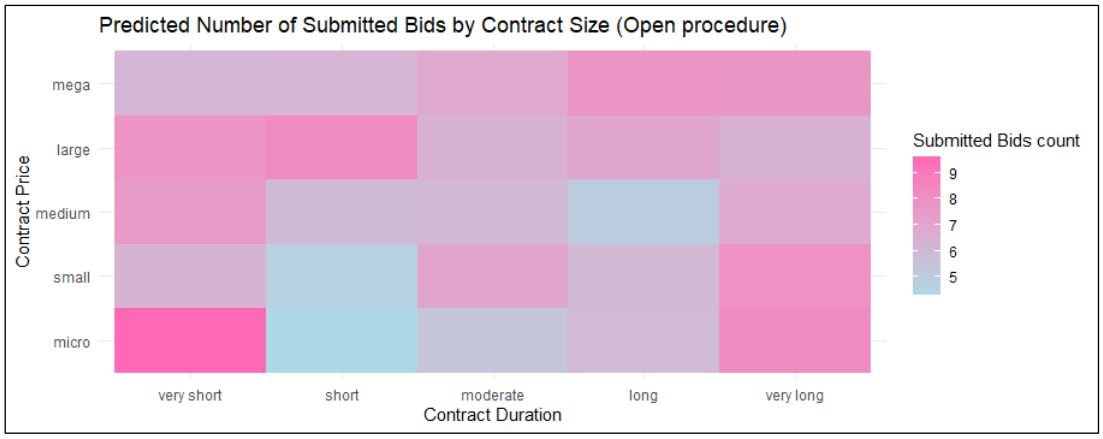

Figure 14. *Heat Map: Size & Predicted Bids - Open Procedure*

Competitive Dialogue

Finally, the examination of the bidding behavior for tenders secured through the competitive dialogue procedure type showed even fewer meaningful results. With only one of the coefficients being statistically significant (see Table 9 below), It is important to note that only 159 tenders in the data were procured through the competitive dialogue procedure, which reduces the scope of analysis for this procedure type. Also, not all combinations of contract price and duration levels exist for this type of procurement procedure. For example, there are no combinations of contracts involving short durations and smaller scale prices, or those involving mega-scale prices and short-term or long-term durations. As with contracts involving an open procedure type, **for contracts acquired via a competitive dialogue procedure, contract duration and price levels also do not have a significant impact on the bidding behavior**, which means that variables and tendering aspects other than contract size could be better predictors of bidding behavior for this type of procurement procedure.

Table 9. *Regression: Contract Size vs. Bids, Competitive Dialogue*

Regression Results

Effect of Contract Scale on Number of Submitted Bids for Competitive Dialogue

Predictor	Coefficient	Standard Error	Z Value	P-value	Significance
(Intercept)	2.000	1.754	1.140	0.257	
contract_scale_durationshort	-0.556	0.792	-0.702	0.484	
contract_scale_durationmoderate	0.000	2.480	0.000	1.000	
contract_scale_durationlong	-2.556	0.924	-2.765	0.007	**
contract_scale_durationvery long	-2.125	1.860	-1.142	0.256	
contract_scale_pricesmall	-0.000	2.148	-0.000	1.000	
contract_scale_pricemedium	0.857	1.875	0.457	0.648	
contract_scale_pricelarge	3.125	1.860	1.680	0.096	
contract_scale_pricemega	3.000	1.894	1.584	0.116	
contract_scale_durationshort:contract_scale_pricemedium	2.198	1.614	1.362	0.176	
contract_scale_durationmoderate:contract_scale_pricemedium	-0.857	3.109	-0.276	0.783	
contract_scale_durationlong:contract_scale_pricemedium	1.698	1.683	1.009	0.315	
contract_scale_durationvery long:contract_scale_pricemedium	3.268	2.641	1.237	0.219	
contract_scale_durationshort:contract_scale_pricelarge	-0.569	1.204	-0.473	0.637	
contract_scale_durationmoderate:contract_scale_pricelarge	-2.681	2.623	-1.022	0.309	
contract_scale_durationlong:contract_scale_pricelarge	-0.569	2.077	-0.274	0.785	
contract_scale_durationmoderate:contract_scale_pricemega	-2.415	2.596	-0.930	0.354	

As with previous indicators, to visualize the relationship between the analyzed variables, we generated the effect plot (Figure 15) and the heat map (Figure 16). As can be observed from Figure 15, the confidence intervals are even wider than in the previous effect plot, which is a clear sign that there is a great level of uncertainty involved when estimating the number of submitted bids using the contract implementation duration and price levels in the context of contracts obtained using a competitive dialogue type of procedure. Similarly, there are no apparent patterns or discernible trends that can be inferred from the heat map on Figure 16, further bolstering the finding that the contract size is not a good predictor of the bidding behavior within contracts acquired via competitive dialogue.

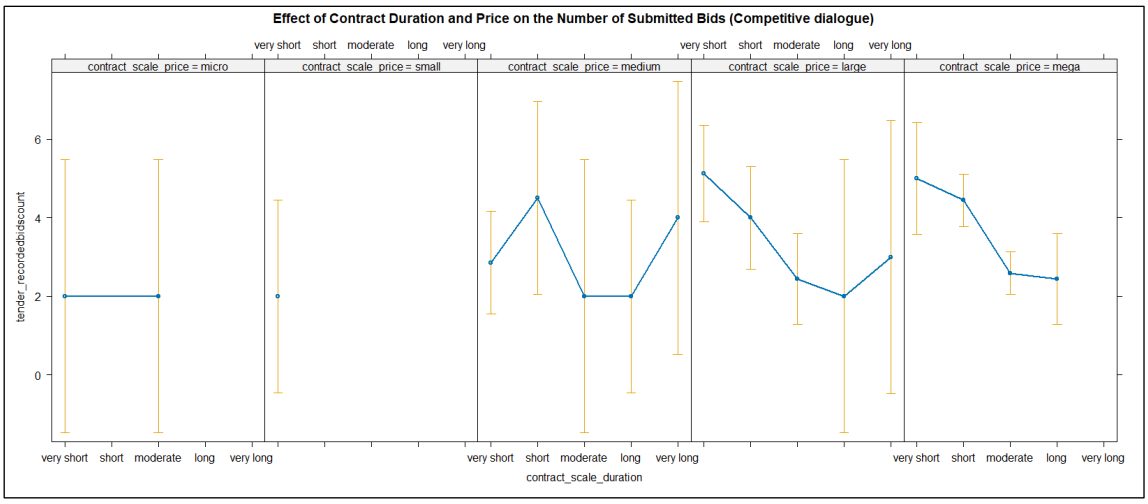

Figure 15. *Effect Plot: Contract Size vs. Bids - Competitive Dialogue*

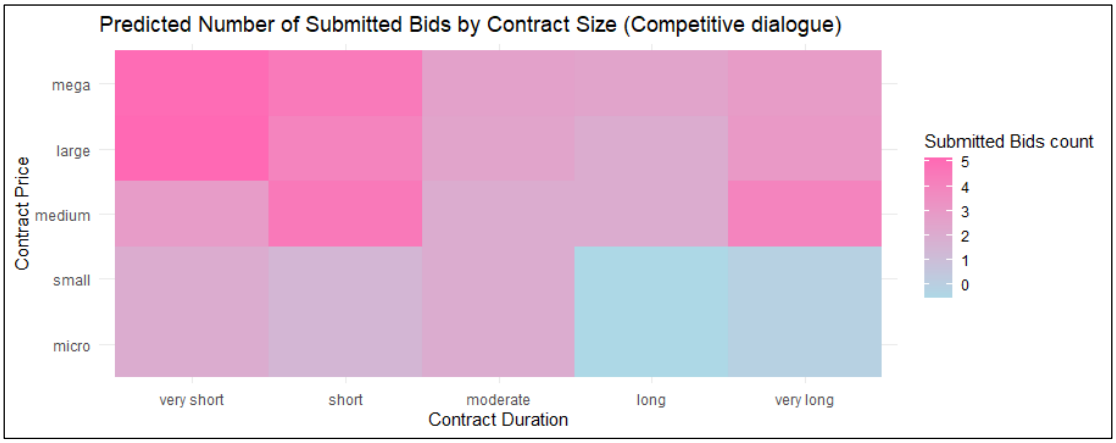

Figure 16. *Heat Map: Size & Predicted Bids - Competitive Dialogue*

CONCLUSION

In conclusion, the thesis explored the relationship between the contract size, defined by both implementation duration and price aspects, and four different corruption risk indicators, which include the use of non-open procedures, the length of the advertisement period, the count of submitted bids, and the relative price increase within Kazakhstan's public procurement system. The overarching objective behind the study was to produce empirical insights and identify the strength and direction of the relationship between these policy-relevant variables using rigorous statistical models. The primary data source analyzed in the paper comes from Kazakhstan's national procurement portal and includes tenders conducted in the country between 2016 and 2020. As such, the empirical findings of study provide crucial insights for informing targeted policy interventions and facilitating anti-corruption efforts in the country. Given the pervasive nature of corruption within Kazakhstan's procurement system, the determination of policy-relevant variables that have an impact on the corruption risks is an imperative to enhance the transparency and integrity standards of procurement process.

The extensive quantitative analysis yielded rich and nuanced insights about the nexus between the size of contracts and corruption risks. The relationship between these variables mostly turned out to be much subtler than it was initially hypothesized when the interaction terms between different contract durations and price levels were introduced to the regression models. First, the examination of the effect of contract magnitudes on the likelihood of open procedure using the logistic regression revealed that the positive effects of contract durations on the likelihood of an open procedure are mitigated by the prices of the contracts, and vice versa. Moreover, it was found as the duration of the contracts with small and medium-scale prices decreases, the likelihood of the open procedure also decreases, while contract prices exhibit little influence on the odds of open procedure for contracts with very long duration.

With regards to advertisement period lengths, the preliminary analysis confirmed the hypothesis and revealed that as the duration of contract increases, the length of the advertisement period also increases, and as the monetary value of contracts increases, the length of the advisement period also progressively increases. Similarly, the linear regression models with incorporation of interaction terms, complemented by the effect plot and heat map visuals have also shown a clear trend that the bigger the scale of the contract, both in terms and duration, the longer is the predicted advertisement period.

The examination of the effects on contract size on the relative price increases using linear regression models has revealed several key insights. Firstly, for low-cost and medium-scale prices contracts, the percentage of relative price increase declines as the implementation duration of such contracts increases. Secondly, contracts with large-scale price level are at greater risk of the relative price increases, when their duration is short. Thirdly, when the contract prices involved are huge, the risk of the relative price increase is high, even when the implementation durations are long.

Finally, the analysis of the count of recorded bids was conducted individually for the three procurement methods present in the data. I found that as contracts with the 'approaching bidders' type of procurement procedure become longer in implementation duration, the number of submitted bids significantly decreases. Interestingly enough, the opposite is true when we consider the price aspect of the contracts' size. The higher the cost of the contracts with the 'approaching bidders' type of procurement procedure, the greater the number of submitted bids. The analysis of interaction term coefficients further showed that as the implementation duration becomes longer, the number of submitted bids decreases for contracts with small-scale prices and the 'approaching bidders' procedure type, and for contracts with bigger budgets (medium, large, and mega-scale prices), the risks associated with a small number of submitted bids significantly increase as their implementation duration extends for longer periods. Additionally,

the heat map revealed that the highest predicted count of recorded bids corresponds to contracts involving very short durations and mega-scale prices. For two other procurement methods (open procedure and competitive dialogue), I found that both contract duration and price do not significantly impact bidding behavior.

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