Università Commerciale "Luigi Bocconi"

PhD School

PhD program in: Economics and Finance

Cycle: 33rd Cycle

Disciplinary Field (code): SECS-P/10

Essays on market structure, competition, and political connection in public procurement

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PhD Thesis by

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Year 2022

Abstract

This thesis spans fields of Industrial Organization, Public Economics, and Political Economy. It focuses on the performance of public procurement auctions in the unified Russian institutional setting of 2011-2019. The first chapter studies the impact of vertical integration between pharmaceutical drug producers and distributors on prices in public procurement auctions for drugs. It concludes that vertical integration is not anti-competitive in procurement markets if upstream competition is tough, but it requires special attention for concentrated upstream markets. Either the merging firms should prove substantial synergy effect, or the antitrust authority can require the mandatory sharing of production technology, generating the exogenous upstream entry. The second chapter investigates the role of tenure in office and local ties of sub-national governors in procurement contracts allocation. It shows that governors without local connections in regions demonstrate predatory behaviour by restricting competition in procurement auctions. Such behaviour becomes worse with tenure in office. In contrast, governors with local ties show a higher level of procurement competition and no tenure effect. The third chapter focuses on firms dynamics and studies how procurement contracts affect firms capital structure. It shows that firms receiving public contracts issue more short-term debt. Moreover, the political connection of firms does not entirely suppress the beneficial access to debt the public contracts create.

Acknowledgements

I am thankful and indebted to my advisor Francesco Decarolis for his guidance, encouragement, and patience. I am very grateful to my co-advisor, Chiara Fumagalli, for her guidance and constructive critique. I want to thank Elisabetta Iossa for her feedback and participation in the evaluation committee. I am indebted to Andrei Yakovlev for his advice and guidance before and during the Ph.D. I also thank Paola Valbonesi and David Szakonyi, without their support, I could not get into the Ph.D. school. I am grateful to my closest friend and co-author, Daniil Esaulov.

I also thank Giancarlo Spagnolo and Leonardo Giuffrida for valuable discussions and reviews; Ksenia Shakhgildyan-Fiorin, Christoph Wolf, Leslie Marx, Robin Lee, Patrick Rey, Pierre Dubois, Daniel Ershov, Elena Podkolzina, Pavel Andreyanov, Adriano De Leverano, Vitalijs Jascisens for comments about this dissertation.

I gratefully acknowledge suggestions about this dissertation from all participants of seminars at HSE University, Bocconi University, Toulouse School of Economics, University of Padova, ZEW Mannheim, BOFIT. Similarly, I thank conference participants at the 19th International Industrial Organization Conference and 48th Conference of the European Association for Research in Industrial Economics.

Finally, this thorny path would be impossible without the support of my wife Natalia and stress absorbing behaviour of my kids Valeria, Georgii, Daria. In addition, the help and care of my parents are invaluable.

Contents

Introduction

Public procurement represents a core economic activity of national governments, and it can be a driver for firms growth and markets development. However, procurement contract allocation is often associated with misbehaviour and competition restrictions. This thesis studies how changes in the market structure from the supply side and incentives of the sub-national elites from the demand side impact competition in public procurement. It also studies how public contracts affect firms capital structure. I consider these questions within the Russian institutional setting of 2011-2019.

Chapter 1, the Job Market Paper, studies the competitive effects of vertical integration between pharmaceutical drug producers and distributors in an auction setting. Utilizing data on 814,000 public procurement auctions in Russia, I identify the causal effect of vertical integration on the procurement prices of drugs. For drugs with few producers, vertical integration increases prices by 12%, while it decreases prices by 1.7% for drugs with many producers. I propose a model where distributors participating in a procurement auction negotiate with upstream producers. In the equilibrium, foreclosure explains the former empirical finding, while the exogenous synergy of the integration drives the latter effect. I use this model for the structural estimation of producer and distributor costs for drugs with two producers. Simulations show that a vertical merger with a synergy effect below 4% of the total cost harms the buyer. For a vertical merger with low synergy, the mandatory sharing of the production technology by the merging producer with a new independent firm is an effective remedy.

The personal role of sub-national rulers is crucial for regional development in countries with weak institutions. Chapter 2 studies the impact of regional governors' tenure in office and their local ties on procurement performance in Russia. To identify the causal effect, we construct instruments for governors' tenure in office by exploiting the regional vote share of the ruling party in past parliament elections. We find that governors without pre-governing local ties in the region (outsiders) demonstrate predatory behaviour, while governors with local ties (insiders) do not. The governors-outsiders restrict competition at awarding stage, and this restriction becomes stronger with their tenure in office. Governors-insiders do not have such a harmful effect of tenure in office. We show that better contracts execution cannot be an explanation for competition restriction by governors-outsiders. The delays in execution and the probability of contract termination either increase or keep stable with tenure in office for governors-outsiders. At the same time, these outcomes decrease with tenure in office for governors-insiders.

Contractual relations of firms with a state may give lenders a positive signal and facilitate access to debt. Chapter 3 studies the impact of access to public procurement contracts on firms access to debt using an extensive survey of Russian manufacturing firms combined with accounting and procurement data. It shows that earnings from state-to-business contracts increase the short-term debt twice larger than revenue from private contracts. The long-term debt is not affected by public contracts differently from private contracts. The debt sensitivity to public contracts is four times larger for politically connected firms, though it is still positive and significant for non-connected and small firms. The paper concludes that political connection does not entirely suppress the beneficial access to debt the public contracts create.

Chapter 1

Competitive effects of vertical integration in auctions

1.1 Introduction

The vertical structure of supply chains is a key feature of many industries in which upstream producers distribute their goods via downstream intermediaries. Vertical integration is quite common in these industries as it helps to extend the business activity to the other levels of the vertical chain. The literature has made significant progress in understanding the effects of vertical integration for traditional retail markets, focusing on the trade-off between foreclosure and efficiency gains. In the last two decades, however, markets in which the intermediaries compete in auctions have received increasing attention. Markets such as online advertising, public procurement, and license selling represent a core economic activity of IT giants and national governments, with auctions and intermediation being key features. Currently, there is much debate regarding the evaluation of vertical mergers. The Federal Trade Commission in the US introduced new vertical integration guidelines in June 2020, and subsequently withdrew them in September 2021, arguing for the necessity *"to consider various features of modern firms, including in digital* *markets"*.[1] In the EU, there is an ongoing review process for vertical integration guidelines focusing on digital markets. However, there is neither theoretical nor empirical evidence regarding the effect of vertical integration when intermediaries compete in auctions.

The chapter addresses this question by focusing on the Pharma industry. This industry has a vertical structure for the supply side: upstream producers manufacture drugs and disseminate them via downstream intermediaries (distributors and pharmacy networks). In many countries in which the public healthcare system is predominant, public hospitals and healthcare authorities constitute a significant demand for drugs to provide inpatient and outpatient treatments. These public buyers have to purchase drugs keeping necessary therapeutic treatment, on the one hand, and foster competition on the other. They achieve this dual goal in two steps. First, in a purchase announcement, the buyer sets a *drug specification*, defined as a combination of active ingredient and dosage, considering different brands as perfect substitutes. This brand substitution intensifies upstream competition among brand producers keeping the necessary level of therapeutic treatment. If there is a single producer of the active ingredient, the wholesale price cap regulated by the government limits the producer's monopoly power. Second, the buyer implements the purchase via a procurement auction, with a minimal price being the only criteria. This intensifies downstream competition among distributors.

This chapter studies the effect of vertical integration between drug producers and distributors on prices in procurement auctions in a setting with brand substitution and price regulation. I collect data on more than 814,000 auctions for drug procurement in Russia from 2014 to 2019. The data include bidders' IDs and bids, as well as information about the drugs purchased, including active ingredients, dosages, prices-per-unit, number of drug units, and brands of the supplied drugs. I extend this with information on *vertical integration events* in the Russian Pharma industry, comprising five mergers and four divestitures. Several factors make the Russian drug procurement data an ideal source

[1] `www.ftc.gov/news-events/press-releases/2021/09/federal-trade-commission-withdraws-vertical-merger-guidelines`

for studying the research question. First, the public procurement of drugs in Russia constitutes one-third of the overall pharmaceutical demand. Second, detailed bidding and contract information helps to identify vertical interactions between producers and distributors. Third, considerable heterogeneity in the number of producers and several vertical integration events, affecting 20% of the markets, provides substantial variation for the retrospective analysis of mergers.

I implement the analysis in three steps. First, I provide reduced-form evidence of the effect of vertical integration on the per-unit procurement prices of drugs. The detailed information about bidders and drug specifications enables the use of the difference-in-differences (DID) approach. The treatment group includes all drug specifications of producers from the integration events. In the DID analysis of mergers, the control group should be chosen with caution, as non-treatment group observations could be indirectly affected by the mergers (Choné and Linnemer (2012)). I overcome this issue by defining the control group as the set of drug specifications for the same broad class of diseases as drug specifications in the treatment group, but excluding the indirect substitutes. This choice for the control group helps, on the one hand, to achieve the parallel pre-trends and, on the other, not to include drug specifications that could be indirectly affected by the integration. The reduced-form analysis leads to an intuitive conclusion that the extent of upstream competition drives the price effect of vertical integration. If the upstream competition is soft, with at most four producers, vertical integration increases procurement prices by around 12%. A reduction in downstream competition is the primary driver of this effect for a single producer case. However, if the upstream competition is tough, with at least five producers, vertical integration decreases the prices by 1.7%. The results are stable to a set of robustness checks, including the stack regression approach from the modern staggered DID literature (Cengiz et al. (2019)).

Second, I propose a model to explain a mechanism for the vertical integration effect. In this model, a public buyer announces a descending auction to purchase a drug, and the set of distributors are potential bidders. The negotiation stage precedes the bidding stage. Distributors negotiate with producers about the *input prices*, production costs are the private information of producers, and the regulated input price cap is common knowledge. When input prices are committed, distributors privately observe delivery costs and participate at the bidding stage. Under the vertical separation (VS) scenario, all producers and distributors are independent. Under the vertical integration (VI) scenario, the integrated distributor has an efficiency gain: double markup elimination and reduction in transaction costs (*synergy effect*). The model compares the ex-ante expected buyer payments under the VI and VS scenarios. For a single producer, in equilibrium, the producer sets the input price at the regulated cap for independent distributors in both scenarios. Therefore, the price setting for rival distributors cannot be a driver for the increase in the buyer payment under the VI scenario. However, I show that the integrated producer has incentives to restrict downstream competition, which leads to a higher buyer payment. For the case of only a few upstream producers, the VI effect is ambiguous as it depends on the cost distributions. The simulation for uniform cost distributions shows that the foreclosure effect dominates efficiency gains and harms the buyer. For the case of many producers, the foreclosure effect is negligible, and when the synergy effect is positive, the buyer payment is lower under the VI scenario.

The reduced-form approach is helpful as a retrospective analysis of mergers. However, it does not help in understanding ex-ante conditions to forbid vertical mergers and potential remedies (Nevo and Whinston (2010)). Moreover, the theory has ambiguous conclusions regarding the case of only a few producers owing to cost-distribution assumptions. Thus, at the third step of my analysis, I structurally estimate producer and distributor cost distributions and simulate vertical mergers under different conditions. I take the VS scenario of the model and choose a set of auctions, where the bidders are distributors, and two independent producers manufacture a drug specification. In the model, the input price of distributors represents an unobserved heterogeneity because the researcher does not observe the outcomes of the negotiation stage. Following the literature on the structural estimation of English auctions with unobserved heterogeneity (Freyberger and Larsen (2017)), I identify the distributions of input prices and distributor costs. The structure imposed on the negotiation stage enables further deduction of producers' cost distribution based on the input price distribution. Next, I use the cost distributions to simulate vertical mergers under different conditions. As a first result, I show that a vertical merger without a synergy effect doubles the profit of the integrated firm compared to the aggregate profit for a separated producer and distributor. However, the merger increases the buyer payment by 17%, so it should not be approved. As a second result, I show that a vertical merger with a synergy effect below 4% of the total cost harms the buyer. I match the effect of vertical mergers from structural model simulations with the reduced-form effect and estimate the synergy effect at around 0.5%–1.5% of the total cost. Moreover, the transaction costs of participants in Russia are around 1% of the procurement value (Balaeva et al. (2020)), representing the primary source for integration synergy. Therefore, a 4% synergy effect for integration is a challenging goal. Finally, I propose a remedy for mergers when synergy is low. I show that the exogenous entry of a third independent producer after the vertical merger, with a 1% synergy effect, reduces buyer payments by 6% and that the merger is profitable for the integrating firms. This suggests that the mandatory sharing of the production technology by the merging producer with a new independent firm is an effective remedy.

Despite using empirical evidence from Russian public procurement only, the results have external validity for other countries with public healthcare systems. Two key features of procurement regulation drive the theoretical and empirical results: price regulation for a single producer; and brand substitution for several producers. The same drug procurement features exist in many EU countries and large developing countries such as China, India, and Brazil, making the paper's findings externally valuable. Moreover, in the US, brand substitution is also a common practice in drug prescriptions for consumers (Bronnenberg et al. (2015), Song and Barthold (2018)), so the results can be a starting point for studying the vertical interactions between drug producers and distributors.

Literature and contribution

The theoretical literature on vertical integration is abundant, mainly discussing conditions in which foreclosure or the efficiency gain effect dominate (Salinger (2014), Fumagalli et al. (2018)). However, the empirical evidence is scarce (Slade (2020)). The literature finds that both foreclosure and efficiency gain effects occur, with the overall effect depending on markets and their structure. Hortaçsu and Syverson (2007), Gayle (2013), Atalay et al. (2014), Gil (2015), Asker (2016), Atalay et al. (2019) found no foreclosure. Crawford et al. (2018) showed the prevalence of efficiency gains on average, but that foreclosure is still a major concern. On the contrary, Hastings and Gilbert (2005), Normann (2011), and Lee (2013) demonstrated the harmful effect of vertical integration. Luco and Marshall (2020) showed that efficiency gains induce the anticompetitive effects of integration in a multiproduct industry.

The paper contributes to the vertical integration literature in two ways. First, I theoretically and empirically study the VI effect on buyer prices when downstream firms compete in auctions. All empirical literature on vertical integration has studied the downstream competition in ordinary markets. The difference can be substantial (Klemperer (2007)). In the auction setting, competing products are perfect substitutes and only price matters. In ordinary markets, product differentiation in terms of geographical location or characteristics is also a relevant dimension of vertical integration evaluation (Houde (2012), Allain et al. (2017)). Therefore, if the efficiency gain effect dominates and is passed through, the buyer can fully internalize it in the auction setting, but not in ordinary markets. Several papers studying vertical integration in auctions (Thomas (2011), Loertscher and Riordan (2019), Waehrer (2019)) have considered integration between a bidder and the auctioneer. This, however, is substantially different from the public procurement setting I study here or similar settings in online advertising and license selling, encompassing mergers between bidders and upstream input suppliers (Klemperer (2002), Athey et al. (2011), Decarolis et al. (2020), Decarolis and Rovigatti (2021)). Second, most studies on vertical integration have considered highly concentrated markets because foreclosure is thought to be a threat (Lafontaine and Slade (2007), Riordan (2008), Salinger (2014), Nocke and Rey (2018)). The exceptions to this are Riordan (1998) and Loertscher and Reisinger (2014). The latter paper considers a model for downstream firms buying an input capacity from the upstream market. It shows that an increase in competition at the *downstream* level increases the anticompetitive effects of vertical integration. The present paper, however, studies the VI effect depending on the *upstream* competition, and the findings align with standard anti-trust reasoning.

This paper also contributes to the literature on the structural estimation of auctions. Unobserved heterogeneity, encompassing factors observable by bidders but not by the econometrician, is common in the literature (Krasnokutskaya (2011), Athey et al. (2011), Hu et al. (2013), Decarolis (2018), Larsen (2021)). These factors are an essential component of bidders' costs in the procurement of non-standardized goods. Although drugs are standardized products, my model rationalizes the unobserved heterogeneity as an equilibrium input price at the negotiation stage. This enables the costs of intermediaries and input suppliers to be identified separately, which is novel in the literature.

The paper also contributes to Pharma industry studies. This is the first paper to study vertical mergers; in contrast, Björnerstedt and Verboven (2016), Newham et al. (2018), Bonaime and Wang (2019) studied horizontal consolidations in Pharma.[2] Regarding the drug-procurement literature, this is one of few papers focusing on the structure of the supply side (Dubois et al. (2021)); most others have focused on the organization of the demand side (Duggan and Scott Morton (2010), Jascisens (2017), Brugués (2020), Cao et al. (2021), Wu (2021)). This paper also extends our understanding of producer and

[2]There is also a strand of literature studying horizontal consolidations in industries with a vertical structure Bushnell et al. (2008), Hosken et al. (2011) Dafny et al. (2012), Gowrisankaran et al. (2015), Schmitt (2017), Craig et al. (2019), Dafny et al. (2019), Iossa et al. (2019), Carril and Duggan (2020), Decarolis and Rovigatti (2021).

distributor profits in the Pharma industry (Dubois and Lasio (2018), Dubois and Sæthre (2020)).

1.2 Institutional setting

In Russia, public organizations such as hospitals and polyclinics provide most healthcare services free of charge. These services include both inpatient and outpatient treatment. Moreover, several national and sub-national (regional) healthcare programs help to protect the population. Some of these programs are seasonal (e.g. vaccination against influenza) or may depend on the epidemiological situation (e.g. to mitigate the spread of tuberculosis). Other programs are permanent and are focused on protecting specific groups of the population, e.g. kids vaccination, provision with drugs and medical devices of people who have pancreatic diabetes, treatment of cancer diseases, and orphan (rare) diseases. Healthcare authorities and public hospitals permanently purchase pharmaceutical drugs via procurement auctions to implement these healthcare services.

Public Procurement (PP) of drugs accounts for 560 billion RUB in 2019 (approximately 8.5 billion USD) and constitutes 35% of the overall pharmaceutical demand in Russia. Public procurement is regulated by 44 Federal Law (FL) for budget-funded organizations and by 223 FL for semi-autonomous organizations and state-owned enterprises. 44 FL is a rigid regulation requiring public buyers to follow specific procurement procedures depending on timing and value. On the other hand, 223 FL is a flexible regulation. It only imposes a scope of competitive procurement regulation, while organizations define specific thresholds and procedures in their internal rules. While few large and competent hospitals can choose to follow 223 FL, the dominant part of public hospitals and healthcare authorities have to follow 44 FL. This paper studies procurement auctions according to 44 FL only since public buyers must follow the same procurement procedures. Moreover, purchases according to 223 FL constitute only 8% of public procurement for drugs.

44FL prescribes to use one of three procedures to procure a drug: (i) *direct purchase* without competitive procedure, with upper bound for the contract value of 200 K RUB (3.1 K USD); (ii) *request for quotations* in the form of first price seal-bid auction, with upper bound for the reserve price of 500 K RUB (7.9 K USD); (iii) *electronic open descending auction* (e-auction) without any restriction on the reserve price.[3] Hereafter, I consider e-auctions only as they constitute the dominant part of purchases in numbers and money value.[4]

Many drugs of different brands have similar therapeutic treatment, as they use the same active ingredient.[5] Taking this into account, a public buyer announces a *bundle* of drugs for purchase. Namely, for each drug in the bundle, the procurer indicates:

1. *Drug specification* containing:
   - active ingredient (AI) of the drug (e.g. Insulin glargine), but not a brand (e.g. Lantus SoloStar of Sanofi);
   - AI dosage (e.g. 100 un/ml, 3 ml);
   - drug form (e.g. solution for infusions).

   All brands with the same AI, dosage, and drug form are considered perfect substitutes.
2. *Quantity:* Number of units in pack and number of packs (e.g. 5 units/pack, 2 packs).
3. Reserve price-per-pack (e.g 3765 RUB/pack (around 60 USD)). If the active ingredient is from the list of *essential drugs*, prices of brands containing this AI are

[3]There are another two procedures, though rarely used for drug purchases: (i) request for proposals – if a hospital purchases a specific drug for a particular patient and committee of doctors should substantiate the necessity of this purchase; (ii) scoring rule auction, where a public buyer can use qualification criteria. In total, these procedures constitute less than 1% of my sample, so I exclude them from the analysis as their procurement procedure is different.

[4]In my sample there are 8.2% of direct purchases and 4% of request for quotations.

[5]Anatomical Therapeutic Chemical Classification (ATC) classifies all active ingredients according to a hierarchical structure in five levels. Figure A1 shows this classification for insulin glargine, which has ATC code at the fifth level A10AE04. Later, I will use this classification to create treatment and control groups for reduced-form estimation.

> regulated at two levels – national and regional – imposing upper bounds at each of them. Wholesale prices from producer to distributors are regulated at the national level, and retail prices, including distributor and pharmacy network markups, are regulated at the regional level. Regulated prices of different brands with the same AI can differ. The reserve price-per-pack in the auction should contain the producer regulated price and distributor markup.[6]

Aggregating in standard way over drug specifications in the bundle, the buyer calculates the reserve price for the bundle, which becomes the public reserve price of the auction. The buyer also specifies delivery duration and location.

If a distributor plans to apply for participation, he negotiates with producers and finally agrees with one of them to get a certificate. The certificate indicates the producer willingness to provide the necessary brand via the distributor.[7] Participants in the auctions are mostly intermediaries – distributors and pharmacy networks.[8] Bidders compete solely in price by placing their *bids for the bundle* according to standard rules of open descending procurement auction with a public reserve price for the bundle. A firm with minimal offer wins. It signs the procurement contract, implements trade with the producer and supplies the bundle according to the announced terms.

Two features of the regulation are essential: (i) price regulation for *essential drugs* and (ii) brand substitution. These features are not a peculiarity of Russian public procurement, but it is common for many countries of the European Economic Area with public healthcare systems and China, India, Brazil, and many others.

[6] The choice of brand to incorporate the producer regulated price into the reserve price is at the discretion of the buyer.

[7] Different distributors can receive certificates from the same producer. A producer certificate is a compulsory document for large auctions with one drug specification in the bundle. Certificates of all applicants are screened before the auction, so applicants without certificates are forbidden to bid.

[8] Producers prefer not to bid directly in the auctions because of substantial distribution and transaction costs.

1.3 Data

To study the effect of vertical integration, I use three datasets. The first dataset is a population of public procurement contracts from July 2014 to September 2019, purchasing anti-neoplastic drugs, systemic antimicrobial drugs, drugs for treating pancreatic diabetes and diseases of the circulatory system. I collected this dataset from the FTP server of the official public procurement website (www.zakupki.gov.ru), and enriched it with the commercial data on drugs classification from IAS Zakupki (www.krasoft.site).[9] This dataset covers 75% of total spending on all types of drugs procured according to 44FL. The original dataset has 946 thousand bundles containing information about 2.8 million drugs. Each bundle corresponds to a contract. Auction participants place bids for a bundle, but the winning bidder's contract specifies the price-per-unit for each drug of the bundle. Hereafter, *drug specification* means a unique combination of an active ingredient and dosage[10]. Drug specification is the natural level of clustering all the drugs in my sample, as competition in auctions occurs at this level. Therefore, each drug specification is a separate market. [11]At the drug level, the data contains the drug description (drug

[9]Standardization of drug specification description and measuring price-per-unit and quantity of units is a complicated task. Public buyers may use different measures of dosage (e.g. for infusions they use dosage description interchangeably as "100mg/ml" or "10%") and different measures of unit (e.g. some buyers calculate the number of packs and other calculate the total number of units, i.e. number of drug units in pack times number of packs). Typos in brands and AI of drugs are also a fundamental problem. Several private firms collect data from the official website and use supervised machine learning classification techniques and extensive human resources to make the description of drug specifications standardized. IAS Zakupki (krasoft.site), Headway Company (hwcompany.ru), IQVIA (iqvia.com), Cursor (cursor-is.ru) among them demonstrate the high quality of classification. Large domestic and international pharmaceutical companies working in Russia as Johnson and Johnson, GlaxoSmithKline, Alcon, R-pharm and pharma media use data of these firms to analyze public procurement of drugs.

[10]This definition omits "drug form" compared to what public buyers specify in an auction announcement. However, it is not restrictive since my final sample has 2013 unique active ingredient-dosage combinations and 2134 ingredient-dosage-drug form combinations. At the same time, some descriptions of drug forms vary over different buyers even if it is the same drug.

[11]In the main analysis, I do not take into account the geographical split of the markets because of two reasons: (i) regulation of prices of drug producers takes place at the national level irrespectively of their production location, (ii) the group of drugs I analyze is essential for social programs of the government, so the supply of these drugs to all the geographical regions is highly stimulated by government. Since supply to different regions is associated with varying distribution costs, which is the responsibility of distributors, I will control for buyers' locations via regional fixed effects.

specification and brand), the quantity of units and contract price-per-unit specified by the supplier. At the bundle level, the data includes bundle reserve price, procurement procedure, number of applicants, ID (fiscal code) and final bid of each bidder, ID of the winner, contract signing date and contract duration. For the analysis, I keep only purchases via electronic open descending auction (e-auctions). They constitute 87% of observations at the bundle level and 93% at the drug level. I also exclude drugs whose drug specification occurs less than ten times in my sample or whose price-per-unit is unreliable[12]. Final sample includes 814,684 contract bundles corresponding to 2,515,412 drugs. 83% of these drugs are from the list of essential drugs, i.e. their prices are regulated.

The second dataset is an official roster of all drugs in Russia registered and certified for sale (grls.rosminzdrav.ru). This dataset includes the brand and name of the corresponding producer. By matching the brands of the first and second datasets, I create a list of drug specifications manufactured by each producer in the procurement sample.

The third dataset is a list of all partial mergers, full mergers and divestitures in the Pharma industry in Russia. The core dataset comes from Zephyr of Bureau van Dijk. I manually extend this list by corporate events from Russian pharma and business media[13]. Among all vertical mergers and divestitures (hereafter *VI events*) between producers and distributors during 2014-2019 (15 VI events), I choose VI events that have enough pre- and post- VI event observations in my procurement data, so nine VI events are remaining.[14] Table A1 of the Appendix shows these VI events. There are three full mergers, two partial mergers, and four divestitures. Hereafter, I call producers involved in these VI events as *VI producers*, and distributors involved in these VI events as *VI distributors* irrespectively of the period before or after the VI events. Other producers are called *Non-VI producers*

[12]Within each drug specification, I exclude observations whose price-per-unit is either below 1% percentile or above 99% percentile.

[13]Among them forbes.ru/tegi/lekarstva, gmpnews.ru, vademec.ru, dsm.ru/marketing/free-information/analytic-reports, home.kpmg/ru/ru/home/insights

[14]For each VI event I calculate the number of drugs, with drug specifications manufactured by the producer involved in this VI event and supplied by the distributor involved in this VI event. I keep only those VI events that have at least ten observations at the drug level in 2 quarters pre- and post- VI event.

and *Non-VI distributors*, respectively.[15]

Table 1.1 shows the descriptive statistics at the drug level with the breakdown by winning distributor and producer of drug specifications. The table shows that both VI distributors and Non-VI distributors supply drugs of both types of producers. The number of drug specifications produced by VI producers is 4.5 times lower compared to Non-VI producers.[16] The normalized price of drug specifications produced by VI producers is lower compared to the prices of Non-VI producers. VI distributors have lower prices of drugs compared to Non-VI distributors.

Win. distributor	Producer	Obs.	Drug spec.	Mean z-price	Median z-price	St.d. z-price
Non-VI distrib.	Non-VI prod.	968598	1614	0.002	-0.063	0.999
Non-VI distrib.	VI prod.	1490452	399	0.000	-0.212	1.001
VI distrib.	Non-VI prod.	38178	1218	-0.016	-0.166	0.987
VI distrib.	VI prod.	18184	227	-0.077	-0.276	0.963

Note. The table shows descriptive statistics at the drug level for the final sample. Column *Win. distributor* shows if the VI distributors supplied the drug. Column *Producer* shows if the drug specification of the supplied drug is produced by the VI producers. Column *Obs.* means the number of observations in this category. Column *Drug spec.* counts the number of different drug specifications in this category. The last three columns are mean, median, and standard deviation of the within drugs specification normalized price. To get z-price, from the price-per-unit of each observation, I subtract the average and divide by the standard deviation of prices of other observations within drug specification.

Table 1.1: Descriptive statistics at the drug level

Table 1.2 shows descriptive statistics at the bundle level for the final sample. The average bundle reserve price is 2.7 M RUB, but 25% percentile is 200 K RUB, and 75% percentile is 1.56 M RUB. The average bundle contains 2.7 different drug specifications, and the average drug HHI concentration in the bundle is 0.67. 53% of bundles contain at least 1% of drugs with drug specifications of VI producers. The average share of these drugs is 38.9%[17], though 75% percentile is 100%. It means that at least 25% of e-auctions purchase bundles containing only drug specifications produced by VI producers. The

[15] Notice, non-VI distributors are not necessary distributors that do not own (or are not owned by) any producer. My definition means that Non-VI distributors do not change their vertical ownership structure during July 2014 - September 2019. The same holds for non-VI producers.

[16] (626=399+227) vs. (2832=1614+1218).

[17] Share of a drug in the bundle is calculated as the ratio of monetary value of the drug to the contract value in percentage.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Bundle reserve price (M RUB)	814,684	2.73	26.55	0.001	0.20	1.56	8,332.50
Number of distinct drug spec.	814,684	2.69	4.84	1	1	2	135
Drug spec. HHI	814,684	0.67	0.38	0	0.3	1	1
Bundle has drug spec. of VI prod.	814,684	0.53	0.50	0	0	1	1
Share of drug spec. of VI prod.(%)	814,684	38.88	45.06	0	0	100	100
Number of applicants	813,523	2.73	2.16	1.00	1.00	4.00	23.00
Rebate for bundle (%)	803,983	11.63	18.25	0.00	0.00	18.31	80.00
VI distrib. applies	814,684	0.073	0.260	0	0	0	1
VI distrib. wins	814,684	0.025	0.155	0	0	0	1

Note. The table shows descriptive statistics at the bundle level for the final sample. *Drug. spec. HHI* is the HHI index calculated via the value shares of each drug specification in the bundle. *Share of drug spec. of VI prod.* is the value share of drugs in the bundle, whose drug specifications are manufactured by VI producers.

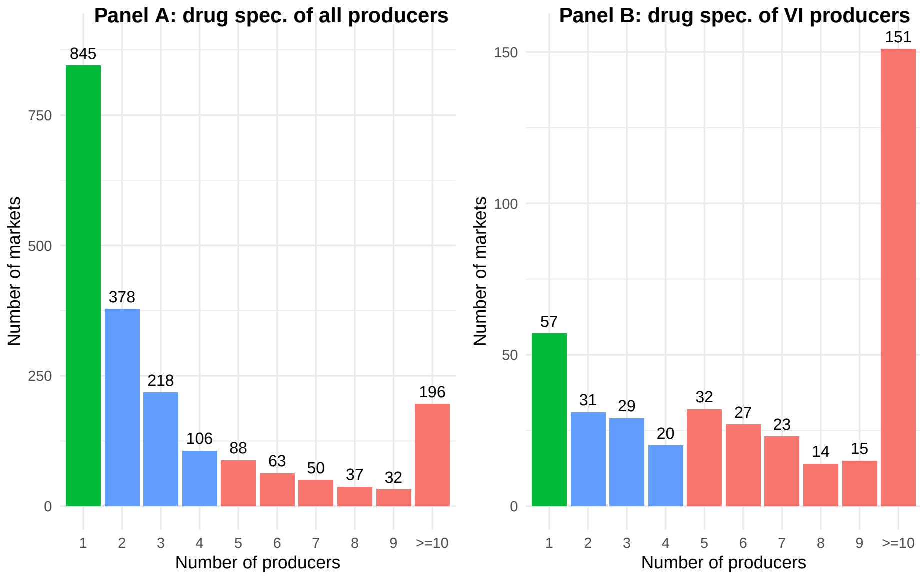
Table 1.2: Descriptive statistics at the bundle level

average number of applicants is 2.73, where 25% percentile is one, and 75% percentile is four. The average auction rebate for a bundle is 11.6% of the reserve price. VI distributors participate in 7.3% of these auctions and win in 2.5% of all 814,684 auctions, i.e. they win in 34% of auctions they participate.

Another essential aspect to understand is how competitive markets are. Figure 1.1 shows the distribution of the number of producers by drug specifications.[18] Panel A shows that 845 markets are monopolized, and 702 markets have from two to four producers. Panel B shows that VI producers participate in some of these highly concentrated markets. VI producers monopolize 57 markets, and 80 markets have from two to four producers.

The descriptive statistics show that bundles often include several drug specifications, some of which are often produced by VI producers. Moreover, VI producers are among few others for some drug specifications. VI distributors actively participate in the auctions by supplying both drugs produced by VI producers and other drugs.

[18] The number of producers for each drug specification is defined as the number of distinct producers manufacturing brands with this drug specification ever supplied to public buyers in my data.



Note. The market is defined as drug specification. Panel A shows the distribution of the number of producers by markets for all drugs in the sample. Panel B shows the same distribution for drug specifications produced by VI producers, i.e. markets, where VI producers act. Drug specifications with more than ten producers are binned at the bin of ten producers.

Figure 1.1: Distribution of the number of producers by markets

1.4 Reduced-form evidence

1.4.1 Identification

I use the difference-in-differences design at the drug level to estimate the effect of VI on the price-per-unit of drugs. Recall that each drug specification – a unique combination of the active ingredient and dosage – is a separate market. For each VI event, I construct a list of drug specifications whose brands are manufactured by VI producer associated with this VI event. Combining these lists over VI events I say that a procured drug is in the *treatment group* if its drug specification is from this combined list. This definition means that treatment is defined at the market level, and each VI event can affect different markets.[19] This definition of treatment group helps to estimate the VI effect both for

[19]While this definition is conceptually correct, the complexity arises because of the staggered nature of the VI events. The same markets can be affected several times by different VI events. To take this into account, I refine this definition as follows. For each VI event, I say that a procured drug is in the treatment group if its drug specification is manufactured by VI producer (as a specific brand) and

auctions, where VI distributors participate, and where they do not. The Control group should be such that: (i) parallel trend assumption in pre- VI event period holds, (ii) control group does not react to the VI events. Therefore, the dynamics of the control group should resemble the dynamics of the treatment group before the VI events, but the control group should not include indirect substitutes for the drugs in the treatment group. This is well recognized problem in the DID estimation of mergers (see e.g. Choné and Linnemer (2012)). Recall that all active ingredients are classified by hierarchical Anatomical Therapeutic Chemical Classification (ATC) with five levels. As an example, Figure A1 shows this classification for insulin glargine, which has ATC code at the fifth level A10AE04. I define a drug as a substitute if its active ingredient belongs to the same Level 4 ATC subclass as a drug in the treatment group. Next, I construct a list of Level 3 ATC subclasses containing all active ingredients of drugs in the treatment group. Drugs that are not in the treatment group and are not substitutes but whose active ingredients belong to this list of Level 3 ATC subclasses are assigned to the control group. For example, suppose drug specifications with insulin glargine are in the treatment group. In that case, all other drugs, which are not in the treatment group and whose ATC4 level subclass is A10AE are substitutes (i.e. drugs with ATC5 level subclasses A10AE01 - A10AE03, A10AE05-A10AE07), and drugs with ATC4 level subclasses A10AB, A10AC, A10AD, A10AF are in the control group (see Figure A1). Table A2 of the Appendix shows the descriptive statistics for the treatment and control groups with breakdown by type of suppliers.

I implement the difference-in-differences approach with multiple VI events and different intensities of the treatment. Assume there exists a model for price-per-unit of a drug

supplied by either VI distributor associated with this VI event or by Non-VI distributors. That is, for the VI event under consideration, I do not ascribe a drug with drug specification produced by VI producer of this event to the treatment group if it is supplied by VI distributors associated with other VI events. Since VI distributors win only 2.5% of all the auctions (see Table 1.2), such refinement is not substantially different from the basic definition.

of the following form:

$$\begin{aligned} ln(price_{q,d,i,t,b,s}) =& \alpha I(d \in D, t \in T) \cdot Intensity + [\beta Num.Applicants_i] + \\ & \delta_q + \mu_d + \lambda_t + \eta_b + \gamma_s + \nu_{ATC3-year} + \mathbf{X_i}\theta + \varepsilon_{q,d,i,t,b,s}, \end{aligned} \tag{1.1}$$

where q units of the drug with drug specification d are procured in auction i at quarter-year t by a buyer from region b and supplied by firm s. D is a treatment group. T is a post- VI event period. *Intensity* equals 1 for full mergers, 0.5 for partial mergers, -1 for divestitures. Set of indicator variables δ_q specifies within drug specification quantity percentiles.[20] Other variables are fixed effect for drug specification μ_d, year-quarter of contract signing λ_t, buyer region η_b, and supplier ID γ_s. Vector X_i is a set of auction characteristics: the number of drug specifications in the bundle, contract duration, indicator if a centralized authority implements procurement. Vertical mergers and divestitures are not random events. Firms have some expectations about the evolution of the markets and make the integration decision. To mitigate this problem, I control for dynamic expectations about markets via ATC3-year fixed affects $\nu_{ATC3-year}$. Noteworthy, if a merger involves many markets, then for each particular market this merger can be thought of as exogenous shock (Dafny et al. (2012), Ashenfelter et al. (2015), Chandra and Weinberg (2018), Decarolis and Rovigatti (2021), Rossi (2019), Carril and Duggan (2020)). Table A2 shows that producers associated with VI events work in at least 16 markets, with most of them working in at least 67 markets. Moreover, if firms have expectations about the merger other than for price-cost margin in public procurement – for example, improvement of quality and better differentiation in retail markets – this would be orthogonal to treatment in public procurement, as procurement regulation disregards the quality dimension via the brand substitution.

[20] One cannot use the quantity per se as different drug specifications are measured in different units, e.g. tablets, flacons. Moreover, even tablets of different drug specifications are not comparable. I use five equally spaced percentiles with cutoffs 20%, 40%, 60%, 80%, and within clusters, defined at the level of drug specifications, I assign each quantity to one of five 20%-percentiles.

In specification (1.1) without control for the *Number of Applicants*, the coefficient α shows the aggregate effect of VI on the logarithm of price. It includes the direct impact on the price (e.g. raising rivals' costs and efficiency gain) and an indirect effect via the change in the downstream competition (e.g. exclusion of rival distributors). However, if one controls for the *Number of Applicants* in (1.1), then coefficient α shows just the direct effect fixing the downstream competition. Therefore, the change in coefficients α of the models with and without *Number of Applicants* as a control helps to separate direct and indirect effects of vertical integration.

In addition to the average effect of vertical integration, it is necessary to study the heterogeneity of the effect, i.e. how the VI affects prices depending on the number of drug specification producers. Therefore, I extend the model (1.1) in the following way:

$$\begin{aligned} ln(price_{q,d,i,t,b,s}) =& \alpha_1 I(d \in D, t \in T) \cdot Intensity \cdot I(\#drug.spec.producers = 1) + \\ & \alpha_2 I(d \in D, t \in T) \cdot Intensity \cdot I(\#drug.spec.producers \in \{2,3,4\}) + \\ & \alpha_3 I(d \in D, t \in T) \cdot Intensity \cdot I(\#drug.spec.producers \geq 5) + \\ & + [\beta \ Num.Applicants_i] + \delta_q + \mu_d + \lambda_t + \eta_b + \gamma_s + \nu_{ATC3-year} + \mathbf{X_i}\theta + \varepsilon_{q,d,i,t,b,s}, \end{aligned} \quad (1.2)$$

where coefficients α_1, α_2 and α_3 show the VI effect for the single producer, several producers (from two to four) and many producers (above five) cases. I use two sub-samples: (i) auctions, where VI distributors participate; (ii) auctions, where only Non-VI distributors participate. For the first sub-sample, foreclosure and efficiency gains are in place. The second sub-sample serves as a placebo test for the VI effect, as the VI producer behaves as an independent upstream firm.

Endogeneity of Number of applicants.

Note that the *Number of applicants* in equations (1.1), (1.2) is an endogenous variable by several reasons. First, it is endogenous because the VI producer may have incentives to foreclose downstream distributors. Second, if application is costly, then a potential bidder decides to apply only if the expected profit is higher than the participation cost (Samuelson (1985), Levin and Smith (1994)).[21] Finally, when the collusion between bidders is an issue, the *Number of applicants* is a nominal measure of competition, while the true measure of competition would be the number of independent groups of bidders. As the primary goal to control for the *Number of applicants* is to isolate the indirect VI effect related to foreclosure, I propose a set of instruments related to the first reason. As a robustness check, I consider an alternative instrument related to the other two reasons and combine these two sets of instruments.

To construct instruments, I use an approach that becomes standard for estimating the effect of competition on prices in ordinary markets. This approach proposes to instrument competition by a merger induced change in expected competition (Dafny et al. (2012), Ashenfelter et al. (2015), Chandra and Weinberg (2018), Decarolis and Rovigatti (2021), Rossi (2019)). The main assumption is that the merger affects many markets, which is plausible in my setting.[22] Recall a buyer announces a bundle, and the VI producer may not manufacture all bundle components. It implies that the *Share of treated drugs* in the bundle – value share of drug specifications of VI producer in the bundle – can be a measure of auction bundle exposure to the treatment. I use this share (denoted $Share_i$) and its interaction with post-VI period ($Share_i \cdot I(t \in T)$) as instruments for the number of applicants. These variables are relevant instruments. Indeed, if the share of treated drugs is high, the VI producer may have incentives to foreclose the rival distributors. Moreover, in this case, the VI distributor has a substantial cost advantage, which disincentivizes the rival distributors from participating due to lower expected profit. These instruments are valid, i.e. they satisfy exclusion restrictions in the price equations (1.1) and (1.2). Indeed, the public buyer orders a bundle of drugs, so all bidders take it as given. Second, I directly control for bundling via the number of drug specifications in the structural equations (1.1)

[21] Different variants of this endogenous entry are discussed by Gentry et al. (2018).
[22] See Table A2 and discussion above.

and (1.2), so additional variation in price associated with bundling is taken into account.[23] Third, Table B1 shows how the share of treated drugs in the bundle changes after the vertical integration. After the VI, in auctions, where VI distributors participate, the share of treated drugs in the bundle increases less compared to the auctions where VI distributors do not participate. It means that public buyers do not deliberately give an advantage to VI distributors via the higher share of treated drugs.[24] Moreover, the share of drugs in the bundle, where VI producer is a single one or among few others, increases little after VI – by 0.17% and 0.54%, respectively. That is, in the markets where VI distributors can have a cost advantage and VI producers can exercise market power, there is a little increase of demand after the vertical integration.

I use OLS/2SLS to estimate equations (1.1) and (1.2) without/with control for the *Number of Applicant*. Clustering at a buyer level takes into account potential correlation of error terms.

1.4.2 Results

Table 1.3 shows the effect of VI on prices with respect to equations (1.1) and (1.2) in auctions, where VI distributors participate. Column 1 and 3 of Panel A shows that, on average vertical integration reduces prices of drugs by 1.5% - 1.7%, i.e. the average effect is pro-competitive. Nevertheless, the effect is highly heterogeneous over the number of producers of drug specifications.

When VI producer is a single one, price increases by 11.4% after the vertical integration if I do not control for the *Number of applicants* (Column 2). After the control for the *Number of applicants*, this effect disappears (Column 4).[25] It suggests that the anti-

[23] One can alternatively control for drug concentration index, like HHI (see Table 1.2), instead of the number of drug specifications. It does not change the results.

[24] One can also interpret this as VI distributors do not deliberately participate in auctions with a higher share of treated drugs.

[25] Panel B of Table 1.3 shows results of the first stage. F statistics for the joint significance of the instruments indicate that instruments are relevant in both specifications (Staiger and Stock (1997)).

competitive effect of VI on prices for a single producer case happens due to the indirect effect of vertical integration on prices (reduction of downstream competition), but not because of the direct effect (raising rivals' cost and efficiency gain).

When VI producer is among few other producers, price-per-unit increases by 12.8-13.5%, after the vertical integration (Columns 2 and 4), and control for the *Number of applicants* does not substantially affect the magnitude of the impact. Therefore, it suggests that the anticompetitive effect of VI on prices is due to the direct VI effect on price (raising rivals' cost) but not due to the indirect effect (downstream competition restriction).

When VI producer is among many other producers, price-per-unit decreases by 1.6%-1.8%, after the vertical integration (Columns 2 and 4), and there is no additional impact of the *Number of applicants*. This pro-competitive VI effect suggests that the efficiency effect dominates when the number of producers is large.

I use the sample of auctions, where VI distributors do not participate as a placebo test of the VI effect. In these auctions, the VI producers act as independent firms for bidders even after the vertical integration. Table 1.4 shows the results. Columns 1 and 3 show the reduction of prices after the VI. There is no VI effect on prices if the upstream market is monopolized or concentrated (Columns 2, 4). For competitive markets, VI reduces prices by 3.4%. These findings confirm that VI producers only exercise market power in concentrated markets if the VI distributor participates in the auction. The price reduction in the case of many producers can be explained by the fact that buyers react to the vertical integration and set the lower reserve price.

The crucial assumption behind the DID results discussed above is the presence of parallel pre-trends before the VI events. Figures B1 and B2 of Appendix show the results of event study design. Prices of the treatment and control group can be seen parallel before the treatment.

	Panel A: Log of price-per-unit of drug			
	OLS	OLS	2SLS	2SLS
	(1)	(2)	(3)	(4)
ATT	-0.017^{***}		-0.015^{**}	
	(0.006)		(0.006)	
ATT (1 producer)		0.114^{*}		0.056
		(0.065)		(0.075)
ATT (2-4 producers)		0.135^{**}		0.128^{**}
		(0.055)		(0.055)
ATT (at least 5 producers)		-0.018^{***}		-0.016^{***}
		(0.006)		(0.006)
Num. of applicants			-0.092^{***}	-0.092^{***}
			(0.009)	(0.009)
# drug spec. FE	850	850	850	850
Observations	123,074	123,074	122,971	122,971
R^2	0.955	0.955	0.953	0.953
	Panel B: Number of applicants			
	(1)	(2)	(3)	(4)
Share of treated drugs			0.009^{***}	0.009^{***}
			(0.001)	(0.001)
Share of treated drugs∗Post VI			-0.003^{***}	-0.003^{***}
			(0.001)	(0.001)
F statistics			144.78	144.89

*p<0.1; **p<0.05; ***p<0.01

Note. Table shows the estimates of Equations (1.1) (Columns 1, 3) and (1.2) (Columns 2, 4) at the drug-level. The sample includes auctions, where VI distributors participate. Panel A shows OLS (Columns 1, 2) and 2SLS (Columns 3, 4) estimates. Panel B shows the results of the first stage for 2SLS. All models control for: quantity percentile FE (bin width of 20%), number of drug specifications, contract duration, an indicator if procurement is centralized, FE on drug specifications, year-quarters, ATC3-years, regions, and suppliers. Errors are clustered at buyer levels. Full output is presented in Table B2 of Appendix.

Table 1.3: Effect of VI on prices – VI distributors are participants

	Panel A: Log of price per unit of drug			
	OLS	OLS	2SLS	2SLS
	(1)	(2)	(3)	(4)
ATT	-0.033^{**}		-0.032^{*}	
	(0.017)		(0.017)	
ATT (1 producer)		-0.065		-0.070
		(0.047)		(0.048)
ATT (2-4 producers)		0.028		0.025
		(0.026)		(0.025)
ATT (at least 5 producers)		-0.034^{**}		-0.033^{*}
		(0.017)		(0.017)
Num. of applicants			-0.043^{**}	-0.043^{**}
			(0.020)	(0.020)
Drug spec. FE	1242	1242	1242	1242
Observations	1,909,394	1,909,394	1,905,849	1,905,849
R^2	0.962	0.962	0.963	0.963

	Panel B: Number of applicants	
	(1)	(2)
Share of treated drugs	0.008^{***}	0.008^{***}
	(0.001)	(0.001)
Share of treated drugs ∗ Post VI	-0.0002	-0.0002
	(0.001)	(0.001)
F statistics	64	64

*p<0.1; **p<0.05; ***p<0.01

Note. Table shows the estimates of Equations (1.1) (Columns 1, 3) and (1.2) (Columns 2, 4) at the drug-level. Sample includes auctions, where VI distributors do not participate. Panel A shows OLS (Columns 1, 2) and 2SLS (Columns 3, 4) estimates. Panel B shows results of the first-stage for 2SLS. All models control for: quantity percentile FE (bin width of 20%), the number of drug specifications, contract duration, an indicator if procurement is centralized, FE on drug specifications, year-quarters, ATC3-years, regions, suppliers. Errors are two-way clustered at buyer and drug specification level. Full output is in Table B3 of Appendix.

Table 1.4: Effect of VI on prices – VI distributor does not participate in auction

1.4.3 Robustness check

This section provides robustness checks of the main results for the sample of auctions, where VI distributors participate. First, since vertical integration events occur at different times, I follow the modern staggered DID literature and implement the stack regression approach. Second, I use an alternative definition for markets by introducing geographical division. Third, I propose an alternative instrument for the *Number of applicants*. Finally, I introduce joint buyer-supplier fixed effects to take into account favouritism and corruption issues in contract allocation. All the changes do not affect the main findings.

The VI events occur in different moments. This raises a potential problem that already treated become control for not-yet treated observations (Callaway and Sant'Anna (2020), Goodman-Bacon (2021)). The literature proposes different approaches, and I follow the stack-regression design (Cengiz et al. (2019)) as it allows to have treatments of different intensities. For each VI event, I choose the treatment and control group as in the main approach, where the control group includes never-treated observation only. For each event-specific dataset – an element of the stack – I introduce the relative time with respect to the treatment, and the treatment happens at time zero (see details in Baker et al. (2021)). I combine all the event-specific datasets in one stack of data and implement regressions (1.1) and (1.2) putting year-quarter-stack FE instead of year-quarter FE (λ_t), keeping the rest of the estimation approach. Table C1 of Appendix shows that the results of stack regression are similar to the main ones.

The second robustness check deals with the market definition. So far, a market is equivalent to a drug specification – a combination of active ingredient and dosage. It assumes that all producers work at the national level without any geographical specialization. Such an approach corresponds to the regulatory perspective (see footnote 11 for details), but some producers may not supply their drug to all Russian regions. In this case, without geographical division, I overestimate the upstream competition. That is, for a fixed drug specification, the set of brands available for a buyer may be narrower than the set of national brands with this drug specification. In this robustness check, I define a market as a combination of drug specification and the Western-Eastern location of public buyers.[26] The number of producers for each market is calculated as the number of distinct producers manufacturing brands ever supplied in this market in my data. Figure C1 of Appendix shows the distribution of the number of producers by markets. There are 64 monopolized markets by VI producers and 82 markets with 2–4 producers. Table C2 shows results of estimation. Columns 2 shows that the VI effect on prices increases a little for monopolized markets and decreases a little for concentrated markets (2-4 producers) compared to the main result (Column 2 of Table 1.3). Column 4 of Table C2 confirms that the price increase in monopolized markets is due to the indirect VI effect because control for the *Number of applicants* mitigates the effect. Similar to the main results, control for the *Number of applicants* does not change the effect of VI for concentrated markets. All in all, the results of this robustness check are similar to the main ones.

The third robustness check is devoted to the instrument for the *Number of applicants*. Identification section highlights three reasons for endogeneity of the *Number of applicants* in Equations (1.1) and (1.2): (i) potential foreclosure, (ii) entry cost, (iii) collusion of bidders. The main instruments *Share of treated drugs* in the bundle and its interaction with post VI event can predict the variation in *Number of applicants* due to the first reason. To cope with the second reason, I implement the standard approach in the literature. Specifically, I use number of potential bidders as an instrument for the number of bidders (De Silva et al. (2008), De Silva et al. (2009), Krasnokutskaya and Seim (2011), Athey et al. (2011), Athey et al. (2013)). Following Athey et al. (2013), I use the maximum number of applicants within clusters, defined as "active ingredient-region-year", as a measure of the potential number of applicants.[27] Note potential number of applicants can also

[26] All public buyers located on the west of the Ural mountains are in the Western location.

[27] To construct clusters as "active ingredient-region-year" I consider only e-auctions with only one active ingredient in the bundle. There are 71610 such clusters, corresponding to 443 active ingredients, 86 regions, six years. Alternative definition of clusters as "active ingredient-region" gives 21992 different

be helpful to solve the endogeneity generated by the third reason, as a higher number of potential applicants would likely result in a higher number of independent groups. Table C3 of Appendix shows the results with the original instruments (Columns 1-2), alternative instrument (Columns 3-4) and their combination (Columns 5-6). The combination of instruments includes all three instruments in the first stage. Results of ATT estimates for different upstream market structures from all these IV strategies are similar.

The fourth robustness check considers the issue of favouritism and corruption in public contracts allocation.[28] I introduce joined buyer-supplier fixed effects in Equations (1.1) and (1.2) to control for potential time-invariant favouritism in contract allocation by buyers to suppliers. The estimation results are shown in Table C4 of Appendix. The results coincide with the main findings regarding the VI effect on prices.

1.5 Theoretical model

This section proposes a theoretical model of procurement auction in an industry with vertical structure. Equilibrium analysis of this game rationalizes the reduced-form evidence and is a foundation for the structural estimation of producer and distributor costs.

1.5.1 Players, timing and cost structure

The buyer announces descending procurement auction to purchase a unit of drug. The public reserve price r is the buyer willingness to pay. The unit of drug is indivisible and can be supplied by at most one distributor. There are N upstream risk-neutral producers of the drug $\{P_i\}_{i=1}^{N}$ and M downstream risk-neutral distributors $\{D_j\}_{j=1}^{M}$ are going to participate in the auction to supply the drug to the buyer. Without loss of generality, I

clusters, but the estimation results are similar.

[28] See a corruption investigation about the head of the Biotech – pharma distributor that had divestiture with producer Biosintez in December 2016 (https://thebell.io/en/fsb-accused-of-stealing-pharma-business-after-arrest-of-billionaire-2))

assume that producers do not participate directly in the auction.[29] The distributors do not own the drug but have to negotiate its price with the producers before bidding. The timing of the game is the following.

Time 1: negotiation stage. The producers observe independent private production costs $(c_i)_{i=1}^N$. All distributors negotiate input prices with all the producers and accept the minimal price. The profile of input(negotiated) prices is $(p_j)_{j=1}^M$. There is no trade at this stage, but commitment about the input prices.

Time 2: bidding stage. The distributors observe independent private delivery costs $(d_j)_{j=1}^M$. The total cost tc_j of distributor j is sum of input price p_j and delivery cost $tc_j = p_j + d_j$. The distributors participate in the descending procurement auction organized by the buyer. The winning distributor trades with the producer at the committed price specified at the negotiation stage and supplies the drug.

I consider two scenarios: (i) *Vertical separation* (VS) scenario when all producers and distributors are independent firms, (ii) *Vertical integration* (VI) scenario when the first producer P_1 is vertically integrated with the first distributor D_1 and other producers and distributors are independent. In VI scenario I define $\{P_i\}_{i=2}^N$ as *rival producers* and $\{D_j\}_{j=2}^M$ as *rival distributors.*

I model the negotiation process at Time 1 as follows. If a producer is unique ($N = 1$), she sets an input price p_j to each distributor j.[30] If there are several producers of the drug ($N > 1$), then each distributor, simultaneously with other distributors, solicits bids from all the producers via an internal descending auction.[31] In the VI scenario, in addition

[29]Participation of a producer in the auction is equivalent to the vertical integration scenario between producer and distributor, which I discuss below.

[30]For simplicity, I assume that distributors have zero bargaining power when the producer is unique, though the main result (Proposition 1) holds even if one assumes Nash bargaining setting and positive bargaining power of distributors that does not change after the vertical integration.

[31]Each distributor negotiates prices with potentially many producers but finally trades with just one of them. Moreover, the production cost is private information of producers. Therefore, I cannot use model of Nash-in-Nash bargaining proposed by Horn and Wolinsky (1988) and extended in Crawford and Yurukoglu (2012), Gowrisankaran et al. (2015), Crawford et al. (2018), Collard-Wexler et al. (2019), Lee et al. (2021)), as it requires complete information at the negotiation stage. An alternative way to model negotiation process is to use auctions (see for example Bulow and Klemperer (1996), Thomas and Wilson (2002), Thomas and Wilson (2005), Klemperer (2007), Ho (2009), Miller (2014), Allen et al. (2019),

to the negotiation, the VI distributor has a right to get the drug internally from the VI producer at the cost $p_1 = c_1 - \delta$, where $\delta \geq 0$ is an exogenous *synergy effect* of the vertical integration. One can think of positive δ as a transaction cost, which is included in c_1 if P_1 interacts with an external distributor, but it is absent when P_1 interacts internally with D_1. Parameter δ is common knowledge.

I assume that producers and distributors are symmetric in VS scenario. Specifically, random variables c_i ($i \in \{1, \dots, N\}$) are independent draws from a continuously differentiable distribution $F(x)$ with support $[\underline{c}, \overline{c}]$ and density $f(x)$. Similarly, d_j ($j \in \{1, \dots, M\}$) are independent draws from a continuously differentiable log-concave distribution $G(x)$ with support $[\underline{d}, \overline{d}]$ and density $g(x)$ that is positive on the interior of the support.[32] The goal of analysis is to compare ex-ante expected buyer payments under VS and VI scenarios, denoted as $\mathbf{E}p^{vs}$ and $\mathbf{E}p^{vi}$, respectively.

1.5.2 Single producer case

I start with the analysis of a single producer case ($N = 1$) and denote the production cost of a single producer as $c \equiv c_1$. For this case, following the procurement regulation of pharmaceuticals, I assume that the government regulates the producer prices. That is, at the negotiation stage, the producer cannot set the price above $\overline{p}$ to any distributor, and $\overline{p}$ is sufficiently smaller than the reserve price r. Specifically, I impose the following assumption.

Assumption 1. *Input prices at the negotiation stage cannot exceed $\overline{p}$, where $\overline{p} \leq p^*_M(c) < r$ and $p^*_M(c)$ is a solution for the upstream monopoly profit maximization problem given*

Loertscher and Marx (2019), Kotowski and Leister (2019), Loertscher and Riordan (2019), Loertscher and Marx (2020)). Descending open auction is a relevant model if one assumes that each distributor can play producers off against each other, up to the point at which the price offered by the lowest cost producer cannot be profitably beaten by the other producers − bargaining leverage of distributor. At that point, the distributor has no more bargaining leverage, and the negotiation ends.

[32]The distribution F is log-concave if $ln(F(x))$ is a concave function of x or, equivalently, if $\frac{F(x)}{f(x)}$ is a non-decreasing function of x (Bagnoli and Bergstrom (2005)). This is standard assumption in the monopoly theory and mechanism design literature (Myerson and Satterthwaite (1983), Maskin and Riley (1984), Riordan and Sappington (1989)) and I am going to use it in a similar setting.

the production cost c and M downstream distributors:

$$\max_p (p - c)\, \mathbf{P}\left(p + \min(d_1, \ldots, d_M) \leq r\right) \tag{1.3}$$

The first term of (1.3) is the profit of the monopolist, who sets the same input prices to all the distributors, given the trade occurs, and the second term is the probability that trade occurs. Assumption 1 implies that upstream monopolist cannot set the price too close to the reserve price even if she can guarantee at least one bidder in the auction. It also implies that the buyer should not set the reserve price too close to $\overline{p}$, so that there are enough incentives for distributors to enter the procurement auction.[33] Appendix D shows that $p^*_M(c)$ is non-decreasing in c and increasing in M. The following proposition characterizes the expected buyer payment under VS and VI scenarios.

Proposition 1. *Let Assumption 1 be satisfied, and assume the single producer commits to work with all the distributors. Then*

i. If synergy effect is zero ($\delta = 0$) *then* $\mathbf{E}p^{vi} = \mathbf{E}p^{vs}$.

ii. If synergy effect is positive ($\delta > 0$) *then* $\mathbf{E}p^{vi} < \mathbf{E}p^{vs}$.

In both cases P_1 *sets prices at the negotiation stage at the level* $\overline{p}$.

See details of the proof in Appendix D. Intuition of Proposition 1 is the following. The single producer in the VS scenario is willing to set the price at $p^*_M(c)$ and in the VI scenario – even above. However, due to the price regulation, she sets the price at $\overline{p}$ to all the distributors, except for D_1 in the VI scenario. Therefore, the vertical integration does not lead to higher input prices for rival distributors in the VI scenario compared to the VS scenario. Moreover, in the VI scenario, if D_1 enters the auction together with a rival distributor, he has incentives to behave like an independent firm because the single

[33]If the reserve price is binding and the auction failed to attract at least one distributor, the buyer has to re-announce the auction at a higher reserve price, so we turn to the case $\overline{p} \ll r$.

producer will get $\overline{p}$ irrespective of who wins the auction. Thus, the competitive advantage D_1 receives by getting the product at the production cost is not passed through to the buyer without synergy effect. However, if the synergy effect is positive, it is partially passed through to the buyer.

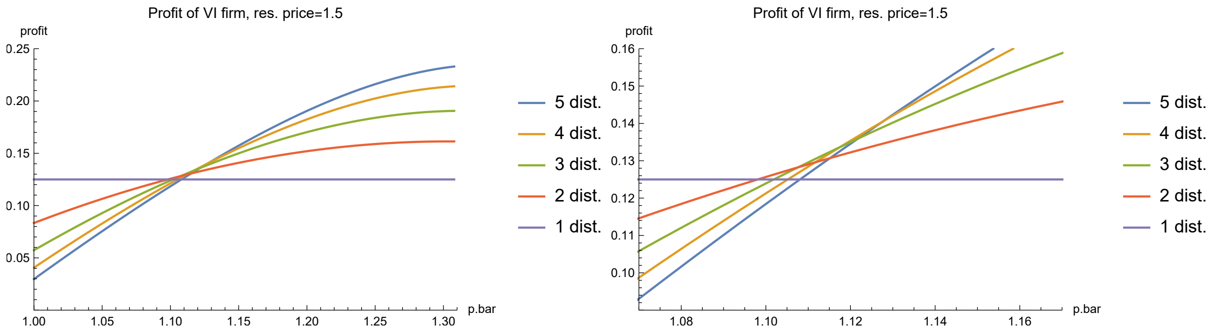
This intuition also emphasizes the importance of Assumption 1. If one relaxes Assumption 1, then in the VS scenario P_1 sets the input price equal to $p_M^*(c)$ and in the VI scenario P_1 sets the input price above $p_M^*(c)$ to rival distributors, which increase the buyer payment.

Remark 1. *If synergy effect is zero* ($\delta = 0$) *and Assumption 1 fails then* $\mathbf{E}p^{vi} > \mathbf{E}p^{vs}$.

Note the importance of commitment assumption in Proposition 1, i.e. P_1 commits not to foreclose (exclude) any downstream distributor.[34] Figure 1.3 shows that if $\bar{p}$ is small enough, then the VI producer has incentives to foreclose(exclude) one or more rival distributors to increase the expected profit (Panel (a)). However, it is not always beneficial for the VI producer to foreclose all rival distributors (Panel (b)), but only some of them. This result is in line with literature findings emphasizing that the inability of the upstream integrated monopolist to extract sufficient profit from downstream rivals generate foreclose incentives (Rey et al. (2014), Fumagalli et al. (2018), Fumagalli and Motta (2020)).[35]

[34] Whether this assumption holds for a specific setting depends on the antitrust regulation. For example, one can think of a regulation in which a single producer is obliged to sell to any certified distributor at a price that does not exceed the posted price.

[35] In a separate study, I show that the integrated producer has no foreclosure incentives in a setting without price regulation. Moreover, in a more general setting in which the integrated producer knows the distribution cost of the integrated distributor at the negotiation stage, all the results mentioned above hold, including Proposition 1 and Remark 1.



(a) Full domain $\bar{p} \in [1, p_5^*(1)]$ **(b)** Subset of $[1, p_5^*(1)]$ for $\bar{p}$

Note. Figure shows the simulation results if $c = 1$, $d_j \sim U[0, 1]$, $M = 5$, $r = 1.5$, $\delta = 0$. X-axis shows $\bar{p}$. Y-axis shows the expected profit of VI firm. Panel (a) has domain $[1, p_5^*(1)]$ and Panel (b) is a zoom in a domain subset.

Figure 1.3: Profit of VI firm for different number of distributors

Let me summarize the model conclusions for the case of a single producer. If there is no foreclosure(exclusion) of any distributor from the deal, then VI is never anti-competitive for the buyer. Moreover, if the synergy effect is positive, then VI is pro-competitive for the buyer. However, foreclosure is harmful to the buyer and under some conditions, it is even beneficial for the integrated firms. These findings rationalize the reduced-form evidence from Table 1.3 for the case of a single producer. When downstream competition is fixed via the control for the *Number of applicants*, the vertical integration has no direct effect on prices. However, the VI has an indirect impact on prices via the change in the downstream competition.

1.5.3 Multiple producers case

Now consider the case with several upstream producers ($N > 1$). Due to competition at the upstream and downstream levels, I assume that the reserve price is not binding.[36] Appendix D shows, the total cost of distributor D_j in the VS scenario has the form

$$tc_j = c_2^{(N)} + d_j \quad (j \in \{1, \dots M\}), \tag{1.4}$$

[36] If $N > 1$, without loss of generality, one can assume that $\bar{c}$ is equal to the regulated price $\bar{p}$ because any producer has to offer a price below $\bar{c}$.

where $c_2^{(N)}$ is the second-lowest producer cost of the profile $(c_1, c_2, \dots c_N)$. In the VI scenario, D_1 becomes asymmetric with respect to the rival distributors because of double markup elimination and the synergy effect δ. Moreover, P_1 may have incentives for RRC, so the total costs of distributors have the following form:

$$tc_1 = min\left(c_2^{(N-1)}, c_1 - \delta\right) + d_1; \tag{1.5}$$
$$tc_j = c_2^{(N)}(\mu) - \rho + d_j \quad (j \in \{2, \dots, M\}),$$

where $c_2^{(N-1)}$ is the second-lowest value of the profile $(c_2, \dots c_N)$ and $c_2^{(N)}(\mu)$ is the second-lowest value of the profile $(c_1 + \mu, c_2, \dots c_N)$. Here μ is a strategic markup P_1 sets to the rival distributors, which characterizes the RRC effect, and ρ is a strategic rebate the lowest cost (*strongest*) rival producer gives to rival distributors anticipating the RRC effect of P_1. Appendix D defines the equilibrium strategies μ and ρ of P_1 and strongest rival producer formally, and it shows that other players have weakly dominant strategies. It turns out that without imposing additional assumptions on distributions of producers and distributors costs, the closed-form solution of the equilibrium is problematic, and the approach via the first-order condition is not feasible because of the possibility of corner solutions. Therefore, only a numerical solution is feasible. Nevertheless, this model exhibits a remarkable result when N is large enough.

Proposition 2. *Assume that non-strongest rival producers and all distributors follow their weakly dominant strategies. Then for any strategies $\mu \geq 0$ and $\rho \geq 0$, the following holds:*

i. if synergy effect is zero ($\delta = 0$) then $\lim_{N\to\infty} \mathbf{E}p^{vi} - \mathbf{E}p^{vs} = 0$;

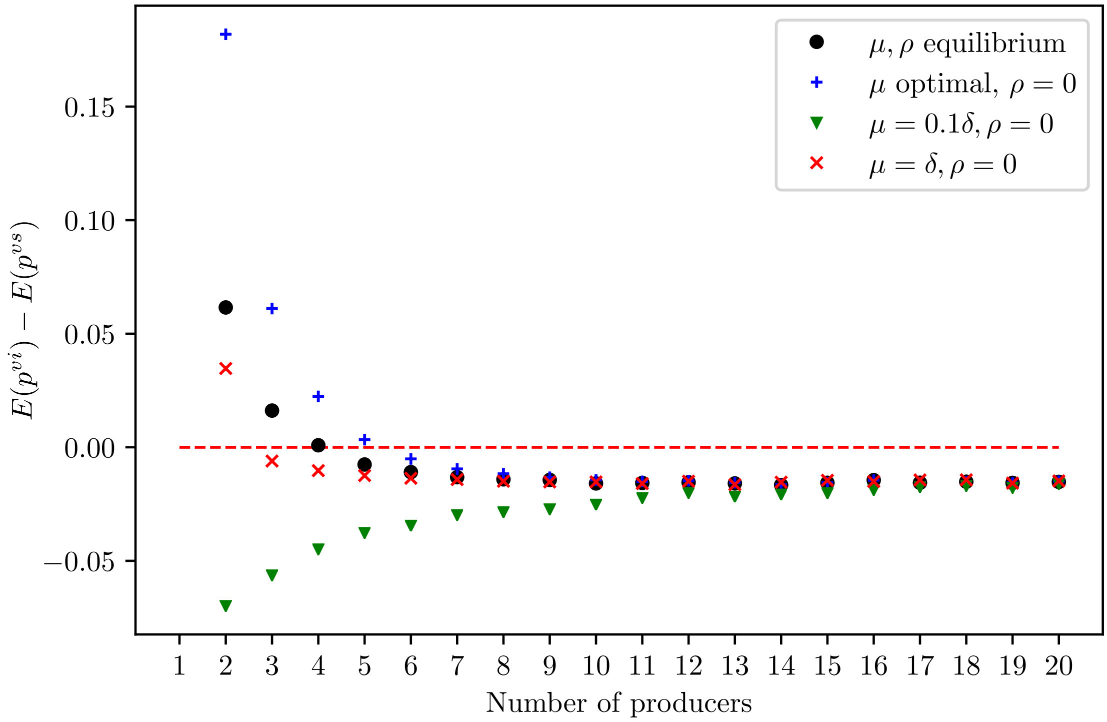
ii. if synergy effect is positive ($\delta > 0$) then $\lim_{N\to\infty} \mathbf{E}p^{vi} - \mathbf{E}p^{vs} < 0$.

See proof in Appendix D. The intuition of Proposition 2 is the following. When the number of producers is large, the RRC effect is negligible because several rival producers can likely undercut the offer of P_1 at the negotiation stage, so the vertical integration cannot harm the buyer.[37] At the same time, the positive synergy effect $\delta > 0$ creates an asymmetry between D_1 and rival distributors. This cost advantage helps D_1 to offer the lower bid in the procurement auction leading to the lower buyer payment.

Figure 1.5 demonstrates the outcomes of the game for uniformly distributed producer and distributor costs and synergy effect $\delta = 0.25$. If the number of producers is large enough ($N \geq 6$), the difference of the expected buyer payment in the VI and VS scenarios is negative irrespective of strategies μ and ρ. In the equilibrium, the VI is pro-competitive if $N \geq 5$. However, if the number of producers is small ($N = 2$ or $N = 3$), then the VI is anti-competitive in the equilibrium as it increases the expected buyer payment.

Propositions 2 rationalizes the reduced-form evidence from Table 1.3 for the case with many producers. The simulation shows that for the case with a few producers, the vertical integration can be anti-competitive. However, the actual effect depends on the costs distributions and synergy effect, which is merely the empirical issue. Structural estimation of producer and distributor costs and simulations of vertical mergers with different synergy effects help to answer this issue.

[37] Notice that foreclosure(exclusion) of rival distributors cannot create an additional effect, since it is equivalent for P_1 to offer $\bar{c}$ at Stage 1. Rival distributors would reject this offer as rival producers can undercut it.



Note. This figure shows a result of simulation of $\mathbf{E}p^{vi} - \mathbf{E}p^{vs}$ for $m = 3$, $c_i \sim U[3,4]$, $d_j \sim U[1,2]$. X-axis shows the number of upstream producers, Y-axis shows the difference in ex-ante expected buyer payment under VI and VS scenarios. The synergy effect $\delta = 0.25$. The black dots show outcomes for equilibrium strategies μ, ρ. Blue crosses show outcomes for optimal μ given $\rho = 0$. Cases $\mu = 0.1\delta$ and $\mu = \delta$ assume that strategy $\mu(c_1)$ is constant.

Figure 1.5: Simulation of $\mathbf{E}p^{vi} - \mathbf{E}p^{vs}$ for different number of producers

1.6 Structural estimation

In this section, I use the VS scenario of the model with multiple producers and propose an identification and estimation strategies of producer and distributor cost distributions from the auction data. Then, taking estimated costs distributions, I simulate vertical mergers under different conditions and derive policy implications for the merger approval.

1.6.1 Identification

In the model with multiple producers and the VS scenario, the total distributor costs have the form (1.4). To fit the data, I extend this form by introducing the observed heterogeneity in the linear-additive form (Haile et al. (2003), Larsen (2021)), so the total cost of distributor D_j ($j \in \{1, \ldots, M\}$) in the auction a has the following structure:

$$tc_{j,a} = \underbrace{c_{2,a}^{(N)}}_{common\,term} + \underbrace{d_{j,a}}_{private\,value} + \underbrace{\beta \mathbf{X_a}}_{observed\,heterogen.}. \tag{1.6}$$

Here $c_{2,a}^{(N)}$ is a negotiated price and it equals to the second-lowest producer costs, $d_{j,a}$ is a distribution cost, and X_a is the observed heterogeneity affecting the total cost via parameters β. In the data, I observe bids from the descending procurement auctions with the public reserve price r_a. With respect to econometrician $c_{2,a}^{(N)}$ is an unobserved heterogeneity. My approach extends the literature on the identification in auctions with unobserved heterogeneity (Krasnokutskaya (2011), Freyberger and Larsen (2017), Larsen (2021)) by rationalizing the unobserved heterogeneity as the equilibrium negotiation price at the upstream level. [38] Following this literature, I impose standard assumptions on bidders behaviour and cost distributions.

Assumption 2. ***(No jumping.)*** *In the descending auction, all bidders follow the weakly dominant strategy of bidding up to their total cost.*

Assumption 3. ***(Independence.)*** *(i) Producer costs $(c_{i,a})_{i=1}^{N}$, distributor costs $(d_{j,a})_{j=1}^{M}$ and the observed heterogeneity $\mathbf{X_a}$ are mutually independent; (ii) Conditional on the observed heterogeneity, auctions are independent.*

Assumption 4. ***(Distributions.)*** *(i) Producer costs are normalized to satisfy $\mathbf{E}\left(c_{2,a}^{(N)}\right) = 0$;*

[38] The identification can also incorporate the unobserved heterogeneity per se, as Appendix E shows. Nevertheless, in the application for procurement of standardized goods, such as drugs, the unobserved heterogeneity is excessive because econometrician observes all the characteristics of auction and drug.

(ii) Characteristic functions of producer and distributor costs have isolated zeros.

Assumption 5. ***(Non-binding reserve price.)*** *The reserve price can be non-binding, i.e.* $\mathbf{P}(\bar{c} + \overline{d} \leq r_a - \beta \mathbf{X_a}) > 0$.

Assumption 2 guarantees that the observed bids reveal the unobserved order statistics of total costs, so the structural approach is feasible.[39] Assumption 3 is necessary to separately identify the distributions of common input price and idiosyncratic distribution cost. Assumption 4 is technical, and it imposes location normalization. Without this assumption, the cost distributions are identified up to the constant shift. One can add a constant to distribution cost and subtract the same constant from the production cost having the same total costs and equilibrium bids. Assumption 5 guarantees that the full support of the producer and distributor cost distributions can be identified; otherwise, only truncated distribution is identified. It also guarantees that in some auctions, all potential distributors can enter so that the potential number of bidders can be inferred from these auctions.

Proposition 3. *If Assumptions 2 - 5 hold, then the producer and distributor cost distributions and observed heterogeneity parameters are identified.*

Appendix E provides the formal proof. The idea of identification is the following. First, to match the additive form of total cost (1.6) with constraints that bids should be non-negative, I make the log-transformation of bids and reserve price and work with them as if they are actual bids and reserve price.[40] Second, I implement the "homogenization" of auctions by taking the residuals of an OLS regression of auction bids and reserve price on the observed heterogeneity. Third, the winning and second-lowest bids help identify the distributions of negotiated price and order statistics of distribution costs. To get the

[39] In the context of Russian procurement, the descending auctions are implemented at the electronic platforms, and each next bid has to propose a rebate no less than 0.5% of the reserve price from the current bid.

[40] Appendix E shows that log-transformation of bids having multiplicative form makes it equivalent to the additive form with the logarithm of bids.

intuition of this step, denote by $b_{k,a}^{(m)}$ the kth lowest homogenized bid in auction a with m observed bidders. Then the expectation and variance of negotiated prices and order statistics of distribution cost can be identified as follows:

$$c_{2,a}^{(N)} : E\left(c_{2,a}^{(N)}\right) = 0, \quad Var\left(c_{2,a}^{(N)}\right) = cov\left(b_{1,a}^{(m)}, b_{2,a}^{(m)}\right); \tag{1.7}$$

$$d_{k,a}^{(M)} : E\left(d_{k,a}^{(M)}\right) = E\left(b_{k,a}^{(m)}\right), \quad Var\left(d_{k,a}^{(M)}\right) = Var\left(b_{k,a}^{(m)}\right) - Var\left(c_{2,a}^{(N)}\right), \tag{1.8}$$

where I use (1.6) and Assumption 4. Finally, having the distributions of negotiated price and order statistics of distribution costs, I invert them to get the original cost distributions:

$$c_i : F(x) = F^{-1}_{Beta(2,N-1)}\left(F_{c_2^{(N)}}(x)\right) \tag{1.9}$$

$$d_j : G(x) = F^{-1}_{Beta(k,M+1-k)}\left(G_{d_k^{(M)}}(x)\right) \tag{1.10}$$

1.6.2 Estimation strategy

I allow for the reserve price to be binding, i.e. distributor D_j enters the auction a if $tc_{j,a} \leq r_a$. It makes the auction entry endogenous, so the unobserved potential number of bidders M can differ from the observed number of bidders m. Following Assumption 5, I estimate the potential number of bidders M in the auction as the maximal number of bidders among all auctions with one active ingredient in the bundle within the cluster defined as “active ingredient-region-year”. Then I choose a specific sample of auctions, satisfying the following conditions: (i) only two vertically separated producers are in the market; (ii) producers do not bid directly in these auctions; (iii) auction bundle includes only one drug specification; (iv) auction reserve price is above 2M RUB (31K USD). Conditions (i) and (ii) guarantee that the auction satisfies the VS scenario and that bidders are distributors. Moreover, the presence of only two producers mitigates the concern that, in reality, the distributors do not negotiate with all the producers. [41] Condition (iii) helps to disregard the potential confounding effect of bundling and enables to analyze bid-per-unit of a drug. Condition (iv) mitigates the issue that distributors can use stored drugs and not re-negotiate with the producers. I keep only drug specifications having at least 500 observations after this filtering procedure. This procedure keeps only three active ingredients *Sunitinib, Sorafenib, Nilotinib* being all of them anti-neoplastic drugs. I estimate the distributions of producer and distributor costs separately for each of these active ingredients.

The estimation procedure starts from calculating the bids-per-unit and reserve price-per-unit of a drug. That is, I divide the final bid for each bidder and the reserve price for a bundle by the quantity of drugs in the bundle. Next, I make log-transformation of bids-per-unit and reserve price-per-unit and consider them as original bids and the reserve price. Next, I "homogenize" these bids and the reserve price to exclude the observed heterogeneity.[42] For homogenized bids and the reserve price, I apply the maximum likelihood approach imposing parametric assumptions.[43] Namely, I assume that producer and distributor costs have normal distributions,[44] i.e. $c_i \sim N(\mu_c, \sigma_c^2)$, $d_i \sim N(\mu_d, \sigma_d^2)$. The likelihood function incorporates the following events (i) observing zero entrants with likelihood $p_0 = \mathbf{P}(m = 0)$; (ii) observing one entrant with likelihood $p_1 = \mathbf{P}(m = 1)$; (iii) observing two entrants and the winning bid x with likelihood $p_2(x) = \mathbf{P}(tc_2^{(M)} = x, m = 2)$; (iii) observing $k \geq 3$ entrants and the winning bid x and the second-lowest bid y with likelihood $p_k(x, y) = \mathbf{P}(tc_2^{(M)} = x, tc_3^{(M)} = y, m = k)$. Appendix E shows how these individual likelihood functions can be expressed via the primitive distributions of producer

[41] In my full data, for a fixed drug specification, a distributor supply brands of three producers, on average, and the median is two.

[42] The vector of the observed characteristics is year and buyer region FE, log of quantity units of the drug.

[43] Appendix E shows that semi-parametric approach is also feasible, but it would require more observations for each active ingredient.

[44] Recall that I work with log-transformed bids, so negative realizations of the normal distribution are not an issue. It would be equivalent to assuming log-normal distributions in the multiplicative form of total costs.

cost $F(x)$, distributor cost $G(x)$, and the number of potential bidders M. The overall log-likelihood function equals to

$$l = \sum_{a:m=0} ln(p_0) + \sum_{a:m=1} ln(p_1) + \sum_{a:m=2} ln(p_2(x_a)) + \sum_{a:m=k\geq 3} ln(p_k(x_a, y_a)) \tag{1.11}$$

and it is maximized on the set of parameters $(\mu_c, \sigma_c, \mu_d, \sigma_d)$ under the normalization constraint $\mathbf{E}\left(c_2^{(N)}\right) = 0$ imposed by Assumption 4 on these parameters. Standard errors of parameters are estimated via bootstrap with 100 replications.

1.6.3 Estimation results and simulations

Table 1.5 shows the estimates from the maximum likelihood. The parameter μ_c is negative because of the normalization Assumption 4. Though the parameters do not have the intuitive interpretation per se, the sum of $\mu_c + \mu_d$ can be interpreted as the logarithm of the unit total cost for a vertically integrated distributor without synergy effect. The coefficient of $ln(quantity)$ in absolute value varies from 0.04% to 0.06% and shows the percentage decrease of total distributor cost when quantity increases by 1%.

I use the parameters of the estimated distributions to simulate vertical mergers under different conditions. Figure 1.7 shows that a merger without synergy effect doubles the profit of the integrated firm compared to the aggregate profit of separated producer and distributor (Panel A). However, such integration harms the public buyer whose expected payment increases by 17%-19% (Panel B). Such an anti-competitive effect happens because the VI producer can raise input prices for rival distributors by limiting the extent of upstream competition. The double markup elimination of VI distributor without synergy effect is not enough to neutralize it. Therefore, the antitrust authority should not approve such vertical mergers.

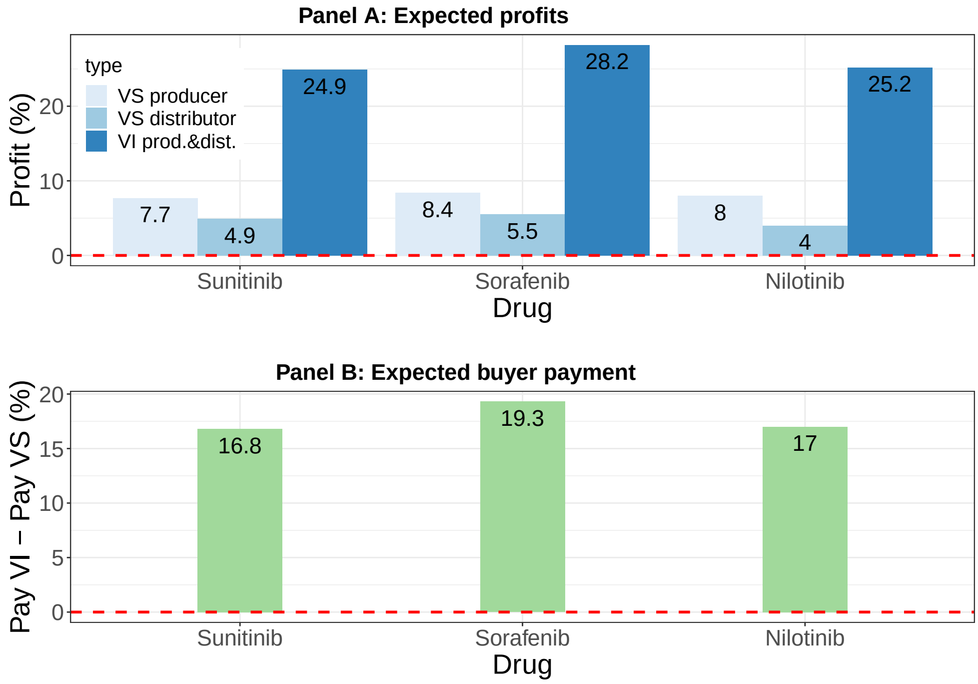
The following simulation quantifies what synergy effect would be sufficient to neutralize the anti-competitive effect of VI. Figure 1.9 shows that if the synergy effect is from 4%

		Sunitinib	Sorafenib	Nilotinib
Producer	μ_c	-0.0749	-0.0846	-0.0775
cost		(0.0456)	(0.0241)	(0.0543)
parameters	σ_c	0.1329	0.1501	0.1374
		(0.0815)	(0.1332)	(0.1009)
Distributor	μ_d	9.1466	7.4769	7.7138
cost		(0.0137)	(0.1386)	(0.0577)
parameters	σ_d	0.1730	0.1959	0.1420
		(0.0935)	(0.0711)	(0.0935)
Observed	ln(quantity)	-0.0512	-0.042	-0.061
heterogeneity		(0.007)	(0.007)	(0.009)
	Regional FE	Y	Y	Y
	Year FE	Y	Y	Y
	Observations	789	730	569
Total cost in log	$\mu_c + \mu_d$	9.0717	7.3923	7.6363
Total cost in RUB	$e^{\mu_c+\mu_d}$	8705	1623	2072

Note. The table shows estimates of expectation and standard deviation for producer and distributor costs, assuming the normal distributions. The observed heterogeneity includes log-quantity of drug units, year and buyer region FE. Bootstraped standard errors are in parentheses.

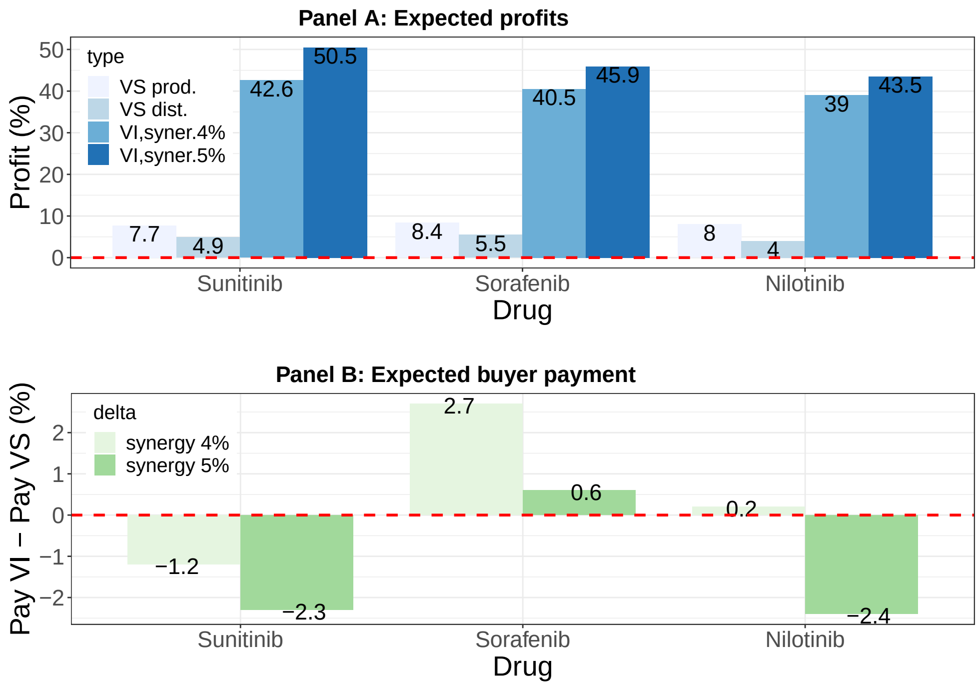
Table 1.5: Parameters of producer and distributor cost distributions

to 5% of the total distributor cost ($\mu_c + \mu_d$ from Table 1.5), then the expected buyer payments under VS and VI scenarios are almost equal, or the payment under VI scenario is even lower (Panel B). Due to the synergy effect, such a merger is even more profitable for the firms (Panel A).



Note. The figure demonstrates the simulation result of a vertical merger without synergy effect for drugs with two producers and three distributors. Panel A shows the producer and distributor's expected profit (as a percentage of their costs) under the VS and VI scenario. Panel B shows the difference in the expected buyer payment under VI and VS scenarios (as a percentage of the expected payment under VS scenario).

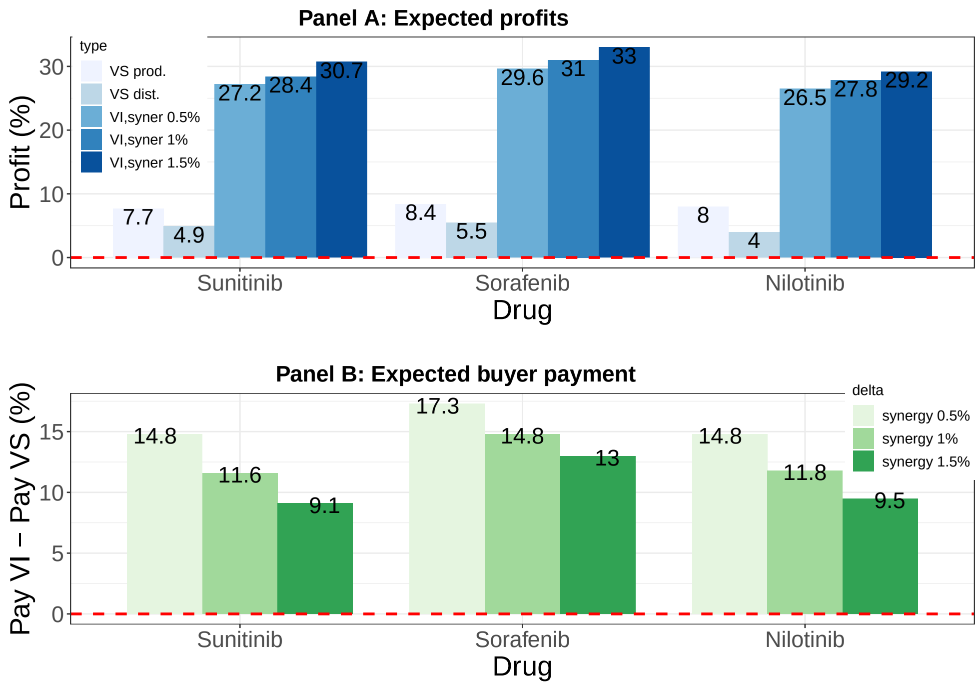
Figure 1.7: Simulation of VI without synergy effect



Note. The figure demonstrates the simulation of vertical mergers with synergies of 4% and 5% of the total cost ($\mu_c + \mu_d$ of Table 1.5) for drugs with two producers and three distributors. For more details, see Note of Figure 1.7.

Figure 1.9: Simulation of VI with synergy effect of 4%-5% of the total costs

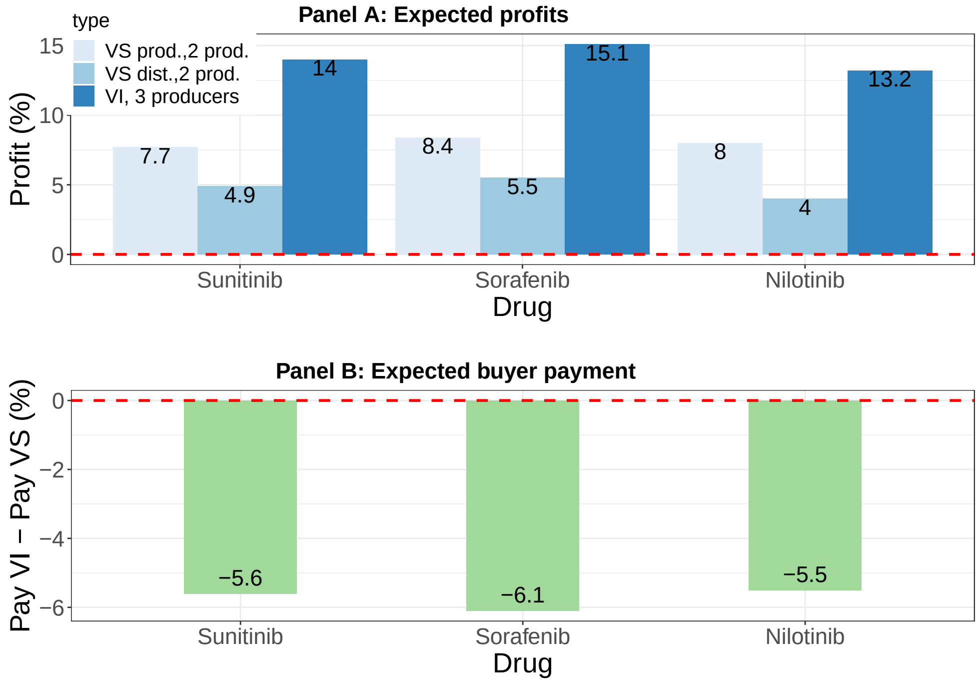
Next, I estimate what synergy effect would rationalize the reduced-form evidence. I match the change in the expected buyer payment from the VI simulation with DID estimate of the VI effect of 12.8%–13.5% (see Table 1.3 for 2–4 producers). Figure 1.11 shows that a merger with synergy from 0.5% to 1.5% of total costs leads to an around 13% increase in the expected buyer payment, suggesting this interval of synergies well explain the average VI effect. Recall that the synergy effect of integration happens because of decreased procurement transaction costs between the integrated producer and distributor. The literature estimates the procurement transaction costs of buyers and suppliers, on average, around 1.4% in the EU (Strand et al. (2011)) and around 1% in Russia (Balaeva et al. (2020)). Noteworthy, the producers–distributors negotiation is a form of internal procurement. Therefore, my estimates of the synergy effect and transaction cost estimates from the literature suggest that the synergy effect of 4% - 5% of vertical integration is challenging.



Note. The figure demonstrates the simulation of vertical mergers with synergies of 0.5%, 1%, 1.5% of the total cost ($\mu_c + \mu_d$ of Table 1.5) for drugs with two producers and three distributors. For more details, see Note of Figure 1.7.

Figure 1.11: Interval estimates of the synergy effect

What can be the effective remedies if the synergy effect is not as significant or absent? In the following simulation, I show that the exogenous entry of a third producer is an effective remedy for the vertical merger with 1% synergy. Figure 1.13 shows the vertical merger simulation with two producers under the VS scenario and three producers under the VI scenario with 1% synergy effect. The buyer payment under the VI scenario with three producers is smaller by around 5.8% compared to the payment under the VS scenario with two producers (Panel B). At the same time, the profit of the integrated firm is higher by 1%-2% than the aggregate profit of producer and distributor in the VS scenario (Panel A). Thus, such a vertical merger with the exogenous entry of a third producer is both pro-competitive for buyers and beneficial for the firms. It suggests that the antitrust authority can approve the vertical merger only if the merging producer sells its production technology to the new independent producer, keeping the production rights but generating the exogenous entry.



Note. The figure demonstrates the simulation of a vertical merger with 1% synergy of the total cost having two producers in the VS scenario and three producers in the VI scenario. For more details, see Note of Figure 1.7.

Figure 1.13: Exogenous entry of the third producer under VI scenario

1.7 Conclusion

The paper studies the competitive effect of vertical integration between pharmaceutical drug producers and distributors in an auction setting. Using detailed data on public procurement of drugs and vertical integrations in Russia, I identify the causal effect of vertical integration on procurement prices. For drugs with few producers, vertical integrations increase prices by 12%, while they decrease prices by 1.7% for drugs with many producers. I propose a model where distributors participating in an auction negotiate with producers. In the equilibrium, foreclosure explains the former empirical result, and the integration synergy drives the latter. I use the model for the structural estimation of producer and distributor cost distributions. Simulations of vertical mergers for drugs with two producers show that mergers with synergies below 4% of the total cost harm buyers, while the observed mergers have estimated synergies of 0.5%–1.5%. I show that for vertical merges with low synergies, the mandatory sharing of the production technology by the merging producer with a new independent firm is an effective remedy. The paper concludes that vertical mergers in concentrated upstream markets require special attention. Antitrust authority may approve a merger if the synergy is substantial or the exogenous upstream entry can be guaranteed.

Chapter 2

Autocratic Governors in Public Procurement

This chapter is based on joint paper with Daniil Esaulov published at the European Journal of Political Economy.

2.1 Introduction

The quality of regional governance and regional institutions is considerably important for state–business relations. Public procurement constitutes one of the main mechanisms of state-business interactions and it plays a significant role in national economies.[1] In imperfect democracies and autocracies, the personal role of governors is crucial for state-business interactions because the quality of regional governance is largely determined by governors and it depends on their incentives. These incentives evolve over time and are vulnerable to the risk of the governors losing power. Traditionally, the explanation of autocrat's behaviour is related to the theory of 'stationary' and 'roving' bandits (Olson, 1993). A 'stationary' (looking-forward) ruler limits rent-seeking behaviour in the short-

[1] In 2017 public procurement expenditures constitute 12% of GDP in OECD countries and up to 40% in developing countries.

run to exchange the larger portion of a revenue for a smaller portion of a larger revenue (Tullock, 2002), while a 'roving' (myopic) ruler enjoys the short-run rent-seeking behaviour in the face of a forthcoming loss of power. The empirical testing of this theory, on both the national and sub-national levels, has led to controversial conclusions. On the one hand, the stability of an autocrat's power, as measured by his/her tenure, is favourable for shaping the business environment and improving institutions, whereas political uncertainty, as measured by incidents of turnover, negatively impacts economic growth and investment. On the other hand, a high rate of turnover may produce higher accountability of rulers, decrease political distortion in the economy and increase institutional quality. The more focused studies have shown that the latter effect is more pronounced when a ruler has local business interest or local ties, so that good quality of institutions would 'insure' that he/she would not lose his/her property after a turnover. Therefore, in addition to tenure and turnover rate, the ruler's local ties play an essential role in shaping regional institutions.

This paper analyses the impact of autocratic governors' tenure and their biographical local ties on public procurement performance on a sub-national level. It is quite natural to use the procurement outcomes of the subordinated local public organizations as governor's performance indicators. Local public contracts are financed from the local budgets and, therefore, the contracts' allocation may reveal the governor's incentives. We conduct our analysis for sub-national regions in Russia that are of interest by several reasons. First, due to the transparency requirements in Russia, the information about population of procurement contracts is open. Second, Russia is characterized by weak democracy, where the federal center either directly appoints and dismisses regional governors or has strong control over regional governors' election. Third, the governors' stability in office is mostly determined by their political loyalty to center, while governors have enough freedom to shape regional economic development. Combination of these factors enables to use Russia as wonderful example to study the role of autocratic governors for public procurement performance.

We collect the contract-level data for population of procurements of road construction and repair works in Russian regions during 2011-2014. These procurements were conducted by regional and municipal authorities and, potentially, could be supervised by regional elites. The database accounts for more than 120,000 contracts. Our main focus is to study the impact of governors' tenure in office[2] and local ties on the level of competition at auctions. However, to have an unambiguous interpretation, we also study executional stage of the contracts. Procurement competition is measured by the number of bidders at auctions. At the executional stage, we consider delay and termination in contract execution. Since tenure in office is endogenous, in order to have causal interpretation, we construct instruments for governor's tenure by exploiting the regional vote share of ruling party in past parliament elections. The choice of road construction and repair procurement is motivated by two reasons. First, this type of procurement constitutes a significant part of annual regional budget expenditures . Second, road construction projects are close to the financial interests of local elites. Two are the examples of corruption scandals in procurement of road constructions works resulting in the arrest of governors Alexander Solovyov and Boris Dubrovsky .

We find the evidence that the local ties and the tenure of governors are important to explain the level of competition at auctions and contracts' execution. The auctions conducted during the period of governors with local ties ('insiders') being in office, on average, demonstrate a 5% higher level of competition than the auctions of governors without local ties ('outsiders'). Moreover, for governors-outsiders, we observe a negative effect of tenure on competition, with a reduction of competition by 2.5% for incumbent governors, while for governors-insiders there is no effect of tenure. The restriction of competition by governors-outsiders may be interpreted in two different ways. The first interpretation says that the restriction of competition indicates favouritism in contract allocation. The

[2]Time in office of the governor up to the date of contract signing.

second interpretation argues that the deliberate restriction of competition is aimed to exclude incompetent and non-qualified participants, so the contracts are better executed. To disentangle these two interpretations, we further analyse the executional stage of the contracts by considering delays and terminations of the contracts. On average, delays in contract execution are 16% (of contract duration) lower for governors-insiders, while the probabilities of contract termination are equal for insiders and outsiders. For governors-insiders longer time in office causes the reduction of both delay and probability of contract termination. For governors-outsiders, the delays increase by 20% for incumbent governors and probability of contract termination keeps stable over time in office. Therefore, we do not find a support for the second interpretation of competition restriction by governors-outsiders and conclude that there is favouritism in their behaviour.

The paper contributes to the literature in two ways. First, this study is closely related to that of Coviello and Gagliarducci (2017). Authors use Italian procurement data and show that longer time in office of municipal majors cause lower procurement competition with a higher probability of contracts being allocated to locally based firms. Unlike Italy, the electoral accountability of Russian governors is significantly lower. Therefore, our analysis is for a different political setting – autocracy, where the stationary and roving bandit theory can be tested. Moreover, following the literature, we take into account local ties together with political stability of governors, which makes this paper different from that of Coviello and Gagliarducci (2017). Second, the paper adds to the strand of empirical literature on stationary and roving bandits by considering public procurement as governors' performance outcomes, while other papers consider the quality of regional institutions as outcomes (investment activity, taxation, corruption, and property rights). The paper confirms that governors-outsiders demonstrate 'predatory' behaviour (Libman et al., 2012) and that the presence of local ties reduces this negative effect (Polishchuk and Syunyaev, 2015).

2.2 Literature review and hypotheses

There is a strand of literature that shows that the quality of regional governance and institutions significantly impacts public procurement performance. Using French and EU data, Chong et al. (2012) and Chong et al. (2013) demonstrated the impact of political institutions, such as political competition and quality of public administration, on the procurers' choice for more transparent procurement procedures. Exploiting Italian procurement data, Coviello and Gagliarducci (2017) showed that in the localities with less efficient courts, contracts are more often awarded to larger suppliers and are subject to longer delays.

In view of weak institutions in developing countries, the quality of regional government is basically determined by regional elites and depends on their incentives and business interests. The connection of businesses with high-level bureaucrats and politicians exists in both developed and developing countries and is usually considered as a 'conflict of interest'. However, such relations occur more frequently in countries with higher corruption (Faccio, 2006). In the literature, these relations are investigated from the perspectives of both business and politicians.

The former strand of literature on firms' political connections and public money allocation consistently demonstrates that the government tends to grant benefits and subsidies to politically connected enterprises (Wu et al., 2012). Also, it has been shown that politically connected firms have more open access to public procurement (Goldman et al., 2013; Amore and Bennedsen, 2013). In the case of Russia at the end of 2010s, (Szakonyi, 2018) showed that firms whose CEOs were elected to regional parliaments had higher access to public contracts. Mironov and Zhuravskaya (2016) demonstrated the association between political cycles in regional elections in Russia and illicit financial transactions to politicians from procurement winning firms. The favouritism in procurement contracts allocation toward firms-donators of political parties was shown for several countries: Brazil

(Boas et al., 2014), Lithuania (Baltrunaite, 2020), Czech Republic (Titl and Geys, 2019).

The latter strand of literature studies bureaucrats' and politicians' incentives to connect with businesses. In imperfect democracies and autocracies, the low accountability of elites to society opens opportunities for them to pursue their own interests (McGuire and Olson, 1996; Acemoglu and Robinson, 2006). Olson (1993) proposed the theory of stationary and roving bandits to explain the empirical fact that not all autocrats demonstrate predatory behaviour. According to this theory, stationary bandits limit their rent-seeking behaviour in the short-run to extract higher revenue in the long-run, while roving bandits extract short-run revenue in the face of a forthcoming loss of power. From the perspective of this theory, the autocratic ruler's tenure and probability of being replaced determine institutional and economic development. However, two strands of empirical literature coexist showing quite the opposite impact of an autocratic ruler's tenure and turnover on economic development.

On the one hand, autocrat stability, measured by tenure, has a positive impact on improving the quality of institutions (Holcombe and Boudreaux, 2013). Simultaneously, political uncertainty, measured by incidents of autocrat turnover, negatively impacts economic growth and investment activity (Alesina et al., 1996; Aisen and Veiga, 2013; Fatás and Mihov, 2013). From this perspective, foreign and domestic firms value political stability and the predictability of rules, and they try to avoid investment activity under uncertainty (Brunetti et al., 1998; Asiedu, 2006). This logic holds even in the case of uncertainty over corruptive behaviour. Samphantharak and Malesky (2008), using the case of highly corrupted Cambodia, showed that governors turnover reduces firms' investment activity because uncertainty about firms' 'bribe schedule' increases. The same result relating to the level of uncertainty of corruption and investment activity was shown for Russia (Levina et al., 2016).

On the other hand, a high rate of turnover may produce greater accountability of autocratic rulers, increase the quality of institutions (Kudamatsu and Besley, 2008; Besley et al., 2013) and decrease political distortion in the economy (Acemoglu et al., 2011). This can be explained by the high probability of an autocrat being replaced causing concern over the quality of institutions and property rights to protect his/her well-being after losing power. Following this argument, McGuire and Olson (1996) stated that elites with business interests have more incentives to enhance the quality of institutions and property rights. Polishchuk and Syunyaev (2015) theoretically and empirically (using cross-country data) showed that the turnover of elites is positively associated with the protection of property rights and that this effect is especially pronounced for elites with strong business interests. Therefore, the presence of business interest of an autocrat might be even more important in explaining his/her 'like stationary bandit' behaviour rather than turnover or tenure.

Reconciling these two strands of the literature, some authors have also claimed that turnover and tenure have a non-linear effect. However, the direction of non-linearity is also arguable. According to a theoretical paper from Acemoglu and Robinson (2006), political elites have stronger incentives for economic development when they are either highly stable or when they face a high degree of political instability. On the contrary, using cross-country data, (Campante et al., 2009) showed the U-shaped relationship between corruption and political stability with minimal corruption in the middle.

The aforementioned literature on relations of political stability with economic development is mainly based on cross-country studies and theoretical modelling. Moreover, this does not provide a particular form of relations between political stability and institutional development. This might also be explained by the variety of countries' specifics. In this paper, we focus on the sub-national level of a large developing country – Russia. The literature reflects substantial attention being paid to sub-national autocracies and the behaviour of regional governors (Gibson, 2005; Gervasoni, 2010; Reuter and Robertson, 2012; Libman et al., 2012; Sidorkin and Vorobyev, 2018). To clarify the possible relations between governors' stability and institutional development, we first describe the existing literature on governors' incentives in Russia.

Using Russian and Chinese cases, Rochlitz et al. (2015) showed that the behaviour of governors in regional development is determined by their future career opportunities. In the case of Russia, governors usually do not have any chance for further promotion, and the governor's office is their final position. Zhuravskaya et al. (2010) found that governors have weak incentives to improve regional investment climate because the dominant part of regional taxes is directed to the federal center. Moreover, the stability of the governors' position generally depends on political loyalty to the central authority. In particular, this stability is determined by the share of votes in the region for the ruling party in federal parliament elections, while regional economic growth is not important (Reuter and Robertson, 2012).

The analysis of the pre-governing period of Russian governors showed that local origin, business-interest and job position in the administration of the same region play an essential role in regional development. Libman et al. (2012) and Shurchkov (2012) showed that new regional elites appointed by the federal government from the outside in the middle of 2000s were characterized by more repressive behaviour in terms of taxation and cared less about the development of small- and medium-sized enterprises compared with locally embedded governors. Rochlitz (2014) reinforced these findings and found that in regions where governors have local ties, raider attacks on businesses are less likely. Sharafutdinova and Steinbuks (2017) showed that firms demonstrate a strong preference for locally embedded governors, who can maintain pre-existing inter-elite connections in terms of regional state–business relations. Therefore, the pre-existence of the local ties for governors-insiders and their responsibility for regional development, described in the abovementioned literature, provide grounds for the following hypothesis, which we link with procurement outcomes:

Hypothesis 1: Auctions conducted in the period of governors-insiders being in office have better procurement outcomes.

The abovementioned literature at the cross-country level showed that an autocrat ruler's tenure is an important factor in explaining the quality of institutions. The analysis at the sub-national level in Russian regions also maintains this finding. Buckley-Farlee (2017) showed that if an incumbent governor wants to be re-elected or re-appointed, he/she tries to reduce regional corruption. Nevertheless, at the end of their career and without further perspective to be re-elected or to be promoted, governors try to increase their own revenue, which leads to higher levels of regional corruption (Sidorkin and Vorobyev, 2018). These results on tenure, combined with Hypothesis 1, lead us to the second hypothesis

Hypothesis 2: High tenure in office of governors-outsiders negatively impacts procurement performance. Governors-insiders have a less pronounced tenure effect on procurement outcomes compared to governors- outsiders.

Hypothesis 2 is in line with the result of Coviello and Gagliarducci (2017), which showed that the longer tenure of Italian municipal majors in office result in a lower procurement competition. Nevertheless, Hypothesis 2 is formulated under the assumption of an autocratic political setting with differentiation between insiders and outsiders.

2.3 Institutional Background

2.3.1 Elections and appointments of governors in Russia

In Post-Soviet Russia between 1992 and 1996, the process of selecting regional governors differed across regions: in some regions, they were directly elected by the population, and in others, they were appointed by local parliaments or by the president. After 1996, governors had to be elected across all regions. This lasted until late 2004 when Russian president Vladimir Putin cancelled governors' elections and introduced a system of appointments by the federal centre. Previously elected governors had to be replaced or reappointed after the expiration of their current terms. The last elected governor's term expired in the end of 2009. The term in office for appointed governors constituted either four or five years.

Governors' elections were restored in October 2012. However, federal center kept control over the elections through 'municipal filters' – the law that prescribes a candidate for gubernatorial office to have a support of 5% to 10% of municipal deputies in order to be registered to participate in gubernatorial elections. Since most of the municipal deputies were partisans of ruling party United Russia, this mechanism was efficient to filter out undesirable candidates from opposition (Ross, 2018). As a consequence of the 'municipal filters', in all 43 regions where governors' elections were conducted in 2012-2014, all the elected governors had been acting regional heads before the elections. As a consequence of the construction of 'vertical power', governors were more accountable to the federal center rather than to the population, independently of whether they were elected or appointed. Reuter and Robertson (2012) showed that the important criterion for a Russian governor to keep his/her position was a sufficient level of regional electoral support for the ruling party United Russia in parliament elections, while regional economic or institutional development was irrelevant. Therefore, governors obtained significant freedom in shaping the regional economy, judicial system, property rights and other important regional institutes. Further analysis of governors' characteristics found that governors with local ties took care of regional economic and institutional development (Rochlitz, 2014; Sharafutdinova and Steinbuks, 2017), while governors without local ties did not (Libman et al., 2012; Shurchkov, 2012).

2.3.2 Public Procurements in Russia

In Russia, public organizations are required to procure goods, works and services through open public tenders. As a response to the problems of a high level of corruption and poor public services in the beginning of the 2000s, a major reform of public procurements was implemented with the adoption of Federal Law on Public Procurement (94-FL) in 2005.

This law had quite rigid regulation regarding the choice of procurement procedures and criteria for selecting suppliers. The four possible procurement procedures were strictly predetermined: (i) open auction is a descending English auction, which is considered as the main procurement procedure and it is obligatory for procurements valued in excess of 500 K RUR ($\sim$ 17 K USD); (ii) requests for quotations is a minimal price sealed-bid auction, which is used for procurements of small amounts (up to 500 K RUR); (iii) single-source contracting is a non-competitive procedure to procure from predetermined suppliers with procurement value under 300 K RUR ($\sim$10 K USD); (iv) tender is scoring rule auction, i.e it is maximal score sealed-bid auction with option for quality criteria. Tender can be used for procurements of complex works and services such as R&D, consulting, complex construction.

Each procurement on road construction and repair in our sample is administrated by the manager of the public organization, which is responsible for the state of roads in a region/municipality. The procurement is financed directly from regional/municipal budget. These expenditures are planned in advance and fixed in the budget's spending for the forthcoming year. By communicating with the regional/municipal administration, the manager is responsible for preparing the technical specification of procurement, which includes the following: (i) the maximal price the buyer is ready to pay (i.e., the reserve price); (ii) a detailed description of the repair/construction object, (iii) the requirements for applicants.

The technical specification is announced in advance, and its description is open for everybody on the official website www.zakupki.gov.ru. When firms submit their applications, the evaluating commission assesses them. The evaluating commission consists of the members of the manager's organization (including the manager), representatives from regional/municipal administration and, if needed, experts on road construction. If the constructed road is managed by the municipality and has regional significance, then the municipality might also invite the representative of regional administration to participate in the commission. The commission evaluates each application and makes conclusions about its compatibility with the requirements in the technical specification. Only the firms with consistent applications are allowed to compete further. For Open auction, the next round of open bidding is held for the firms with consistent applications, where the firm with the minimal price wins the contract. If only one application is consistent, then the contract is signed at the reserve price with such firm. The winner of Requests for quotations is the firm with consistent application and the minimal price, which is specified in the same application. The winner of Tender is the firm with consistent application and the maximal score. The score is calculated by the Commission by accounting for the proposed price and qualification of the firm with appropriate weights (the weights are described in the technical specification). When the winner is determined, the manager concludes the contract with the firm and monitors its execution. If poorly executed, the contract might be terminated with partial (possible zero) payment on it when both sides agree. If one side disagrees, the decision regarding the amount of payment is conducted through an arbitrage court. To complete the work detailed in the terminated contract, the organization runs a new auction with appropriate adjustments to its size.

This procedure of the supplier selection allows regional/municipal administration to participate in two stages: preparation of the technical specification and evaluation of the applications. Thus, the governors' favouritism might show up in both of them. In the former stage, the technical specification might be excessively demanding, so few firms might try to satisfy it and other firms do not apply. In the latter stage, by using discretionary power, unwilling firms might be excluded from competition.

2.4 Data

To test the hypotheses of Section 2, we analyse open contract-level data on public procurements merged with public organizations' information, regional and governors' characteristics. The main corpus of the data consists of the contract information on road construction and repair works in Russia in 2011-2014. The primary source of information on public contracts is available on the official website www.zakupki.gov.ru that was run in 2011. All public buyers must place their auction announcements and contracts of the value in excess 100 K RUR into this website. This information includes all of the life-cycle stages: call for auction, awarding stage, contract characteristics, execution payments and dates. As we use contract-level data, we also need to control for procurers' and suppliers' characteristics (Ohashi, 2009; De Silva et al., 2008; Decarolis, 2018), such as procurer activity and size. This information was collected from the website www.clearspending.ru, which presents annual information on procurers and suppliers. As the regional quality of institutions plays an important role in determining the procurement outcomes, we exploited the regional information collected from the federal statistical website www.fedstat.ru about regional procurement budgets, GRP and quality of roads. The full description of the collected data and their sources are presented in Table F1 of the Appendix F.

The initial contract-level data consists of around 157,000 contracts on road construction and repair awarded between 2011-2014. To collect information about executional stage, these contracts are followed until the date of completion or 30th April 2017, whichever comes first. For the purpose of our research, we chose only contracts signed by procurers of the regional and municipal subordination level.[3] As a result, we have a sample of 144,149 contracts. These contracts were awarded through different procurement procedures: both competitive (open auctions, request for quotations, tenders) and non-competitive (single-source contracting). We deliberately exclude small contracts of the value below 100 K RUR ($\sim$3 K USD) as they are underrepresented in the official website and are out of interest for governors. We also exclude contracts with unrealistically short duration (10 days or lower) and unrealistically long delays as outliers. Thus, after cleaning the data and excluding some observations with important missing or un-

[3]Federal-level road construction procurements are managed by public organization of federal-level subordination, so we assume that they hardly can be manipulated by regional governors.

reliable information, the database is reduced to 120,180 contracts containing all types of procedures from 2011-2014. This sample does not differ from the population in its basic characteristics (see Table F5 of Appendix F).

The database for analysis contains the following characteristics: (i) call for auction and bidding information including procurement procedure and level of competition during the bidding process (reserve price, the number of applicants, number of bidders and winning bid); (ii) contract information (including contract values, terms of delivery, ID codes of procurers and suppliers); (iii) information on annual contract numbers and contract values by each procurer and supplier during 2011-2014;[4] (iv) information on the factual contract execution date and status. Table F2 in the Appendix F presents the descriptive statistics of the variables by groups of characteristics. Noteworthy, that open auction is the main procurement procedure, which constitutes 77% of all contracts. Moreover, the type of procedure is important in explaining both competition at auctions and execution of contracts (Decarolis, 2014). Therefore, we will provide results for both the total sample and the sample of open auctions separately.

The average contract duration is 147 days for all types of procurement procedures and 157 days for open auctions. The average contract price is equal to 1.6 M RUR ($\sim$ 53 K USD). The share of contracts signed with suppliers from the same region as the procurer constitutes on average 92

In order to control for regional diversity in dynamics, we use procurers' ID to identify their regions and add the following regional information: (i) logarithm of regional public spending per cap; (ii) logarithm of GRP per capita; (iii) regional road accident rate; (iv) share of roads of regional significance with good quality. Descriptive statistics of regional characteristics are presented in Table F3 of the Appendix F. This table shows the considerable variation in regional characteristics from the perspective of budgets and institutions.

[4]Each procurer and supplier may have contracts other than road construction and repair.

Finally, we use a dataset on Russian governors used in previous studies[5] (Reuter and Robertson, 2012; Libman et al., 2012). This dataset contains information on all of the regional governors during 2000-2014. In particular, for each governor this database includes the following: (i) exact start and end of governor's terms; (ii) birth date; (iii) information on governor's positions before becoming a governor including region of the previous job; (iv) information on whether the governor was elected or appointed. Using this data, we also define regional governor as *insider* if he/she had the job position in the same region during the pre-governance period for at least a total of three years. For 2011-2014, we have information on 125 different governors in 83 Russian regions. The governors' characteristics are presented in Table F4 of the Appendix F. This table shows that half of all governors had at most five years' tenure in office and almost 25% of all governors had tenure longer than nine years. Nevertheless, there are some governors with extremely long tenures. Almost 69% of governors are insiders, and only 34% of governors have ever passed through the election process (i.e., 66% of them were assigned by central authority and were never elected). For our analysis it will be important to understand the turnover of the governors in regions. During 2011-2014, governor turnover occurred in 38 regions[6]; and a governor-insider was replaced by an outsider or vice versa in 20 regions[7]. By using the signing date of each contract, we match the procurement information with information on the corresponding governor in office. This matching procedure naturally yields the restriction on the period we analyse. Procurement data start from 2011, while the governors' information is bounded by 2014 above. For each contract, we compute the governor's tenure in the office by the date of the contract signing.

Our main interest is to estimate the impact of the governor's status as an insider and his/her tenure on procurement performance. We consider the following procurement outcomes: number of bidders in auction; normalized delay in contract execution[8]; and

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[5]https://iims.hse.ru/en/csid/databases

[6]Total number of contracts signed in these regions is 66,625 out of 120,180

[7]Total number of contracts signed in these regions is 33,669 out of 120,180

[8]Delay normalized with respect to contract duration. Computed as the delay divided by the difference

indicator of contract execution to be terminated. The first variable characterizes procurement competition, while the last two variables describe the problems with the contract's execution. A small number of bidders may indicate competition restriction and/or the supplier's low incentives to participate in auctions. Note that we define the number of bidders only for competitive procurement procedures. Thus, analysis of this variable naturally excludes nearly 7,500 *single-source contracts*, where supplier is selected in uncompetitive manner. Table 2.1 shows that the average number of bidders is 1.59. This fact demonstrates a low level of competition in procurement of road construction. We deliberately do not consider price rebates as auction outcome because interpretation of results with this variable is ambiguous. A high rebate might be a consequence of a high reserve price as well as a low winning bid. Moreover, a price rebate does not indicate the competition restriction. The delays in contract execution and contract terminations characterize the efficiency of the contract execution. Table 2.1 shows that on average, contracts are executed 5-6 days before the deadline, and contract terminations occur in 7-8% of cases.

Procurement outcome	**All procedures**			**Open auctions**		
	mean	**sd**	**no. of obs.**	**mean**	**sd**	**no. of obs.**
Number of bidders	1.59	0.91	112 620	1.51	0.92	92 733
Delay, days	-6.07	102.4	96 651	-4.9	105.1	74 562
Normalized delay	0.26	1.86	96 651	0.29	1.88	74 562
Terminated contract, dummy	0.075	0.26	99 767	0.085	0.28	76 947

Note. Note: the first block uses the whole sample of contracts, the second block uses sample of open auctions. Descriptive statistics for the *Number of bidders* were computed using sample without single-source contracts for the first block. *Delay* is the number of days between the actual execution date and the contract execution date. *Normalized delay* is *Delay* divided by the contract duration. *Terminated contract* is dummy variable equal to one if the execution of contract was terminated. *Delay, Normalized delay* and *Terminated contract* were computed by the date of data collection (April 30, 2017), so the contracts with execution in process by this date are excluded.

Table 2.1: Descriptive statistics for the dependent variables

between the predetermined contract execution date and signing date.

2.5 Empirical strategy

To verify the impact of local ties and the tenure of governors on procurement competition and contract execution, we run a set of regression models using contract-level data. As the main independent variables, we consider governor's insider status (*Insider*) as a dummy variable and exact number of years in office by the date of the contract signing (*Tenure in office*). As an alternative to *Tenure in office* we also consider governor's number of terms in office by the date of the contract signing (*Term in office*), or dummy variable *Incumbent*, which equals to zero if the date of contract signing corresponds to the first governor's term in office and one if this is his/her second term or larger. We use these two alternative measures of tenure by two reasons. First, as we discuss below, governor's tenure is likely to be endogenous. However, given the term in office, the tenure is determined by the date of contract signing. Therefore, this is the number of terms in office that makes Tenure in office endogenous. Second, we can have more accurate estimates by using *Term in office* as we are planning to use instruments that vary over this factor, but not over Tenure in office given particular term. Moreover, Coviello and Gagliarducci (2017) also use *Term in office* rather than *Tenure in office* when they approach to IV estimates. The set of other control variables in regression models includes the characteristics of governors, contracts, procurers, suppliers, and regions, including regional fixed effects. The complete list of controls and their descriptive statistics is presented in Table F2 of the Appendix F. The following procurement outcomes are considered as dependent variables: (i) the number of bidders in auction; (ii) the normalized delay in contract execution; (iii) the indicator of contract to be terminated. The first variable measures the level of competition at the awarding stage and the last two variables measure quality of contract execution. The basic model specification has the following linear form:

$$y_{tir} = [\beta I_{ir}] + \gamma T_{tir} + \delta_1 W_t + \delta_2 X_{ir} + \delta_3 Z_{tr} + u_r + \epsilon_{tir} \tag{2.1}$$

where y_{tir} is the outcome of the auction with the sequential number $t$held during the term of the ith governor at region r. Here, I_{ir} is an indicator of governor-insider, T_{tir} is the governor's Tenure in office (Term in office/Incumbent), W_t is a vector of the contract/suppliers/procurer characteristics, X_{ir} is a vector of the governor's characteristics, Z_{tr} is a vector of the regional characteristics and u_r is the regional fixed effect. Note that vector Z_{tr} controls for regional heterogeneity in dynamics through some observed characteristics, and u_r controls for fixed unobserved regional heterogeneity. Such control for unobserved regional heterogeneity is important to disentangle the regional effect from the governor effect as well as to take into account that historically regions are subject to different institutional settings. The square brackets of the first summand in (2.1) means that in some specifications we exclude insider status of the governor from the regression. Namely, this happens when we estimate equation (2.1) for subsample of insiders and outsiders separately.

The main focus is on the estimates of coefficients β and γ. Coefficient β shows the average difference in procurement outcomes between insiders and outsiders. Coefficient γ shows the average increment of the dependent variable if Tenure in office increases by one year or Term in office/Incumbent increases by one. To address the problem of heteroscedasticity of errors, we use the White's correction of estimators for standard deviations of coefficients. The regional fixed effects are introduced as a set of dummy variables.

In previous section it was shown that 77% of all the contracts were concluded through Open auctions. Moreover, this procedure is mandatory for procurements with reserve price above 500 K RUR ($\sim$17 K USD). Therefore, we will show the estimation result both for all the procurement procedures and for the sample of contracts concluded through Open auctions.

As we stated in Hypothesis 2, the effect of Tenure in office might vary depending on the Insider status of governors. Therefore, we run regression models for insiders and outsiders separately by dividing the data into two subsamples. Moreover, we interpret the tenure effect only for these subsamples because the interpretation of tenure in the combined sample might be vague.

Time in office and parliament elections

The main concern in estimation of casual effect of time in office on the procurement outcomes is that time in office is endogenous (see e.g. Coviello and Gagliarducci (2017)). For example, close to a new election, if the incumbent governor believes that he/she might be re-elected, he/she may intensify efforts to successfully execute publicly valuable contracts (such as road constructions) in order to attract even more votes, and in such manner, to increase probability to be re-elected. On the contrary, if governor has strong belief not to be re-elected, then he/she might intensify corruption in the end of his/her term, in order to extract short-run revenue in the face of a forthcoming loss of power. While the former argument may have lower support in weak democracies, for the latter argument we have strong support for the case of Russia (Sidorkin and Vorobyev, 2018). As we mentioned before, in the period 2005-2012 governors were directly appointed by president, and governors' elections were restored only in October 2012. However, even under elections of governors, the central government kept control over the election results through municipal filters. Under such conditions, the time in office of governor is highly determined by his loyalty to the central authority. Indeed, Reuter and Robertson (2012) showed that governor's future re-appointment strongly depends on the share of votes in the region for the ruling party United Russia (UR) in parliament elections, which were held by this governor. This hints to exploit regional and federal election results for UR in region as instruments for the governor's tenure. In what follows, we explain the way of construction of these instruments.

Elections in federal parliament are held on the same day all over the regions. There are two federal parliament elections that are relevant to us: December 2007 and December

2011. Elections in regional parliaments are not unified all over the regions and must be conducted once in 4-5 years. UR is represented in all the regions and historically has different share of its supporters over the regions. We construct two instruments basing on UR share of votes in region for federal and regional parliament elections separately. Namely, in our 2011-2014 procurement data for each contract-level observation and corresponding governor who manages this contract, we consider federal/regional election, which was held during the previous term of this governor or during the last term of the former governor (see Figure 2.1). We take the UR share of votes in region in this election as a value of instrumental variable for the observation. Therefore, we have two instrumental variables corresponding to preceding federal and regional elections. We keep them separately, as impact of the federal election may be thought of higher importance to influence the probability of re-appointment/re-election compared to the regional election results.

Intuitively, these instruments are relevant due to the following reason. If UR had high share of votes in election then the governor, who managed this election, would be kept for the next term. Therefore, at the date of contract signing the governor's term would likely be higher than one. This situation corresponds to the case in Figure 2.1, when governor i and j is the same person. On the contrary, if UR had low share of votes in election then the governor, who managed this election, would be fired. Thus, at the date of contract signing the new governor's term should be one. This situation corresponds to the case in Figure 2.1, when governor i and governor j are different persons.

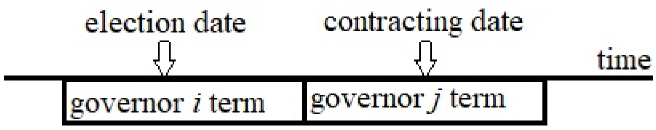

Figure 2.1: Timeline of the contract signing date and election date for instruments

It is noteworthy, that our instruments vary over governor's terms, but not over exact time in office, so these instruments may have not enough variability to properly explain Tenure in office. Therefore, in interpretation of IV estimates we will focus on Term in office and Incumbent controls, rather than Tenure in office. Moreover, by the construction, the instruments have enough explanatory power to disentangle the first governor's term from others, but they cannot disentangle terms larger than one. Therefore, we think of IV with Incumbent measure of time in office as the most efficient estimate.

These instruments are likely to be valid, i.e. they satisfy the exclusion restriction from equation (2.1). Indeed, given the re-appointment/re-election decision by the central government, the results of past parliament elections in the previous term do not impact the current contract performance. This intuitively should be true, since the results of past parliament elections in the previous term determines reappointment decision of a governor by the federal centre, but when the appointment decision is done, those results of past parliament elections are no more relevant for the governor to take care (as those parliament elections were held in previous term). Moreover, in our 2SLS estimates we control for regional unobserved heterogeneity through regional fixed effects as we do in equation (2.1), so any regional historical specificities are captured by them. In particular, historical time-invariant bias of regional population to/against UR will be captured by these fixed effects. Thus, at the first stage we estimate the following model

$$T_{tir} = [aI_{ir}] + b_1 UR\_Reg_{tr} + b_2 UR\_Fed_{tr} + c_1 W_t + c_2 X_{ir} + c_3 Z_{tr} + u_r + \varepsilon_{tir} \qquad (2.2)$$

where T_{tir} is the ith governor's Term in office (Incumbent indicator)at the contract signing date t at region r, $UR\_Reg_{tr}(UR\_Fed_{tr})$ is the regional UR vote share in regional(federal) election in the previous term, and rest of controls are similar to equation (2.1). At the second stage we estimate (2.1) with heteroscedasticity robust standard errors.

2.6 Results

. Panel A of Table 2.2 presents the OLS estimates of model (2.1) for the number of bidders, where time in office is measured through Tenure in office . The level of competition in the auctions conducted during the governing of insiders is higher, on average, by approximately 0.05 bidders in comparison to outsiders (Panels A-C, Columns 1 and 2). In relative values, it corresponds to 3

VARIABLES	(1) All procedures	(2) Open auctions	(3) All procedures	(4) Open auctions	(5) All procedures	(6) Open auctions
			Panel A: Tenure in office (OLS)			
Tenure in office	0.0026**	0.0033***	0.00067	0.00094	-0.073***	-0.10***
	(0.0011)	(0.0013)	(0.0013)	(0.0015)	(0.014)	(0.017)
Insider	0.053***	0.057***				
	(0.013)	(0.016)				
R-squared	0.517	0.507	0.538	0.526	0.498	0.497
			Panel B: Term in office (OLS)			
Term in office	0.020***	0.025***	0.026***	0.029***	-0.018	-0.013
	(0.0050)	(0.0056)	(0.0058)	(0.0065)	(0.015)	(0.017)
Insider	0.048***	0.050***				
	(0.013)	(0.016)				
R-squared	0.517	0.507	0.538	0.526	0.497	0.496
			Panel C: Incumbent (OLS)			
Incumbent	0.028***	0.033***	0.020*	0.018	-0.035**	-0.031*
	(0.0085)	(0.0096)	(0.012)	(0.014)	(0.015)	(0.016)
Insider	0.053***	0.057***				
	(0.013)	(0.016)				
R-squared	0.517	0.507	0.538	0.526	0.497	0.496
Observations	112,620	92,733	76,208	62,839	36,412	29,894
Sample	Ins&Outs	Ins&Outs	Insiders	Insiders	Outsiders	Outsiders

Note. Significance levels: '***' 0.01 '**' 0.05 '*' 0.1. The table reports OLS estimates from model (2.1). Robust standard errors are in parentheses. The dependent variable is Number of Bidders - number of bidders in the procurement procedure. Time in office measures are: Tenure in office - the exact governor's time in office by the date of contract signing (Panel A); Term in office - the number of governor's terms in office by the date of contract signing (Panel B); Incumbent – equals zero if Term in office is 1 and equals one if Term in office is larger than 1 (Panel C). Insider – dummy equal to one if the governor is an insider. Other control variables include the governor's age, governor's age squared, indicator that the governor had been elected at least once, dummy variables for year of contract signing, procurement procedure, logarithm of the reserve price, number of applicants, contract duration, number of items, procurer/supplier/regional controls, and regional dummy variables. Sample reports the sample selection used for estimation: columns 1 and 2 use the combined sample of insiders and outsiders, columns 3 and 4 use the sample of insiders, and columns 5 and 6 use the sample of outsiders. Columns 1, 3 and 5 report the results of estimation using all procedures except for single source. Columns 2, 4, 6 report the results of estimation using only the sample of open auctions.

Table 2.2: OLS estimates for the number of bidders

Results in Table 2.3 resolve the endogeneity problem. Table 2.3 reports the first stage and 2SLS estimates for number of bidders for two measures of time in office: Term in office and Incumbent. The first stage estimates show that our instruments are relevant to explain Term in office (Panel A) and Incumbent (Panel B) for both insiders and outsiders. We do not observe the significant effect of Insider status on number of bidders in the model with Term in office (Panel A Columns 1-2), while the coefficient is positive and its magnitude is comparable with corresponding OLS estimate. This might happen because (i) the instruments have low explanatory power to disentangle the terms of governors larger than one due to the way the instruments are constructed (ii) the insiders, on average, have more terms in office compared to governors-outsiders (see Table 2.7). Therefore, the estimates with Incumbent measure of time in office (Table 2.3 Panel B) are the most efficient, especially for the combined sample (Columns 1-2). The model with Incumbent shows that auctions of governors-insiders, on average, have by 0.08 bidders more (Panel B Columns 1-2), which corresponds to 5

From Table 2.3 we can conclude that insiders, on average, have higher competition in auctions, and time in office is relatively neutral to the level of competition for them. On the contrary, for governors-outsiders, time in office causes reduction in the level of competition. Such restriction of competition during the governing of outsiders might be interpreted in different ways. The first interpretation says that restriction of competition indicates favouritism in contract allocation, which even becomes more pronounced when a governor-outsider is settled (i.e., with high tenure). The second interpretation argues that deliberate restriction of competition helps to exclude incompetent and non-qualified participants, so the contract may be better executed. Under the second interpretation, the increase in the governor's tenure indicates growth of his/her experience in the selection of well-qualified suppliers, so it results in lower competition.

To disentangle these two interpretations, we further analyse the executional stage of the contracts by considering delays and terminations of the contracts. Table 2.4 demonstrates OLS and 2SLS estimates for normalized delays in contracts execution.[9] Panel

[9]The first stage results of 2SLS estimates are similar to Table 2.3, so we do not present them in Tables 2.4 and 2.5.

VARIABLES	(1) All procedures	(2) Open auctions	(3) All procedures	(4) Open auctions	(5) All procedures	(6) Open auctions
			Panel A: Term in office			
			First stage estimates			
UR regional share	0.014***	0.016***	0.020***	0.024***	0.013***	0.013***
	(0.00036)	(0.00040)	(0.00053)	(0.00059)	(0.00016)	(0.00018)
UR federal share	0.0033***	0.0017***	0.019***	0.017***	-0.045***	-0.045***
	(0.00033)	(0.00037)	(0.00054)	(0.00060)	(0.00022)	(0.00024)
			2 SLS estimates			
Term in office	0.067**	0.052*	0.027	0.036	-0.036**	-0.039**
	(0.028)	(0.028)	(0.023)	(0.026)	(0.015)	(0.017)
Insider	0.013	0.029				
	(0.026)	(0.028)				
R-squared	0.516	0.507	0.538	0.526	0.497	0.496
			Panel B: Incumbent			
			First stage estimates			
UR regional share	0.0095***	0.012***	0.0095***	0.012***	0.017***	0.017***
	(0.00028)	(0.00031)	(0.00042)	(0.00046)	(0.00017)	(0.00019)
UR federal share	-0.0031***	-0.0038***	0.0050***	0.0052***	-0.038***	-0.039***
	(0.00023)	(0.00025)	(0.00029)	(0.00031)	(0.00029)	(0.00030)
			2 SLS estimates			
Incumbent	-0.048	-0.053	0.064	0.060	-0.039**	-0.039**
	(0.037)	(0.035)	(0.059)	(0.054)	(0.016)	(0.018)
Insider	0.082***	0.090***				
	(0.020)	(0.021)				
R-squared	0.516	0.506	0.538	0.526	0.497	0.496
Observations	112,620	92,733	76,208	62,839	36,412	29,894
Sample	Ins&Outs	Ins&Outs	Insiders	Insiders	Outsiders	Outsiders

Note. Significance levels: '***' 0.01 '**' 0.05 '*' 0.1. The table reports First stage as well as 2SLS estimates from models (2.1) and (2.2). Robust standard errors are in parentheses. The dependent variable is Number of Bidders - number of bidders in the procurement procedure. Time in office measures are: Term in office (Panel A); Incumbent (Panel B). The rest of description is similar to Table 2.2.

Table 2.3: 2SLS estimates for the number of bidders

E (as well as OLS estimates of panels A-C) shows that, on average, insiders have lower delays by 16-26% of contract duration (Columns 1, 2) compared to outsiders. For panel D the effect of Insider is insignificant. This can be explained by the same argument as we mentioned for Table 2.3 Panel A: low efficiency of the estimate for combined sample (Columns 1-2) due to the low explanatory power of instruments for Term in office and substantial difference in the number of terms in office between governor insiders and outsiders. With respect to the effect of time in office, governors-outsiders demonstrate growth of delays by 19-20% of contract duration per term (Table 2.4, Panel D, Columns 5-6) or by 20-21% for incumbent governors (Panel E, Columns 5-6). Similar results are observed for OLS estimates (Panels A-C, Columns 5-6). For governors-insiders 2SLS estimates demonstrate significant reduction of normalized delays with time in office (Table 2.4, Panels D-E, Columns 3-4), while OLS estimates do not show any significant association between time in office and normalized delays (Panels A-C, Columns 3-4).

VARIABLES	(1) All procedures	(2) Open auctions	(3) All procedures	(4) Open auctions	(5) All procedures	(6) Open auctions
			Panel A: Tenure in office (OLS)			
Tenure in office	0.0029	-0.00074	-0.000041	-0.0071	0.19***	0.19***
	(0.0036)	(0.0042)	(0.0042)	(0.0050)	(0.051)	(0.053)
Insider	-0.16***	-0.18***				
	(0.035)	(0.042)				
R-squared	0.065	0.067	0.066	0.067	0.070	0.079
			Panel B: Term in office (OLS)			
Term in office	0.050***	0.039*	0.034	0.014	0.20***	0.19***
	(0.018)	(0.020)	(0.022)	(0.026)	(0.044)	(0.045)
Insider	-0.18***	-0.22***				
	(0.034)	(0.041)				
R-squared	0.065	0.067	0.066	0.067	0.070	0.079
			Panel C: Incumbent (OLS)			
Incumbent	0.078**	0.067**	0.023	-0.022	0.24***	0.25***
	(0.031)	(0.033)	(0.047)	(0.055)	(0.050)	(0.051)
Insider	-0.17***	-0.21***				
	(0.034)	(0.041)				
R-squared	0.065	0.067	0.066	0.067	0.070	0.080
			Panel D: Term in office (2SLS)			
Term in office	-0.36***	-0.10	-0.44***	-0.36***	0.19***	0.20***
	(0.12)	(0.12)	(0.095)	(0.11)	(0.049)	(0.050)
Insider	0.13	-0.11				
	(0.097)	(0.096)				
R-squared	0.059	0.067	0.059	0.063	0.070	0.079
			Panel E: Incumbent (2SLS)			
Incumbent	0.039	0.21	-0.94***	-0.58**	0.20***	0.21***
	(0.14)	(0.13)	(0.25)	(0.25)	(0.055)	(0.055)
Insider	-0.16***	-0.26***				
	(0.059)	(0.059)				
R-squared	0.065	0.067	0.059	0.065	0.070	0.080
Observations	96,651	74,562	64,106	49,997	32,545	24,565
Sample	Ins&Outs	Ins&Outs	Insiders	Insiders	Outsiders	Outsiders

Note. Significance levels: '***' 0.01 '**' 0.05 '*' 0.1. The table reports OLS estimates in Panels A-C and 2SLS estimates in Panels D-E from models (2.1), (2.2). Robust standard errors are in parentheses. The dependent variable is Normalized delay - delay divided by the duration of the contract. Time in office measures are: Tenure in office - the exact governor's time in office by the date of contract signing (Panel A); Term in office - the number of governor's terms in office by the date of contract signing (Panels B, D); Incumbent – equals zero if Term in office is 1 and equals one if Term in office is larger than 1 (Panels C, E). Insider – dummy equals one if the governor is an insider. Other control variables include the governor's age, governor's age squared, indicator of repeated contract, indicator that the regions of procurer and supplier coincide, indicator that the governor had been elected at least once, dummy variables for year of contract signing, procurement procedure, logarithm of the contract price, contract duration, number of items, procurer/supplier/regional controls, and regional dummy variables. The contracts with execution in process by 30 April 2017 are excluded. Sample reports the sample selection used for estimation: columns 1 and 2 use the combined sample of insiders and outsiders, columns 3 and 4 use the sample of insiders, and columns 5 and 6 use the sample of outsiders. Columns 1, 3 and 5 report the results of estimation using all procedures. Columns 2, 4, 6 report the results of estimation using only the sample of open auctions.

Table 2.4: OLS and 2SLS estimates for normalized delays in contract execution

The results of contract terminations are presented in Table 2.5. There is no difference between insiders and outsiders in terms of the probability of the contract to be terminated for both 2SLS and OLS estimates (Columns 1, 2). For governors-outsiders the OLS estimates of time in office are ambiguous as different measures of time in office have different directions and level of significance (Panels A-C, Columns 5-6). However, the 2SLS estimates, which are thought to be unbiased, are either statistically significant only at 10% level (Panel D, Columns 5-6) or insignificant (Panel E, Columns 5-6). This means that higher time in office just marginally reduces the probability of contract termination for governors-outsiders. For governors-insiders we observe that higher time in office substantially reduces the probability of contract termination: 2SLS estimates are significant at 1% level and magnitude of coefficients are more than 6 times larger compared to governor-outsiders for both Term in office and Incumbent (Table 2.5, Panels D-E, Columns 3, 4).

Abovementioned empirical evidence on contract executions does not support the second interpretation we proposed for restriction of competition. That is, the restriction of competition does not lead to better execution of the contracts for governors-outsiders; on the contrary, execution is either stable for them or becomes worse with time in office. At the same time, governors-insiders, on average, have both higher competition and better executions and time in office is either insignificant or it helps to improve procurement performance.

2.7 Robustness check

In this subsection, we check robustness of our results in three steps by varying the specifications of the empirical model, sample of analysis, and measurement of delays in contract execution.

The first step of the robustness check concerns the nature of dependent variable, which

VARIABLES	(1) All procedures	(2) Open auctions	(3) All procedures	(4) Open auctions	(5) All procedures	(6) Open auctions
	Panel A: Tenure in office (OLS)					
Tenure in office	-0.00070	0.00017	-0.00087	0.00022	0.034***	0.033***
	(0.00048)	(0.00059)	(0.00059)	(0.00073)	(0.0057)	(0.0073)
Insider	0.0021	-0.0054				
	(0.0050)	(0.0061)				
R-squared	0.123	0.133	0.139	0.150	0.099	0.110
	Panel B: Term in office (OLS)					
Term in office	-0.011***	-0.0090***	-0.011***	-0.0079**	-0.015**	-0.017**
	(0.0024)	(0.0029)	(0.0030)	(0.0037)	(0.0061)	(0.0071)
Insider	0.0077	0.0022				
	(0.0050)	(0.0061)				
R-squared	0.123	0.134	0.139	0.150	0.098	0.110
	Panel C: Incumbent (OLS)					
Incumbent	-0.012***	-0.014***	-0.016**	-0.016*	-0.017***	-0.022***
	(0.0041)	(0.0049)	(0.0066)	(0.0082)	(0.0064)	(0.0075)
Insider	0.0040	0.00050				
	(0.0049)	(0.0059)				
R-squared	0.123	0.134	0.139	0.150	0.098	0.110
	Panel D: Term in office (2SLS)					
Term in office	-0.018	-0.023	-0.057***	-0.076***	-0.011*	-0.012*
	(0.015)	(0.016)	(0.010)	(0.013)	(0.0062)	(0.0073)
Insider	0.013	0.013				
	(0.012)	(0.014)				
R-squared	0.123	0.133	0.135	0.143	0.098	0.110
	Panel E: Incumbent (2SLS)					
Incumbent	-0.017	-0.025	-0.15***	-0.17***	-0.010	-0.011
	(0.017)	(0.018)	(0.026)	(0.028)	(0.0069)	(0.0081)
Insider	0.0056	0.0045				
	(0.0080)	(0.0088)				
R-squared	0.123	0.133	0.132	0.141	0.098	0.110
Observations	99,767	76,947	66,561	51,920	33,206	25,027
Sample	Ins&Outs	Ins&Outs	Insiders	Insiders	Outsiders	Outsiders

Note. Significance levels: '***' 0.01 '**' 0.05 '*' 0.1. The table reports OLS estimates in Panels A-C and 2SLS estimates in Panels D-E from models (2.1), (2.2). Robust standard errors are in parentheses. The dependent variable is Terminated contract - dummy variable equal to one if the execution of the contract was terminated and zero otherwise. For the rest of details see note of Table 2.4.

Table 2.5: OLS and 2SLS estimates for termination in contract execution

measures competition in auctions. Number of bidders has a countable nature, it is always positive and there are many auctions with only one participant, so there is significant mass at unity. These features of the dependent variable are not captured by the linear model. In order to overcome this issue, we use exponential rather than linear functional form for Number of bidders:

$$y_{tir} = exp\left([\beta I_{ir}] + \gamma T_{tir} + \delta_1 W_t + \delta_2 X_{ir} + \delta_3 Z_{tr} + u_r + \epsilon_{tir}\right) \tag{2.3}$$

Such specification also allows to interpret coefficients β and γ as semi-elasticities, so they show a relative rather than absolute increment in the number of bidders. We estimate model (2.3) in two ways. First, assuming exogeneity of the time in office, we estimate it via negative binomial regression. Second, by relaxing the exogeneity assumption, we use the logarithm transformation of (2.3) and estimate it through 2SLS for two measures of time in office - Term in office and Incumbent.[10]

Table 2.6 reports results of both the negative binomial estimates (Panels A-C) and 2SLS estimates for logarithm of Number of bidders (Panels D, E). Similarly to results of Table 2.3 (Panel B), 2SLS estimates of model (2.3), with Incumbent as a measure of time in office, show that competition in auctions conducted by governors-insiders is, on average, higher by 3-4% and this effect is significant (Table 5, Panel E, Columns 1-2). Estimates from negative binomial model support this result (Table 2.6, Panels A-C, Columns 1-2). Insignificance of Insider for the model with Term in office as a measure of tenure (Table 2.6, Panel D, Columns 1-2) is related to the same problem of low efficiency of the estimate for combined sample as the one mentioned above (see results for Tables 2.3 and 2.4). For governors-outsiders time in office significantly reduces the competition (Panels D-E, Columns 5-6), while for governors-insiders time in office has no detrimental effect (Panels D-E, Columns 3-4).

The second step of the robustness check concerns the governor's time in office. It is worth noting that the number of contracts, where governor's time in office is longer than three terms is significantly larger for insiders compared to outsiders (see Table 2.7).

Thus, estimates of the coefficients for time in office in the regression models for insiders and outsiders might be driven by different intervals of tenure. Due to this fact,

[10]Similarly to OLS, estimates from negative binomial model can be interpreted only in terms of association, but not in terms of causality. As negative binomial model is non-linear, the non-linear IV implementation is available either via control function approach or via non-linear GMM (see e.g. (Cameron and Trivedi, 2005, 2009)). The control function approach requires too restrictive assumption of independence (rather than zero correlation) of instrument and error terms of the structural and first stage equations (Wooldridge, 2015). Non-linear GMM in exponential models can suffer from poor convergence (Nichols, 2008). Therefore, as Nichols (2008) suggests, we make logarithm transformation of exponential equation (2.3) and exploit standard 2SLS to overcome the endogeneity problem.

VARIABLES	(1) All procedures	(3) Open auctions	(5) All procedures	(7) Open auctions	(9) All procedures	(11) Open auctions
Panel A: Tenure in office (Neg. binomial, Number of Bidders is dependent variable)						
Tenure in office	0.0016*	0.0022**	0.00025	0.00020	-0.062***	-0.087***
	(0.00084)	(0.0010)	(0.00094)	(0.0011)	(0.0097)	(0.013)
Insider	0.035***	0.039**				
	(0.013)	(0.016)				
Panel B: Term in office (Neg. binomial, Number of Bidders is dependent variable)						
Term in office	0.016***	0.021***	0.019***	0.023***	-0.010	-0.0025
	(0.0037)	(0.0044)	(0.0043)	(0.0051)	(0.010)	(0.012)
Insider	0.030**	0.032*				
	(0.013)	(0.016)				
Panel C: Incumbent (Neg. binomial, Number of Bidders is dependent variable)						
Incumbent	0.016**	0.022***	0.012	0.0096	-0.027**	-0.022*
	(0.0064)	(0.0076)	(0.0089)	(0.010)	(0.011)	(0.012)
Insider	0.035***	0.040**				
	(0.013)	(0.016)				
Panel D: Term in office (2SLS, ln(Number of Bidders) is dependent variable)						
Term in office	0.031**	0.021	0.013	0.015	-0.014*	-0.017*
	(0.015)	(0.015)	(0.012)	(0.013)	(0.0079)	(0.0089)
Insider	-0.00059	0.0097				
	(0.013)	(0.014)				
Panel E: Incumbent (2SLS, ln(Number of Bidders) is dependent variable)						
Incumbent	-0.030	-0.033*	0.015	0.012	-0.014*	-0.016*
	(0.020)	(0.019)	(0.031)	(0.028)	(0.0087)	(0.0097)
Insider	0.034***	0.039***				
	(0.0100)	(0.010)				
Observations	112,620	92,733	76,208	62,839	36,412	29,894
Sample	Ins&Outs	Ins&Outs	Insiders	Insiders	Outsiders	Outsiders

Note. Significance levels: '***' 0.01 '**' 0.05 '*' 0.1. The table reports estimates from model (2.3) by using negative binomial model for Number of Bidders (Panels A-C) and 2SLS for ln(Number of Bidders) (Panels D, E). Robust standard errors are in parentheses. For the rest of details see Note of Table 2.2.

Table 2.6: Estimates for the exponential functional form of the number of bidders

	Insiders	**Outsiders**	**Total**
1st term	46 178	28 836	75 014
2nd term	9 557	10 028	19 585
3rd term	12 072	795	12 867
4th term	10 571	42	10 613
5th term	2 101	0	2 101

Note. The table reports the number of contracts signed during each of the corresponding governor's term. The total sample size is 120,180 observations. Column 1 reports the number of contracts for governors-insiders, Column 2 – for governors-outsiders.

Table 2.7: Number of observations corresponding to different intervals of tenure

we exclude contracts corresponding to time in office longer than three terms and run 2SLS estimates with Incumbent as endogenous measurement of time in office. The results of the first stage and 2SLS estimates are presented in Table 2.8. Similarly to the main results, Table 2.8 shows that governors-insiders, on average, have higher competition (Panel B, Columns 1-2), lower normalized delays (Panel C, Columns 1-2) and there is no significant difference in probability of contract termination (Panel D, Columns 1-2) compared to governors-outsiders. Moreover, incumbent governors-insiders do not deteriorate competition (Panel B, Columns 3-4), and they reduce delays and probability of contract termination (Panel C-D, Columns 3-4). On the contrary, incumbent governors-outsiders deteriorate competition (Panel B, Columns 5-6), increase delays (Panel C, Columns 5-6) and do not reduce probability of contract termination (Panel D, Columns 5-6).

In the third step of the robustness check, we consider delays instead of normalized delays as a proxy of the quality of contract execution. The results are presented in Table 2.9. These results support the main findings of Table 2.4. On average, governors-insiders show lower absolute delays by 17-22 days (Table 2.9, Columns 1-2) and delays become even shorter with time in office (Table 2.9, Columns 3-4). Oppositely, delays of governors-outsiders increase by 22-24 days per term or by 24-26 days for incumbent (Table 2.9, Columns 5-6).

2.8 Conclusion

In this paper, we present the evidence regarding to what extent and what type of autocratic governors at the sub-nation level may distort public procurement outcomes. In particular, we study the impact of the tenure of autocratic governors and their local ties on the restriction of competition in public procurement. We exploit contract-level procurement data on road construction in Russian regions during 2011-2014 and biographical information of governors. To overcome the problem of endogeneity of governor's tenure

	(1) All procedures	(2) Open auctions	(3) All procedures	(4) Open auctions	(5) All procedures	(6) Open auctions
			Panel A: First stage			
UR regional share	0.011***	0.013***	0.012***	0.016***	0.016***	0.017***
	(0.00031)	(0.00033)	(0.00050)	(0.00054)	(0.00017)	(0.00019)
UR federal share	-0.0035***	-0.0044***	0.0046***	0.0050***	-0.040***	-0.039***
	(0.00024)	(0.00027)	(0.00033)	(0.00036)	(0.00024)	(0.00026)
			Panel B: Number of bidders (2SLS)			
Incumbent	-0.044	-0.053	0.089	0.067	-0.045***	-0.040**
	(0.035)	(0.033)	(0.057)	(0.051)	(0.016)	(0.018)
Insider	0.11***	0.12***				
	(0.020)	(0.022)				
R-squared	0.513	0.504	0.533	0.522	0.497	0.496
			Panel B: Normalized delay (2SLS)			
Incumbent	0.042	0.15	-1.01***	-0.72***	0.20***	0.21***
	(0.13)	(0.11)	(0.22)	(0.21)	(0.055)	(0.056)
Insider	-0.18***	-0.27***				
	(0.054)	(0.055)				
R-squared	0.062	0.065	0.053	0.059	0.070	0.080
			Panel C: Terminated contract (2SLS)			
Incumbent	-0.0030	-0.012	-0.11***	-0.15***	-0.010	-0.011
	(0.016)	(0.017)	(0.025)	(0.026)	(0.0069)	(0.0081)
Insider	0.0034	-0.000026				
	(0.0074)	(0.0083)				
Observations	89,027	68,667	55,853	43,651	33,174	25,016
R-squared	0.120	0.131	0.134	0.143	0.098	0.110
Sample	Ins&Outs	Ins&Outs	Insiders	Insiders	Outsiders	Outsiders

Note. Significance levels: '***' 0.01 '**' 0.05 '*' 0.1. The table reports First stage estimates (Panel A) as well as 2SLS estimates from models (2.1) and (2.2) for time in office measured through Incumbent and different dependent variables: Number of bidders (Panel B), Normalized delay (Panel C), Terminated contract (Panel D). Sample includes only contracts with Term in office not larger than 3. Robust standard errors are in parentheses. For the rest of details in estimation see Notes of Tables 2.2-2.5 for corresponding dependent variables.

Table 2.8: 2SLS estimates for different dependent variables for sample with at most 3 terms

in office we exploit instruments based on the regional vote share of ruling party in past parliament elections. We show that governors without local ties in regions (outsiders) demonstrate predatory behaviour by restricting the level of competition in auctions. Such behaviour becomes worse with tenure in office. In contrast, governors with local ties in regions (insiders) demonstrate a higher level of competition and no tenure effect. These results persist after controlling for auction, procurer and regional characteristics and regional and year fixed effects. To have an unambiguous interpretation of these results, we also use ex-post data on contract execution.

The contracts of governors-outsiders have longer delays and tenure in office deteriorates this auction outcome, while delays of governors-insiders decrease with tenure. Moreover,

VARIABLES	(1) All procedures	(2) Open auctions	(3) All procedures	(4) Open auctions	(5) All procedures	(6) Open auctions
			Panel A: Term in office (2SLS)			
Term in office	-5.38	7.29	-16.7***	-10.9*	21.8***	23.7***
	(6.60)	(6.79)	(4.99)	(6.09)	(2.44)	(2.79)
Insider	-3.87	-17.5***				
	(5.21)	(5.65)				
R-squared	0.132	0.132	0.130	0.131	0.139	0.143
			Panel B: Incumbent (2SLS)			
Incumbent	24.9***	28.0***	-33.6**	-14.6	24.4***	26.0***
	(7.56)	(7.71)	(13.4)	(14.0)	(2.70)	(3.06)
Insider	-17.1***	-21.9***				
	(3.24)	(3.45)				
Observations	96,651	74,562	64,106	49,997	32,545	24,565
R-squared	0.131	0.131	0.130	0.131	0.140	0.143
Sample	Ins&Outs	Ins&Outs	Insiders	Insiders	Outsiders	Outsiders

Note. Significance levels: '***' 0.01 '**' 0.05 '*' 0.1. The table reports 2SLS estimates from model (2.1). Robust standard errors are in parentheses. The dependent variable is Delay - difference between the actual execution date and the contract execution date. For the rest of details in estimation see Note of Table 2.4.

Table 2.9: 2SLS estimates for delays (in days) in contract execution

governors-outsiders do not reduce the probability of contract termination with tenure, but governors-insiders do. Therefore, the restriction of competition by governors-outsiders, which worsens with tenure in office, cannot be explained by better contract execution. Thus, we conclude that favouritism operates in public contract allocation by governors-outsiders. Several robustness checks using subsamples, different model specifications and alternative measures of contract execution lead to similar results.

For weak democracies or sub-national autocracies, where results of democratic elections are manipulated, our findings provide the grounds for the implementation of policies wherein locally based governors are preferred compared with governors-outsiders. Moreover, there is an evidence that procurement regulation should limit the discretionary power of governors over public procurement outcomes.

Chapter 3

State-business relations and access to external financing

3.1 Introduction

In perfect financial markets, internal and external financing are perfect substitutes for investment (Modigliani and Miller, 1958). However, under market imperfection, characterized by an asymmetry of information and agency cost, lenders are under risk. Therefore, even if the investment project may give positive profit to both lender and borrower, the credit may be rationed, because the lender cannot distinguish between reliable and unreliable borrowers (Stiglitz and Weiss, 1981). To reduce the information asymmetry, the borrower may signal to the lender about its own quality (Cho and Kreps, 1987). The value of assets as collateral is traditionally considered a signalling channel to guarantee access to debt, i.e. asset-based debt (Chaney et al., 2012). However, the recent literature emphasizes even more importance of earnings in determining debt access (Lian and Ma, 2021), i.e. earning-based debt. Other signalling channels are relations of the borrower and state via political connection and state ownership (Khwaja and Mian, 2005; Li et al., 2009). Discovering alternative signaling channels is important during crises, like the COVID-19 pandemic, because crises usually shrink business-to-business activity. It is also especially relevant for small firms because the traditional channels are quite limited for them.

This paper considers contracting with the state using public procurement as another signalling channel related to earning-based debt. There are at least two reasons to assume that public procurement contracts may create a good signal to the lenders about quality of project undertaken by the firm. First, the risk of default of public organization is low, so the contract is likely to be paid. Second, reputational advantages in future contracts with other public organizations create incentives for the firm to execute the current contract properly. Moreover, public contracts are usually paid after the execution, so the firm may need external financing to implement it. Therefore, the lenders are more inclined to give a credit based on state-to-business contracts and the firm is more prone to issue of debt compared to business-to-business contracts. Thus, one can assume that debt is more sensitive to earnings from public contracts than from private ones.

The paper empirically tests this hypothesis using data from an extensive survey of manufacturing firms – "Russian Firms in a Global Economy". The survey was conducted in 2014 and contained information about 1950 firms from 60 Russian regions. It includes questions about firms' activities during the recent years. The survey is extended by accounting and public procurement information of these firms for 2011-2018. I use Leverage – the ratio of total annual debt to tangible fixed assets (TFA) – as a measure of debt, where the normalization enables to take into account asset-based debt. The ratio of the total annual value of procurement contracts to TFA is the measure of public earnings (Public contracts). I consider the annual revenue less the public earnings normalized to TFA as a measure of private earnings (Private contracts).

First, I show that debt sensitivity to public contracts is more than twice as large as debt sensitivity to private contracts, controlling for firm- and year- fixed effects. Namely, 10% increase in the value of public contracts (private contracts) with respect to TFA is associated with 1.8% (0.7%) increase in total debt with respect to TFA. This is in line with the hypothesis that contracting with the state gives a positive signal to lenders. Second, I also argue that the debt sensitivity to public contracts is likely to be causal. The paper shows that neither the annual lag nor the annual lead of Public contracts is associated with the Leverage given firm- and time- fixed effects, i.e. the changes in Leverage and Public contracts are contemporaneous. In line with this, I show that only the short-term leverage is sensitive to Public contracts, while the long-term leverage is insensitive. This indicates that firms winning public contracts usually of short duration may need more short-term debt because the contract execution requires investments and public authorities pay later than private companies.

The literature consistently shows that politically connected firms have easier access to debt and higher access to public procurement contracts. In the results above, it may be a political connection that induces the high debt sensitivity to public procurement contracts despite control for firm- and time- fixed effects. In contrast, for non-connected firms, public contracts may not give the advantage in access to debt. Therefore, I test how Leverage sensitivity to Public contracts depends on the firms' political connections. The survey asks a question indicating political connections via organizational (non-financial) support firms received from federal, regional, and local governments. I show that the debt sensitivity to public contracts of politically connected firms is four times as large as that of non-politically connected. That is politically connected firms issue more debt than non-politically connected firms for given a level of public contracts. This discrepancy is even higher if a firm receives support from the federal government than firms receiving support from regional or local governments. Despite this, for non-connected firms, the debt sensitivity to public contracts is still positive and substantially higher than the debt sensitivity to private contracts.

Finally, I study the heterogeneity of debt sensitivity with respect to the firm size. If the debt is substantially sensitive to public contracts for small business enterprises (SBE) then widely used procurement preferences for SBE are not only relevant for the support and survival of small firms but are also helpful in developing corporate financing decisions. I show that debt sensitivities to both Public and Private contracts for non-SBEs are twice as large as the corresponding sensitivities for SBEs. Nevertheless, even for politically non-connected SBEs, there is still a positive and significant gap between sensitivities to public and private contracts. This result concludes that despite the limited signaling channels SBEs possess, public contracts serve as a relevant channel, and procurement preferences for SBEs are policy-relevant mechanisms beyond the straightforward financial support.

The results are robust to a set of modifications. First, I redefine the political connection by extending the government support to both organizational and financial as well as considering state ownership as an alternative measure of political connection. The results regarding the gap in debt sensitivities between public and private contracts for politically non-connected firms hold, as well as the result of higher debt sensitivity to public contracts for connected firms maintains. Second, via the Heckman model, I show that the sample selection problem due to the missings in financial information is not an issue.

The paper's findings are policy relevant, as they show that public contracts are beneficial for access to debt, and political connection does not entirely suppress it. This result is essential for the crisis periods when private demand shranks and public demand from a state can support the normal corporate financing decisions. Moreover, since many reliable signaling channels, like certification or state subsidies, oftenly are not available to small firms, public procurement opens access to debt via auctions' preferences.

Related literature and contribution

This paper is related to three strands of literature. The first strand considers firm-specific and macroeconomic factors of capital structure. Value of assets traditionally serves as collateral for loans, so it positively affects firms' access to debt (Rajan and Zingales, 1995; Moore and Kiyotaki, 1997; Chaney et al., 2012). The recent literature emphasizes that cash-flow, measured using operating earnings, is even more important in determining debt access (Drechsel and Kim, 2021; Ivashina et al., 2021; Lian and Ma, 2021). Particularly, for the US non-financial firms, Lian and Ma (2021) show that 20% of debt is based on assets, whereas 80% is based on cash-flows from firms' operations. Macroeconomic and institutional factors, like inflation, size of banking sector and scale of corruption, are the main determinants of variation in leverage for small unlisted companies (Jõeveer, 2013). However, these factors also affect the leverage of large firms both in developed and developing countries (Demirgüç-Kunt and Maksimovic, 1998, 1999; Booth et al., 2001; Frank and Goyal, 2009; Fan et al., 2012; Fungáčová et al., 2015). I contribute to this strand of literature by showing that earnings received from different channels – public and private contracts -– affect access to debt differently, taking into account industry-level dynamics and firm-level heterogeneity via year-industry and firm fixed effects.

The second strand of literature considers the impact of public procurement on firms' performance. The literature shows that demand shocks, stemming from public procurement, increase firm growth measured using revenue and employment (Ferraz et al., 2015; Weichselbaumer et al., 2018; Hoekman and Sanfilippo, 2018). This effect is particularly prominent for small firms, as public procurement enables to relax their financial constraints (Lee, 2017; Fadic, 2020). As small firms are more capacity constrained, they are disadvantaged in competitive auctions compared to medium and large firms. Therefore, procurement regulations often prescribe to give preferences to small firms or to sed-aside part of auctions for them (Marion, 2007; Athey et al., 2013; Nakabayashi, 2013; Shelton and Minniti, 2018). Public demand is also helpful for firms' survival, though it does not improve productivity (Bessonova, 2019; Cappelletti and Giuffrida, 2021). Hebous and Zimmermann (2021) show that federal purchases in the US increase firms' investment. Their findings indicate that the effect of government purchases works through easing firms' access to short-term debt. They show that public contracts affect short-term debt growth for financially constrained firms. I contribute to this literature by estimating the gap in debt sensitivity to public and private contracts.

The third strand of literature studies the role of political connection in firms' performance. This literature can be split into two directions, studying the effect of political connection on firms' capital structure and access to public procurement. In this literature, a firm is classified as politically connected if it is state-owned or its CEO participates in elections, belongs to the government, or political parties. The first direction of literature studying the relation between firms' political connection and capital structure shows that politically connected firms have higher access to debt. For the case of Pakistan, Khwaja and Mian (2005) show that firms, where CEOs participate in elections, borrow 45% more and have 50% higher default rates. The easier access to debt for connected firms occurs exclusively in government banks – private banks provide no preferences to politically connected firms. For the case of China, (Li et al., 2009; Song et al., 2011) show that state-owned-enterprises (SOE) have higher access to debt, particularly to long-term debt. Moreover, the state ownership and political background of the CEO can inter-affect the firm efficiency. Chen et al. (2011) show that SOE firms have lower investment efficiency. Politically connected CEOs reduce it even more, but only in SOE firms, whereas the investment efficiency of non-SOE firms is not affected by the CEO's political connection. Government subsidies, as an alternative channel of state-business relations, can also affect the capital structure. Meuleman and De Maeseneire (2012) show that government subsidies to small firms positively signal their quality and result in easier access to long-term debt. However, the problem of subsidies allocation is also closely related to political connections. The second direction of literature studying the relationship between political connection and public contracts/subsidies allocation shows that if a CEO becomes politically connected, the firm's operating returns boost mostly due to increased public expenditure. It happens in both low- and high-corruption environment Cingano and Pinotti (2013); Amore and Bennedsen (2013); Szakonyi (2018). Literature also shows that for firms with connected CEO, the revenue from public procurement contracts and public subsidies increase (Wu et al., 2012; Goldman et al., 2013). The standard mechanism to award a contract to the connected firm is a non-transparent and non-competitive procurement procedure (Palguta and Pertold, 2017; Tkachenko et al., 2017; Dávid-Barrett and Fazekas, 2020). This paper links together these two directions of literature on the political connection. It shows how debt sensitivity to public procurement earnings is affected by firms' political connection, but public contracts are beneficial for access to debt even for non-connected firms.

The closest study to this paper is (di Giovanni et al., 2022). Using Spanish firms' accounting and procurement data for 2000-2013, it shows that public contracts increase debt. Moreover, for young firms, the authors provide reduced-form evidence for a significant and positive gap in debt sensitivity to public and contracts. My findings are in line with both these results. However, this paper differs from (di Giovanni et al., 2022) as it emphasizes the role of political connection in debt sensitivity to public contracts. Moreover, this paper also shows the reduced-form evidence of the gap in debt sensitivity to public and private contracts for small rather than young firms.[1]

3.2 Data description

The paper uses three datasets linked together. The primary data is an extensive survey of Russian manufacturing firms – "Russian Firms in a Global Economy" (RuFIGE). The survey was conducted by the HSE University in 2014 and contained information about 1,950 firms from 60 Russian regions.[2] The same survey was used by (Levina et al., 2016)

[1]Noteworthy, (di Giovanni et al., 2022) emphasizes "*...in Section 5 we have seen that smaller firms, typically the most constrained, do not participate in procurement.*", which is probably due to the limitation that Spanish public authorities must publish information only about relatively large procurement contracts. Therefore, the authors have to use counterfactual simulations to provide evidence of debt sensitivity to public contracts for small firms. My paper does not have this limitation, so I can provide the reduced-form evidence.

[2]The survey is designed to be representative by firms' industry. Given the importance of large firms and their relatively low number in the population, they were intentionally oversampled compared to their population proportion. The survey provides sampling weights. I am using these weights in the regression analysis to have unbiased results with respect to population. More information about the survey is

to analyze firms' decentralization decision. The survey contains a large range of questions about firms' activity during 2011-2013. Some questions reveal information not available in open accounting reports. In particular, the survey includes two questions about firms' financial and non-financial relations with different levels of government. The question No.104 of the questionnaire reads:

"Did your firm receive any ***financial*** *support from federal, regional and municipal government in 2012-2013? (Give one answer in each row)".*

To answer this question, the respondents filled in the form shown in Table 3.1. Therefore, the survey provides information about financial support from each level of government separately. The next question No.105 reads:

"Did your firm receive any ***organizational*** *support from federal, regional and municipal government in 2012-2013? Organizational support is any non-financial support, for example: help in contacts with Russian and foreign partners, and with other public authorities; attraction of investors, etc. (Give one answer in each row)".*

Table 3.1 is the form to be filled for this question.

		Yes	No	Hard to answer	No answer
1	From federal government				
2	From regional government				
3	From local government				

Table 3.1: Form to answer the questions about financial and non-financial support.

I use the second question about organizations support to construct an indicator for political connections of firms. Namely, I define that a firm had received a government *Support* if the respondent answered "Yes" at any government level for the second question. The firm had received *Federal support* if "Yes" is chosen in the first row of Table 3.1 for the second question. Similarly, I construct the *Regional support* and Local support. These variables are indicators of political connection with different levels of government. I use

provided at the website of the Institute for Industrial and Market Studies, Higher School of Economics: https://iims.hse.ru/en/rfge/.

them as the main indicators of political connection. There are 17% of firms receiving any government organizational support so that 5.5% of firms receive federal support, 10% receive regional support, and 11.7% receive local support. An alternative definition of political connection, where I use both questions about financial and organizational supports is presented as a robustness check.[3] Other variables from the survey data are the establishment date, firm size, two-digits industry code, indicator of being part of a holding, indicator of being in a business association, presence of some state-ownership and foreign-ownership, locality type where the firm is registered. The descriptive statistics for the variables are shown at Table G1 of the Appendix G. There are 3.4% of firms with state ownership and use it as another alternative measure of political connection.

The second data is the accounting balance sheets of firms from the survey. The survey data were linked with the firms' official accounting information for 2011-2018[4], so the analyzed data has a panel structure. The balance sheets, among others, include annual information on revenue, tangible fixed assets, long-term and short-term debt. To measure the amount of debt at the firm-year level I use *Leverage* — a ratio of total annual debt (sum of long-term and short-term debt) to tangible fixed assets (TFA). Such normalization enables to take into account asset-based debt flexibly, as tangible fixed assets are traditionally considered to be collateral, determining firms' access to debt (Rajan and Zingales, 1995; Frank and Goyal, 2009; Chaney et al., 2012). The recent literature emphasizes the substantial importance of earnings in determining the access to debt (Drechsel and Kim, 2021; Ivashina et al., 2021; Lian and Ma, 2021), so I construct *Revenue-TFA* equal to the ratio of annual revenue to TFA.

Finally, the information about public procurement contracts was collected from the official website on Public Procurement in Russia. The website contains all the contracts above 100 K RUB ($\sim$ 1.5 K USD). Each contract, among others, includes fiscal code

[3]If one considers both organizational and financial support, then there are 23% of firms receiving any government support, 8.5% of firms receive federal support, 14.5% receive regional support, and 14% receive local support.

[4]Collected from ruslana.bvdep.com

of supplier, sign date and contract value. I aggregated all contracts to get the total value of contracts at a firm-year level and linked it to the survey data. Exploiting this data, I construct *Contracts-TFA* equal to the ratio of the total annual value of public procurement contracts to TFA. I winsorize 1% of the largest positive values of *Leverage*, *Revenue-TFA*, and *Contracts-TFA* to avoid inaccuracies in the accounting information. Next, I calculate the normalized revenue from private contratcs (*Priv.Revenue-TFA*) as the difference between *Revenue-TFA* and *Contracts-TFA*. The descriptive statistics for Leverage, Priv.Revenue-TFA and Contracts-TFA are shown in Table 3.2.

Variable	Obs	Mean	Std. Dev.	Median	Min	Max
Leverage	10,719	7.96	13.99	2.94	0	99.03
Priv.Revenue-TFA	10,719	23.62	70.35	6.34	0	1144.06
Contracts-TFA	10,719	0.86	6.2	0	0	150.79

Table 3.2: Descriptive statistic for Leverage, Priv.Revenue-TFA, Contracts-TFA

3.3 Empirical methodology

In this section, I present the empirical approach to estimate the association between public contracts' value and access to debt. Leverage is a dependent variable. The primary explanatory variable is Contracts-TFA. The main focus of the analysis is to differentiate the debt sensitivity to public and private contracts. The econometric specification has the following form

$$Leverage_{it} = \alpha C_{it} + \gamma R_{it} + \lambda_t + \delta X_i + \epsilon_{it} \tag{3.1}$$

where t stands for the sequential year and i is the firm index. Variable C_{it} is the Contracts-TFA, R_{it} is the Priv.Revenue-TFA. Variable λ_t denotes year fixed effect. The vector variable X_i is either the set of time-invariant firm's attributes presented in Table G1 of Appendix or the firm's fixed-effect.[5] The specification with firm-fixed effects is more

[5]Intercept is always included in all the models.

flexible as it allows to control for unobserved time-invariant characteristics. Therefore, I will interpret specification with firm fixed effects whenever possible. Leverage sensitivity to Contracts-TFA is α and to Priv.Revenue-TFA is γ. The interpretation is the following: 1% increase of public contracts (private contracts) is associated with α % (γ %) increase of debt with respect to TFA. Following the hypothesis that state-to-business contracts create an additional positive signal to lenders compared to business-to-business contracts, I present the result of the statistical test $H_0 : \alpha = \gamma, \quad H_1 : \alpha > \gamma$. In some specifications, I will also consider short-term leverage and long-term leverage instead of the leverage calculated with respect to the total debt, but the right-hand side is preserved. When I estimate the Leverage sensitivity to Contracts-TFA separately for firms with and without political connection, I consider the following extension of specification (3.1):

$$Leverage_{it} = \alpha C_{it} + \beta C_{it} * S_i + \gamma R_{it} + \lambda_t + \delta X_i + \epsilon_{it} \tag{3.2}$$

where $S_i = 1$ if firm i is politically connected. In specification (3.2), α is a Leverage sensitivity to Contracts-TFA for non-connected firms and $\alpha + \beta$ is the sensitivity for politically connected firms. If β is positive and significant, then debt sensitivity to public contracts is significantly larger for politically connected firms.

I estimate models (3.1)-(3.2) by the weighted least squared method with weights to be inversely proportional to the probability of inclusion in the sample by firm size.[6] Errors ϵ_{it} are clustered at firm-level, correcting for a correlation between error terms over time within a firm.

[6]For example, a weight of 100 in a survey, means that the probability of this observation to be included in the sample under simple random sampling from the population is 1/100. This is a standard approach to analyze surveys (Cameron and Trivedi, 2009)

3.4 Results

Table 3.3 shows the estimation results of model (3.1). Column 1 shows that variation in the Contracts-TFA is significant to explain the variation in Leverage. The magnitude of the effect preserves with controls on firm's attributes (column 2). However, it substantially reduces after control for Priv.Revenue-TFA (columns 3 and 4). I interpret the coefficients of column 4, as it is the most flexible specification containing firms fixed effects. Namely, interpretation for α (γ) means that 1% increase in public (private) contracts is associated with 0.18% (0.07%) increase in total debt with respect to TFA. The gap in debt sensitivity between public and private contracts is statistically significant (p-value of the test is 0.003). This result implies that public contracts increase debt twice as much as private contracts. The economic significance of the difference is substantial: if annual public procurement contracts equal to TFA[7], then public contracts allow to issue of by 11% (of TFA) more debt than private contracts. This is in line with the explanation that contracting with the state gives a positive signal, so the lender is more prone to lend on the state-to-business earning-base than on the business-to-business earning-base.

Noteworthy, estimates of α and γ cannot be interpreted causally as participation in public procurement auctions is a strategic firms' decision.[8] If this decision is time-invariant, then the endogeneity issue is mitigated by the set of firms fixed effects in column 4 (Table 3.3). It hardly can be the case, because if a firm meets attractive debt opportunities, it is more likely she patriciates in the auction. Moreover, many banks offer special credit lines for firms supplying in public procurement.[9] Nevertheless, Table G2 of the Appendix G shows that increase in Contracts-TFA is contemporaneously associated with an increase in Leverage, i.e. neither the yearly lead no lag of Contracts-TFA are

[7]This is close to the mean value for Contract-TFA (see Table 3.2)

[8]Table 3.2 shows that at least 50% of firms-years have zero procurement contracts, i.e. many firms do not participate in public procurement.

[9]See e.g. https://sberbank-ast.ru/Page.aspx?cid=672

	(1)	(2)	(3)	(4)	(5)	(6)
			Dependent variable: Leverage			
VARIABLES	Total	Total	Total	Total	Short-term	Long-term
Contracts-TFA (α)	0.31***	0.30***	0.21***	0.18***	0.17***	0.011
	(0.055)	(0.053)	(0.042)	(0.042)	(0.040)	(0.0095)
Priv.Revenue-TFA (γ)			0.071***	0.069***	0.067***	0.0027**
			(0.0073)	(0.0079)	(0.0075)	(0.0010)
Observations	10,719	10,654	10,654	10,719	10,719	10,719
Number of firms	1,646	1,636	1,636	1,646	1,646	1,646
Firm attributes	N	Y	Y	N	N	N
Firm FE	N	N	N	Y	Y	Y
Year FE	N	Y	Y	Y	Y	Y
P-value: $\alpha = \gamma$			.001	.003	.004	.201

Note. Significance levels: '***' 0.01 '**' 0.05 '*' 0.1. The table shows the estimates of specification (3.1) by the weighted least squared method with weights to be inversely proportional to the probability of inclusion in the sample by firm size. The dependent variable of columns 1-4 is Leverage – the ratio of total debt to tangible fixed assets (TFA). The dependent variable of column 5 is the short-term leverage (short-term debt over TFA), and of column 6 is the long-term leverage (long-term debt over TFA). Main control variables are Contract-TFA (the ratio of annual public procurement contracts to TFA) and Priv.Revenue-TFA (the ratio of private revenue to TFA). Columns 2 and 3 include time-invariant firms attributes presented at Table G1 of Appendix G. Standard errors are clustered at the firm-level correcting for a correlation between error terms within a firm. P-value shows the result of test $H_0 : \alpha = \gamma, \quad H_1 : \alpha > \gamma$.

Table 3.3: Leverage sensitivities to Contracts-TFA and Priv.Revenue-TFA

associated with Leverage. So, it is likely that the increase in Leverage is caused by the increase in Contracts-TFA, or at least, the factors that may impact both Leverage and Contracts-TFA have the same short-term dynamics as these variables.

To further argue that the effect mentioned above is not spurious and deeper understand the mechanism of the impact of public contracts on debt, I study how different types of debt – short-term and long-term – are related to procurement contracts. Noteworthy, the procurement contracts usually are of short duration – below one year – as public buyers need to exhaust their annual budget by the end of a calendar year (Liebman and Mahoney, 2017).[10] Therefore, one can expect to have a positive gap in short-term debt sensitivity

[10]Contracts on construction can be of long duration (above one year), but for our sample of manufacturing firms these contracts are rare.

between public and private contracts ($\alpha > \gamma$), but not in long-term debt.[11] Columns 5 and 6 of Table 3.3 show the results of model (3.1), where the dependent variables are short-term leverage and long-term leverage, respectively. Following the expectation, column 5 shows that public contracts induce higher short-term debt than private contracts: p-value of test $\alpha = \gamma$ is 0.004. For long-term leverage, the coefficient α is insignificant, γ is significant, but the test fails to reject that $\alpha = \gamma$ (p-value is 0.2). This result indicates the mechanism: upon receiving a public contract, the firm increases the short-term debt to execute the contract and lenders are willing to provide the debt. It also explains why we observed the contemporaneous effect of public contracts on debt and substantiates the argument of non-spurious association between debt and public contracts.

As the next step, I estimate specification (3.2) to study the diversity of Leverage sensitivity to Contracts-TFA for firms with and without political connection. Table 3.4 demonstrates the results. Column 1 shows that Leverage sensitivity to Contracts-TFA for firms with political connection ($\alpha + \beta = 0.58$) is 4 times as large as that of firms without connection ($\alpha = 0.15$). The coefficient β in column 1 can be interpreted as follows: if annual public procurement contracts equal to TFA then a politically connected firm can attract by 43% more debt than non-politically connected firms. The divergence is even more drastic for firms receiving support from the federal government. Given the same level of public contracts, a firm connected with the federal government can attract by 143% more debt than a non-politically connected firm (column 2 of Table 3.4). Firms, receiving support from the regional and local government, attract by 44%-47% more debt than non-politically connected firms for the same value of public contracts (columns 3-4 of Table 3.4). These findings are in line with literature showing that political rents increase with the strength of the political connection (Khwaja and Mian, 2005). Noteworthy, the coefficient α for Contracts-TFA is still positive and significant, and it is still significantly larger than γ for Priv.Revenue-TFA (see p-value for columns 1-4, Table 3.4). This finding

[11] In accounting, the short-term debt is issued for at most one year, and long-term debt is longer than one year.

shows that political connection does not entirely suppress the beneficial access to debt the public contracts create.

VARIABLES	(1)	(2)	(3)	(4)
	Dependent variable: Leverage			
Contracts-TFA (α)	0.15***	0.17***	0.16***	0.15***
	(0.036)	(0.039)	(0.038)	(0.036)
Contracts-TFA *	0.43**			
Org. gov. support (β)	(0.17)			
Contracts-TFA *		1.43***		
Org. federal support (β)		(0.17)		
Contracts-TFA *			0.47**	
Org. regional support (β)			(0.24)	
Contracts-TFA *				0.44**
Org. local support (β)				(0.17)
Priv.Revenue-TFA (γ)	0.069***	0.069***	0.069***	0.069***
	(0.0079)	(0.0079)	(0.0079)	(0.0079)
Observations	10,719	10,719	10,719	10,719
R-squared	0.210	0.212	0.209	0.210
Number of firms	1,646	1,646	1,646	1,646
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
P-value: $\alpha = \gamma$	.012	.005	.008	.012

Note. Significance levels: '***' 0.01 '**' 0.05 '*' 0.1. The table shows the estimates of specification (3.2) by the weighted least squared method with weights to be inversely proportional to the probability of inclusion in the sample by firm size. The dependent variable is Leverage. Main control variables are Contract-TFA, its interaction with different levels of government organizational support, and Priv.Revenue-TFA. All models include firm fixed effects. Standard errors are clustered at the firm-level. P-value shows the result of test $H_0 : \alpha = \gamma, \quad H_1 : \alpha > \gamma$.

Table 3.4: Leverage sensitivities to Contracts-TFA by government support

Finally, I study the gap in debt sensitivity by firm size. Table 3.5 shows the results.

For small firms, column 1 shows that debt sensitivity to public contracts is twice as large as debt sensitivity to private contracts, and this gap is statistically significant. Column 2 shows that the result holds even if one takes into account the contribution of political connection. For medium and large firms the debt sensitivities to both Public

	(1)	(2)	(3)	(4)
VARIABLES		Dependent variable: Leverage		
Contracts-TFA (α)	0.16***	0.13***	0.33***	0.27***
	(0.044)	(0.038)	(0.068)	(0.058)
Contracts-TFA *		0.53*		0.21***
Org. gov. support (β)		(0.29)		(0.080)
Priv.Revenue-TFA (γ)	0.066***	0.066***	0.11***	0.11***
	(0.0080)	(0.0081)	(0.016)	(0.016)
Observations	4,858	4,858	5,861	5,861
R-squared	0.202	0.206	0.272	0.275
Number of firms	835	835	811	811
Firm size	Small	Small	Med.&Large	Med.&Large
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
P-value: $\alpha = \gamma$	.018	.04	.001	.006

Note. Significance levels: '***' 0.01 '**' 0.05 '*' 0.1. The table shows the estimates of specifications (3.1) (columns 1 and 3) and (3.2) (columns 2 and 4) by the weighted least squared method with weights to be inversely proportional to the probability of inclusion in the sample by firm size. Columns 1 and 2 include only small firms, Columns 3 and 4 include medium and large firms. The dependent variable is Leverage. Main control variables are Contract-TFA, its interaction with government organizational support, and Priv.Revenue-TFA. All models include firm fixed effects. Standard errors are clustered at the firm-level. P-value shows the result of test $H_0 : \alpha = \gamma, \quad H_1 : \alpha > \gamma$.

Table 3.5: Leverage sensitivities to Contracts-TFA by firm size

and Private contracts are twice as large as the corresponding sensitivities for small firms (column 3), but the contribution of the political connection is less important (column 4). These results conclude that even for politically non-connected small firms, there is still a positive and significant gap between sensitivities to public and private contracts.

3.5 Robustness check

This section provides robustness of the main results. I implement two variations of the main results presented in the previous section: (i) redefine the political connection by extending the government support to both organizational and financial as well as considering state ownership as an alternative measure of political connection; (ii) use Heckman selection model to take into account missings in financial information.

The first variation deals with the alternative definition of politically connected firms. Recall, that in the main definition a firm is called politically connected if it receives organizational support. This robustness check redefines that a firm is politically connected if it has state ownership (Table G3 columns 1-3) or if it receives organizational and financial support (Table G3 columns 4-6). Table G3 shows that the results are very close to the one, presented in Table 3.4 for all firms and in Table 3.5 for small and non-small firms — coefficients of interactions have the same magnitude and sign. It supports the finding that public contracts are beneficial to debt access even for non-connected and small firms. Nevertheless, the political connection is an essential factor that determines access to debt and leverage sensitivity to public contracts.

The second step of robustness check deals with the sample selection issue. There are around 5 thousand firm-year missing observations as accounting data is absent, so the panel is not balanced. I want to check how this selection of observations affects the main results. Missing values of Priv.Revenue-TFA are imputed to be equal to the average Priv.Revenue-TFA of other non-missing observations within clusters defined as Industry-Region-Year-Firm size. This procedure enables to restore 3808 missing Priv.Revenue-TFA. Instead of imputing Leverage, I use Heckman selection model to correct for missing values in the dependent variable (Heckman, 1979). There is no official Stata package working with fixed effects in Heckman framework, so we opt to use the random effect model (on firms) with a set of firm's attributes as control variables.[12] Results are presented in Table G4 of Appendix. Coefficients of the interaction of Contracts-TFA with government support are smaller compared to the main results, but they are positive and significant. Overall, the results are similar to the main one, emphasizing the significant gap in debt sensitivity to public and private contracts.

[12]Table 3.3 shows that coefficients for Contract-TFA and Priv.Revenue-TFA are close in the random-effect model (Column 3) and fixed-effect model (Column 4).

3.6 Conclusion

The paper presents evidence regarding the extent to which public procurement contracts can open access to debt and how this access depends on political connection. As the primary data, I use an extensive survey of Russian manufacturing firms — “Russian Firms in a Global Economy” (RuFIGE), including about 1,950 firms from 60 Russian regions. This data is extended by accounting and public procurement information for 2011-2018. The paper shows that if a firm receives public contracts, it issues more debt than a firm with private contracts, given the size of these contracts equal. This finding is in line with the argument from theoretical literature that state-to-business contracts can serve as a signalling channel to a lender about the borrower’s quality. The paper also explains a mechanism: to execute a public contract the borrower issues of short-term debt, and there is no long-term effect of public contracts on the debt. As debt sensitivity to public procurement contracts may entirely be explained by firms’ political connection, I study how the sensitivity depends on the political connection. The paper shows that the debt sensitivity to public contracts is four times larger for politically connected firms, though it is still positive and significant for non-connected and small firms. Therefore, I conclude that public contracts are beneficial for access to debt, and political connection does not entirely suppress this benefit.

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Appendix A

Distributor	Producer	Share change	Event type	Event date
biocad	farmstandart	20% → 70%	Partial merger	31.12.2015
eskom	medpolimer	100% → 0%	Divestiture	04.03.2016
biotek	biosintez	100% → 0%	Divestiture	20.12.2016
sia	biokom	0% → 100%	Full merger	01.02.2017
sia	sintez	17% → 51%	Partial merger	01.02.2017
eskom	medpolimer	0% → 100%	Full merger	08.02.2017
protek	rafarma	0% → 100%	Full merger	17.04.2017
sia	sintez	100% → 0%	Divestiture	29.11.2018
sia	biokom	100% → 0%	Divestiture	29.11.2018

Note. Table shows changes in ownership structure between PD producers and distributors. The full merger implies a change in the ownership share from 0% to at least 50% plus one share. The partial merger implies a change in the ownership share from share higher than 0% to at least 50% plus one share. All VI events, containing SIA as a distributor, were conducted by the financial company Marathon Group, which had a dominant share in SIA as well as acquired partially or fully several producers. In the VI events Farmstandard - Biocad and Eskom-Medpolimer both parts are simultaneously producers and public procurement suppliers of the drugs. Farmstandard supplies drug specifications produced by Biocad quite rarely in my sample (71 drugs), while the opposite is frequent enough (387 drugs). Similarly, Medpolimer supplies drug specifications produced by Eskom not frequently enough in my sample (511 drugs), while the opposite is dominant (3995 drugs). Therefore, I consider only one side of these VI events, where Biocad and Eskom are suppliers. All the results are robust if I consider two sides of these events since new observations add marginally to the estimates.

Table A1: Corporate events that change vertical integration structure

Supplier	Producer	Obs.	Drug spec.	Mean z-price	Median z-price	St.d. z-price
biocad	Control	59	2	-0.624	-0.944	1.069
biocad	Treatment	378	16	-1.231	-1.266	0.701
biotek	Control	4229	218	-0.069	-0.195	0.924
biotek	Treatment	10526	100	-0.160	-0.296	0.890
eskom	Control	364	22	0.382	0.127	1.177
eskom	Treatment	3871	67	0.369	0.264	1.102
protek	Control	146	43	-0.190	-0.374	1.008
protek	Treatment	248	22	-0.166	-0.342	0.810
sia	Control	1370	159	-0.043	-0.101	0.928
sia	Treatment	3161	117	-0.192	-0.413	0.813
unmerged	Control	525362	843	0.001	-0.079	1.000
unmerged	Treatment	1490452	399	0.001	-0.212	1.000

Note. The table shows the descriptive statistics in the treatment and control groups in auctions, where VI and Non-VI distributors are suppliers, i.e. they are winners of auctions. For calculation of z-prices see the note of Table 1.1.

Table A2: Descriptive statistics of treatment and control groups at the drug level

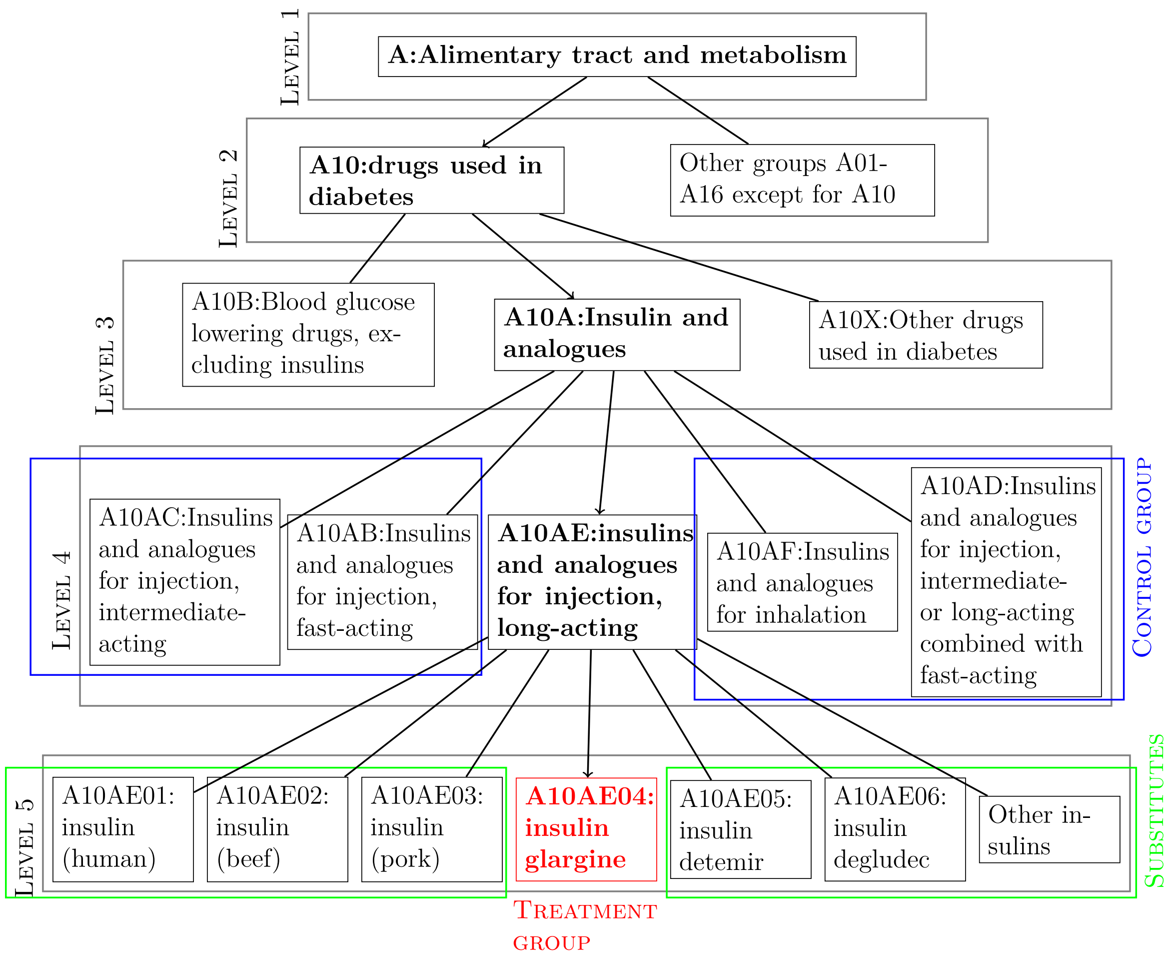


Figure A1: ATC classification for insulin glargine

Appendix B

	Dependent variable: Share of treated drugs			
	Share(total)	Share(1 prod.)	Share(2-4 prod.)	Share($\geq$ 5 prod.)
	(1)	(2)	(3)	(4)
Ln(reserve price)	0.284*	−0.136***	−0.114***	0.534***
	(0.152)	(0.012)	(0.019)	(0.155)
Num. of drug spec.	0.753***	0.012***	0.011***	0.730***
	(0.140)	(0.003)	(0.003)	(0.137)
Duration	0.008***	0.0002***	0.0004**	0.008***
	(0.002)	(0.0001)	(0.0002)	(0.002)
Centr. author.	−3.288**	0.172***	0.694***	−4.154**
	(1.621)	(0.062)	(0.145)	(1.653)
Number of customers	0.789***	−0.0003	−0.008***	0.798***
	(0.057)	(0.001)	(0.003)	(0.057)
If share treat. drugs $\geq$ 1% $*$ Post VI	22.362***	0.167***	0.540***	21.655***
	(0.664)	(0.018)	(0.039)	(0.638)
If share treat. drugs $\geq$ 1% $*$ Post VI $*$ VI distr. part.	−3.562***	−0.079*	0.079	−3.562***
	(0.841)	(0.048)	(0.147)	(0.841)
Procurer FE	8055	8055	8055	8055
Year-quarter FE	YES	YES	YES	YES
Observations	814,684	814,684	814,684	814,684
R^2	0.267	0.019	0.015	0.264

*p<0.1; **p<0.05; ***p<0.01

Note. Column 1 has total share of treated drugs in the bundle as dependent variable. Dependent variables in Columns 2, 3, 4 are share of treated drugs in the bundle with 1, 2–4, $\geq$ 5 producers, respectively. Coefficient of the variable *"If share treat. drugs $\geq$ 1% $*$ Post VI $*$ VI distr. part."* shows how the share of treated drugs change after the VI in auctions, where VI distributors participate compared to auctions, where VI distributors do not participate. Errors are clustered at the procurer level. Variable *VI dist. part.* means that VI distributor is one of participant. Observations are at the bundle level. Sample includes all auctions.

Table B1: VI effect on share of treated drugs

	Dependent variable: Log of price-per-unit of drug			
	OLS	OLS	2SLS	2SLS
	(1)	(2)	(3)	(4)
Quantity: 20-40%	−0.022***	−0.022***	−0.015**	−0.015**
	(0.007)	(0.007)	(0.006)	(0.006)
Quantity: 40-60%	−0.054***	−0.054***	−0.034***	−0.034***
	(0.008)	(0.008)	(0.008)	(0.008)
Quantity: 60-80%	−0.090***	−0.090***	−0.053***	−0.053***
	(0.008)	(0.008)	(0.008)	(0.008)
Quantity: more 80%	−0.137***	−0.137***	−0.070***	−0.070***
	(0.008)	(0.008)	(0.010)	(0.010)
Number of drug spec.	0.002***	0.002***	−0.001	−0.001
	(0.0004)	(0.0004)	(0.001)	(0.001)
Duration	0.00001	0.00001	0.00005**	0.00005**
	(0.00002)	(0.00002)	(0.00002)	(0.00002)
Centr. procurement	−0.038***	−0.038***	−0.004	−0.004
	(0.007)	(0.007)	(0.009)	(0.009)
ATT	−0.017***		−0.015**	
	(0.006)		(0.006)	
ATT (1 producer)		0.114*		0.056
		(0.065)		(0.075)
ATT (2-4 producers)		0.135**		0.128**
		(0.055)		(0.055)
ATT (at least 5 producers)		−0.018***		−0.016***
		(0.006)		(0.006)
Num. of applicants			−0.092***	−0.092***
			(0.009)	(0.009)
Drug spec. FE	850	850	850	850
Region FE	YES	YES	YES	YES
Distributor FE	YES	YES	YES	YES
Year-quarter FE	YES	YES	YES	YES
ATC3-year FE	YES	YES	YES	YES
Observations	123,074	123,074	122,971	122,971
R^2	0.955	0.955	0.953	0.953

*p<0.1; **p<0.05; ***p<0.01

Note: See description of Table 1.3.

Table B2: Effect of VI on prices if VI distributors participate

	Dependent variable: Log of price per unit of drug			
	VI dist. part.	VI dist. part.	No VI dist.	No VI dist.
	(1)	(2)	(3)	(4)
Quantity: 20-40%	-0.051^{***}	-0.051^{***}	-0.049^{***}	-0.049^{***}
	(0.009)	(0.009)	(0.009)	(0.009)
Quantity: 40-60%	-0.087^{***}	-0.087^{***}	-0.081^{***}	-0.081^{***}
	(0.013)	(0.013)	(0.015)	(0.015)
Quantity: 60-80%	-0.134^{***}	-0.134^{***}	-0.122^{***}	-0.121^{***}
	(0.018)	(0.018)	(0.022)	(0.022)
Quantity: more 80%	-0.199^{***}	-0.199^{***}	-0.176^{***}	-0.176^{***}
	(0.022)	(0.022)	(0.029)	(0.029)
Number of drug spec.	0.001	0.001	0.0001	0.0001
	(0.001)	(0.001)	(0.0004)	(0.0004)
Duration	0.0001^{***}	0.0001^{***}	0.0001^{***}	0.0001^{***}
	(0.00002)	(0.00002)	(0.00002)	(0.00002)
Centr. procurement	-0.041^{***}	-0.041^{***}	-0.024^{***}	-0.024^{***}
	(0.007)	(0.007)	(0.008)	(0.008)
ATT	-0.033^{**}		-0.032^{*}	
	(0.017)		(0.017)	
ATT (1 producer)		-0.065		-0.070
		(0.047)		(0.048)
ATT (2-4 producers)		0.028		0.025
		(0.026)		(0.025)
ATT (at least 5 producers)		-0.034^{**}		-0.033^{*}
		(0.017)		(0.017)
Num. of applicants			-0.043^{**}	-0.043^{**}
			(0.020)	(0.020)
Drug spec. FE	1242	1242	1242	1242
Region FE	YES	YES	YES	YES
Distributor FE	YES	YES	YES	YES
Year-quarter FE	YES	YES	YES	YES
ATC3-year FE	YES	YES	YES	YES
Observations	1,909,394	1,909,394	1,905,849	1,905,849
R^2	0.962	0.962	0.963	0.963

*p<0.1; **p<0.05; ***p<0.01

Note: See description of Table 1.4.

Table B3: Effect of VI on prices if VI distributors do not participate

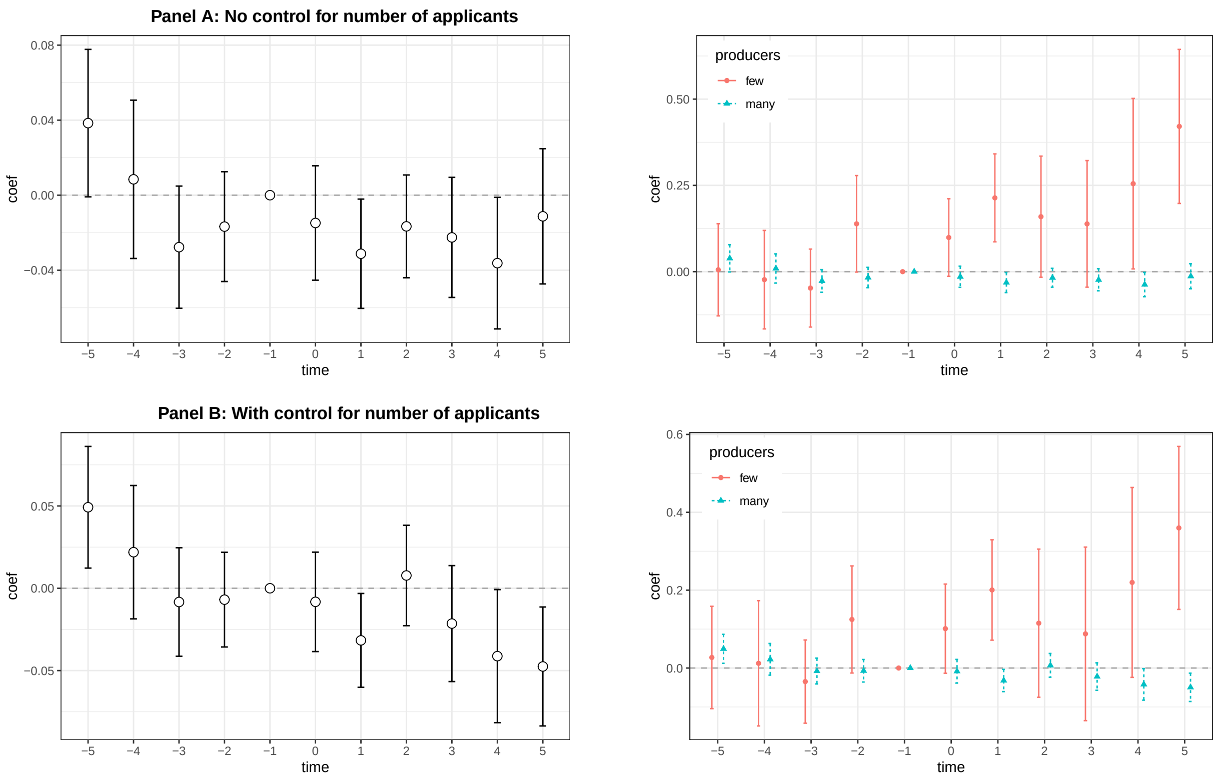


Figure B1: Event-study for price-per-unit. VI distributors participate

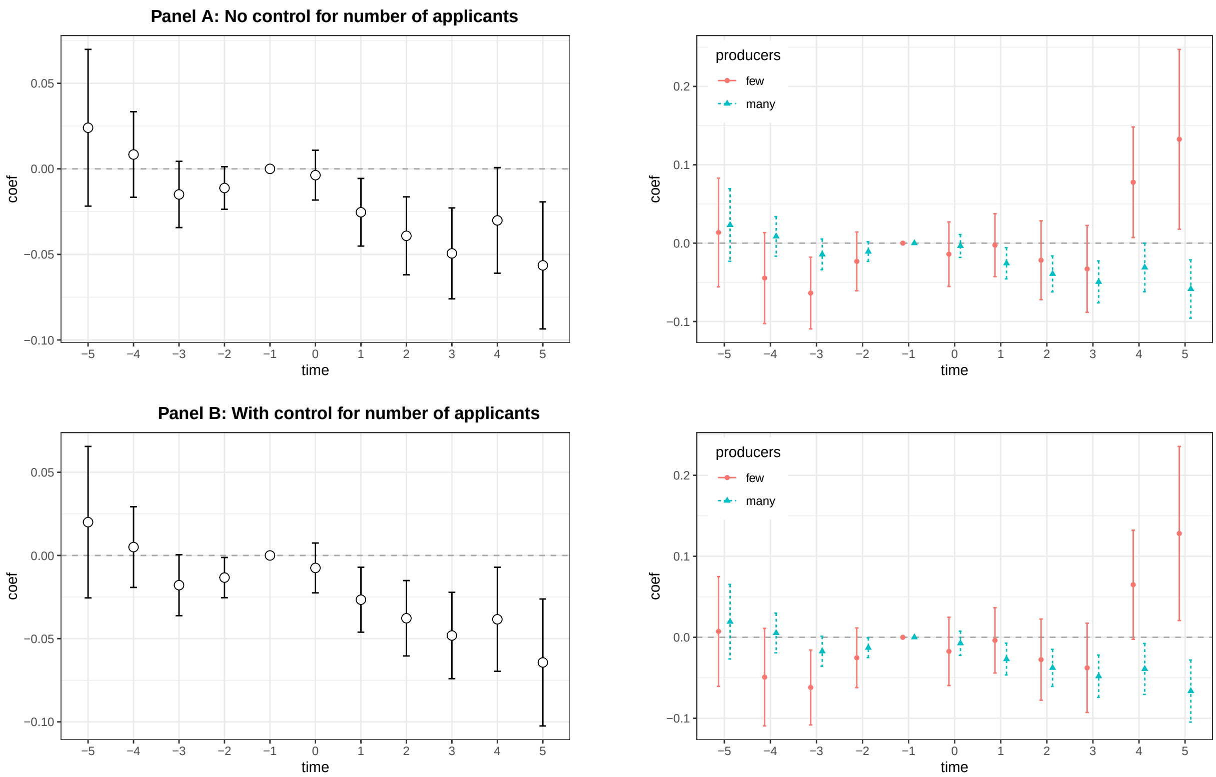


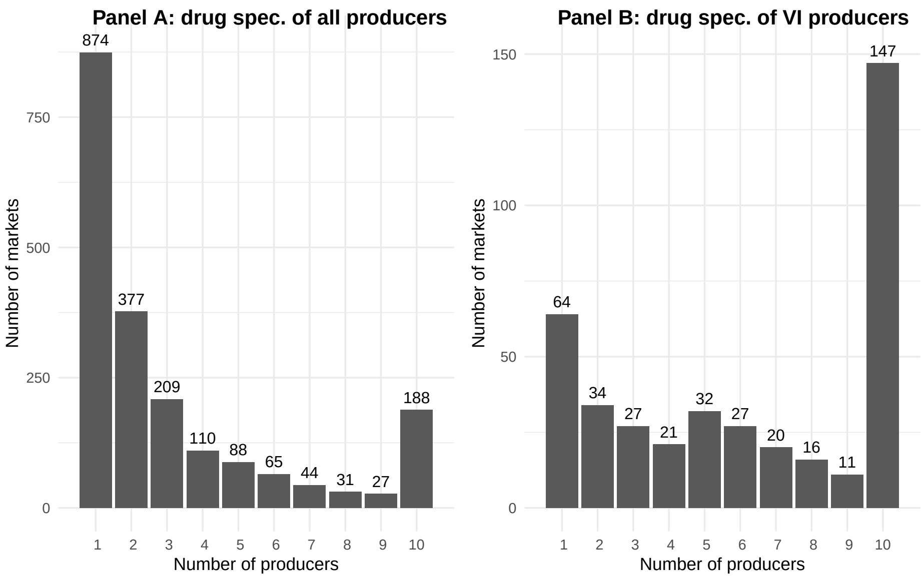
Figure B2: Event-study for price-per-unit. VI distributors do not participate

Appendix C

	Log of price-per-unit			
	OLS	OLS	2SLS	2SLS
	(1)	(2)	(3)	(4)
ATT	0.004		-0.026^{**}	
	(0.010)		(0.012)	
ATT (1 producer)		0.110		0.087
		(0.163)		(0.152)
ATT (2-4 producers)		0.112^{**}		0.079^{*}
		(0.048)		(0.048)
ATT ($\geq$ 5 producers)		0.004		-0.026^{**}
		(0.010)		(0.012)
Num. of applicants			-0.083^{***}	-0.083^{***}
			(0.007)	(0.007)
F stat. (1st stage)			109.03	108.99
Drug spec. FE	592	592	591	591
Region FE	YES	YES	YES	YES
Stack-year-quarter FE	YES	YES	YES	YES
R^2	0.954	0.954	0.954	0.954
Note:				*p<0.1; **p<0.05; ***p<0.01

Note. Table shows the result of stack regression approach for the sameple of auctions, where VI distributors participate. For the rest of description see Note of Table 1.3.

Table C1: Effect of VI on prices - stack regression approach



Note. For all drugs in the sample Panel A shows the distribution of the number of producers by markets. Market is defined as combination of drug specification and Western/Eastern position of a buyer. Panel B shows the same distribution, but for markets, where VI producers act. Markets with more than 10 producers are binned at the bin of 10 producers.

Figure C1: Distribution of the number of producers by geographical markets

	Dependent variable: Log of price-per-unit of drug			
	OLS	OLS	2SLS	2SLS
	(1)	(2)	(3)	(4)
ATT	-0.017^{***}		-0.015^{**}	
	(0.006)		(0.006)	
ATT (1 producer)		0.124^{**}		0.050
		(0.062)		(0.072)
ATT (2-4 producers)		0.099^{**}		0.091^{**}
		(0.041)		(0.042)
ATT (at least 5 producers)		-0.018^{***}		-0.016^{***}
		(0.006)		(0.006)
Num. of applicants			-0.092^{***}	-0.092^{***}
			(0.009)	(0.009)
# drug spec. FE	850	850	850	850
Observations	123,074	123,074	122,971	122,971
R^2	0.955	0.955	0.953	0.953

*p<0.1; **p<0.05; ***p<0.01

Note. Market is defined as combination of drug specification and Western-Eastern location of public buyers. The number of producers for each market is calculated as the number of distinct producers manufacturing brands ever supplied in this market in my data. For the rest of description see Note of Table 1.3.

Table C2: Effect of VI on prices - geographical markets

	Panel A: Log of price-per-unit of drug					
	Original instruments		Alternative instrument		Altern. and origin. instruments	
	(1)	(2)	(3)	(4)	(5)	(6)
ATT	−0.015**		−0.016***		−0.016***	
	(0.006)		(0.005)		(0.006)	
ATT (1 producer)		0.056		0.084		0.078
		(0.075)		(0.068)		(0.069)
ATT (2-4 producers)		0.128**		0.133**		0.132**
		(0.055)		(0.054)		(0.054)
ATT (at least 5 producers)		−0.016***		−0.017***		−0.017***
		(0.006)		(0.005)		(0.006)
Num. of applicants	−0.092***	−0.092***	−0.048***	−0.048***	−0.056***	−0.056***
	(0.009)	(0.009)	(0.004)	(0.004)	(0.003)	(0.003)
Drug spec. FE	850	850	850	850	850	850
Observations	122,971	122,971	122,971	122,971	122,971	122,971
R^2	0.953	0.953	0.956	0.956	0.956	0.956

	Panel B: Number of applicants					
	Original instruments		Alternative instrument		Altern. and origin. instruments	
	(1)	(2)	(3)	(4)	(5)	(6)
Share of treated drugs	0.009***	0.009***			0.008***	0.008***
	(0.001)	(0.001)			(0.0005)	(0.0005)
Share of treated drugs ∗ post VI	−0.003***	−0.003***			−0.002***	−0.002***
	(0.001)	(0.001)			(0.001)	(0.001)
Max. num. of applicants			0.213***	0.213***	0.210***	0.210***
			(0.006)	(0.006)	(0.007)	(0.007)
F statistics	144.78	144.89	1085.96	1086.46	585.45	585.32
R^2	0.525	0.525	0.548	0.548	0.554	0.554

*p<0.1; **p<0.05; ***p<0.01

Note. Column 1-2 are identical to Columns 3-4 of Table 1.3. Columns 3-4 use *Maximum number of applicants* within cluster “Active ingredient-region-year” as an instrument. Columns 5-6 use both original instruments and alternative instrument. Panel A shows 2SLS estimates and Panel B shows first stage estimates. For the rest of description see Note of Table 1.3.

Table C3: Effect of VI on prices - alternative instruments

	Dependent variable: Log of price-per-unit of drug			
	OLS	OLS	2SLS	2SLS
	(1)	(2)	(3)	(4)
ATT	-0.025^{***}		-0.013^{**}	
	(0.006)		(0.006)	
ATT (1 producer)		0.103^{*}		0.055
		(0.063)		(0.071)
ATT (2-4 producers)		0.135^{**}		0.139^{**}
		(0.057)		(0.058)
ATT (at least 5 producers)		-0.026^{***}		-0.014^{**}
		(0.006)		(0.006)
Num. of applicants			-0.086^{***}	-0.085^{***}
			(0.012)	(0.012)
# drug spec. FE	850	850	850	850
Buyer-Supplier FE	21853	21853	21842	21842
Observations	123,074	123,074	122,971	122,971
R^2	0.968	0.968	0.968	0.968

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Note. Joined buyer-supplier fixed effects are introduced in Equations (1.1) and (1.2). For the rest of description see Note of Table 1.3.

Table C4: Effect of VI on prices - control for potential corruption

Appendix D

Properties of $p^*_M(c)$

The second term in equation (1.3) is $\mathbf{P}\left(p + \min(d_1, \ldots, d_M) \leq r\right) = 1 - (1 - G(r - p))^M \equiv G_M(r-p)$, where $G_M(x)$ is the distribution of the minimum of delivery costs $\min(d_1, \ldots, d_M)$ among m distributors with density $g_M(x)$. The first-order condition of (1.3) yields that $p^*_M(c)$ is a solution of the following equation:

$$p - c = \frac{G_M(r-p)}{g_M(r-p)}. \tag{3}$$

The log-concavity of $G(x)$ yields the log-concavity of $G_M(x)$ (Bagnoli and Bergstrom (2005)). This in turn guarantees the second-order condition of (1.3)is satisfied and $p^*_M(c)$ is non-decreasing in c. Notice that G_{M-1} dominates G_M in terms of the reverse hazard rate, so $p^*_M(c)$ is increasing in M.

Proof of Proposition 1.

For a sequence of variables $\{X_1 + \nu, X_2, X_3, \ldots X_m\}$ and ν by $X_k^{(m)}(\nu)$ denote the kth smallest value of the sequence, i.e. $X_1^{(m)}(\nu) = min\{X_1 + \nu, X_2, X_3, \ldots X_m\}$. If $\nu = 0$ denote $X_k^{(m)} \equiv X_k^{(m)}(0)$. It is immediate to see that $X_k^{(m)}(\nu)$ is non-decreasing function of ν. By $X_k^{(m-1)}$ denote the kth smallest value of the sequence $\{X_2, X_3, \ldots X_m\}$ without X_1. The game is solved backward.

First, consider the VS-scenario. At Stage 2 independent distributors participate in the descending auction. Therefore, the weakly dominant strategy of the distributor j is to stay in the auction until the current price reaches the total cost $\widetilde{tc}_j = p_j + d_j$. Delivery cost is exogenous, while input price p_j is a result of the negotiation. Now let us consider Stage 1. Recall, in VS-scenario all the distributors are symmetric from the perspective of the producer, so she sets the identical price $p \in [c_1, \overline{p}]$ to all the distributors, i.e. $p_j = p$.

Since the producer is profit maximizer, she solves the maximization problem (1.3) subject to $p \leq \overline{p}$. By Assumption 1 the solution is $p = \overline{p}$. Therefore, the total cost of distributor j in VS scenario is $\widetilde{tc}_j = \overline{p} + d_j$ and the buyer payment is the second smallest among the total costs $p^{vs} = \widetilde{tc}_2^{(m)}$, conditional on trade and the downstream competition. The the expected buyer payment (conditional that trade occurs)[13] is

$$\mathbf{E}p^{vs} = \mathbf{E}\left(\min(\overline{p} + d_2^{(m)}, r)\middle| \overline{p} + d_1^{(m)} \leq r\right). \tag{4}$$

Now, consider the VI scenario. By assumption P_1 commits to work with all m distributors. D_1 receives the drug at a cost $c_1 - \delta$, so his total cost is $tc_1 = c_1 - \delta + d_1$. The input price of rival distributors includes mark-up $\mu = p - c_1$, which is identical for all distributors due to the symmetry, i.e. their total cost is $tc_j = c_1 + \mu + d_j$ ($j = \overline{2, m}$). Let me consider Stage 2. Due to the vertical integration with P_1, D_1 knows what mark-up μ the producer sets to the other distributors. Because of descending auction at the downstream level, for each current bid level b of the bidding process, D_1 can infer that payoff $b - c_1 - \mu$ goes to the distributor who made this bid, and the rest $c_1 + \mu$ is passing to the producer. If at some moment of bidding process the bid level reaches $b = c_1 + \mu + d_1 - \delta$, D_1 has no more incentives to stay in the auction (if he is still in). Indeed, if D_1 continues to stay in the auction the total profit of D_1 and P_1 becomes less than μ, but if he leaves the auction, the profit of P_1 is guaranteed to be μ. Therefore, the weakly dominant strategy of D_1 is to stay until $c_1 + \mu + d_1 - \delta$ rather than until his total cost tc_1, i.e. D_1 behaves as if he is vertically separated but having the discount parameter δ. Anticipating such behavior of

[13] One call also consider the unconditional expected buyer payment, but in this case the assumption about continuation of the game is required if trade does not occur. One should assume that the buyer has an outside option where she can buy at the reserve price, or she runs another auction with a higher reserve price. Moreover, my data includes only auctions with least one bidder, i.e. auctions where contracts are signed.

D_1, at Stage 1 the VI-producer P_1 solves the following maximization problem

$$\max_{p \leq \overline{p}} (p - c_1)\mathbf{P}(min(tc_1, \ldots, tc_m) \leq r). \tag{5}$$

Notice that that for any input price $p > 0$ and $\delta \geq 0$ random variable $p + \min(d_1, \ldots, d_m)$ dominates $min\,(c_1 - \delta + d_1, p + \min(d_2, \ldots, d_m))$ in terms of reverse hazard rate. Therefore, the unrestricted solution $p_m^{vi}(c_1)$ of (5) is not smaller than the unrestricted solution of (1.3), i.e. $p_m^{vi}(c_1) \geq p_m^*(c_1)$, so by Assumption 1, restricted solution of (5) is $p = \overline{p}$. Note that probability that trade occurs in (5) of VI-scenario is higher compared to the one in (1.3) of VS-scenario for any p, because due to efficiency gain D_1 is more likely to enter the auction. This means that without the upper bound $\overline{p}$, VI producer would like to set higher price than $p_m^*(c_1)$. Therefore, conditional on trade and downstream competition, the buyer payment is $tc_2^{(m)} = \widetilde{tc}_2^{(m)}(-\delta)$ and conditional expected buyer payment is

$$\mathbf{E}p^{vi} = \mathbf{E}\left(\min(\widetilde{tc}_2^{(m)}(-\delta), r) \middle| min(tc_1, \ldots, tc_m) \leq r\right). \tag{6}$$

Notice $\widetilde{tc}_2^{(m)}(-\delta) \leq \widetilde{tc}_2^{(m)}$ point-wise. This inequality is strict with positive probability when $\delta > 0$, e.g. when D_1 has the second smallest total cost in VS-scenario. Therefore, for $\delta = 0$ we have $\mathbf{E}p^{vs} = \mathbf{E}p^{vi}$ and for $\delta > 0$ we have $\mathbf{E}p^{vs} > \mathbf{E}p^{vi}$. ∎

Multiple producer case: definition of equilibrium

First, consider the VS-scenario. The game is solved backward. At Stage 2, the weakly dominant strategy of distributor j is to stay in the auction until the current price reaches the total cost $\widetilde{tc}_j = p_j + d_j$. When $n > 1$, at Stage 1 each distributor runs an inner descending open auction among all producers and chooses the minimal price. Since all the inner auctions are run simultaneously for the same realization of production costs $(c_i)_{i=1}^n$, the producer with the minimal cost wins all the inner auctions[14] and the input price of all distributors is $p_j = c_2^{(n)}$.[15] Therefore, the total cost of distributor j is $\tilde{tc}_j = c_2^{(n)} + d_j$ and the expected buyer payment is

$$\mathbf{E}p^{vs} = \mathbf{E}\left(c_2^{(n)} + d_2^{(m)}\right). \tag{7}$$

Now, consider the VI-scenario and assume that P_1 commits to work with all the distributors. Let $c_1+\mu$ be the ultimate offer of P_1 at Stage 1 in negotiations with rival distributors, which is the same for all rivals distributors due to symmetry. Strategy $\mu \in [0, \overline{p} - c_1]$ is what P_1 chooses to maximize expected profit of the integrated firm $P_1\&D_1$. Choice of μ characterizes the RRC effect.

Consider the case, when at Stage 2 the VI producer P_1 is the input supplier of all distributors. In this case, the total costs of D_1 is $tc_1 = c_1 - \delta + d_1$. Moreover, P_1 was able to overbid all other independent producers at Stage 1, i.e. $c_1 + \mu \leq c_1^{(n-1)}$. Therefore, the input prices of rival distributors is $p_j = c_1^{(n-1)}$ and their total costs is $tc_j = c_1^{(n-1)} + d_j$ ($j \in \{2, \ldots, m\}$). Since P_1 supplies to all distributors, at Stage 2, similarly to the case of $n = 1$, D_1 stays in the auction until price reaches $c_1^{(n-1)} - \delta + d_1$ rather than $c_1 - \delta + d_1$. Indeed, if D_1 observes that $d_1 - \delta > d_1^{(m-1)}$, he has no incentives to win the auction, because if he looses then the profit of P_1 is $c_1^{(n-1)} - c_1$, but if he wins then the total profit of $P_1\&D_1$ is lower. Therefore, the total profit of $P_1\&D_1$ is $c_1^{(n-1)} - c_1 + d_1^{(m-1)} - d_1 + \delta$ if $d_1 - \delta \leq d_1^{(m-1)}$, and $c_1^{(n-1)} - c_1$ otherwise.

Consider the case, when at Stage 2 VI producer P_1 is not the input supplier of all distributors, i.e. P_1 is an input supplier either for D_1 or for nobody. In this case, at Stage

[14]In non-cooperative equilibrium, producers do not split between distributors, as the minimal cost producer has always incentives to marginally undercut other producers in all the inner auctions and to become the supplier of all distributors.

[15]Note that $c_2^{(n)}$ is not parametrized by j, i.e. each distributor has the same input price and potentially the same input supplier. The assumption that negotiation process of each distributor is run for the same realization of production costs $(c_i)_{i=1}^n$ does not affect the ex-ante expected buyer payment, but simplifies derivations.

2 all the distributors stay in the procurement auction until their total costs $tc_j = p_j + d_j$. If $tc_1 \leq tc_1^{(m-1)}$ then D_1 wins and $P_1\&D_1$ aggregate profit is $tc_1^{(m-1)} - tc_1$, otherwise D_1 looses and $P_1\&D_1$ earn zero. At Stage 1 the negotiation process defines the input prices of distributors. The equilibrium input price of D_1 is $p_1 = min\left(c_2^{(n-1)}, c_1 - \delta\right)$. Rival producer with the lowest cost wins the inner auctions of all rival distributors at the price $c_2^{(n)}(\mu)$. Note that $c_2^{(n)}(\mu)$ is non-decreasing in μ. The lowest cost rival producer anticipates that P_1 can strategically increase μ in order to raise costs of rival distributors, so she may want to give additional rebate ρ to the price $c_2^{(n)}(\mu)$ for rival distributors in response to this strategy.[16] Therefore the total cost of distributors are:

$$tc_1 = min\left(c_2^{(n-1)}, c_1 - \delta\right) + d_1. \tag{8}$$

$$tc_j = c_2^{(n)}(\mu) - \rho + d_j \quad (j \in \{2, \dots, m\})$$

Let me introduce the following events:

(i) $A = \left\{c_1 + \mu \leq c_1^{(n-1)}\right\}$, when P_1 is the input supplier to all distributors;

(ii) $B = \left\{c_1^{(n-1)} < c_1 - \delta\right\}$, when P_1 is not an input supplier to any distributor;

(iii) $C = \left\{c_2^{(n-1)} < c_1 - \delta\right\}$, when P_1 is not an input supplier to any distributor and D_1 input price is lower than $c_1 - \delta$;

(iv) $D = \left\{d_1 - \delta < d_1^{(m-1)}\right\}$, when delivery cost of D_1 (including the efficiency gain) is the lowest one;

(v) $E = \left\{tc_1 < tc_1^{(m-1)}\right\}$, when the total cost of D_1 is the lowest and tc_j are defined in (8).

Notice that $C \subset B \subset \overline{A}$, so $\overline{A} \cap \overline{B}$ means that P_1 is the input supplier to D_1 only. The equilibrium strategies of the game are functions $\mu(c_1) : [\underline{c}, \overline{c}] \rightarrow [0, \overline{p} - c_1]$ and

[16] Note that lowest cost rival producer observes $c_2^{(n)}(\mu)$, but not c_1. Moreover, in many cases she cannot infer c_1 from $c_2^{(n)}(\mu)$ as $c_2^{(n)}(\mu)$ is not necessary strictly monotone in c_1.

$\rho(c_1^{(n-1)}, c_2^{(n)}(\mu)) : [\underline{c}, \overline{c}] \times [\underline{c}, \overline{p}] \to \mathbb{R}^+$ that solve the following system of maximization problems:

$$\begin{aligned} \underset{\mu}{argmax}\ & \mathbf{E}\left(c_1^{(n-1)} - c_1 + d_1^{(m-1)} - d_1 + \delta \middle| c_1, \rho, A \cap D\right) \mathbf{P}(A \cap D | c_1, \rho) + \\ & \mathbf{E}\left(c_1^{(n-1)} - c_1 \middle| c_1, \rho, A \cap \bar{D}\right) \mathbf{P}(A \cap \bar{D} | c_1, \rho) + \\ & \mathbf{E}\left(tc_1^{(m-1)} - tc_1 \middle| c_1, \rho, \bar{A} \cap E\right) \mathbf{P}(\bar{A} \cap E | c_1, \rho); \end{aligned} \tag{9}$$

$$\underset{\rho}{argmax}\ \left(c_2^{(n)}(\mu) - \rho - c_1^{(n-1)}\right) \mathbf{P}\left(\bar{E} \middle| c_2^{(n)}(\mu), c_1^{(n-1)}, \mu, \bar{A} \cap \bar{B}\right). \tag{10}$$

The expected buyer payment is

$$\begin{aligned} \mathbf{E}p^{vi} = & \mathbf{E}\left(c_1^{(n-1)} + d_1^{(m-1)} \middle| A \cap D\right) \mathbf{P}(A \cap D) + \\ & \mathbf{E}\left(c_1^{(n-1)} + \min\left\{d_1 - \delta, d_2^{(m-1)}\right\} \middle| A \cap \bar{D}\right) \mathbf{P}(A \cap \bar{D}) + \mathbf{E}\left(tc_2^{(m)} \middle| \bar{A}\right) \mathbf{P}(\bar{A}). \end{aligned} \tag{11}$$

Proof of Proposition 2.

Preliminary setting.

To prove Proposition 2 I consider Non-VI and VI scenario in parallel, i.e. I will assume that realizations of random variables c_i ($i = \overline{1,n}$) and d_j ($j = \overline{1,m}$) are the same for both cases. From ex-ante perspective (i.e. expectation of buyer's payment) this makes no difference as if I consider cases before and after the VI separately. I start with an auxiliary lemma.

Lemma 1. $\lim_{n\to\infty} \mathbf{E}c_2^{(n)}(\mu) - \mathbf{E}c_2^{(n)}(0) = 0.$

Proof of Lemma 1. First let me find the pdf of $c_2^{(n)}$.

$$\mathbf{P}\left(c_2^{(n)} > x\right) = \mathbf{P}\left(c_1^{(n)} > x\right) + \mathbf{P}\left(c_2^{(n)} > x, c_1^{(n)} < x\right) = (1 - F(x))^n + n\,(1 - F(x))^{n-1} F(x).$$

So the pdf of $c_2^{(n)}$ is

$$f_2(x) = -\mathbf{P}\left(c_2^{(n)} > x\right)' = n(n-1)F(x)\left(1-F(x)\right)^{n-2} f(x).$$

Denote by $c_2^{(n-1)}$ the second smallest element of the sequence $(c_2, \dots, c_n)$ without element c_1. Recall that by assumption $f(x)$ has finite support $[\underline{c}, \overline{c}]$. Let me calculate

$$\mathbf{E}c_2^{(n-1)} - \mathbf{E}c_2^{(n)} = \int_a^b x(n-1)(n-2)F(x)\left(1-F(x)\right)^{n-3} f(x)dx -$$

$$\int_a^b xn(n-1)F(x)\left(1-F(x)\right)^{n-2} f(x)dx = \int_a^b x(n-1)f(x)F(x)\left(1-F(x)\right)^{n-3}\left(nF(x)-2\right)dx \le$$

$$\int_a^b x(n-1)f(x)F(x)\left(1-F(x)\right)^{n-3}(n-2)dx \xrightarrow[n\to\infty]{} 0$$

as $(n-1)(n-2)\left(1-F(x)\right)^{n-3} \xrightarrow[n\to\infty]{} 0$ for all $x \in (\underline{c}, \overline{c}]$. Note also that $c_2^{(n-1)} - c_2^{(n)} \ge 0$ as $c_2^{(n)}$ is the second smallest among n realizations, while $c_2^{(n-1)}$ is the second smallest among the same realizations except for the first one. Therefore, $\lim\limits_{n\to\infty} \mathbf{E}c_2^{(n-1)} - \mathbf{E}c_2^{(n)} = 0$. As $c_2^{(n-1)} \ge c_2^{(n)}(\mu) \ge c_2^{(n)}(0)$, we have that $\lim\limits_{n\to\infty} \mathbf{E}c_2^{(n)}(\mu) - \mathbf{E}c_2^{(n)}(0) = 0$. ■

Proof of Proposition 2.

Recall that pre-merger the total cost of jth ($j = \overline{1,m}$) distributor is $\tilde{tc}_j = c_2^{(n)}(0) + d_j$ and the buyer payment is $\tilde{tc}_2^{(m)} = c_2^{(n)}(0) + d_2^{(m)}$. The post-merger total costs of D_1 is $tc_1 = \min\left(c_2^{(n)}(0), c_1 - \delta\right) + d_1$, total costs of jth ($j = \overline{2,m}$) distributor is $tc_j = c_2^{(n)}(\mu) - \rho + d_j$. Note that the event when P_1 is the input supplier for all distributors has zero probability in limit. Indeed, $\mathbf{P}\left(c_1 + \mu \le c_1^{(n-1)}\right) \le \frac{1}{n}$ (as c_i are iid), so $\mathbf{P}\left(c_1 + \mu \le c_1^{(n-1)}\right) \xrightarrow[n\to\infty]{} 0$. Henceforth, I consider the event when P_1 is not the input supplier for all distributors. Under this event the payment of buyer is $tc_2^{(m)}$. Note that $tc_2^{(m)}$ is non-increasing in ρ, so it is enough to prove Proposition 2 for $\rho = 0$. For the rest of the proof consider $\rho = 0$. Let me decompose the expected post-merger payment of the buyer by several events and compare post- and pre- merger conditional expected payments.

$$\begin{aligned}\mathbf{E}tc_2^{(m)} =&\mathbf{E}\left(tc_2^{(m)}\middle|tc_1 = tc_1^{(m)}\right)\mathbf{P}\left(tc_1 = tc_1^{(m)}\right) + \\ &\mathbf{E}\left(tc_2^{(m)}\middle|tc_1 = tc_2^{(m)}\right)\mathbf{P}\left(tc_1 = tc_2^{(m)}\right) + \\ &\mathbf{E}\left(tc_2^{(m)}\middle|tc_1 > tc_2^{(m)}\right)\mathbf{P}\left(tc_1 > tc_2^{(m)}\right).\end{aligned} \tag{12}$$

The first summand is for the event when D_1 has minimal total cost, the second - D_1 has the second smallest total cost, the third - D_1 has the third minimal total cost or larger. Conditional expectation of the first summand of (12) can be further decomposed into two events - when D_1 wins pre-merger and when D_1 looses pre-merger and wins post-merger.

$$\begin{aligned}\mathbf{E}\left(tc_2^{(m)}\middle|tc_1 = tc_1^{(m)}\right) = &\mathbf{E}\left(tc_2^{(m)}\middle|d_1 = d_1^{(m)}\right)\mathbf{P}\left(d_1 = d_1^{(m)}\right) + \\ &\mathbf{E}\left(tc_2^{(m)}\middle|tc_1 = tc_1^{(m)}, d_1 > d_1^{(m)}\right)\mathbf{P}\left(tc_1 = tc_1^{(m)}, d_1 > d_1^{(m)}\right)\end{aligned} \tag{13}$$

The conditional expectation of the first summand of (13) satisfies

$$\begin{aligned}\mathbf{E}\left(tc_2^{(m)}\middle|d_1 = d_1^{(m)}\right) = \mathbf{E}\left(c_2^{(n)}(\mu) + d_2^{(m)}\middle|d_1 = d_1^{(m)}\right) \geq \\ \mathbf{E}\left(c_2^{(n)}(0) + d_2^{(m)}\middle|d_1 = d_1^{(m)}\right) = \mathbf{E}\left(\widetilde{tc}_2^{(m)}\middle|d_1 = d_1^{(m)}\right)\end{aligned} \tag{14}$$

This case corresponds to the event when D_1 wins auction pre-merger, and so wins post-merger. However, the post-merger the cost of the second winner is higher as $c_2^{(n)}(\mu) \geq c_2^{(n)}(0)$, so the ex-ante expected payment increases.

The conditional expectation of the second summand of (13) satisfies

$$\begin{aligned}\mathbf{E}\left(tc_2^{(m)}\middle|tc_1 = tc_1^{(m)}, d_1 > d_1^{(m)}\right) =&\mathbf{E}\left(c_2^{(n)}(\mu)\middle|tc_1 = tc_1^{(m)}, d_1 > d_1^{(m)}\right) + \\ &\mathbf{E}\left(d_1^{(m)}\middle|tc_1 = tc_1^{(m)}, d_1 > d_1^{(m)}\right)\end{aligned} \tag{15}$$

This case corresponds to the event when D_1 wins auction post-merger, bust looses pre-merger. Ex-ante expected buyer payment can either increase because $c_2^{(n)}(\mu) \geq c_2^{(n)}(0)$ and so

$$\mathbf{E}\left(c_2^{(n)}(\mu)\,\middle|\,tc_1 = tc_1^{(m)}, d_1 > d_1^{(m)}\right) \geq \mathbf{E}\left(c_2^{(n)}(0)\,\middle|\,tc_1 = tc_1^{(m)}, d_1 > d_1^{(m)}\right) \tag{16}$$

or decrease because $d_1^{(m)} \leq d_2^{(m)}$ and so

$$\mathbf{E}\left(d_1^{(m)}\,\middle|\,tc_1 = tc_1^{(m)}, d_1 > d_1^{(m)}\right) \leq \mathbf{E}\left(d_2^{(m)}\,\middle|\,tc_1 = tc_1^{(m)}, d_1 > d_1^{(m)}\right) \tag{17}$$

The exact sign will depend on distributions $F(.)$ and $G(.)$

Conditional expectation of the second summand of (12) can be further decomposed into three events: when D_1 is second best before and after the merger, D_1 becomes the second best after VI because of efficiency gain, D_1 becomes the second best after VI because of rivals foreclosure.

$$\begin{aligned}\mathbf{E}\left(tc_2^{(m)}\,\middle|\,tc_1 = tc_2^{(m)}\right) = \mathbf{E}\left(tc_2^{(m)}\,\middle|\,tc_1 = tc_2^{(m)}, d_1 = d_2^{(m)}\right)\mathbf{P}\left(tc_1 = tc_2^{(m)}, d_1 = d_2^{(m)}\right) + \\ \mathbf{E}\left(tc_2^{(m)}\,\middle|\,tc_1 = tc_2^{(m)}, d_1 > d_2^{(m)}, d_1 + \min\left(c_2^{(n)}(0), c_1 - \delta\right) < d_2^{(m)} + c_2^{(n)}(0)\right) \\ \mathbf{P}\left(tc_1 = tc_2^{(m)}, d_1 > d_2^{(m)}, d_1 + \min\left(c_2^{(n)}(0), c_1 - \delta\right) < d_2^{(m)} + c_2^{(n)}(0)\right) +\end{aligned} \tag{18}$$

$$\begin{aligned}\mathbf{E}\left(tc_2^{(m)}\,\middle|\,tc_1 = tc_2^{(m)}, d_1 > d_2^{(m)}, d_2^{(m)} + c_2^{(n)}(0) < d_1 + \min\left(c_2^{(n)}(0), c_1 - \delta\right) < d_2^{(m)} + c_2^{(n)}(\mu)\right) \\ \mathbf{P}\left(tc_1 = tc_2^{(m)}, d_1 > d_2^{(m)}, d_2^{(m)} + c_2^{(n)}(0) < d_1 + \min\left(c_2^{(n)}(0), c_1 - \delta\right) < d_2^{(m)} + c_2^{(n)}(\mu)\right) +\end{aligned}$$

The conditional expectation of the first summand of (18) satisfies

$$\mathbf{E}\left(tc_2^{(m)}\middle|tc_1=tc_2^{(m)},d_1=d_2^{(m)}\right)=\mathbf{E}\left(d_1+\min\left(c_2^{(n)}(0),c_1-\delta\right)\middle|tc_1=tc_2^{(m)},d_1=d_2^{(m)}\right)\leq \tag{19}$$

$$\mathbf{E}\left(d_1+c_2^{(n)}(0)\middle|tc_1=tc_2^{(m)},d_1=d_2^{(m)}\right)=\mathbf{E}\left(\tilde{tc}_2^{(m)}\middle|tc_1=tc_2^{(m)},d_1=d_2^{(m)}\right)$$

as $\min\left(c_2^{(n)}(0),c_1-\delta\right)\leq c_2^{(n)}(0)$. This case corresponds to the event when D_1 is the second best pre-merger and post-merger. However, cost of D_1 decreases because of efficiency gain and so the ex-ante expected buyer payment decreases.

The conditional expectation of the second summand of (18) satisfies

$$\mathbf{E}\left(tc_2^{(m)}\middle|tc_1=tc_2^{(m)},d_1>d_2^{(m)},d_1+\min\left(c_2^{(n)}(0),c_1-\delta\right)<d_2^{(m)}+c_2^{(n)}(0)\right)\leq \tag{20}$$

$$\mathbf{E}\left(d_2^{(m)}+c_2^{(n)}(0)\middle|tc_1=tc_2^{(m)},d_1>d_2^{(m)},d_1+\min\left(c_2^{(n)}(0),c_1-\delta\right)<d_2^{(m)}+c_2^{(n)}(0)\right)$$

by the way the event is defined. This case corresponds to the event when D_1 becomes more efficient than the pre-merger second-best, so the ex-ante expected buyer payment decreases.

The conditional expectation of the third summand of (18) satisfies

$$\mathbf{E}\left(tc_2^{(m)}\middle|tc_1=tc_2^{(m)},d_1>d_2^{(m)},d_2^{(m)}+c_2^{(n)}(0)<d_1+\min\left(c_2^{(n)}(0),c_1-\delta\right)<d_2^{(m)}+c_2^{(n)}(\mu)\right)\geq \tag{21}$$

$$\mathbf{E}\left(d_2^{(m)}+c_2^{(n)}(0)\middle|tc_1=tc_2^{(m)},d_1>d_2^{(m)},d_2^{(m)}+c_2^{(n)}(0)<d_1+\min\left(c_2^{(n)}(0),c_1-\delta\right)<d_2^{(m)}+c_2^{(n)}(\mu)\right)$$

by the way the event is defined. This case corresponds to the event when D_1 becomes the second-best post-merger because input cost of the pre-merger second-best increases, so the ex-ante expected buyer payment increases.

Conditional expectation of the third summand of (12) satisfies

$$\mathbf{E}\left(tc_2^{(m)}\middle|tc_1 > tc_2^{(m)}\right) = \mathbf{E}\left(c_2^{(n)}(\mu) + d_2^{(m)}\middle|tc_1 > tc_2^{(m)}\right) \geq \mathbf{E}\left(c_2^{(n)}(0) + d_2^{(m)}\middle|tc_1 > tc_2^{(m)}\right), \tag{22}$$

as $c_2^{(n)}(\mu) \geq c_2^{(n)}(0)$. This case corresponds to the event when post-merger D_1 has total cost higher than second-best. In this case the RRC effect increases the ex-ante expected buyer payment.

Let us now look at all the events, when post-merger ex-ante expected buyer payment is higher than the pre-merger one. They are (14), (16), (21), (22). In all these cases, the difference between post-merger and pre-merger ex-ante expected buyer payment does not exceed expectation of $c_2^{(n)}(\mu) - c_2^{(n)}(0)$ (conditional on the corresponding event), which by Lemma 1 tends to zero as $n \to \infty$.

Events, where post-merger ex-ante expected buyer payment is lower than the pre-merger one, are (17), (19), (20). In all these events difference between post-merger and pre-merger ex-ante expected buyer payment does not tends to zero $n \to \infty$ and for $\delta > 0$ the events in (19), (20) have positive probability in limit. ■

Appendix E

Incorporating of unobserved heterogeneity

To incorporate the unobserved heterogeneity per se, I need to impose more structure. If one admits the presence of the unobserved heterogeneity, then the total cost structure has the form

$$tc_{j,a} = \underbrace{c_{2,a}^{(N)}}_{common\,term} + \underbrace{d_{j,a}}_{private\,value} + \underbrace{\beta \mathbf{X_a}}_{observed\,heterogen.} + \underbrace{u_a}_{unobserved\,heterogen.} \tag{23}$$

This form is an extension of 1.6 incorporating the unobserved heterogeneity term. u_a. Obviously, two bids of an auction cannot identify the distribution of u_a as they are used to identify the distribution of $c_{2,a}^{(N)}$. Additional structure on the reserved price enables to identify the distribution of u_a. Namely, I need to assume the reserve price to be of the following form

$$r_a = \tilde{r_a} + \beta \mathbf{X_a} + u_a \tag{24}$$

On top of this, I need the following additional assumptions on top of Assumptions 2 – 5:

Assumption 6. ***(Independence of unobserved heterogeneity.)*** *Unobserved heterogeneity u_a is independent of producer costs $(c_{i,a})_{i=1}^{N}$, distributor costs $(d_{j,a})_{j=1}^{M}$ and of observed heterogeneity $\mathbf{X_a}$.*

Assumption 7. ***(Normalization.)*** *(i) Unobserved heterogeneity is normalized to satisfy $\mathbf{E}(u_a) = 0$; (ii) Characteristic function of u_a has isolated zeros.*

The identification of the unobserved heterogeneity follows the logic of input price identification.

One-to-one correspondence between multiplicative and additive forms of total cost structure

This section shows that there is one-to-one correspondence between multiplicative and additive forms of total cost. Assume the total cost has the following multiplicative form:

$$TC_{j,a} = \underbrace{C_{2,a}^{(N)}}_{common\, term} \cdot \underbrace{D_{j,a}}_{private\, value} \cdot \underbrace{e^{\beta \mathbf{X_a}}}_{observed\, heterogen.} \tag{25}$$

So the winning bid and other order statistics of bids satisfy

$$\text{winning bid: } b_{1,a}^{(m)} = TC_{2,a}^{(M)} \tag{26}$$
$$\text{other bids: } b_{k,a}^{(m)} = TC_{k+1,a}^{(M)}$$

If we take the logarithm of the bids and and all components of the total cost (25), we are back to the additive form, represented in (1.6):

$$tc_{j,a} = ln(TC_{j,a}),\ c_{2,a}^{(N)} = ln\left(C_{2,a}^{(N)}\right),\ d_{j,a} = ln\left(D_{j,a}\right) \tag{27}$$

$$tc_{j,a} = \underbrace{c_{2,a}^{(N)}}_{common\, term} + \underbrace{d_{j,a}}_{private\, value} + \underbrace{\beta \mathbf{X_a}}_{observed\, heterogen.} \tag{28}$$

Proposition 3: identification of costs distributions

Without loss of generality we can assume absence of the observed heterogeneity as it can be easily identified and subtracted via the regression of the observed bids on the observed characteristics. Let me start from the result, showing how the order statistics of total costs and knowledge of input price identify the distribution of the distribution cost. Consider the conditional probability

$$\mathbf{P}\left(tc_2^{(m)} = x | tc_3^{(m)} = y, c_2^{(N)} = z\right) = \mathbf{P}\left(d_2^{(m)} = x - z | d_3^{(m)} = y - z\right) = \tag{29}$$

$$\mathbf{P}\left(d_2^{(2)} = x - z | d_2^{(2)} \leq y - z\right) = f_{d_2^{(2)}}(x - z | y - z) \tag{30}$$

Now consider the case when the third order statistics of total costs hits the upper bound. Then $\forall x \in [\underline{c}+\underline{d}, \overline{c}+\overline{d}]$ from (29) we have

$$\mathbf{P}\left(tc_2^{(m)} = x | tc_3^{(m)} = \overline{c}+\overline{d}\right) = \mathbf{P}\left(tc_2^{(m)} = x | c_2^{(N)} = \overline{c}, d_3^{(m)} = \overline{d}\right) = f_{d_2^{(2)}}(x-\overline{c})$$

Since we observe the left-hand side in the data, the right hand side identifies the distribution of $d_2^{(2)}+\overline{c}$. However, the upper bound $\overline{c}$ can be unobserved. I identify it from Assumption 4. Namely,

$$\mathbf{E}(d_2^{(2)}+\overline{c}) = \mathbf{E}(d_2^{(2)}+c_2^{(N)}) - \mathbf{E}(c_2^{(N)}) + \overline{c} = \mathbf{E}(tc_2^{(2)}) + \overline{c}. \tag{31}$$

Here I used that $\mathbf{E}(c_2^{(N)}) = 0$. In (31) left-hand side is already identified and term $\mathbf{E}(tc_2^{(2)})$ is observed in the data, so $\overline{c}$ is identified. Therefore, we can identify the distribution of order statistics of d_j and the distribution of d_j is identified from (1.9).

Now we can identify the distribution of c_i. We observe in the data $tc_2^{(m)} = d_2^{(m)} + c_2^{(N)}$. We already identified the distribution of $d_2^{(m)}$ and the distribution of $c_2^{(N)}$ can be identified from the ratio of characteristic functions under independence Assumption 3:

$$\varphi_{c_2^{(N)}}(t) = \frac{\varphi_{tc_2^{(m)}}(t)}{\varphi_{d_2^{(m)}}(t)}.$$

The distribution of c_i is identified from the distribution of $c_2^{(N)}$ by inversion (1.9).

Elements of the liklihood function

The likelihood function (1.11) includes the following elements:

$$p_0 = \mathbf{P}(m=0) = \mathbf{P}(tc_j > r \;\forall\, j) = \int_{-\infty}^{\infty} [1-G(r-z)]^M \, dF_{c_2^{(N)}}(z) \tag{32}$$

$$p_1 = \mathbf{P}(m=1) = \int_{-\infty}^{\infty} MG(r-z)\,[1-G(r-z)]^{M-1} \, dF_{c_2^{(N)}}(z) \tag{33}$$

$$p_2(x) = \mathbf{P}(tc_2^{(M)} = x, m = 2) = \mathbf{P}(tc_1^{(M)} < x,\, tc_2^{(M)} = x,\, tc_3^{(M)} > r) = \int_{-\infty}^{\infty} MG(x-z)g(x-z)\left[1 - G(r-z)\right]^{M-2} dF_{c_2^{(N)}}(z) \text{ for } x \le r \tag{34}$$

$$p_k(x,y) = \mathbf{P}(tc_2^{(M)} = x, tc_3^{(M)} = y, m = k) = \mathbf{P}(tc_1^{(M)} < x,\, tc_2^{(M)} = x, tc_3^{(M)} = y, tc_j^{(M)} \in (y, r]\, (j = \overline{4,k}), tc_{k+1}^{(M)} > r) = \int_{-\infty}^{\infty} \frac{M!}{(k-3)!(M-k)!} G(x-z)g(x-z)g(y-z)\left[G(r-z) - G(y-z)\right]^{k-3} \cdot \left[1 - G(r-z)\right]^{M-k} dF_{c_2^{(N)}}(z) \text{ for } x \le y \le r \text{ and } k \ge 3 \tag{35}$$

And the constraint

$$\mathbf{E}\left(c_2^{(N)}\right) = \int_{-\infty}^{\infty} zn(n-1)F(z)\left[1 - F(z)\right]^{n-2} dz = 0 \tag{36}$$

Appendix F

Name	Description	Type
Procurement outcome		
Number of bidders	Number of bidders in auction	Quantitative
Delay	Difference between the actual execution date and contract execution date (days)	Quantitative
Normalized delay	Delay normalized with respect to the contract duration period. Computed as the delay divided by the difference between the contract execution date and signing date	Quantitative
Terminated contract	If contract was terminated during the execution period	Factor (1-yes, 0-no)
Governors controls		
Tenure in office	Exact governor's time in office by the date of contract signing, (years)	Quantitative
Term in office	Sequential number of the governor's term by the date of contract signing	Quantitative
Incumbent	If the governor is in the office for the second or more terms by the date of contract signing	Factor (1-yes, 0-no)
Age	Age of the governor by 01.01.2011, (years)	Quantitative
Elected	If at the contract signing date the governor was elected (after October 2012).	Factor (1-yes, 0-no)
Insider	If the governor had the job position in the same region during the pre-governance period for at least a total of three years	Factor (1-yes, 0-no)
Contract controls		
Repeated contract	If the pair of procurer/supplier had 3 or more repeated contracts during 2011-2014. The first two contracts are not marked as repeated	Factor (1-yes, 0-no)
Log contract price	Logarithm of contract price, (ln RUR)	Quantitative
Log reserve price	Logarithm of reserve price, (ln RUR)	Quantitative
Number of items	Number of different items specified in contract to be implemented	Quantitative
Duration	Duration of contract (in days)	Quantitative
Procurement procedure	Dummy variable for one of the four procurement procedure: open auction, request for quotation, tender, single source	Factor
Bidding controls		
Number of applicants	Number of applicants to participate in auction	Quantitative

Name	Description	Type
	Customer controls	
Log procurer contracts sum	Logarithm of the sum of procurer contracts' during the corresponding year, (ln RUR)	Quantitative
Regional subordination	If firm subordination type is regional	Factor (1–yes, 0–no)
Municipal subordination	If firm subordination type is municipal	Factor (1–yes, 0–no)
Activity: public administration	If firm's OKVED (Russian classification of economic activities) corresponds to "Public administration, military security and social services"	Factor (1-yes, 0-no)
Activity: unknown	If firm's OKVED (Russian classification of economic activities) is unknown	Factor (1-yes, 0-no)
	Supplier controls	
Log supplier contracts sum	Logarithm of the sum of supplier contracts' during the corresponding year, (ln RUR)	Quantitative
Same region	If supplier and customer are from the same region	Factor (1-yes, 0-no)
	Regional controls	
Log spending	Logarithm of overall regional spending per capita during the corresponding year, (ln RUR)	Quantitative
Log GRP	Logarithm of GRP per capita during the corresponding year, (ln RUR)	Quantitative
Accident rate	Number of road accidents with injured people	Quantitative
Good roads share	Share of roads complying with standards, (in %)	Quantitative

Table F1: Description of variables

Variable	All procedures				Open auctions			
	mean	**sd**	**min**	**max**	**mean**	**sd**	**min**	**max**
Number of bidders	1.585	0.91	1	19	1.505	0.92	1	16
Delay	-6.07	102.4	-442	654	-4.9	105.1	-442	654
Normalized delay	0.26	1.86	-0.996	51	0.29	1.88	-0.996	51
Terminated contract	0.075	0.26	0	1	0.085	0.28	0	1
Governors controls								
Tenure in office	5.15	5.04	0	21.24	5.21	5.06	0	21.24
Age	52.9	7.87	35	71	52.9	7.93	35	71
Elected	0.09	0.29	0	1	0.1	0.3	0	1
Insider	0.67	0.47	0	1	0.68	0.47	0	1
Term number	1.71	1.08	1	5	1.72	1.08	1	5
Incumbent	0.38	0.48	0	1	0.38	0.49	0	1
Contract/bidding controls								
Repeated contract	0.47	0.5	0	1	0.51	0.5	0	1
Log contract price	14.3	1.65	11.5	23.2	14.6	1.56	11.5	23.2
Log reserve price	14.3	1.66	11.5	23.2	14.7	1.58	11.5	23.2
Duration	147	179	11	3702	157	189	10	3702
Number of applicants	2.14	2.03	1	38	2.26	2.26	1	38
Open auction	0.77	0.42	0	1	1	-	-	-
Tender	0.01	0.07	0	1	-	-	-	-
Request for quotations	0.16	0.37	0	1	-	-	-	-
Single source	0.06	0.24	0	1	-	-	-	-
Number of items	1.08	1.08	1	122	1.08	1.17	1	122
Procurer controls								
Log procurer contracts sum	18.3	2.59	11.5	25.55	18.6	2.42	10.6	25.77
Regional subordination	0.2	0.4	0	1	0.2	0.4	0	1
Municipal subordination	0.8	0.4	0	1	0.8	0.4	0	1
Activity: public administration	0.68	0.47	0	1	0.67	0.47	0	1
Supplier control								
Log supp. contracts sum	17.7	2.25	10.2	25.8	18	2.03	10.6	25.8
Same region	0.92	0.27	0	1	0.92	0.27	0	1
Regional controls								
Log spending	10.2	0.58	5.26	12.25	10.2	0.56	5.26	12.25
Log GRP	12.6	0.51	11.1	15.3	12.6	0.5	11.06	15.3
Accident rate	3967	2876	24	12010	3999	2832	24	12010
Good roads share	0.41	0.19	0.008	0.95	0.41	0.19	0.008	0.95
Year controls								
Sign year2011	0.19	0.39	0	1	0.17	0.38	0	1
Sign year2012	0.3	0.46	0	1	0.29	0.46	0	1
Sign year2013	0.34	0.47	0	1	0.35	0.48	0	1
Sign year2014	0.17	0.38	0	1	0.19	0.39	0	1

Table F2: Descriptive statistics

	min	q25	median	q75	max	mean	sd
Population	42 906	774 751	1 194 781	2 362 928	2 035 490	1 729 044	1 742 850
GRP per capita (RUR)	85 191	181 088	256 256	340 473	3 971 959	376 999	521 351
Overall spending per capita (RUR)	445	17 774	23 508	31 989	169 826	31 848	29 302
Number of road traffic accidents with injured	28	1 010	1 960	3 111	11 617	2 431	2 098
Share of roads of regional significance with good quality (%)	3	25	36	50	84	38	18

Table F3: Regional characteristics

	Mean	sd	min	q25	median	g75	max
Tenure in office (up to the end of 2014 or leaving the office, in years)	6.52	5.26	1	2	5	9	22
Age (by 2011)	52.71	8.08	35	47	53	59	71
Governor was elected after October 2012 - dummy	0.34	0.48					
Insider–dummy	0.69	0.46					

Table F4: Governors characteristics

Variable	Population		Sample of analysis	
	Mean	Num. contracts	Mean	Num. contracts
Number of bidders	1.59	120 356	1.585	112 620
Normalized delay	0.6	119 851	0.26	96 651
Terminated	0.075	119 851	0.075	99 767
Duration	149	144 149	147	120 180
Repeated contract	0.46	144 149	0.47	120 180
Log contract price	14.175	144 149	14.3	120 180
Open auction	0.76	144 149	0.77	120 180
Tender	0.006	144 149	0.01	120 180
Request for quotations	0.17	144 149	0.16	120 180
Single source	0.06	144 149	0.06	120 180
Regional subordination	0.19	144 149	0.2	120 180
Municipal subordination	0.81	144 149	0.8	120 180

Table F5: Comparing means for initial reduced samples

Appendix G

Variable name	Variable values	Firms Obs.	%
Industry	Food	441	22.62
	Textile	173	8.87
	Wood	216	11.08
	Chemical	200	10.26
	Nonmetal	172	8.82
	Metal	242	12.41
	Machines	266	13.64
	Electronic	132	6.77
	Vechiles	108	5.54
	Total	1950	100
State ownership	No	1884	96.62
	Yes	66	3.38
	Total	1950	100
Foreign ownership	No	1864	95.59
	Yes	86	4.41
	Total	1950	100
Establish date	<1992	543	27.98
	1992-1999	411	21.17
	>2000	987	50.85
	Total	1941	100
Firm size	Small	1071	54.92
	Medium	315	16.15
	Large	564	28.92
	Total	1950	100

Variable name	Variable values	Firms Obs.	%
In business association	No	1629	83.54
	Yes	321	16.46
	Total	1950	100
Part of holding	No	1621	83.13
	Yes	329	16.87
	Total	1950	100
Government support	No	1620	83.08
	Yes	330	16.92
	Total	1950	100
Federal support	No	1843	94.51
	Yes	107	5.49
	Total	1950	100
Regional support	No	1755	90.00
	Yes	195	10.00
	Total	1950	100
Local support	No	1722	88.31
	Yes	228	11.69
	Total	1950	100
Locality	Moscow	116	5.95
	Reg. Center	803	41.18
	Other city	880	45.13
	Town\Village	151	7.74
	Total	1950	100

Note. Table shows firms' attributes collected from the survey answers and their distribution. Overall, there are 1950 firms participating in the survey.

Table G1. Descriptive statistics of firm characteristics from the survey

VARIABLES	(1)	(2)	(3)	(4)
	Dependent variable: Leverage			
Contracts-TFA				0.17***
				(0.043)
Lag of Contracts-TFA	0.022		0.011	-0.012
	(0.048)		(0.027)	(0.030)
Lead of Contracts-TFA		0.012	0.022	0.012
		(0.018)	(0.018)	(0.013)
Priv.Revenue-TFA	0.068***	0.069***	0.066***	0.066***
	(0.0074)	(0.0083)	(0.0082)	(0.0081)
Observations	9,443	9,471	8,202	8,202
R-squared	0.189	0.193	0.191	0.201
Number of firms	1,631	1,636	1,620	1,620
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y

Note. Significance levels: '***' 0.01 '**' 0.05 '*' 0.1. The table shows the estimates of specification (3.1), where Contracts-TFA is introduced with either lag (Column 1) or lead (Column 2) or with both (Column 3) and together with the contemporaneous effect of Contracts-TFA (Column 4). The dependent variable is Leverage. Leads and lags of Contract-TFA are yearly. Standard errors are clustered at the firm-level, correcting for a correlation between error terms within a firm. The model is estimated by the weighted least squared method with weights to be inversely proportional to the probability of inclusion in the sample by firm size. All models include firm and year fixed effects.

Table G2. Contemporaneous effect of Contracts-TFA on Leverage

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Leverage					
Contracts-TFA (α)	0.18***	0.16***	0.32***	0.14***	0.12***	0.29***
	(0.042)	(0.044)	(0.069)	(0.035)	(0.037)	(0.060)
Contracts-TFA *				0.42***	0.53***	0.15
Any gov. support (β)				(0.13)	(0.19)	(0.12)
Contracts-TFA *	0.32**	0.31**	0.24			
State ownership (β)	(0.13)	(0.12)	(0.17)			
Priv.Revenue-TFA (γ)	0.069***	0.066***	0.11***	0.069***	0.066***	0.11***
	(0.0079)	(0.0080)	(0.016)	(0.0079)	(0.0080)	(0.016)
Observations	10,719	4,858	5,861	10,719	4,858	5,861
R-squared	0.205	0.202	0.272	0.211	0.209	0.273
Number of firms	1,646	835	811	1,646	835	811
Firm size	All	Small	Med.&Large	All	Small	Med.&Large
Firm FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
P-value: $\alpha = \gamma$	.004	.019	.002	.024	.081	.004

Note. Significance levels: '***' 0.01 '**' 0.05 '*' 0.1. The table shows the estimates of specifications (3.2) by the weighted least squared method. The dependent variable is Leverage. The government support is constructed using the question about organizational support. Main control variables are Contract-TFA, its interaction with state-ownership (columns 1-3) and any government support (columns 4-6), and Priv.Revenue-TFA. Columns 1 and 4 include all firms. Columns 2 and 5 include small firms. Columns 3 and 6 include medium and large firms. All models include firm and year fixed effects. Standard errors are clustered at the firm-level.

Table G3. Leverage sensitivities to Contracts-TFA: alternative definition of political connection

VARIABLES	(1)	(2)	(3)	(4)
	Dependent variable: Leverage			
Contracts-TFA (α)	0.26***	0.24***	0.21***	0.39***
	(0.019)	(0.020)	(0.028)	(0.038)
Contracts-TFA *		0.12**	0.13*	0.11
Org. gov. support (β)		(0.051)	(0.073)	(0.074)
Priv.Revenue-TFA (γ)	0.11***	0.11***	0.097***	0.14***
	(0.0025)	(0.0025)	(0.0073)	(0.0038)
Observations	14,517	14,517	7,977	6,540
Firm size	All	All	Small	Med.&Large
Firm attributes	Y	Y	Y	Y
Firm FE	N	N	N	N
Year FE	Y	Y	Y	Y

Note. Significance levels: '***' 0.01 '**' 0.05 '*' 0.1. The table shows the estimates of specifications (3.1) (Column 1) and (3.2) (Columns 2-4) by the Heckman selection model. The dependent variable is Leverage. Main control variables are Contract-TFA, its interaction with organizational government support, and Priv.Revenue-TFA. All models include year fixed effects and firm's attributes. Columns 1 and 2 include all firms. Column 2 includes small firms. Column 3 includes medium and large firms. Robust standard errors are in parenthesis.

Table G4. Leverage sensitivities to Contracts-TFA: Heckman selection model