

ARE WE PAYING TOO MUCH?

THE COST OF LOW COMPETITION IN PUBLIC PROCUREMENT

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Publication: Working Papers 1/2026: Are We Paying Too Much?

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kkv.fi

ISSN 2954-1859

Are We Paying Too Much? The Cost of Low Competition in Public Procurement

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February 25, 2026[†]

Abstract

There is a lack of competition in public procurement in the European Union and the situation has become worse in recent years. I use a comprehensive data set of public procurement auctions in Finland between 2017 and 2025 to estimate the cost of low competition relative to more competitive auctions. Using matching, I find that having two or more bidders instead of one is associated with a 15% decrease in procurement costs. Having just one additional bidder in single-bid auctions could reduce costs by 9%. These estimates are robust to different specifications, showing that stimulating competition in public procurement is likely to lead to huge savings for the public sector and taxpayers. Back of the envelope calculations suggest annual savings between 144 and 176 million euros if more bidders were attracted.

Keywords: competition, public procurement, single-bid contracts, auction

JEL: D44, H57, L13

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[†]Some earlier results of this paper have been published in Finnish Competition and Consumer Authority's (FCCA) Policy Brief 1/2025 and as part of my master's thesis. I am grateful to Ciprian Domnisoru for supervising my master's thesis and for his helpful comments and guidance. I also want to thank Jan Jääskeläinen for his valuable comments and suggestions in different stages of this project. In addition, I thank participants at the Finnish Economic Association 2026 conference and the FCCA research seminar for their helpful feedback.

1 Introduction

Public procurement accounts for roughly one-seventh of the GDP in the European Union (OECD, 2023), and in Finland, procurement costs reached 38.7 billion euros or 14.0% of the GDP in 2024 (State Treasury Finland, 2024; Statistics Finland, 2024). This makes it a significant part of the modern economy and its public expenditure. However, most procurement contracts receive only few bids. In the European Union from 2011 to 2021, the proportion of the contracts that received only one bid increased from 23.5% to 41.8% and the average number of bidders went down from 5.7 to 3.2 (European Court of Auditors, 2023). Similarly in Finland, the share of single-bid contracts in larger procurements doubled from approximately 10% to 20% during the same period (European Court of Auditors, 2023). The current government of Finland is planning to introduce a requirement to repeat procurement auctions that were not properly conducted and received only one bid, in an attempt to ensure competition and reduce the number of single-bid contracts (Ministry of Economic Affairs and Employment of Finland, 2025).

The recent observations and the policy proposal emphasize the need for research on why there is a lack of competition in public procurement, why the situation is getting worse, and what can be done to enhance competition. In this paper, I examine how much additional competition could lower procurement costs and what the scope of possible cost savings could actually be. I especially focus on single-bid contracts, as the potential benefit from additional competition should theoretically be the greatest in those (e.g. Milgrom, 2004). I use a comprehensive data set of invitations to tender (ITTs)¹ from Finland between January 2017 and May 2025 to estimate the association between the number of bidders and the winning bid. The data set covers between 40% and 70% of procurements in Finland, the coverage

¹Procurers post a notification of the procurement auction to public procurement notice board Hilma when firms are able to bid to the auction. This notification is called *invitation to tender*.

increasing throughout the years. This data set allows me to derive descriptive statistics about the level of competition in public procurement auctions in Finland, as well as to perform empirical analysis on the potential benefits of increasing competition. My main sample contains 18,251 ITTs with information on expected prices and winning bids, among other contract characteristics.

I use nearest neighbor matching to estimate the association between the level of competition and procurement costs. Matching methods are rarely used in the public procurement literature, but they are sometimes applied to examine differences in performance between different auction formats. Athey et al. (2011) compare outcomes between open and sealed bid auctions using propensity score matching and Lewis and Bajari (2011) use nearest neighbor matching as a robustness check when comparing lowest-bid and scoring auctions. In this paper, matching allows me to better account for contract heterogeneity and endogeneity in the level of competition, as contracts differ by multiple observable and unobservable characteristics that may affect the level of competition. To study this relationship, previous literature has mainly used simpler regression models with more strict assumptions, mainly due to data limitations. My larger and more extensive data set allows me to use this more complicated methodology, although I also include simpler models for comparison.

I find that receiving the average number of bidders in the most similar other ITTs instead of just one is associated with 15.3% smaller winning bid on average, when single-bid ITTs are matched to the most similar other ITTs with a higher number of bidders. This can be interpreted as a 15.3% decrease in procurement costs, giving an idea of the extent of potential savings in procurement auctions if more bidders can be attracted. Having two bidders instead of one is associated with a 9.2% smaller winning bid, and having more than six bidders instead of one would lower costs up to 24.2%. These estimates are stable across different specifications and empirical methods. They also remain broadly similar across different sectors,

although they mostly reflect results in construction ITTs. The association between competition and procurement costs in product and service ITTs appears slightly weaker. Scoring auctions are more often used in product and service ITTs but the auction format does not explain the observed difference between sectors, albeit possible savings from scoring auctions appear to be lower overall. Additionally, in the product sector, the possible savings may be lower in general due to a smaller number of potential firms in the market. Nevertheless, the results indicate large potential cost reductions in procurement auctions, ranging from 144 million to 176 million euros annually if at least one additional bidder can be attracted to contracts with more potential bidders. 45% of these savings would come from larger contracts in which the expected cost is above the EU procurement thresholds.

These results are in line with economic theory. More bids in auctions should decrease the final price and improve quality, driven by two separate forces: more efficient firms bidding to auctions if there exist such firms, and by the so-called *competition effect*. As firms are uncertain about the other firms' valuations for the procurement contract, they start to bid closer to their expected cost to increase their chances of winning the auction (Vickrey, 1961). This effect is strongest when the number of bidders is low, as is the case in most of the procurement auctions in Finland. After roughly six bidders or more, the benefits from increased competition become marginally small, as empirically shown by, e.g. Jääskeläinen et al. (forthcoming), and Aagaard and Linaa (2024).

My results confirm this, as I find that each additional bid lowers the winning bid less and less until the relationship flattens after roughly six bids. This nonlinearity may be due to multiple different reasons. If competition is fierce, rational firms may update their bids higher due to the winner's curse, affiliation effect, or entry effect. More specifically, as the competition increases, firms may fear that the winner is the one who underestimates the costs the most (Wilson, 2021), or the one who overestimates the level of competition the most (Pinkse and Tan, 2005),

as firms are not sure of their own production costs in many cases. Thus, firms may raise their bids. Additionally, entry costs can start to play more significant role if competition increases and the probability of winning shrinks (Li and Zheng, 2009). These reasons may even reverse the relationship between the number of bids and the winning price.

In addition to quantifying potential benefits from increased competition, I show suggestive evidence that there are more potential bidders in the market. In 75.8% of the single-bid ITTs, the winning firm has usually faced competition in other procurements in which they have participated, indicating that there are more firms in the market who could participate in these single-bid auctions. In the construction sector, this share is over 90%. This indicates that firms that win single-bid auctions usually do not operate in markets that have very different market dynamics than those participating in procurement auctions with multiple bidders. These findings may mean that there are often potential firms in the market, but in many cases not all procurement units are able to attract these firms to bid.

My findings contribute to two branches of empirical literature on public procurement. Firstly, I contribute to the procurement literature discussing different policy measures taken to increase the level of competition. The study most directly related to this paper is Titl (2025), who uses a difference-in-differences design to study the impact of a policy change in Czechia that required repeating the auctions if only one bid was submitted. The number of bids increased from 1 to 2.4 on average, leading to a roughly 6% decrease in procurement costs on average. This effect was driven by an increase in the length of the bidding period and by providing more information about the contract. My estimated results are larger, but they estimate the potential savings in single-bid contracts under the assumption that more bidders can be attracted, which may not be the case in at least 25% of the contracts.

Other empirical studies on procurement policies have examined the effects of

increased publicity requirements on procurements in Italy (Coviello and Mariniello, 2014) and the USA (Carril et al., 2026), the use of framework agreements and the conduct of procurements in larger centralized procurement units in Italy leading to direct (Bandiera et al., 2009) and indirect savings (Lotti et al., 2024), and the change from beauty contests to more rule-based procurements in Sweden (Hyytinen et al., 2018), among many others. This literature also examines the overall performance and expertise of procurement units. Best et al. (2023) show that 39% of the differences in prices paid in public procurements in Russia are due to individual bureaucrats and organizations conducting the procurements. Bandiera et al. (2009) show that 82% of the differences in procurement costs between procurement units is due to unintentional passive waste instead of pure corruption.

Secondly, I also contribute to a smaller literature that directly examines the relationship between the level of competition and procurement costs. Due to data limitations, these studies have usually been very industry-specific. For example, MacDonald et al. (2002) find that in agricultural product procurements in the US, costs from single-bid auctions are 4.2% to 8.2% higher than from three-bid auctions, depending on the product. More general studies include, e.g. Aagaard and Linaa (2024) and (Jääskeläinen et al., forthcoming). Aagaard and Linaa (2024) find that the ratio of the winning price and the expected cost reduces as the number of bids increases, two bids being associated with 4.6% lower procurement costs, and at least six bids with 12.8% lower. Aagaard and Linaa (2024) also summarize this literature and show that estimates from an additional bidder fluctuate from 2.1% in procurement auctions in Turkey (Onur et al., 2012) up to 12% in bus route auctions in London (Amaral et al., 2013). My larger sample allows me to use a more complicated methodology that takes the endogeneity in the level of competition better into account, yielding estimates that are from the higher end of the spectrum. Using a simpler methodology, I also obtain results that are comparable to those in the previous literature. Similarly, when endogeneity has been addressed in previous

studies, estimates have increased (Aagaard and Linaa, 2024). (Jääskeläinen et al., forthcoming) also briefly examine whether there are even potential firms in the market, concluding that this is usually the case. I examine the extent of potential bidders by investigating whether winning firms in single-bid ITTs have usually faced competition in other procurement auctions. In general, how realistic it is to obtain more competition has not been extensively examined in the empirical literature.

The rest of this paper is divided into five sections. Section 2 gives an overview of public procurement in Finland, the level of competition there, and what kinds of ITTs have attracted only one bidder. Section 3 describes the data and the main sample and explains the empirical strategy. Section 4 presents the empirical results. Section 5 discusses the policy implications of the results from previous sections, including a discussion of the possibility of increasing competition, as well as back-of-the-envelope calculations for potential cost savings. Section 6 concludes.

2 Institutional Setting

2.1 Public Procurement in Finland

In Finland, public procurement contracts that exceed certain industry-specific value thresholds must be auctioned.² These contracts account for roughly 15 billion euros annually, which is more than one-third of all procurement costs in Finland (Merisalo et al., 2021). These auctions are conducted as first-price sealed bid auctions, meaning that the winner is the firm that is willing to deliver the goods or provide the service with the lowest cost or the one that gets the highest score if a scoring criteria is used. Procurers make preparations for the auction and then publish an invitation to tender (ITT) to national public procurement notice board Hilma system, where firms can find it. In practice in recent years, roughly 70 percent of procurement auctions are conducted using Cludia software where firms are able to submit their bids and where the procurers are able to evaluate them. The bidding window is open only for a limited period and during that time all the firms that meet the qualification criteria can send a bid. This is the procedure in open auctions. While bidding, firms can not see each other's bids or the total number of bids in the procurement. If the contract is awarded, the procurer is obligated to award the contract to the most economically advantageous bidder. This is the one who bid the lowest price in auctions purely decided by the bid price, and the one with the highest overall score in scoring auctions where quality criteria are also taken into account.

Open auctions account for approximately 90% of the procurement auctions in Finland. The rest are mainly restricted auctions, where the procurer can allow only certain firms to make their bids. Some contracts using open procedure are

²€60,000 for products, services and design competitions, €150,000 for construction works, €400,000 for healthcare services, €300,000 for other special services, and €500,000 concession contracts. (Julkisten Hankintojen Neuvontayksikkö, 2025)

conducted as framework agreements, i.e. contracts where a firm commits to deliver goods or services at specific prices and conditions within the certain time frame, or using dynamic purchasing system (DPS), where qualified suppliers can enter any time when the system is in operation and participate in minicompetitions within the DPS. The main focus of this study is the standard open auctions and their procurement process, excluding framework agreements and dynamic purchasing systems as their competition dynamics may be different from the standard procedure.

2.2 Competition in Procurement Auctions in Finland

In general, there is a lack of competition in public procurement contracts in Finland. Figure 1 shows the distribution of number of bidders across all public procurement ITTs in Finland. The median number of bidders is three, and the most common number is only two. Like discussed in the previous section, the benefits from receiving more bids are the greatest when the number of bids is low, so there is potential for huge savings for the public bodies in Finland if more bidders were attained.

The distribution shown in Figure 1 is present with all types of procurers, regardless of whether they are a municipality or a governmental entity (Hiilamo et al., 2023). However, Figure 2 shows that the shape of the distribution differs slightly depending on the sector. The distribution of service ITTs and construction ITTs is very similar, although the tail of the distribution is narrower in the latter case. Relatively large number of service ITTs receiving high number of bidders is due to usage of framework agreements in many service industries, for example in health care. In contrast, product procurements often have only one or two bidders, making the sector less competitive overall.

Hiilamo et al. (2023) show that other characteristics, mainly geographic location and more specific industry, correlate with the number of bidders. Procurers in cities tend to receive more bids than their counterparts in rural areas, and in some specific industries, the level of competition is low in general. This relationship

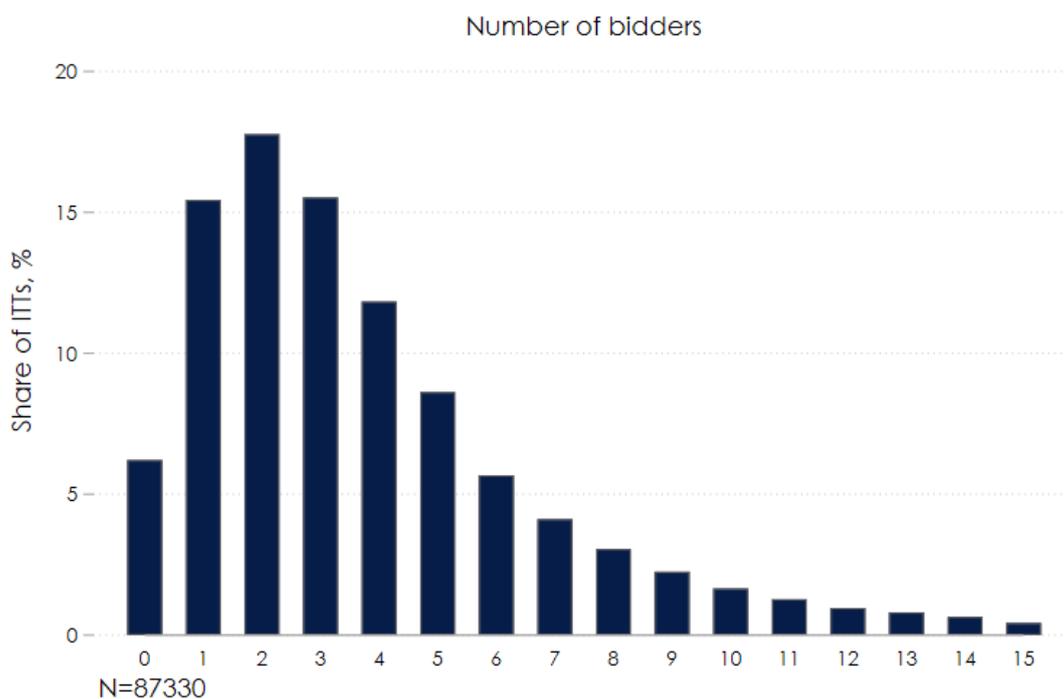


Figure 1: The number of bidders in all public procurement auctions observed in the data between 2017 and 2025.

between location and level of competition is also illustrated in Figure 3a which shows that in Eastern and Northern Finland, the number of bidders is generally lower than in regions where three major metropolitan areas are located (Helsinki, Tampere, and Turku). ITTs in these regions receive on average one additional bid compared to more rural regions. Likewise, the share of single-bid contracts is generally lower in Western half of the country, as seen in Figure 3b. However, there are also some neighboring regions where the level of competition is different, even if their other characteristics are quite similar. For example, it is not clear why there are significantly fewer single-bid ITTs in Central Finland compared to North Savo. Overall, the competition outcomes in Central Finland seem to be the best in the whole country on average. The general patterns, i.e. less competition in East and North, are broadly similar across different sectors (see Figures B.1, B.2, B.3).

15.6% of all ITTs (as seen in Figure 1) had only a single bidder in Finland between January 2017 and May 2025. If ITTs without any bids are dropped, this

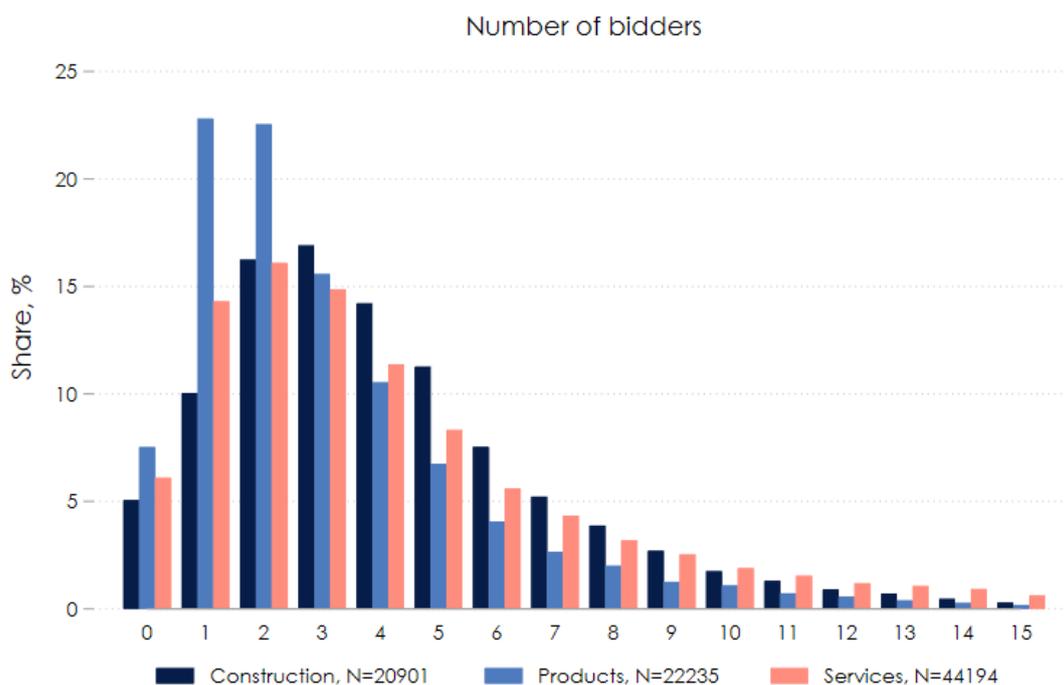


Figure 2: The number of bidders in different sectors in all public procurement auctions observed in the data between 2017 and 2025.

proportion climbs up to 16.6%, which means that one of every sixth awarded contract receives only one bid. This share differs geographically as shown in Figure 3b. In contrast to the recent European-wide trend of a rising share of single-bid contracts (European Court of Auditors, 2023), the proportion of single-bid ITTs in Finland has increased only modestly during the sample period, by approximately two percentage points. Figure 4 illustrates the share of single-bid ITTs in Finland during the sample years. A few large procurements may change yearly shares a lot, so too much emphasis should not be placed on individual years; instead, the general trend should be examined. The trend is slightly upwards sloping, but the slope is very modest. This difference between European Court of Auditors (2023) and my data may be due to sample differences as European Court of Auditors only observes large contracts that have passed the EU-level notification thresholds. Their sample period is also longer. When looking at the share of single-bid ITTs in pure values in Figure 4, the upward trend is slightly stronger and the share has increased

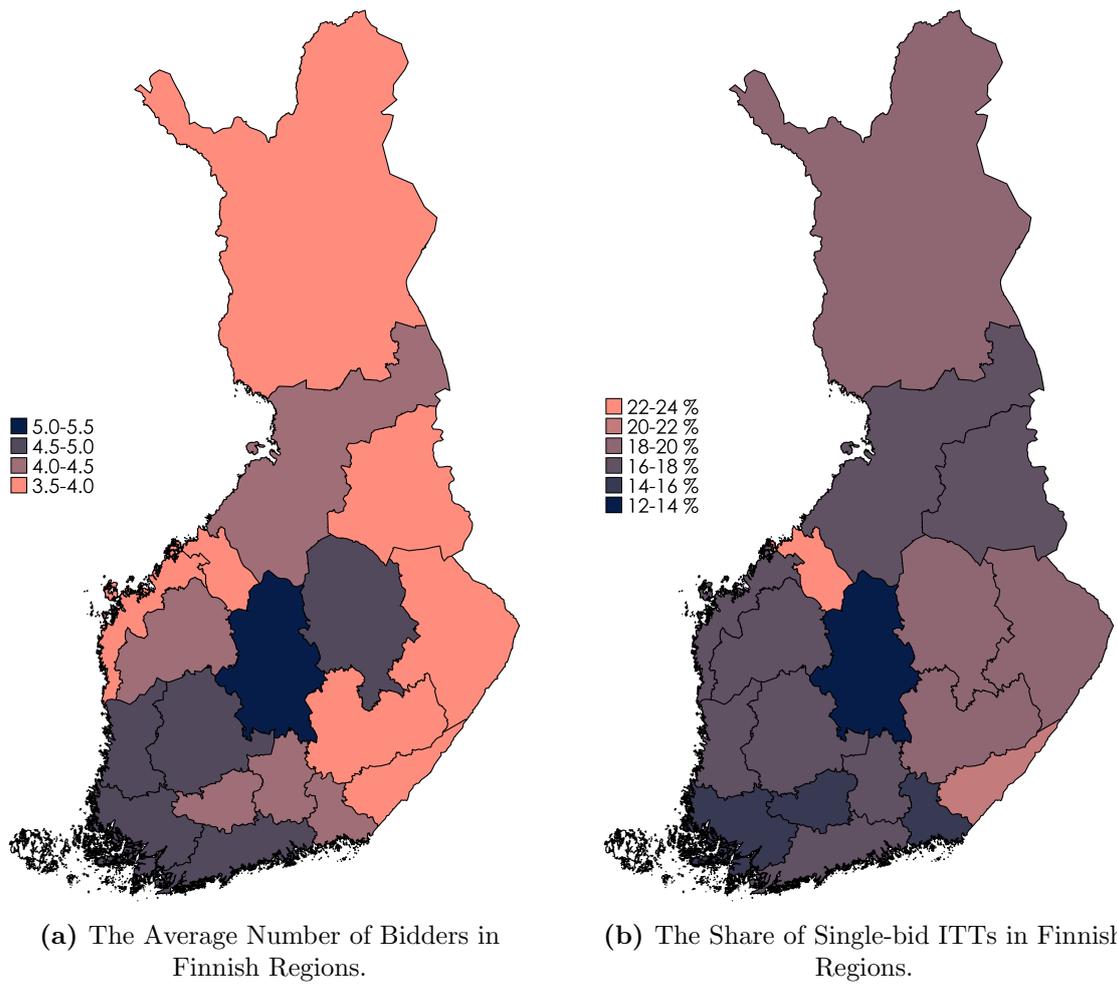


Figure 3: Procurement ITTs and the level of competition across Finland. Procurements by government entities are excluded.

4 percentage points during the sample period. Although these trends are not as significant as in other parts of Europe, they still tilt to the same direction.

Figure 5 presents the most common industries with single-bid ITTs in Finland. There have been more than 2,000 single-bid ITTs in construction, roughly 1,000 in medical equipment and products, and more than 500 in seven other industries as well. It is worth noting that these industries are mostly the ones that have most procurement contracts anyway, explaining the high number of single-bid ITTs in them. The percentages at the end of each bar indicate the share of single-bid ITTs within that industry. In construction, which is the largest industry, only 10.7% of all ITTs receive one bid, making it quite a modest share of ITTs even if there

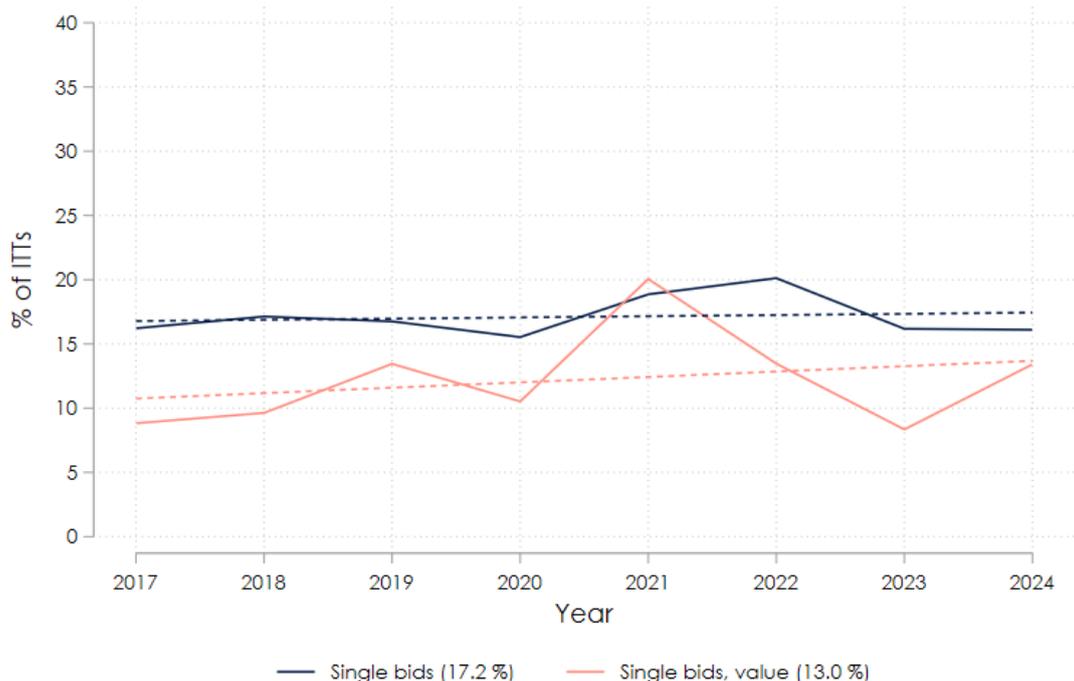


Figure 4: The yearly share of single-bid ITTs and their values in euros in Finland. The percentage in parenthesis accounts for the mean share across the years. The dotted lines show the linear trend across the years.

are over two thousand of them. However, in many large industries single-bid ITTs account for a higher share of the ITTs, especially in medical equipment, transport equipment, educational services, and science equipment. Generally, the level of competition is very industry-specific and concentrated toward product industries, indicating a variety of reasons behind this problem. In industries where the share of single-bid ITTs is fairly modest, enhancing competition can be expected to be easier than in sectors where the lack of competition is more of an industry-level problem. Luckily, e.g. construction seems to fit into the first category.

Figure 6 presents the industries with the highest shares of single-bid ITTs within them. The highest shares of single-bid ITTs are in agricultural machinery with 48.8% and science equipment with 43.5%. With some exceptions, most of the industries with a high number of single-bid ITTs are quite small and are not included in Figure 5. This can indicate that in many smaller industries, the lack of com-

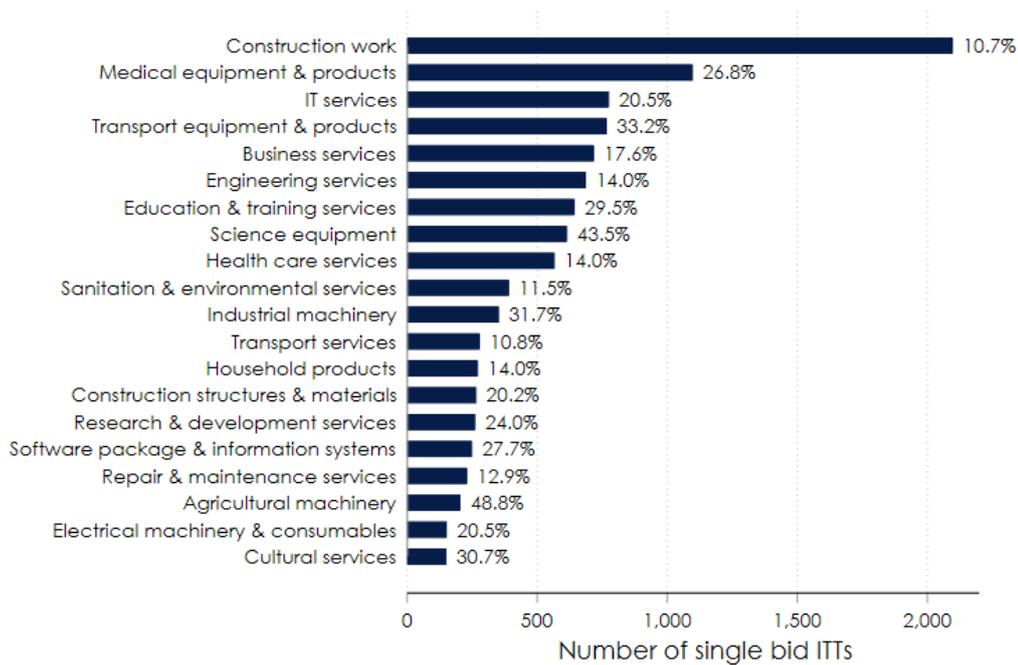


Figure 5: 20 industries with most ITTs that received only a single bid between 2017 and 2025. Labels in bars indicate the percentage of the ITTs within the industry that received only a single bid.

petition may be an industry-specific problem, and at the same time, enhancing competition in such industries is probably more challenging. In larger industries where the share of single-bid ITTs is lower, it should be possible to achieve more competition as there are many more firms bidding for other procurement auctions within these industries. The focus of enhancing competition should especially be directed to these industries, as gains from these are likely to be the largest, and they are likely to be achieved more easily using practices that procurers can do instead of requiring larger industry-level solutions. The potential for attaining more competition is explored further in Section 5.

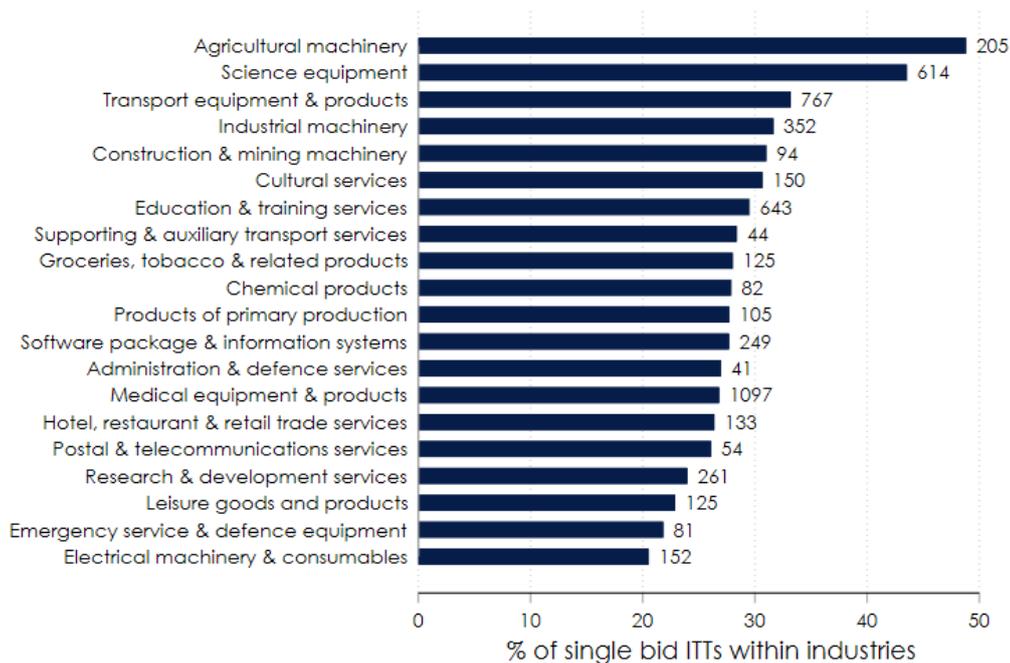


Figure 6: Top 20 industries with the highest share of ITTs that received only a single bid between 2017 and 2025. Labels in bars indicate the number of the ITTs within the industry.

3 Data and Empirical Approach

3.1 Data

In my empirical analysis, I use public procurement data obtained from procurement software run by Cloudia Oy. My data contains 87,330 procurement ITTs from January 2017 to May 2025. This covers roughly 40 to 70 per cent of all ITTs in Finland, depending on the year. Out of these ITTs, 51,429 are ITTs in which I observe bid prices. The data set includes information on the procurers, bidders, bid prices, expected cost of the contract, and other contract and procurer characteristics such as the length of the bidding window, the time of the bidding window, the procurer type, the procurement notice type, and other variables and documents that are used to determine the location of the procurement. Thus, the location of the procurement does not refer to the location of the procurement unit but reflects as closely as possible the municipality where the actual location of the procurement

is. My data set also includes CPV-codes (*common procurement vocabulary*) that classify the industry of the contract. However, every variable is not available for all ITTs, shrinking the usable sample.

The data set is merged with business register data from Statistics Finland and ALMA Talent, which contains information on turnover and the number of personnel in Finnish companies, and with public procurement notice board (Hilma) data, which includes all notifications of procurement contracts in Finland. The business register data sets allow the usage of firm characteristics in the analysis, and Hilma data allow me to identify the expected cost of the contract more accurately as the information is partly lacking from both data sets. Procurement units determine the expected cost of the contract, but it is not necessarily based on engineering estimates, for example. It may reflect different budgetary objectives or previous prices paid for the same products. However, these measurement errors should not be correlated with the number of bidders or other observed variables. Hilma data also include information about the procurement process, such as whether the winner of the auction is determined using the lowest bid or quality score criteria, and sometimes the chosen contractors are also observed.

The key variables are the winning bid and the expected cost of the contract. These two variables form the main outcome variable of the analysis, the ratio between the two. This normalization accounts for the contract heterogeneity as the contracts differ in size. The winning bid is identified either using the bid of the chosen observed contractor or the lowest bid in the ITT. Because I do not always observe the real contractor, especially in matching auctions, the observed winning bid may be lower than the real one.

3.2 Main Sample

My data contains observations of all types of procurement auctions, ranging from typical one-stage sealed-bid auctions to framework agreements and dynamic pur-

chasing systems. My data also include different types of auction formats such as closed procedures and negotiations. Like mentioned in Section 2, competition dynamics in these different types of mechanisms may behave differently compared to the typical one-stage open procedure auctions where any firm able to fulfill the qualification criteria may participate in the auction. Thus, I only include these typical open procedures into the main sample, excluding not only closed procedures and negotiations, but also framework agreements and dynamic purchasing systems.

Many ITTs in my data set do not have bid prices and are dropped from the sample. Likewise, some ITTs do not have information about the expected cost in either of those datasets and are similarly dropped. Even if both of the values are available, sometimes the bid information in the data can be in a different unit than the expected cost. This can happen, e.g. if bidders submit their bids as hourly or unit cost when the number of units is not known beforehand, instead of bidding the whole cost of the contract, making the calculated ratio between the winning bid and expected price very small. This is typical in framework agreements, so they are dropped from the sample by design. Examining the distribution of the ratio between the winning bid and the expected cost, there is a discontinuity in the distribution around the ratio of 0.4 (see Figure B.4). All ITTs with smaller ratio are dropped as the price information in most of them is likely reported in different units. However, it is not as clear where to place the threshold in the upper side of the distribution. Thus, I calculate the standard deviation of the ratio between the winning bid and the expected cost and only include ITTs that are less than two standard deviations above the industry mean of the ratio, as ratios larger than that are probably a result of special cases, such as the procurer greatly miscalculating the expected cost or the contract being substantially long. The cutoffs are selected quite cautiously to avoid dropping appropriate observations. However, because these thresholds are quite arbitrary, the volatility of the empirical results to the thresholds is examined for robustness. After these measures, the main sample consists of 18,251 procurement

ITTs that have information about the number of bids, as well as the ratio between the winning bid and the expected cost of the contract.

In addition to the main sample, a broader sample is used in parts of the analysis where the exact price information is not needed. In that sample, only framework agreements, DPSs, and minicompetitions are dropped, but other open auctions are kept in the sample. This sample is used in the analysis exploring the level of potential competition in Section 5.

3.3 Descriptive Statistics

In Figure 7, the industry composition of the data sets and the main sample is compared to each other. My data closely follow the data from Hilma, indicating that it is a representative subsample of all ITTs in Finland. However, the main sample does not follow the two datasets as closely. Construction is still the largest industry in the main sample, but its proportion is substantially higher. In reality, its share is 27% of the contracts compared to almost 45% in the main sample. Significant differences are also observed in health care services, IT services, business services, and transport services, among several smaller categories. In contrast, transport equipment and products, as well as science equipment, are overrepresented in the main sample.

The pattern roughly follows the division between service and product procurements and is present even in smaller industries. There are two main explanations for this. Firstly, health care and transportation services are typically procured using framework agreements, so they are dropped from the sample by design. In other cases, the expected cost information of service contracts is lacking more often than with product contracts, explaining the differences between the data sets and the main sample. This is amplified by the fact that especially in service and product ITTs, the bid prices are more often declared in hourly or unit prices whereas the expected cost still reflects the total cost of the contract. However, ITTs without

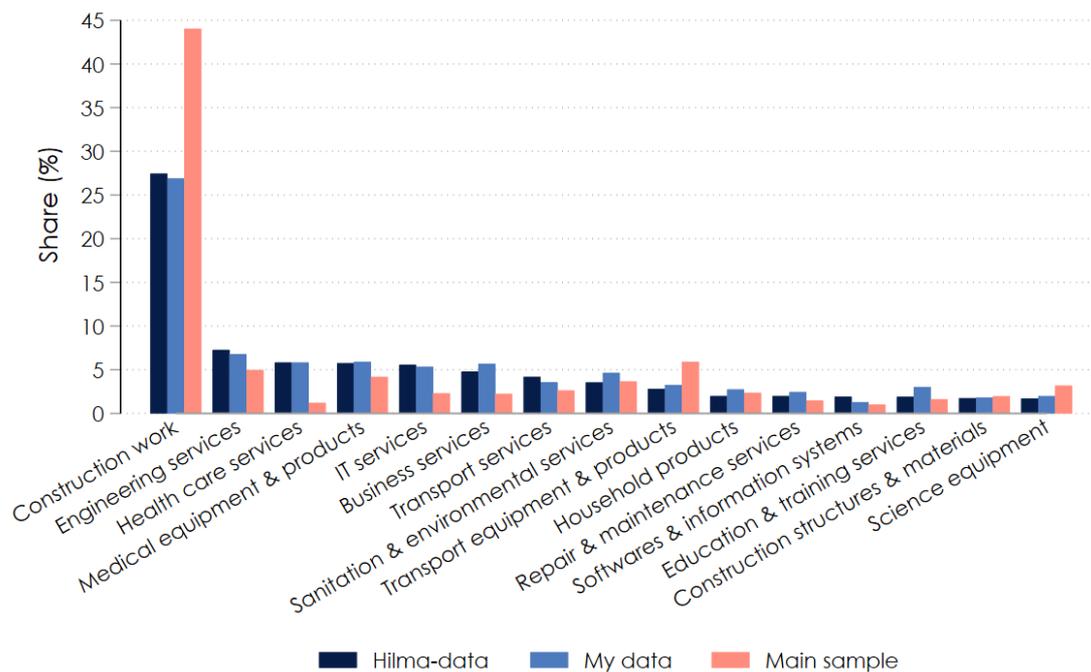


Figure 7: The share of industries (2-digit cpv-codes) in the data sets and in the main sample.

expected cost or bid price information do not differ significantly from other ITTs, apart from the fact that those contracts are more often service contracts.³

Figure 8 descriptively illustrates the behavior of the outcome variable. As the number of bidders increases, the ratio between the winning bid and the cost estimate decreases, like the economic theory and the previous empirical literature suggest. This relationship appears to be nonlinear as well. The winning bid in ITTs with only a single bidder is higher than its expected cost on average. This changes in ITTs with two bids as the winning bid drops by 6 percentage points. After that, the change in the winning bid becomes smaller as the number of bidders increases, and after roughly six bids, the gains from getting more bids seem to become marginal.

³There is some evidence that contracts without expected cost information are somewhat larger than other contracts, mainly because bid prices in them are on average slightly larger. However, this may also reflect the fact that they include fewer contracts in which bid prices are declared as hourly or unit prices. There is also some evidence that enclosing the expected cost may reduce information asymmetries between bidders, changing their bidding behavior (De Silva et al., 2009).

The winning bid stabilized to be about 17 percentage points lower than the cost estimate and may even start rising again. The distribution of the number of bidders is broadly similar in the main sample and overall, which can be seen by comparing the distributions in Figures 1 and 8.

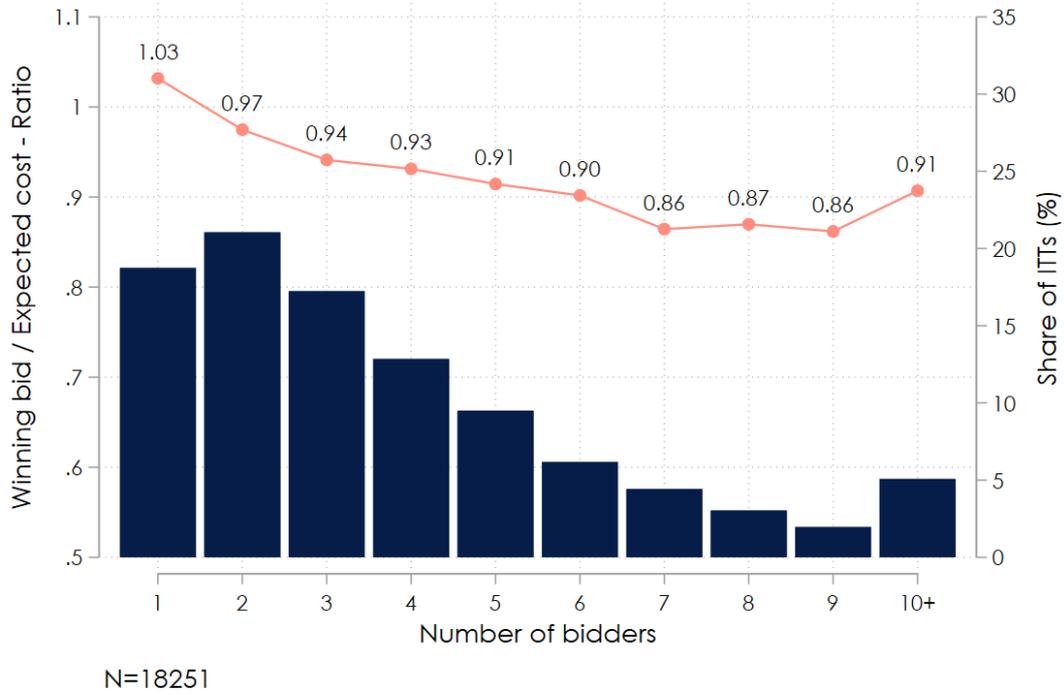


Figure 8: The distribution of the number of bids in the main sample, and the evolution of the ratio between the winning bid and the expected cost of the contract.

Table 1 presents summary statistics for key variables, as well as selected tender, procurer, and bidder characteristics for ITTs in the main sample. Contracts that attract more bidders are larger on average when measured by expected cost. For example, the mean expected cost of ITTs receiving four bids (about €1.02 million) is nearly three times that of single-bid contracts (about €0.37 million). Differences are also visible in median values: the median expected cost increases from €144,000 for single-bid contracts to roughly €347,000 for contracts receiving seven bids. The winning bid evolves similarly to the expected cost. In the empirical analysis, all ITTs with more than six bids are combined into one category, as the ratio between the winning bid and the expected cost seems to change only marginally after that.

Non-price characteristics of tenders also exhibit some patterns. Single-bid contracts are more frequently located in municipalities with larger populations. However, the distance to a large city does not correlate as clearly with the number of bidders, although the location of single-bid contracts is slightly closer to large cities. Scoring auctions are used more often in single-bid ITTs than in other with more bidders. However, this share is still below the prevalence of scoring auctions in Finnish procurement data overall (about 61%), which is expected as price information is more often missing from scoring auctions, excluding them from the main sample.

Contracts with few bidders tend to be concentrated to smaller procurers, calculated as the mean annual value of procurement contracts in a procurement unit. At the same time, the distribution of ITTs with a particular number of bidders remains quite stable across different kinds of procurement units, with only a few exceptions. Municipality owned corporations account for 25% of single-bid ITTs whereas medium-sized municipalities account for an additional 21%. Overall, 39% of single-bid ITTs are procured by municipalities. This suggests that attracting competition in municipalities could be especially beneficial in decreasing the number of single-bid contracts. When comparing procurer type shares across different number of bidders, single-bid ITTs are more concentrated on higher education providers and health care districts, which is expected as they require more specialized equipment and services with possibly fewer suppliers. On the other hand, medium-sized municipalities (10,000–100,000 inhabitants) account for a smaller share of single-bid contracts than of contracts with multiple bidders. However, these patterns should be interpreted with caution, as often the better performing procurement units exhibit worse outcomes as their needs are also more complicated (Decarolis et al., 2020).

Bidder characteristics also vary with the number of bidders. The median size of bidders in ITTs with a higher number of bidders is larger than in ITTs with

fewer bidders, measured by their turnover. However, the mean bidder size actually decreases as the number of bidders increases. Similar patterns emerge when the number of employees in bidding firms is examined. Firms participating in ITTs with few bidders also tend to face less competition in other procurement auctions. Nevertheless, even winners of single-bid contracts typically operate in markets where competition exists elsewhere: the median winning firm in a single-bid ITT faces two competing bidders in other procurements in which it participates, and the mean number of competing bidders in other auctions is about 3.3, indicating that they usually do not operate in industries with very little competition overall.

Table 1: Summary table.

Variable	Number of bidders										Sample mean
	1	2	3	4	5	6	7	8	9	10+	
N	3420	3841	3145	2344	1732	1126	807	553	357	926	18251
<i>Tender characteristics</i>											
Expected cost, mean	374,508	517,776	875,151	1,020,138	1,028,920	1,706,301	1,255,052	1,393,179	1,721,565	2,798,792	937,268
Expected cost, median	144,000	174,000	209,100	250,000	301,250	350,000	346,800	400,000	416,500	500,000	214,200
Winning bid, mean	401,116	520,458	839,491	957,041	984,876	1,628,395	1,157,566	1,321,950	1,533,559	2,681,755	903,499
Winning bid, median	137,207	155,358	191,280	232,016	268,952	299,988	272,510	307,020	376,380	420,629	191,520
Population in the procurement location	189,265	177,409	162,330	162,630	156,228	156,966	166,608	150,210	198,007	158,179	169,988
Distance from a large city	57.88	61.20	62.88	61.17	61.13	54.71	52.49	57.02	41.42	48.39	58.91
Scoring auction	0.48	0.43	0.36	0.34	0.32	0.28	0.32	0.28	0.29	0.36	0.38
<i>Procurer characteristics</i>											
Size of the procurer, mean	1.14	1.11	1.14	1.31	1.27	1.35	1.28	1.16	1.29	1.04	1.18
Share of ITTs by procurer type											
Municipality, small	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.10	0.07
Municipality, medium	0.21	0.24	0.27	0.27	0.29	0.31	0.34	0.31	0.31	0.33	0.27
Municipality, large	0.12	0.12	0.12	0.13	0.13	0.14	0.14	0.13	0.21	0.13	0.13
Municipality owned corporation	0.25	0.24	0.27	0.26	0.27	0.28	0.26	0.29	0.24	0.25	0.26
Hospital district (-2022)	0.04	0.03	0.02	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.02
Wellbeing service county (2023-)	0.04	0.04	0.03	0.02	0.01	0.01	0.01	0.02	0.00	0.02	0.03
Government entity	0.17	0.18	0.18	0.19	0.17	0.14	0.15	0.12	0.14	0.12	0.17
Higher education provider	0.09	0.05	0.03	0.02	0.02	0.01	0.01	0.02	0.00	0.01	0.04
Other	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.04	0.02
<i>Bidder characteristics</i>											
Mean competition faced by bidders	3.30	3.88	4.43	4.90	5.34	5.82	6.14	6.40	6.69	8.99	4.80
Median competition faced by bidders	2	3	3.5	4	4	4.5	5	5	5	6	4
N of personnel in bidders, mean	221.18	260.72	251.87	271.92	276.84	243.12	225.60	228.12	194.57	207.04	247.11
N of personnel in bidders, median	21.61	40.37	59.21	78.16	88.00	96.73	93.71	88.96	88.51	94.46	53.00
Turnover of bidders, mean	99,566,632	96,016,744	95,441,328	94,603,688	99,749,968	76,945,688	74,663,720	70,311,384	57,160,080	51,520,520	90,838,304
Turnover of bidders, median	7,781,596	16,730,402	22,196,700	28,192,926	31,077,858	32,579,100	33,898,280	32,980,814	31,573,764	34,070,592	20,340,206

Notes: Prices and firm turnovers are inflation-adjusted to 2025 euros. Size of the procurer refers to the annual expected value of the procurement contracts by the procurer (in tens of millions of euros). Mean or median competition refers to how many competing firms bidders have faced in other procurements they have bid, conditional on that the firm has participated on another procurement auction.

3.4 Empirical Methodology

I use a basic OLS as a benchmark to estimate how much lower winning bids are in ITTs that received multiple bids compared to the single-bid ITTs. The two models used are slightly modified versions of the empirical designs used by, e.g. Aagaard and Linaa (2024); Onur et al. (2012). The first model (OLS 1) is specified as

$$\ln \frac{P_i}{P_i^e} = \beta_0 + \beta_1 N_i + \beta_2 N_i^2 + \beta_3 X_{j,i} + \epsilon_i \quad (1)$$

where the dependent variable is the logarithm of the ratio between the winning bid in the ITT P_i and the expected cost P_i^e of the contract i , N_i is the number of additional bidders, and $X_{j,i}$ vector of controls and fixed effects. Bid prices and cost estimates are inflation-adjusted to 2025 euros. Controls include the procurer size measured by the yearly sum of estimated values of their procurement contracts (in tens of millions of euros), the expected cost of the contract (in millions of euros), the distance to a larger city from the location of the procurement, and the population size of the location. The vector $X_{j,i}$ includes fixed effects for industry, year, notification type, type of the procurer, and procurer. ϵ_i denotes for the error term, and the coefficients of interest is β_1 . ITTs that have received only a single bid are the omitted category. The square of the number of additional bids is included into the design to account for the possible nonlinearity of the relationship. I also include results from a version of the model without the square term as it is a typical specification in the previous empirical literature.

These models make a strong assumption that the underlying relationship between the winning bid and the number of bidders is either linear or quadratic, which may be incorrect, although the quadratic form is in line with economic theory. Thus, an additional OLS model (OLS 2) with dummies according to the number of bidders is used to not force the relationship to any specific functional form. This model is specified as

$$\ln \frac{P_i}{P_i^e} = \delta_0 + \delta_1 X_{j,i} + \beta_2 D_2 + \dots + \beta_7 D_7 + \epsilon_i \quad (2)$$

where dummies D_n take value 1, when $N_i = n$, for $n = 2, \dots, 7$. The coefficients of interest are β_n , identifying the associated approximate percentage change in the winning bid when n additional bidders have bid instead of only one. If the number of bidders exceeds 7, then dummy $D_7 = 1$. Seven dummies are specified because the cost decrease from an additional bidder seems to become marginal after that, like discussed in Section 3.3. The same controls and fixed effects are included as in the previous OLS models.

The OLS coefficients show how much lower the winning bids are in percentages in ITTs that received more bids instead of only one. However, ITTs with different number of bidders may still differ from each other, even after controlling for observable characteristics. And secondly, it is not clear how many bids single-bid ITTs could realistically receive. Thus, I also use matching to investigate this relationship further. This allows me to better account for the contract heterogeneity as I compare more similar ITTs with each other, and I do not need to make assumptions about the functional form of the relationship (Black, 2015). As I match single-bid ITTs with the most similar ITTs with more bidders, I can also estimate how much procurers could potentially save on average if they had to repeat those auctions or if they conducted the procurement process in more professional manner in the first place.

I use nearest neighbor covariate matching where I match similar ITTs with each other by minimizing their distance from one another according to the ITT specific observable characteristics as running variables; the size of the procurer, the expected cost of the contract, the distance to a larger city from the procurement location, and the population size of the location. Because multiple running variables may introduce bias to the main estimates (Abadie and Imbens, 2006), a bias correction is used (Abadie and Imbens, 2011). To account for the fact that the observable

characteristics are in different scales or units, I use Mahalanobis distance, matching ITTs with each other by minimizing the distance of

$$\|\mathbf{X}_i - \mathbf{X}_j\| = \sqrt{(\mathbf{X}_i - \mathbf{X}_j)' \hat{\Sigma}_X^{-1} (\mathbf{X}_i - \mathbf{X}_j)}$$

where \mathbf{X} is the vector of observable characteristics for the ITTs i and j , and $\hat{\Sigma}_X$ the sample variance-covariance matrix of \mathbf{X} (Cunningham, 2021). Furthermore, I match these ITTs inside industries (3-digit CPV codes⁴), two year-groups⁵, tender notice types, and procurer types, depending on the specification. Contracts are more similar within these groups, but this procedure has its downside as finding matches becomes harder as the matching is done within more subgroups. The same is true when the number of running variables increases. However, these matches are likely to be much more similar with each other and differ only by some unobservable procurer-side characteristics such as procurer competence, or by firm-size variation in firm capacity, for example.

This matching procedure estimates the average treatment effect (ATE) of having more bidders on the procurement costs if all the characteristics that affect the number of bidders are controlled, i.e. compared ITTs are very similar in terms of attracting bidders. However, some (un)observed procurer-side characteristics are still likely to affect the number of bidders. For simplicity, all the observed procurer-side measures are excluded from the analysis as well-performing procurement units probably do multiple things right compared to others. This also includes seasons as procurers can usually affect the timing when they do procurements and should anticipate the upcoming procurements in advance. Thus, matching results can be

⁴3-digit CPV codes are observed for 65.6% of the sample. In others, only 2-digit CPV codes are observed. The results do not significantly change if ITTs are matched only within 2-digit CPV codes or if ITTs with only 2-digit codes are dropped from the sample.

⁵Years during high inflation (2021-2022) seem to exhibit systematically larger ratios for the outcome variable, probably due to procurement units unable to rise their cost estimates accordingly (see Figure B.5). Thus, 2021 and 2022 ITTs are matched only within themselves.

interpreted as an association between the number of bidders and the winning bid if procurers conducted the procurement process in a more desirable way and if that led to a higher number of bidders. Estimates can be interpreted as possible cost savings from receiving more bids to single-bid ITTs under these conditions.

As the outcome variable is in logarithmic form in each of these empirical models, the coefficients of interest account for the approximate percentage change in the outcome variable, the ratio between the winning bid and the expected cost. However, the exact percentage change is calculated by $(\exp(\beta) - 1) \cdot 100$ and starts to differ substantially from the approximation as the estimates become larger. For completeness, I keep the estimate in the tables but use the exact percentage changes in text, figures and back-of-the-envelope calculations.

4 Results

The main results are illustrated in Figure 9 and are presented in Table 2. In the table, the first OLS specification (1) presents the estimate assuming that the level of competition and procurement costs are linearly associated. This is a typical specification in the literature and hence I use it as a benchmark in my analysis. An additional bidder is associated with a 3.2% decrease in the winning bid, which is in-line with previous literature.⁶ The second OLS specification (2) presents estimates when the square term is included into the regression. The first additional bidder is associated with a 6.2% decrease in the winning bid, much larger than the linear estimate. As the number of additional bidders increases, the change in the winning bid decreases according to the second polynomial. This is shown in Figure 9. The sensitivity of these estimates for the inclusion and exclusion of controls and fixed effects is investigated in Table A.1, which shows that the main coefficients are quite stable, especially after controlling for industry. The specification (7) in Table A.1 is used in the main analysis and in Figure 9.

Estimates for OLS 2 are presented in specification (3) in Table 2. Having two bidders instead of one is associated with a 8.4% decrease in the winning bid, and having three bidders is associated with a 12.9% smaller winning bid. Having more than six bidders is associated with 19.8% decrease in the winning bid compared to the baseline. These estimates are slightly larger than OLS 1 estimates with the square term, which can be seen from Figure 9. The sensitivity of the estimates is investigated in Table A.2, which shows that the results are similarly stable as OLS 1 estimates after controlling for the industry. The specification (7) in Table A.2 is used in the main analysis and is illustrated in Figure 9.

The matching results are presented as specifications (4) to (7) in Table 2. In

⁶Because the regression models used are in log-linear form, the coefficients of interest are approximate percentage changes. The exact percentage change is calculated as $(\exp(\beta) - 1) \cdot 100$ and is used in the text and in the figures.

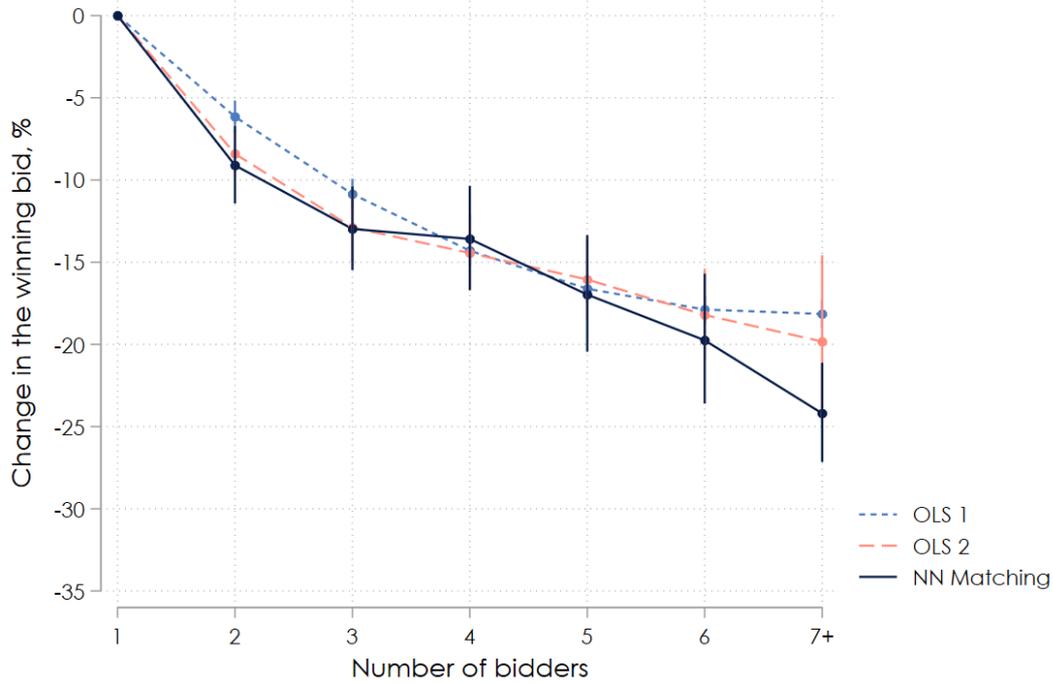


Figure 9: Main results illustrated. As the number of bidders increases, the winning bid decreases. OLS 1 denotes for specification (2), OLS 2 for specification (3), and NN Matching for specification (7) in Table 2.

specification (4), ITTs are matched according to the running variables and within 3-digit industries. Having two bidders instead of one is associated with a 8.2% decrease in the winning bid, having three would decrease the winning bid by 13.7% and having at least seven by 19.4%. Throughout the number of bidders, these estimates are roughly in line with the estimates from OLS 2 model, although individual estimates jump around a little. In other specifications, ITTs are matched within a larger number of subgroups, but the estimates stay quite stable. Individual estimates may vary from one specification to another, but they are not statistically significantly different from each other.

In specification (7) the matching subgroups are the most complex, ITTs are matched only with other ITTs in the same 3-digit industry, the same year group, using the same notice type and awarded by a similar kind of procurer. However, the estimates are not that different; having two bidders instead of one is associated

with a 9.2% decrease in the winning bid and having at least seven bidders by 24.2%. Specification (7) is also illustrated as the NN Matching -curve in Figure 9. The estimates follow closely OLS 2 estimates, being only slightly larger especially when the number of bidders is higher. The estimate for having seven or more bidders is larger in specification (7) but in other matching specifications, it is more in line with the OLS 2 estimate.

Overall, Figure 9 illustrates that regardless of the specific method or specification used, the results stay fairly stable, point to the similar direction, and show a non-linear association between the winning bid and the number of bidders, confirming the theoretical predictions from auction theory are present in public procurement auctions in Finland. As more and more similar ITTs are compared with each other, either using fixed effects and matching after that, the estimates become slightly larger, although the standard errors grow as well. This is in line with the previous empirical literature as when endogeneity has been better accounted for, the estimates have increased slightly. The estimates in Table 2 are large compared to previous studies, but usually assume that the relationship between the number of bidders and procurement costs is linear instead of quadratic or allows it to vary, resulting in lower average estimates. The specification (1) in Table 2 illustrates that my data can also produce a lower estimate if simpler methodology is used.

There is a concern that the choice of the thresholds of the outcome variable determining which observations were dropped from the main sample, discussed in Section 3.2, may bias the estimated results. To account for this, the main OLS results (specification (3) in Table 2) are estimated for different thresholds. As the thresholds become stricter, more and more presumably correct observations are dropped from the sample, resulting in the estimates depending mechanically from the sample thresholds. The results are shown in Figures B.6 and B.7. Figure B.6 illustrates the coefficients and their standard errors depending on the different lower sample threshold (0.4 in the main sample), keeping the upper threshold,

Table 2: Main results.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS 1	OLS 1	OLS 2	NNM	NNM	NNM	NNM
Additional bidder	-0.033*** (0.004)	-0.070*** (0.005)					
Additional bidder ²		0.006*** (0.001)					
2 bidders			-0.088*** (0.008)	-0.086*** (0.011)	-0.090*** (0.011)	-0.100*** (0.011)	-0.096*** (0.013)
3 bidders			-0.138*** (0.012)	-0.147*** (0.012)	-0.125*** (0.012)	-0.139*** (0.013)	-0.139*** (0.015)
4 bidders			-0.156*** (0.014)	-0.133*** (0.015)	-0.129*** (0.015)	-0.136*** (0.016)	-0.146*** (0.019)
5 bidders			-0.175*** (0.015)	-0.191*** (0.018)	-0.176*** (0.019)	-0.181*** (0.019)	-0.186*** (0.022)
6 bidders			-0.201*** (0.017)	-0.203*** (0.024)	-0.182*** (0.024)	-0.242*** (0.020)	-0.220*** (0.026)
7+ bidders			-0.221*** (0.032)	-0.216*** (0.021)	-0.213*** (0.019)	-0.231*** (0.018)	-0.277*** (0.020)
N	18251	18251	18251	18115	17945	17753	17007
	Controls			Matching pairs			
Industry	Yes						
Year	Yes	Yes	Yes		Yes	Yes	Yes
Notice type	Yes	Yes	Yes			Yes	Yes
Procurer type	Yes	Yes	Yes				Yes
Procurer	Yes	Yes	Yes				

Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The outcome variable is the logarithm of the ratio between the winning bid and the expected cost. Standard errors are clustered to 2-digit industry level in OLS specifications. Industry fixed effects consists all 3-digit cpv-codes. Notice type fixed effects for EU contract notices and national contract notices. Procurer type fixed effects controls for municipalities, wellbeing services counties, hospital districts, governmental bodies, joint municipal authority / central purchasing bodies, and others. In the case of matching, the matching pairs indicate if the ITTs have been matched inside them. The procurer size, calculated as the yearly average expected value of procurement unit's procurements, the expected cost of the contract, the distance from the procurement location to a large city, and the population of the procurement location are used as continuous variables for which the Mahalanobis distance between ITTs is minimized. In matching ITTs are matched in two groups, years 2021-2022 between each other and the rest of the years between each other. As the matching pairs become more complicated, the sample size drops as it becomes harder to find matches to observations.

determined by industry specific thresholds, the same. Similarly in Figure B.7, the lower threshold of 0.4 is fixed and the upper threshold is allowed to vary, this time using constant thresholds across industries. Both figures show that although the

estimates differ depending on the chosen thresholds, they are still economically meaningful even if either of these thresholds were chosen differently. As the sample restrictions become stricter, the estimates become smaller and closer to those in the previous literature.

The results in Table 2 show how much procurement costs may decrease in public procurement auctions if more bidders participated in single-bid ITTs. The relationship illustrates that the greatest gains occur in situations when the initial number of bidders is very low. This is confirmed by an additional analysis that examines the association of one additional bidder in different initial situations. When the initial number of bids is just one or two, even one additional bid goes a long way, but after that, the association diminishes (see Table A.3).

However, it is not clear how many bidders could realistically bid into those ITTs with only one initial bidder. To account for this, I estimate the same association but allowing single-bid ITTs to be matched with the most similar other ITTs with more than one bidder. The number of bidders is not forced to be any particular level, so the ITTs are matched to the most similar other ITTs regardless of how many additional bidders they have, making the counterfactual more realistic. These estimates give an idea how much could be saved, e.g. if single-bid ITTs had to be auctioned again or the procurement procedure was being handled more professionally, resulting in a higher number of bidders. The results are shown in the first panel of Table 3. If more than one bidder was attracted to the single-bid ITTs, the winning bid could be 12.9% to 15.3% lower. Estimates differ slightly depending on the specification, but these are not statistically significantly different from each other. In specification (4), the winning bid would be 15.3% lower. In a median single-bid ITT, such a reduction in the winning bid would mean about €22,000 lower price paid on average.

One concern is that when matching different ITTs, some matched ITTs differ greatly from each other but are still matched together, biasing the results. How-

ever, when I force matching to happen only between more and more similar ITTs by decreasing the allowed 'distance' or 'caliper' between them, estimating the specification (4) from the first panel of Table 3, the estimates stay stable and statistically not different from each other (see Figure B.8). Likewise, when I force observations to have different number of matches, the estimates remain stable.

The estimates in the first panel of Table 3 are larger than those in Titl (2025) who estimates that repeating single-bid auctions led to only a 6% decrease in procurement costs and to one additional bidder in Czechia. The results in Table 3 estimate the potential savings from additional bidders assuming that more bidders can be attracted, which is probably not always possible. There are always some uncertainty and natural variation in the level of obtained competition. When taking into account the share of contracts that are not able to attract more competition, the actual average savings would likely be smaller.⁷ Additionally, Czechia and Finland are geographically different markets as Finland is a more sparsely populated and also less corrupt country, which may partly explain the larger estimates.⁸ Finland may have more local monopolies that know they rarely face competition, and less corruption may allow the competition effect to work better, as firms do not collude as often with procurers or contracts are not as often tailored to certain firms. From the methodological point of view, similarly to the results in Table 2, the chosen sample thresholds also affect these estimates, and stricter thresholds would have led to smaller estimates, as seen in Figure B.9 for the lower and in Figure B.10 for the higher threshold. However, estimates remain high compared to 6%, regardless of the chosen thresholds.

In the second panel of Table 3, the results are estimated separately for different

⁷Using the additional descriptive evidence from Section 5, there may be more potential bidders in 75% of the single-bid ITTs. This would mean that these results apply to those auctions only, making the average association $15.3\% \cdot 0.75 = 11.5\%$. For one additional bidder, this would be $10.3\% \cdot 0.75 = 6.9\%$, which is already close to the estimates from Czechia.

⁸Czechia is the 46th least corrupt country in the world (Transparency International, 2024).

sectors. Due to smaller samples, the estimates jump around more than the main estimates. Estimates for the construction sector are slightly higher than the overall estimates, and more bidders lead between 15.2% and 17.7% lower winning bid. In service procurements, estimates for possible savings are less precise and differ between specifications. The winning bid is observed to be 11.4% to 15.8% lower in similar contracts that receive multiple bids. In product procurements, estimates are consistently lower than in others, possible gains being between 10.1% and 12.9%.

To further examine the level of competition in different sectors, the specification (5) in Table 2 is estimated separately for different sectors. Figure 10 illustrates this estimated relationship and shows that the winning bid in construction ITTs evolves quite similarly to the overall sample as the number of bidders increases. However, estimates for product and service ITTs follow a slightly different trajectory. For those sectors, the gains from additional competition seem to be lower in general, albeit the estimates are less precise. This phenomenon also holds true when the OLS specification (3) in Table 2 is estimated for robustness (see Table A.4); the benefit from additional bidders seems to flatten out earlier in product and service ITTs than in construction ITTs. In product contracts, this may be due to the fact that there may be less competition in product industries in general, as shown in Figure 2 for all ITTs and Figure B.11 for the main sample. This is not the case with service ITTs as the number of bidders in those contracts is distributed more similarly with the whole sample.

There may be other reasons that can explain the difference between sectors. Most service contracts are awarded using scoring auctions, in which the competition dynamics may differ because price is not the only criterion evaluated. The share of scoring auctions in product ITTs is also higher than in construction. If other criteria than price are taken into account, the winning bid may not be the cheapest one, especially if these other aspects are not perfectly positively correlated with the price. Thus, scoring rules may soften price competition relative to lowest-bid

Table 3: Matching results, receiving the average number of bidders in the most similar other ITTs instead of one bidder.

	(1) NNM	(2) NNM	(3) NNM	(4) NNM
1 to average bidders	-0.153*** (0.014)	-0.138*** (0.012)	-0.151*** (0.012)	-0.166*** (0.013)
N	17555	16821	15483	12091
1 to average bidders				
Construction	-0.195*** (0.019)	-0.172*** (0.019)	-0.165*** (0.019)	-0.170*** (0.019)
N	8040	7919	7891	7368
Products	-0.107*** (0.012)	-0.113*** (0.012)	-0.127*** (0.013)	-0.138*** (0.014)
N	5191	4842	4384	2994
Services	-0.139*** (0.041)	-0.121*** (0.033)	-0.166*** (0.030)	-0.172*** (0.033)
N	4324	4060	3208	1729
Matching pairs				
Industry	Yes	Yes	Yes	Yes
Year		Yes	Yes	Yes
Notice type			Yes	Yes
Procurer type				Yes

Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The outcome variable is the logarithm of the ratio between the winning bid and the expected cost. Matching pairs indicate if the ITTs have been matched inside industries (3-digit cpv-code), two year groups (2021-2022, and the rest of the years), notice types (EU contract notices and national contract notices), and procurer types (municipalities, wellbeing services counties, hospital districts, governmental bodies, joint municipal authority / central purchasing bodies, and others). The procurer size, calculated as the yearly average expected value of procurement unit's procurements, the expected cost of the contract, the distance from the procurement location to a large city, and the population of the procurement location are used as continuous variables for which the Mahalanobis distance between ITTs is minimized. As the matching pairs become more complicated, the sample size drops as it becomes harder to find matches to observations.

auctions, resulting in higher bid prices (e.g. Asker and Cantillon, 2008). To further examine this, the matching specification (5) from Table 2 is estimated separately for lowest-bid auctions and scoring auctions for different sectors (see Figure B.12).

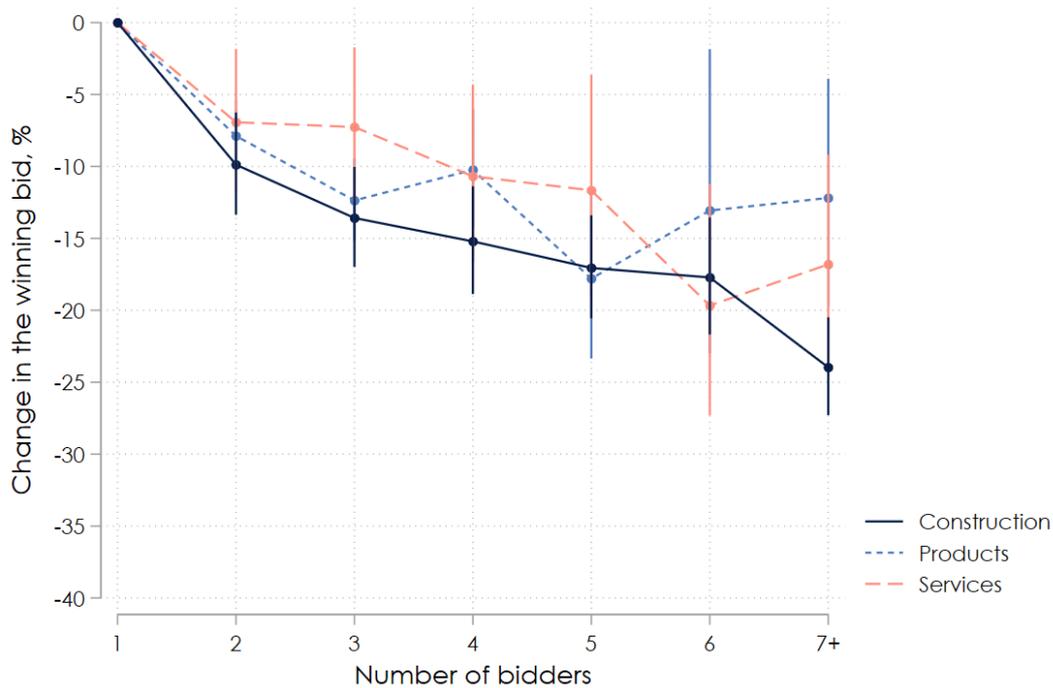


Figure 10: NN Matching specification (5) from Table 2 estimated for different sectors.

There exists a difference between the auction formats, lowest-bid auctions being associated with higher savings estimates although the estimates are quite imprecise. Furthermore, when the results of Figure 10 are estimated by matching only the same kind of auctions with each other, the main results hardly change and the difference between sectors persists (see Figure B.13). Nevertheless, when matching results from Table 3 are estimated separately for different auction mechanisms, the potential savings seem to be generally lower when quality criteria are used (see Table A.5). However, this can also be a result of scoring auctions being negatively associated with competition, leading to a lower number of bidders and higher price compared to price-only auctions.

These results suggest that the differences between sectors can not be explained by the differences in auction mechanisms used and indicate that there are other mechanisms in play that explain why additional competition does not seem to lead to as low procurement costs in other sectors as in construction. However, the auction

format choice may matter for procurement outcomes as my results suggest that the association between procurement costs and competition may not be as strong in those auctions. Jääskeläinen et al. (2026) have found that scoring rules may reduce competition in procurement auctions, especially when used in industries where their usage is rare. My results suggest that the possible gains from additional competition in scoring auctions may also be lower in general, even if more competition were to be attained. However, this result is only suggestive and requires further research.

5 Discussion

All the estimated results in the previous section rely on the assumption that more competition can be achieved in the first place. Previous empirical literature discusses many policy changes from other countries that have led to a higher level of competition and lower procurement costs. It is not clear why attracting more bidders would not be possible in Finland as well. Next, I will show some evidence that there are indeed more firms that could bid into auctions with only a single bidder, and do some simple calculations to further quantify the extent of possible cost reductions from additional competition.

One way of examining the level of potential competition in single-bid ITTs is to examine whether the firms face competition in other procurement auctions they participate in the same industry. This especially shows if firms winning single-bid contracts operate in industries where competition is always lacking. Figure 11 shows the distribution of the number of potential bidders across sectors in single-bid ITTs. The figure includes all single-bid ITTs that are conducted as open auctions but are not framework agreements or part of DPSs. Out of these single-bid ITTs, only 7.9% or over 700 ITTs are won by firms that normally also do not face any competition from other firms.⁹ In contrast, 75.8% of the single-bid ITTs are won by firms that usually face competition in other procurements where they participate, indicating that there are firms in the market that did not bid in these particular ITTs, but probably could have.¹⁰ This suggests that the firms bidding to single-bid ITTs do not typically operate in very specific markets without any competition, but are often competing with other firms.

⁹Firms that do not usually face competition from other firms are usually smaller than other firms that have won single-bid ITTs, and may operate in very narrow industries. However, some of the ITTs may still be such were more competition could be achieved.

¹⁰The overall percentages can be seen in Figure B.14, which shows that only 24.2% of the single-bid ITTs are won by the firms that do not usually face competition in other procurement auctions (7.9%), or are participating for the first time (16.3%).

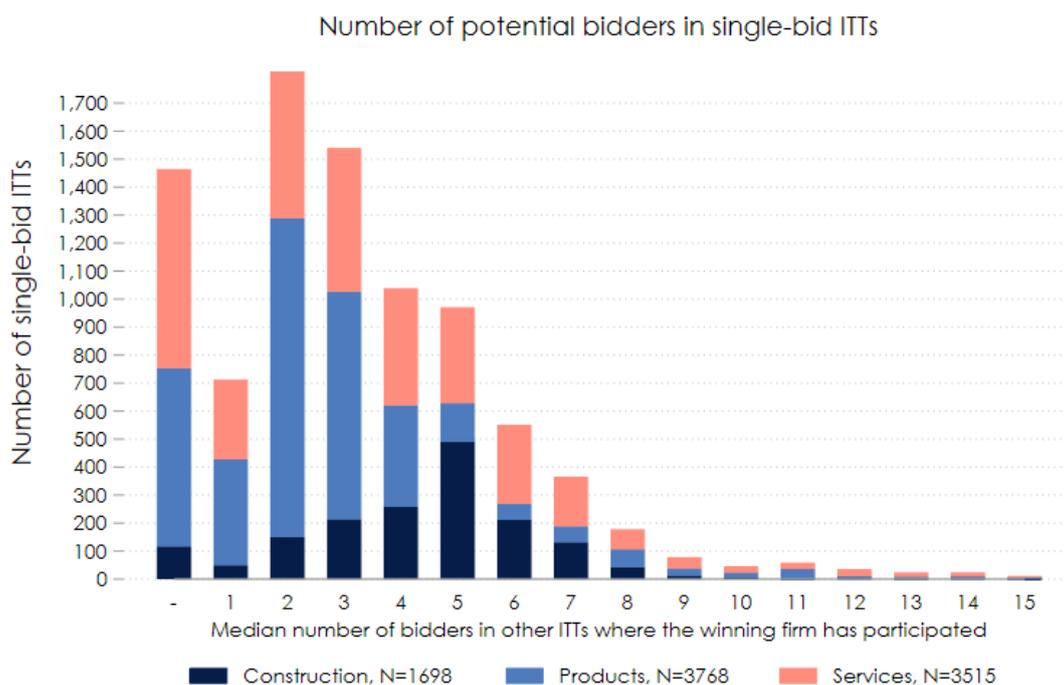


Figure 11: Number of potential bidders in single-bid ITTs, according to the median number of firms in other procurement auctions where the firm has participated. First bar indicates firms that have not bid to other ITTs.

As shown in Figure 11, there are differences in the level of potential competition between different sectors. Less than 10% of single-bid construction ITTs are won by firms facing no competition at all, and instead firms usually face a lot more competition in other procurements. This is less true for single-bid product ITTs, as there is not that much competition overall in the sector. However, more than 72% of these ITTs are still won by a firm that usually faces at least some competition, indicating that it is not hopeless to increase competition in product contracts either. The number of potential bidders is more evenly distributed in service procurements, and I observe that a large number of firms winning single-bid service ITTs have not participated in any other procurements, demonstrating the diversity of service contracts. Nevertheless, in all sectors, at least 70% of single-bid ITTs are won by a firm facing competition in other procurement auctions, indicating that the problem is not so much that there are no firms that could bid in the auctions, but that they

do not do that.

This sparks a question: how much could be saved if more competition were to be achieved? I do back-of-the-envelope calculations using sector-level saving estimates from the second panel of Table 3 with the knowledge that single-bid contracts account for roughly 13.1% of the contracts in monetary value (1.95 billion euros annually). I allocate this value between different sectors according to the number of single-bid ITTs within them, resulting in annual potential savings of 231 million euros. I calculate the savings separately for different sectors and different selection mechanisms to account for the fact that the association between competition and procurement prices seems to behave differently depending on those attributes. The calculations are presented in more detail in Table 4. The estimated savings of 231 million euros should be interpreted as theoretical maximum as it assumes that all single-bid ITTs could receive more bids without any costs from attaining more competition. When ITTs won by firms that usually do not face competition or have bid only once are excluded (see Figure 11), the potential savings would still be 176 million euros annually. If I assume that these ITTs with potentially more bidders would get one additional bid, potential savings would be 144 million euros annually. These estimates set lower and upper bounds for annual cost savings from single-bid contracts that have more potential bidders, with the assumption that they could also attract at least one additional bidder. Like shown in Figure 11, for most ITTs there seem to be more firms in the market that could have made a bid.

In my sample, contracts with estimated values above the EU procurement thresholds account for roughly 53% of procurement spending, measured using expected contract values. The share of single-bid contracts is slightly lower above the EU thresholds than below them: single-bid contracts represent 15.5% of contracts above and 19.5% of contracts below the thresholds. As single-bid contracts are less common among higher-value procurements, approximately 45% of single-bid contracts in monetary terms occur above the EU procurement thresholds in my

Table 4: Back-of-the-envelope calculations of potential annual savings.

	Overall value	Value share	% of the auction type	% of ITTs where more potential bidders	% Savings estimate	=
A. Savings if all single-bid contracts could receive more bidders						
Lowest-bid auctions						
Construction	1950	0.156	0.783		0.177	42.2
Products	1950	0.376	0.443		0.135	44.8
Services	1950	0.469	0.391		0.135	48.3
Scoring auctions						
Construction	1950	0.156	0.217		0.130	8.57
Products	1950	0.376	0.547		0.092	36.5
Services	1950	0.469	0.609		0.091	50.7
						231
B. Savings if single-bid contracts with potential bidders received more bids						
Lowest-bid auctions						
Construction	1950	0.156	0.783	0.902	0.177	38.0
Products	1950	0.376	0.443	0.731	0.135	32.8
Services	1950	0.469	0.391	0.717	0.135	34.6
Scoring auctions						
Construction	1950	0.156	0.217	0.902	0.130	7.72
Products	1950	0.376	0.547	0.731	0.092	26.8
Services	1950	0.469	0.609	0.717	0.091	36.3
						176
C. Savings if single-bid contracts with potential bidders received two bids						
Lowest-bid auctions						
Construction	1950	0.156	0.783	0.902	0.123	26.4
Products	1950	0.376	0.443	0.731	0.115	27.9
Services	1950	0.469	0.391	0.717	0.115	29.5
Scoring auctions						
Construction	1950	0.156	0.217	0.902	0.096	5.72
Products	1950	0.376	0.547	0.731	0.084	24.6
Services	1950	0.469	0.609	0.717	0.076	30.4
						144

Notes: The overall value of single-bid contracts is determined using yearly mean of their monetary value from Figure 4. It is assumed that the yearly overall value of contracts above national procurement thresholds is 15 billion euros. The value of single-bid contracts is allocated for different sectors using the share of ITTs in them. The share of scoring auctions in single-bid contracts calculated from HILMA data. The savings estimates are calculated by estimating the results from Table 3 column (2) for different scenarios in panels A and B. In panel C, the results for one additional bidder from Table 2 column (3) for different scenarios. Due to data limitations, combined savings estimate for product and service procurements is used in lowest-bid auctions.

sample.¹¹ Based on these estimates, 65 to 79 million euros of the total annual savings would come from contracts above the EU thresholds, while the remaining 79 to 97 million euros would come from contracts below the thresholds.

These savings estimates can be compared to the costs of hiring additional procurement personnel. Typically an additional procurement professional costs approximately €60,000 annually, which makes the estimated savings rather large.¹² For example, adding one additional procurement professional to each Finnish municipality, which would be a very extreme measure, would cost only about 18 million euros annually, compared to the potential benefits of at least 144 million euros.

These calculated savings are only suggestive and rely on the assumptions made in the empirical analysis and in this section, but they show that potential savings from reducing the number of single-bid contracts are large and economically meaningful, even if compared to possible costs of investing in better procurement practices. Furthermore, even changing some assumptions does not change the overall economic significance of the potential savings. For example, if savings-estimates were reduced by one-third, annual savings would still be between 96 and 118 million euros. However, there are challenges in obtaining these savings even if the procurement process itself were conducted more professionally. There is a risk that these cost reductions are in expense of quality or result in renegotiations, as winning firms may be the ones that underestimate their production costs the most. Theoretically, first-price sealed-bid auctions may favor bidders that are less likely to deliver products or services very well due to adverse selection (Spulber, 1990) or

¹¹There exists uncertainty regarding the share of the contracts are above EU procurement thresholds due to data limitations. Nevertheless, even if a broader sample of all ITTs with expected cost information is used, the share of single-bid contracts above EU procurement thresholds remains quite stable.

¹²In the municipality sector, the monthly total salary of a procurement official was €3,948 in October 2023 (Kunta- ja hyvinvointialueyönantajat KT, 2023). If I take into account additional costs that an employer has from an employee, the monthly cost of additional professional is assumed to be €5,000, meaning €60,000 annually.

moral hazard (McAfee and McMillan, 1986). Indeed, Decarolis (2014) finds that at least half of the benefits from increasing competition are lost in renegotiations in Italy, unless the lowest bids are screened more thoroughly. This underlines the competence of the procurement unit and can probably be tackled by investing in hiring procurement professionals. Bid screening also increases awarding times of the contracts, which is costly. Decarolis (2014) finds that screening reduces savings by one-third but the net cost reductions from additional bidders would still stay economically very meaningful. The extent of renegotiations and cost overruns is not known in Finland due to a lack of data, but it is likely that they play a role here as well. However, it is very unlikely that their costs would be so high that they would negate all the positive effects from increased competition. Kang and Miller (2021) find that in negotiated IT and telecommunication product contracts in the US, costs overrun by 8% on average and contract durations were 41% longer than originally expected.

Previous literature has also found more positive signs. In standardized goods, Titl (2025) finds that cost reductions are driven by new competitors instead of worsening quality. Similarly, Coviello and Mariniello (2014) find that increased publicity did not result in more renegotiations and that the price reductions were driven by larger and more efficient firms bidding in auctions. Carril et al. (2026) show that this is especially the case with less complex procurements. These studies suggest that it is not certain that lower costs would automatically lead to lower quality, which is often feared.

6 Conclusion

I show that receiving additional bids in procurement auctions is associated with over 15% lower procurement costs, meaning annual savings up to 176 million euros from those contracts alone in Finland, underlying the potential benefits of investing in public procurement. Even receiving just one additional bid for single-bid ITTs could reduce costs by 9%, leading to savings up to 144 million euros annually. 45% of the savings would come from larger contracts with expected values above EU procurement thresholds. These savings are conditional on the fact that more competition can be achieved in the first place, which often seems to be the case, as single-bid contracts are mostly won by firms that usually face competition in other procurements in which they have participated. Especially construction is an industry where single-bid ITTs could be reduced greatly as construction firms very often face competition in other procurements, and generally the level of competition in the industry is relatively high.

Back-of-the-envelope calculations show that even though investing in public procurement is costly, the benefits are likely much greater. Future research is needed to identify and quantify different measures that can increase the number of bidders in Finnish public procurement auctions, as well as investigating the extent of renegotiations and cost overruns that diminish the positive effect of increased competition. Similarly, more research is needed to investigate possible markets where there is a real lack of potential bidders. Nevertheless, improving efficiency in public procurement does not seem to be as hopeless as often described.

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Appendix

A Tables

Table A.1: OLS 1 sensitivity.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Additional bidder	-0.026*** (0.001)	-0.051*** (0.005)	-0.066*** (0.005)	-0.066*** (0.005)	-0.068*** (0.005)	-0.069*** (0.005)	-0.070*** (0.005)
Additional bidder ²		0.004*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)
Procurer size		0.006*** (0.002)	0.004* (0.002)	0.005** (0.002)	0.003 (0.002)	0.002 (0.002)	-0.090*** (0.024)
Expected cost		0.002** (0.001)	0.001** (0.000)	0.001** (0.000)	-0.0001 (0.000)	-0.0001 (0.000)	-0.0003 (0.001)
Distance to a large city		0.004 (0.005)	0.004 (0.005)	0.004 (0.005)	0.006 (0.005)	0.005 (0.005)	0.019* (0.009)
Area population		-0.007*** (0.002)	-0.006*** (0.002)	-0.006*** (0.002)	-0.007*** (0.002)	-0.007*** (0.002)	-0.002 (0.004)
N	18251	18251	18251	18251	18251	18251	18251
Industry			Yes	Yes	Yes	Yes	Yes
Year				Yes	Yes	Yes	Yes
Notice type					Yes	Yes	Yes
Procurer type						Yes	Yes
Procurer							Yes

Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The outcome variable is the logarithm of the ratio between the winning bid and the expected cost. Standard errors are clustered to the 2-digit industry level in specification 8. Industry fixed effects consists all 3-digit cpv-codes. Notice type fixed effects for EU contract notices and national contract notices. Procurer type fixed effects controls for municipalities, wellbeing services counties, hospital districts, governmental bodies, joint municipal authority / central purchasing bodies, and others.

Table A.2: OLS 2 sensitivity.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2 bidders	-0.066*** (0.009)	-0.068*** (0.009)	-0.082*** (0.009)	-0.082*** (0.009)	-0.086*** (0.009)	-0.086*** (0.009)	-0.088*** (0.008)
3 bidders	-0.100*** (0.009)	-0.103*** (0.009)	-0.131*** (0.009)	-0.130*** (0.009)	-0.136*** (0.009)	-0.136*** (0.009)	-0.138*** (0.012)
4 bidders	-0.110*** (0.010)	-0.115*** (0.010)	-0.150*** (0.011)	-0.148*** (0.011)	-0.155*** (0.010)	-0.156*** (0.010)	-0.156*** (0.014)
5 bidders	-0.128*** (0.011)	-0.133*** (0.011)	-0.169*** (0.012)	-0.166*** (0.011)	-0.176*** (0.011)	-0.177*** (0.011)	-0.175*** (0.015)
6 bidders	-0.150*** (0.013)	-0.157*** (0.013)	-0.196*** (0.014)	-0.191*** (0.014)	-0.201*** (0.013)	-0.202*** (0.013)	-0.201*** (0.017)
7+ bidders	-0.168*** (0.010)	-0.174*** (0.010)	-0.214*** (0.011)	-0.208*** (0.011)	-0.223*** (0.010)	-0.223*** (0.011)	-0.221*** (0.032)
Procurer size		0.006*** (0.002)	0.004* (0.002)	0.005** (0.002)	0.002 (0.002)	0.002 (0.002)	-0.090*** (0.024)
Expected cost		0.002** (0.001)	0.001** (0.000)	0.001** (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.001)
Distance to a large city		0.004 (0.005)	0.004 (0.005)	0.004 (0.005)	0.006 (0.005)	0.005 (0.005)	0.018* (0.009)
Area population		-0.007*** (0.002)	-0.006** (0.002)	-0.006*** (0.002)	-0.007*** (0.002)	-0.007*** (0.002)	-0.002 (0.004)
N	18251	18251	18251	18251	18251	18251	18251
Industry			Yes	Yes	Yes	Yes	Yes
Year				Yes	Yes	Yes	Yes
Notice type					Yes	Yes	Yes
Procurer type						Yes	Yes
Procurer							Yes

Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The outcome variable is the logarithm of the ratio between the winning bid and the expected cost. Standard errors are clustered to the 2-digit industry level in specification 8. Industry fixed effects consists all 3-digit cpv-codes. Notice type fixed effects for EU contract notices and national contract notices. Procurer type fixed effects controls for municipalities, wellbeing services counties / hospital districts, governmental bodies, joint municipal authority / central purchasing bodies, and others.

Table A.3: Matching results, one additional bid in different initial situations

	(1) NNM	(2) NNM	(3) NNM	(4) NNM
1 to 2 bidders	-0.086*** (0.011)	-0.090*** (0.011)	-0.100*** (0.011)	-0.096*** (0.013)
2 to 3 bidders	-0.049*** (0.011)	-0.048*** (0.011)	-0.046*** (0.013)	-0.042** (0.013)
3 to 4 bidders	-0.019 (0.012)	-0.029* (0.013)	-0.033* (0.013)	-0.027 (0.015)
4 to 5 bidders	-0.026 (0.014)	-0.018 (0.015)	-0.019 (0.015)	-0.016 (0.017)
5 to 6 bidders	-0.043* (0.018)	-0.037* (0.019)	-0.049** (0.019)	-0.038 (0.021)
6 to 7+ bidders	-0.016 (0.018)	-0.031 (0.019)	-0.040* (0.020)	-0.038 (0.021)
Matching pairs				
Industry	Yes	Yes	Yes	Yes
Year		Yes	Yes	Yes
Notice type			Yes	Yes
Procurer type				Yes

Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The outcome variable is the logarithm of the ratio between the winning bid and the expected cost. In the case of matching, the fixed effects indicate if the ITTs have been matched inside industries, notice types, procurer types and Finnish regions. The procurer size, calculated as the yearly average expected value of procurement unit's procurements, the expected cost of the contract, the distance from the procurement location to a large city, and the population of the procurement location are used as continuous variables for which the Mahalanobis distance between ITTs is minimized. Matching is performed separately for each estimate, resulting to different sample sizes ranging from 1816 to 6891.

Table A.4: Main results separately for different sectors.

	Construction		Products		Services	
	OLS 2	NNM	OLS 2	NNM	OLS 2	NNM
2 bidders	-0.091*** (0.018)	-0.104*** (0.020)	-0.082*** (0.014)	-0.082*** (0.014)	-0.096*** (0.019)	-0.072** (0.027)
3 bidders	-0.158*** (0.018)	-0.146*** (0.021)	-0.131*** (0.024)	-0.132*** (0.017)	-0.128*** (0.024)	-0.075* (0.030)
4 bidders	-0.182*** (0.018)	-0.165*** (0.023)	-0.131*** (0.019)	-0.108*** (0.023)	-0.159*** (0.029)	-0.113** (0.035)
5 bidders	-0.200*** (0.018)	-0.187*** (0.022)	-0.177*** (0.020)	-0.196*** (0.036)	-0.151*** (0.037)	-0.124** (0.044)
6 bidders	-0.231*** (0.020)	-0.195*** (0.025)	-0.211*** (0.035)	-0.140* (0.062)	-0.155*** (0.032)	-0.219*** (0.051)
7+ bidders	-0.277*** (0.017)	-0.274*** (0.023)	-0.173*** (0.025)	-0.130** (0.046)	-0.157*** (0.037)	-0.184*** (0.045)
N	8040	8038	5533	5344	4678	4563
	Controls	M. P.	Controls	M. P.	Controls	M. P.
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Notice type	Yes		Yes		Yes	
Procurer type	Yes		Yes		Yes	
Procurer	Yes		Yes		Yes	

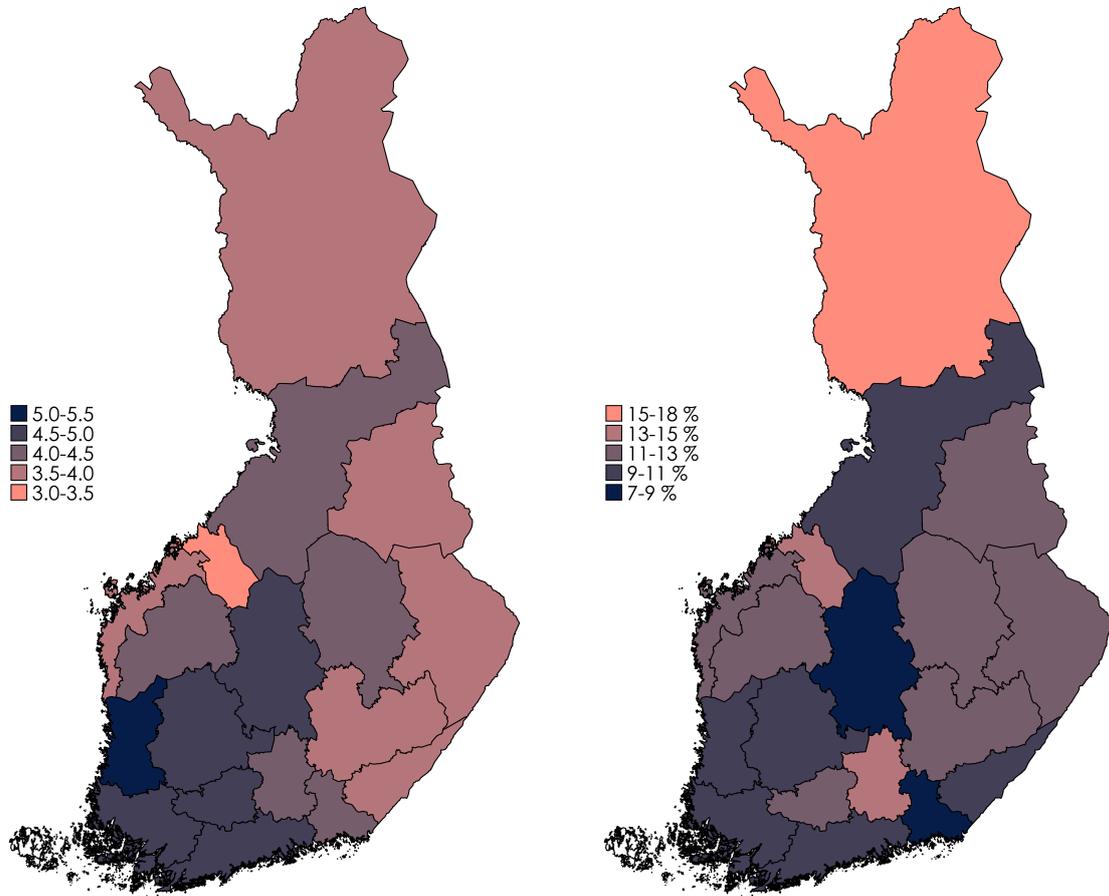
Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The outcome variable is the logarithm of the ratio between the winning bid and the expected cost. Standard errors are clustered to the 2-digit industry level in OLS specifications. In the case of matching, the matching pairs (M. P.) indicate if the ITTs have been matched inside industries (3-digit cpv-codes), two year groups, notice types, and procurer types. The procurer size, calculated as the yearly average expected value of procurement unit's procurements, the expected cost of the contract, the distance from the procurement location to a large city, and the population of the procurement location are used as continuous variables for which the Mahalanobis distance between ITTs is minimized. As the matching pairs become more complicated, the sample size drops as it becomes harder to find matches to observations.

Table A.5: Matching results separately for different selection criteria, receiving the average number of bidders in the most similar other ITTs instead of one bidder.

	(1) NNM	(2) NNM	(3) NNM	(4) NNM
1 to average bidders, lowest bid auctions				
All ITTs	-0.195*** (0.019)	-0.179*** (0.019)	-0.196*** (0.018)	-0.200*** (0.021)
N	8594	8031	7361	6130
Construction	-0.229*** (0.023)	-0.195*** (0.023)	-0.196*** (0.022)	-0.202*** (0.024)
N	5683	5599	5580	5227
Products and services	-0.151*** (0.033)	-0.145*** (0.035)	-0.174*** (0.027)	-0.165*** (0.036)
N	2911	2432	1781	903
1 to average bidders, scoring auctions				
All ITTs	-0.112*** (0.017)	-0.110*** (0.018)	-0.135*** (0.020)	-0.148*** (0.022)
N	4823	4325	3707	2371
Construction	-0.178*** (0.051)	-0.139** (0.051)	-0.166*** (0.049)	-0.172*** (0.048)
N	992	992	954	781
Products and services	-0.094*** (0.016)	-0.099*** (0.018)	-0.125*** (0.019)	-0.132*** (0.021)
N	3831	3333	2753	1590
Matching pairs				
Industry	Yes	Yes	Yes	Yes
Year		Yes	Yes	Yes
Notice type			Yes	Yes
Procurer type				Yes

Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The outcome variable is the logarithm of the ratio between the winning bid and the expected cost. Matching pairs indicate if the ITTs have been matched inside industries (3-digit cpv-code), two year groups (2021-2022, and the rest of the years), notice types (EU contract notices and national contract notices), and procurer types (municipalities, wellbeing services counties, hospital districts, governmental bodies, joint municipal authority / central purchasing bodies, and others). The procurer size, calculated as the yearly average expected value of procurement unit's procurements, the expected cost of the contract, the distance from the procurement location to a large city, and the population of the procurement location are used as continuous variables for which the Mahalanobis distance between ITTs is minimized. As the matching pairs become more complicated, the sample size drops as it becomes harder to find matches to observations.

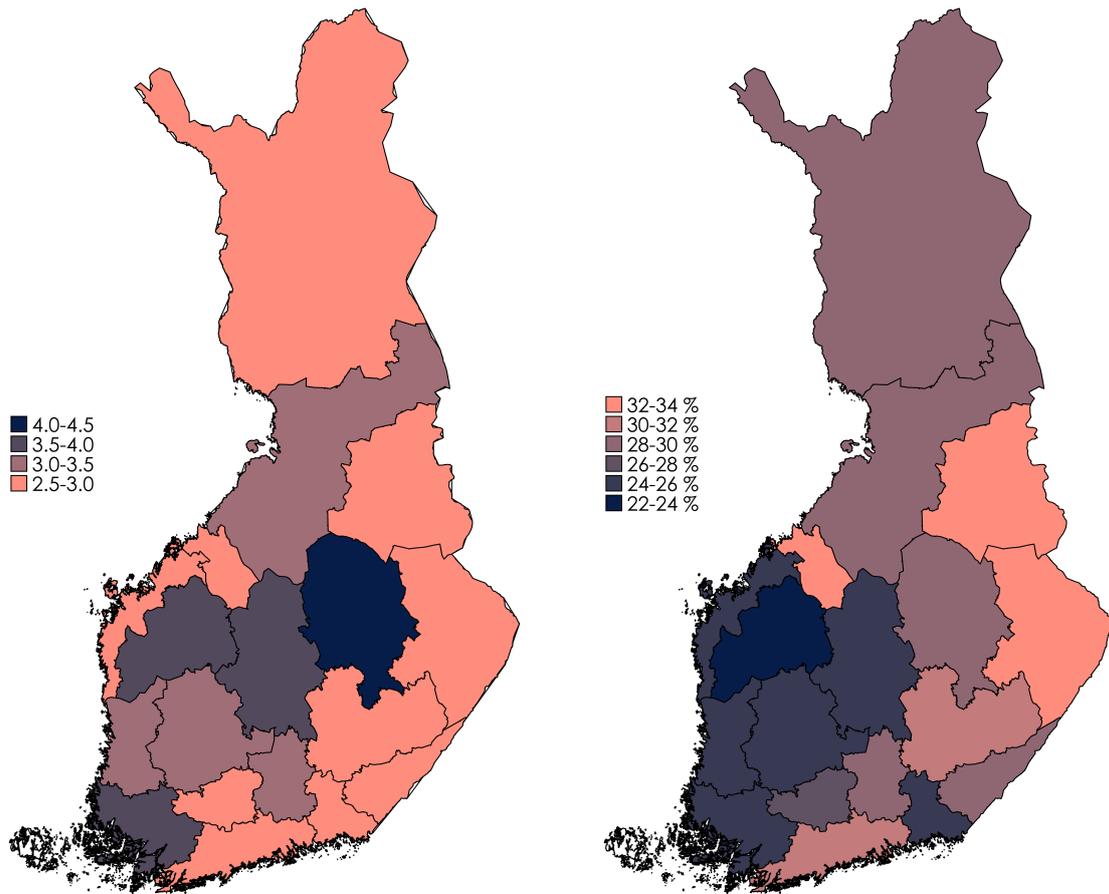
B Figures



(a) The Average Number of Bidders in Finnish Regions, Construction ITTs.

(b) The Share of Single-bid Construction ITTs in Finnish Regions.

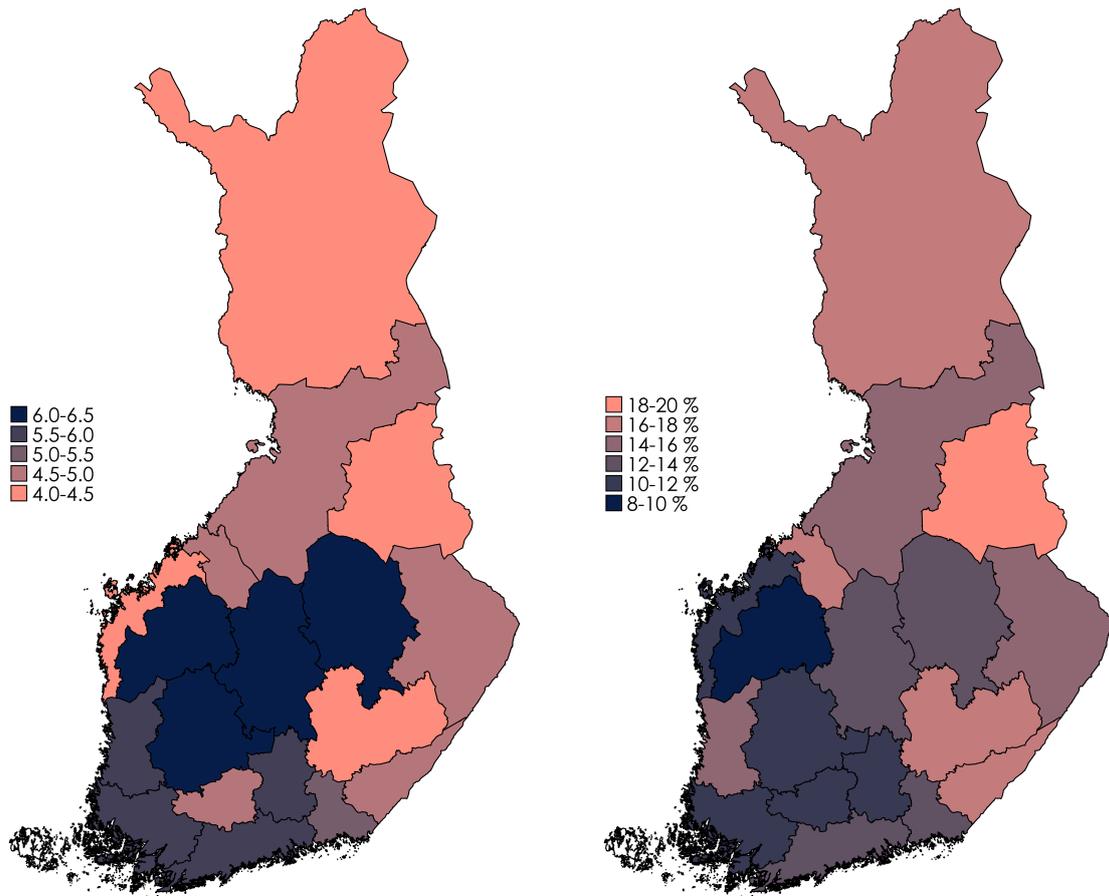
Figure B.1: Construction ITTs and the level of competition across Finland. Procurements by government entities are excluded.



(a) The Average Number of Bidders in Finnish Regions, Product ITTs.

(b) The Share of Single-bid Product ITTs in Finnish Regions.

Figure B.2: Product ITTs and the level of competition across Finland. Procurements by government entities are excluded.



(a) The Average Number of Bidders in Finnish Regions, Service ITTs.

(b) The Share of Single-bid Service ITTs in Finnish Regions.

Figure B.3: Service ITTs and the level of competition across Finland. Procurements by government entities are excluded.

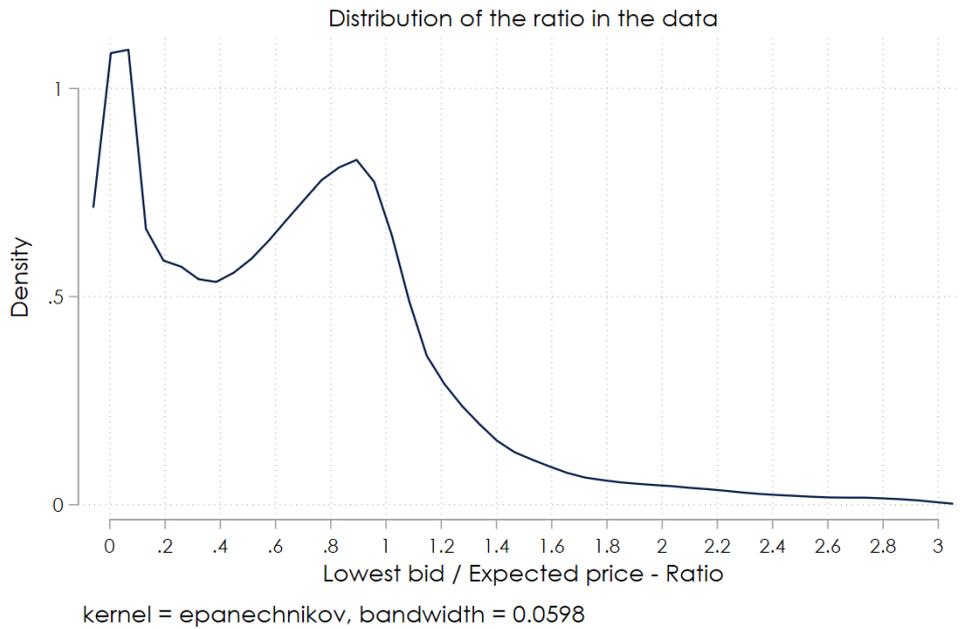


Figure B.4: Distribution of the main outcome variable in the data. There are some observations that have very low ratio between the winning bid and the expected cost, which can be seen from the graph. The trend changes roughly when the ratio is 0.4.

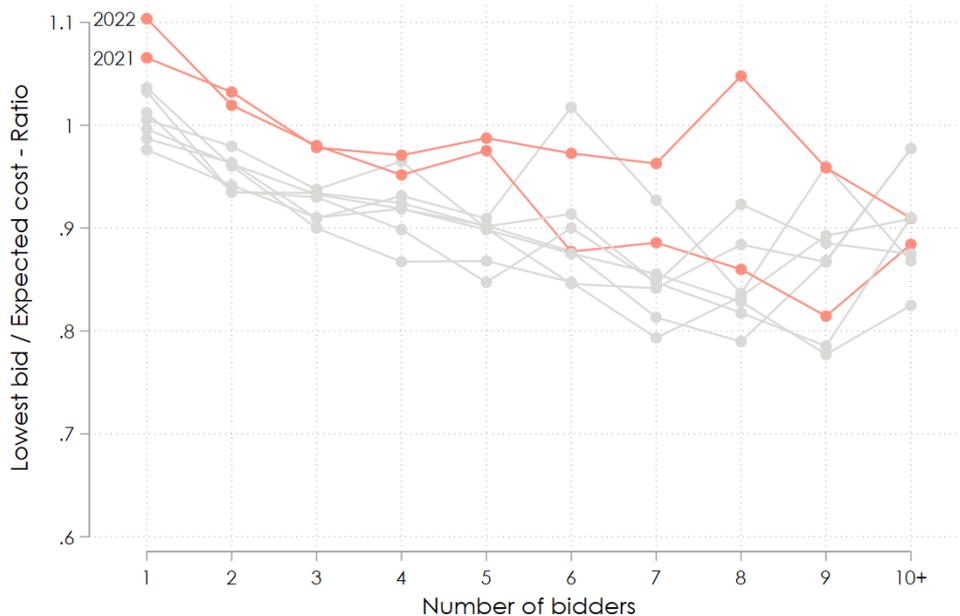


Figure B.5: Descriptive graph about the relationship between the number of bidders and the outcome variable across the years. Years defined by higher inflation (2021, 2022) have consistently higher ratios where most of the ITTs are.

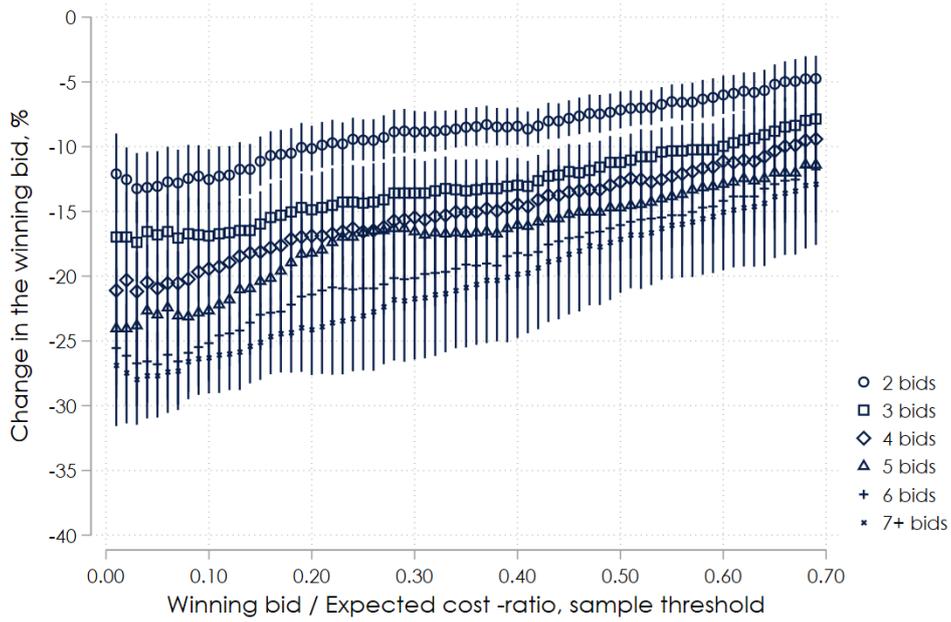


Figure B.6: OLS 2 results, specification (2) in Table 2, depending the chosen sample threshold. The upper threshold follows the procedure explained in Section 3.2.

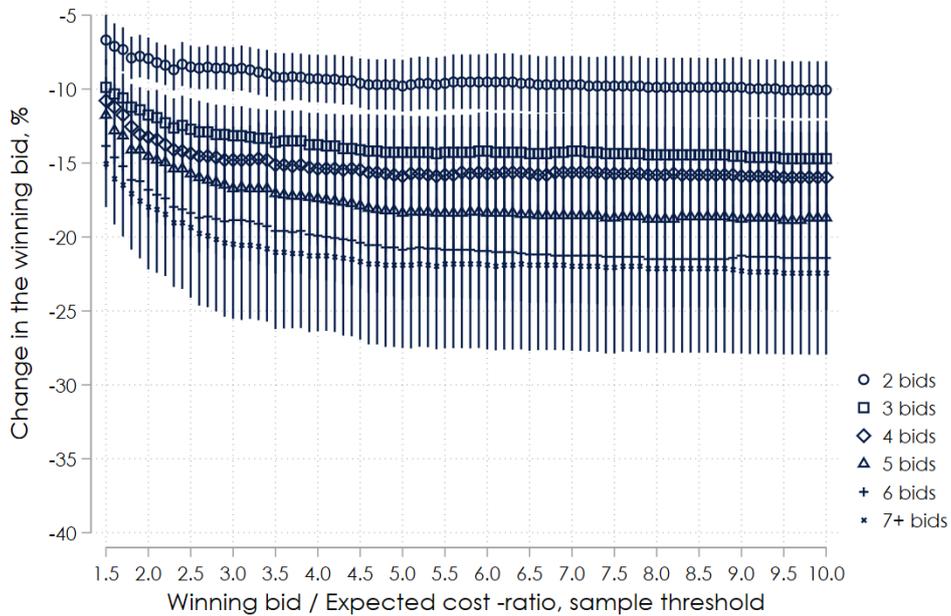


Figure B.7: OLS 2 results, specification (2) in Table 2, depending the chosen sample threshold. The lower threshold fixed to 0.4.

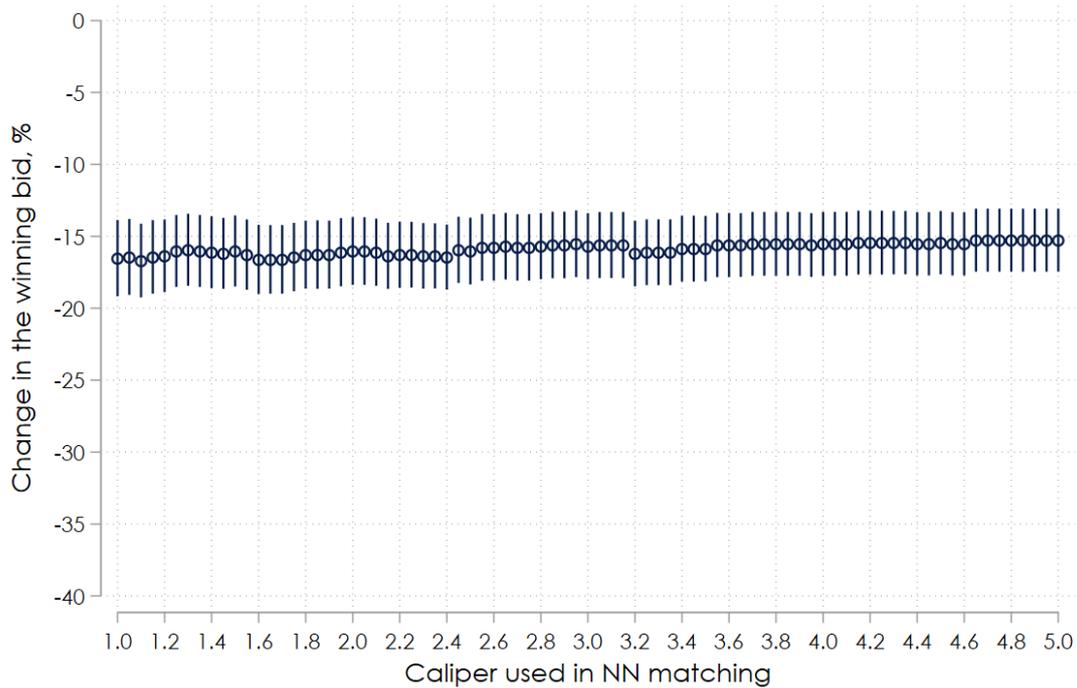


Figure B.8: NN Matching results, specification (4) in Table 3, depending on the caliper used (how small the distance between matches has to be according to the running variables).

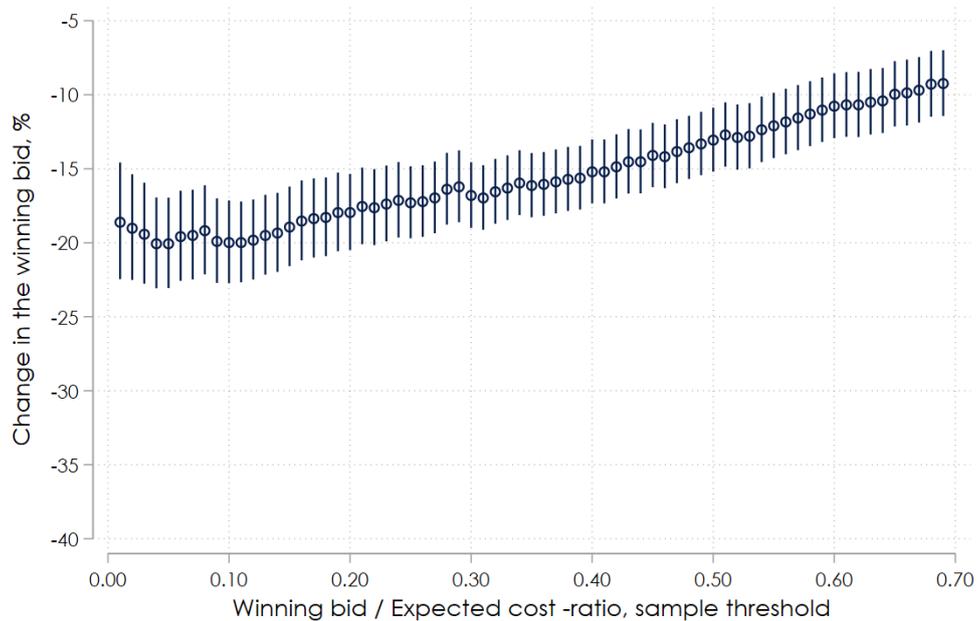


Figure B.9: NN Matching results, specification (4) in Table 3, depending on the chosen sample threshold. The upper threshold follows the procedure explained in Section 3.2.

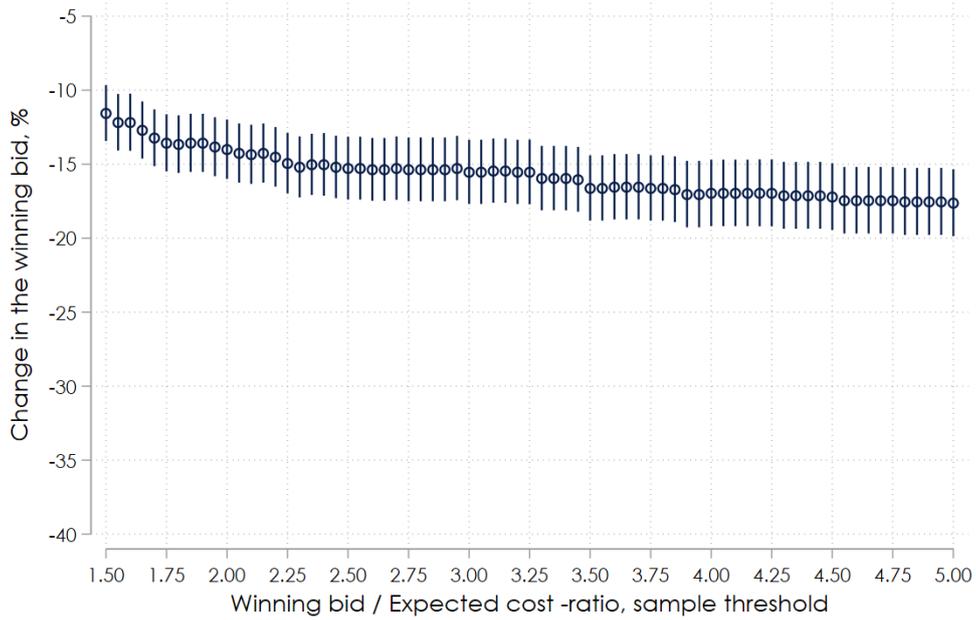


Figure B.10: NN Matching results, specification (4) in Table 3, depending on the chosen sample threshold. The lower threshold fixed to 0.4.

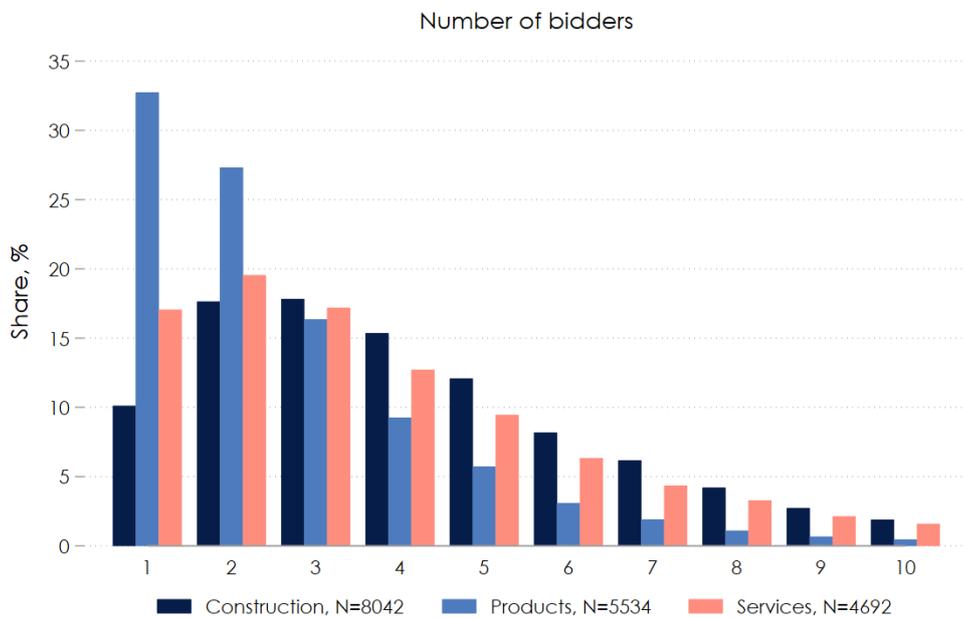
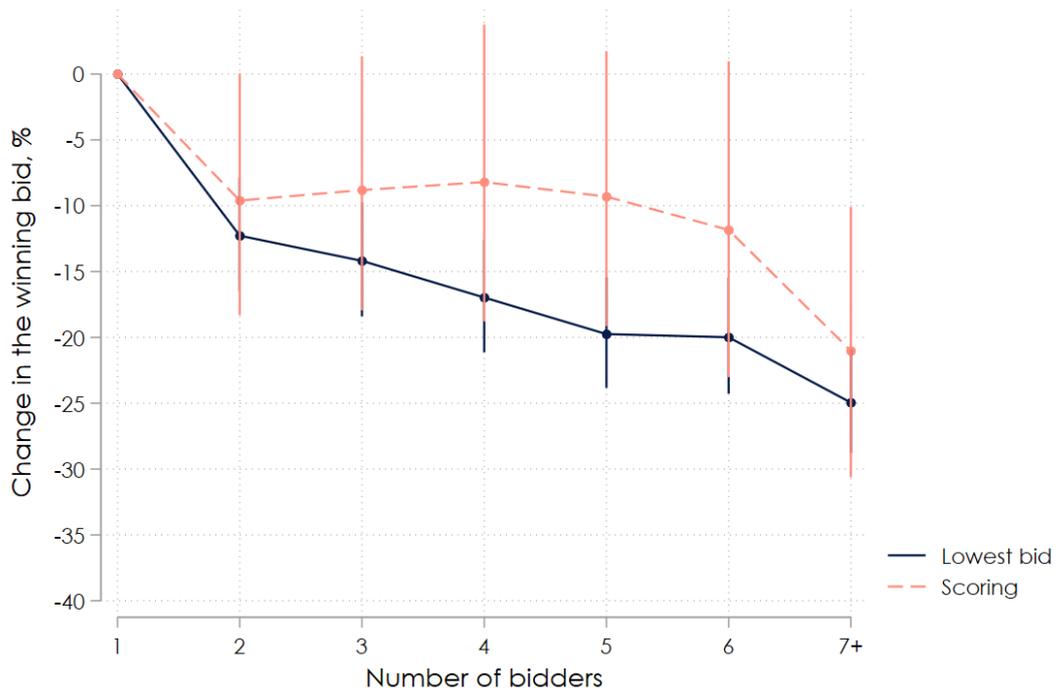
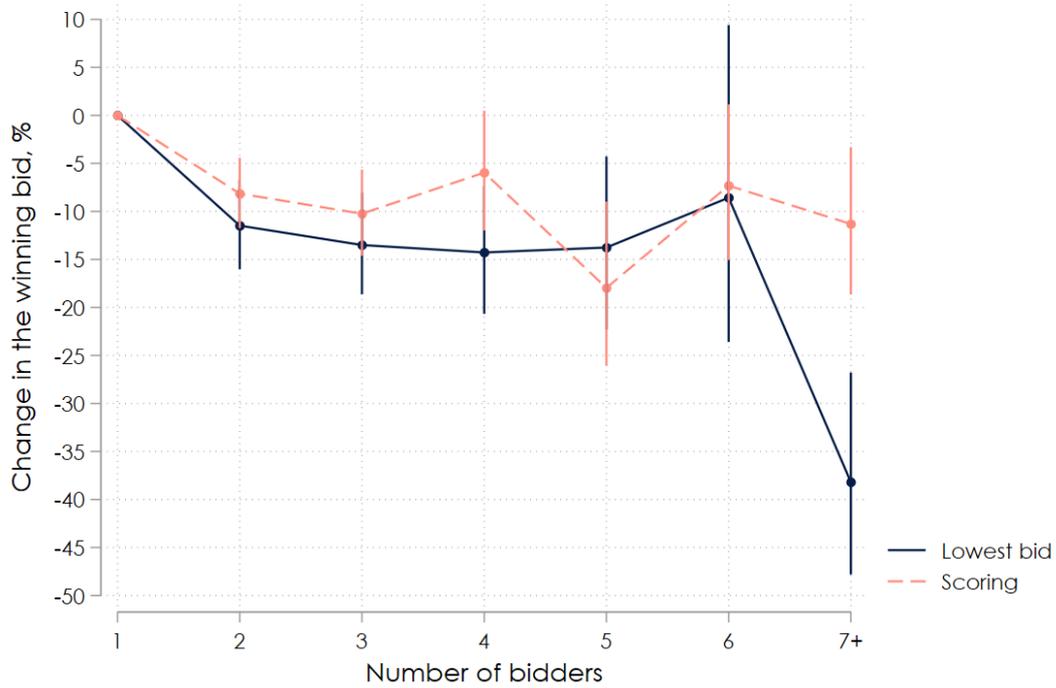


Figure B.11: Distribution of number of bidders in different sectors in the main sample.



(a) Construction ITTs.



(b) Product and service ITTs.

Figure B.12: NN Matching specification (5) from Table 2 estimated for ITTs with different selection criteria used.

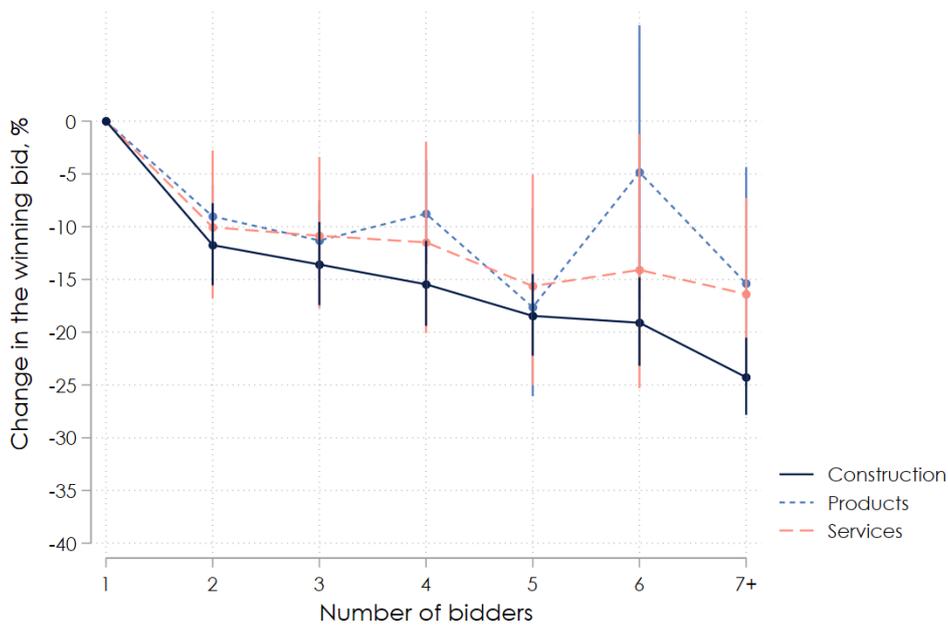


Figure B.13: NN Matching specification (5) from Table 2 estimated for procurements with different selection criteria used, matching ITTs within their auction mechanisms (lowest bid, scoring).

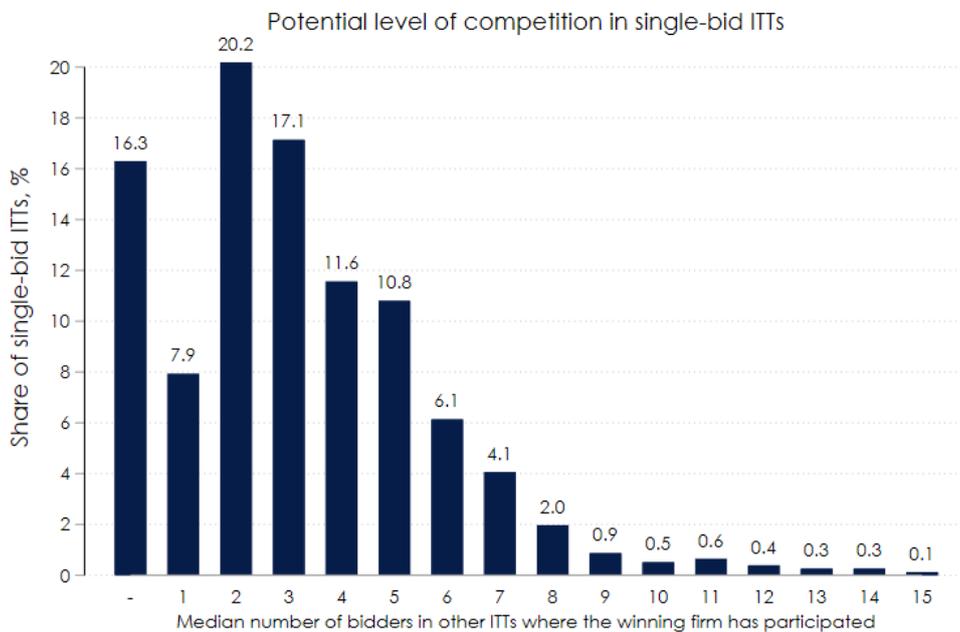


Figure B.14: Number of potential bidders in single-bid ITTs, according to the median number of firms in other procurement auctions where the firm has participated. First bar indicates firms that have not bid to other ITTs. The number above the bars indicate the percentage share.