# The impact of competition for public contracts on public finances*

Kasper Bek Aagaard
The Danish Competition and Consumer Authority, kbaa@kfst.dk

Jesper Gregers Linaa
The Danish Competition and Consumer Authority, jgl@kfst.dk, and Department of Economics, University of Copenhagen, jesper.linaa@econ.ku.dk

Keywords: Public procurement, public finances, competition
JEL codes: E69, H57

October 2024

Abstract

The price of a public contract is lower the more bidders participate in the tendering processes. This analysis is based on data from more than 2,000 Danish tenders published in the period of 2015 to 2022. The findings suggest that contracting authorities pay lower prices for tendered contracts when competition, measured by the number of bidders, is strong. The results indicate that, on average, the contracting authority achievies a price reduction of 10-13% when four bids are received instead of just one. Furthermore, the analysis shows that the risk of receiving an expensive winning bid, defined as a contract price exceeding the expected contract price by more than 20%, is reduced when competition increases.

The analysis also adds to the ongoing debate on funding the welfare state, indicating that effective public procurement plays a critical role in securing financing. If procurement rules are used to pursue other goals it might reduce competition and will require the public sector to find other funding sources.

Overall, the analysis shows that there can be significant benefits for society in ensuring public procurement processes are as frictionless and competitive as possible.

* This discussion paper is based on The Competition and Consumer Authority (2023), which also serves as documentation for. Thanks to comments by colleagues at the Danish Competition and Consumer Authority, the Danish Competition Council, Thomas Bue Bjørner and Anders Munk-Nielsen. All errors and interpretations are solely the responsibility of the authors.

# 1. Introduction

This paper investigates the relationship between the number of bids in public procurement auctions and the resulting contract prices, exploring how increased competition can lead to more favorable outcomes for contracting authorities. Public procurement plays a critical role in the allocation of public resources, and competition among bidders is often considered a key factor in determining the efficiency of the procurement process.

The public sector in Denmark purchases goods and services for an amount equivalent to about 16% of GDP each year, according to the Danish Competition and Consumer Authority (2023). That was more than €60 billion in 2022 (€64 billion in 2024-prices). Therefore, from an economic perspective, it is crucial that the public sector can make these purchases at competitive prices.

To ensure the best use of public funds, all major public procurements must be conducted through EU tendering procedures. This is mandated by the Danish Public Procurement Act, which implements the EU's procurement directives. Each year, the public sector purchases goods, services and works worth approximately €20-22 billion through EU tenders, equivalent to around 5% of GDP.

There is significant variation in the level of competition among suppliers for public contracts offered through tenders. This is reflected, for example, in the varying number of suppliers submitting bids for different public tenders.

This paper investigates whether stronger competition in EU tenders, measured by the number of bids, is associated with a lower final price for contracting authorities.

The answer is yes. The analysis shows that prices are lower when more bids are received. There is a clear negative relationship between the number of bids and the final contract price, and it is found that marginal price reductions decrease with each additional bid.

On average, the price is 2.5-3% lower for each additional bid received. However, the effect is much larger when there are fewer bidders. For example, when there are two bids instead of one, the price is nearly 5% lower on average. Similarly, the price is just over 1% lower on average when there are six or more bids instead of five.

A typical Danish tender receives just under four bids on average. The analysis, which is based on data from more than 2,000 Danish tenders between 2015 and 2022, finds that receiving four bids instead of just one is associated with price reductions of 10-13% for the public sector. Rough estimates suggest that the public sector would have paid around €2-3 billion more annually for tendered procurements if all tenders had received only one bid.

This is likely to be a conservative estimate of the overall economic impact, as lower prices likely also applies to other types of public sector purchasing, such as smaller purchases and tendering procedures governed by the national Danish act

on tendering in the construction and engineering sector below the value-thresholds in the Public Procurement Directives.[1] The data used in this analysis is limited to Danish EU tenders; therefore potential price reductions on other types of public sector purchasing are not included.

On the flipside, the analysis also shows that the risk of the contracting authority accepting a particularly expensive bid – defined as a price at least 20% higher than what was estimated in the procurement material – decreases significantly as the number of bidders increases, indicating stronger competition for the contract.

It is not surprising that more bids contribute to a reduction in price. A high number of bidders is a sign that there are many suppliers in the market, indicating strong competition. Furthermore, the anticipation of multiple bids can itself encourage bidders to lower their prices. Additionally, with more bids, the contracting authority is more likely to receive offers from suppliers with relatively lower costs, who are better positioned to submit competitive bids. Conversely, in markets with fewer suppliers, there is a higher risk of suppliers colluding to set higher prices, as noted by Fabra and Motta (2018).

The findings are also aligned with results from international studies that find that prices are lower when there is more competition for the task, measured by the number of bids, as shown in studies by Amaral (2013), Macdonald (2002), and Lobo (2001). These studies report price differences that are on par with or higher than the effects found in this analysis.

This analysis suggests that lower prices can be achieved by receiving more bids, regardless of whether the tender pertains to goods, services, or construction- and engineering projects (referred to hereafter as *works contracts*), and regardless of whether the contracting authority is a municipality, a region, the state, or other contracting authorities.[2]

The analysis also contributes to the ongoing debate on the funding of the welfare state. Traditionally, the focus has been on increasing labor supply, reducing natural unemployment, making budget cuts, or increasing taxes. The results presented here show that an efficient public procurement system significantly contributes to financing. Hence, formulation and implementation of effective public procurement involves a trade-off; if procurement rules are used to pursue other goals, it is important to recognize that imposing more requirements in the procurement procedures will likely result in fewer bidders participating in the competition. This will reduce public savings and necessitate finding alternative funding sources.

[1] The Danish Act on Tendering Procedures in the Construction Sector (https://www.retsinformation.dk/eli/lta/2005/338) regulates tendering in the construction sector when the contract value is below approximately €5.4 million.

[2] Other contracting authorities are procuring bodies of a public nature that is not the state, municipalities, or regions. Examples include housing associations, utility companies, and SKI (the State and Municipal Procurement Service).

The analysis focuses solely on price effects from the perspective of the contracting authority and does not account for potential effects on quality or transaction costs.

## 2. Data

The analysis is based on data from the Danish Competition and Consumer Authority's public procurement database with information on Danish EU tenders. The database contains information on the vast majority of Danish EU tenders above the thresholds for goods, services, and works. [3]

Contracting authorities are required to publish their tenders and follow a series of procedural steps outlined in the Danish Public Procurement Act when the contract exceeds the EU threshold values. The thresholds depend on the specific service and are, for example, approximately €5.5 million for procurement of works and approximately €143,000 for procurement of goods or services.

The database contains information on the number of received bids, the contract value, i.e., the price of the winning bid, and the contracting authority's initial expectation of the contract value (referred to hereafter as *expected contract value*). In addition, there is information about the contract type (goods, services, or works) and the type of contracting authority (state, municipality, region, or other contracting authority).

The dataset contains information on the vast majority of Danish EU tenders from the period 2015-2022. However, some tenders are not included in the analysis, among other things due to missing essential information.

This applies to tenders conducted through accelerated procedures or direct awards, as these are not competitive in the same way as standard tendering procedures. Framework agreements have also been excluded, as determining the actual contract value of a framework agreement is associated with relatively high uncertainty.[4] In addition, tenders where relevant information is missing or where there is a high risk that the relevant information contains errors have not been included. This applies, for example, to tenders where the final contract value is reported to be more than double or less than half of the expected contract value.

For tenders with multiple subcontracts, the number of bids received for the first subcontract is used as a proxy variable for the number of bids received for the overall tender. This is relevant in approximately 18% of the analyzed tenders. While alternative data handling strategies were considered, none are without limitations. As a sensitivity check, the analysis was also conducted using two additional

[3] The threshold values are limits set by the European Commission in accordance with international agreements within the framework of the WTO.

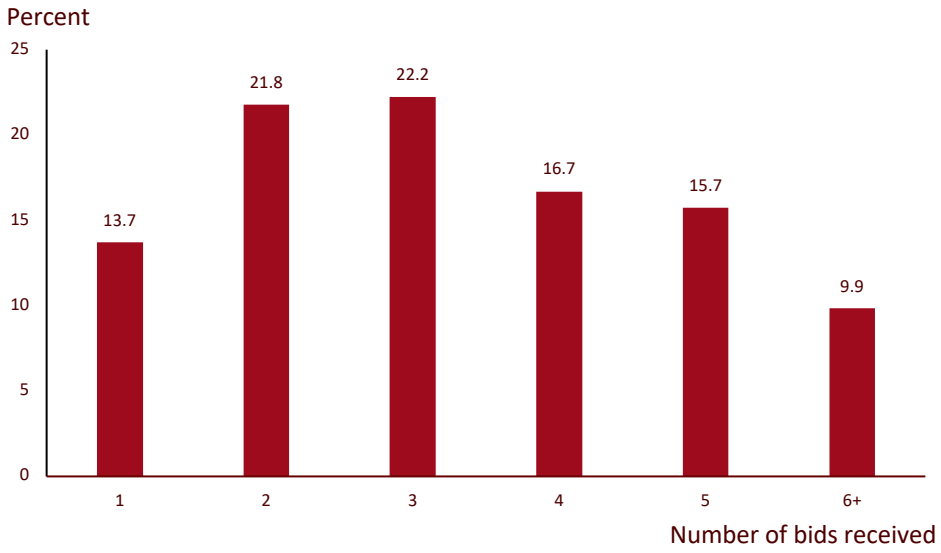
[4] A framework agreement is an ongoing contract with the possibility of multiple call-off contracts (purchases) for uniform procurements over a specified period of time.

methods: focusing exclusively on tenders with only one contract and evaluating at the subcontract level, where each subcontract is treated as an individual tender procedure. Neither sensitivity check had a substantial impact on the results.

The analysis is based on fully completed tenders from the period 2015-2022 and includes *open procedures*, *restricted procedures*, and *negotiated procedures*.[5] These procurement procedures account for 87% of all Danish EU tenders (excluding framework agreements). An overview of the distribution of the included and excluded tenders by different types of tenders, etc., is presented in Appendix 1.

In the analysis, data is used for a total of 2,223 different tenders published in the period from 2015 to 2022. For these tenders, three bids were most commonly submitted. In just under 14% of the tenders, only one bid was received, while in one out of ten tenders, six or more bids were submitted, as shown in Figure 1.

**Figure 1. Distribution of bids received in Danish tenders**




Source: The Danish Competition and Consumer Authority.

In the analysis, the price of the winning bid, $P$, which is ultimately the value of the contract, is evaluated relative to the expected contract value, $P^e$. The contracting

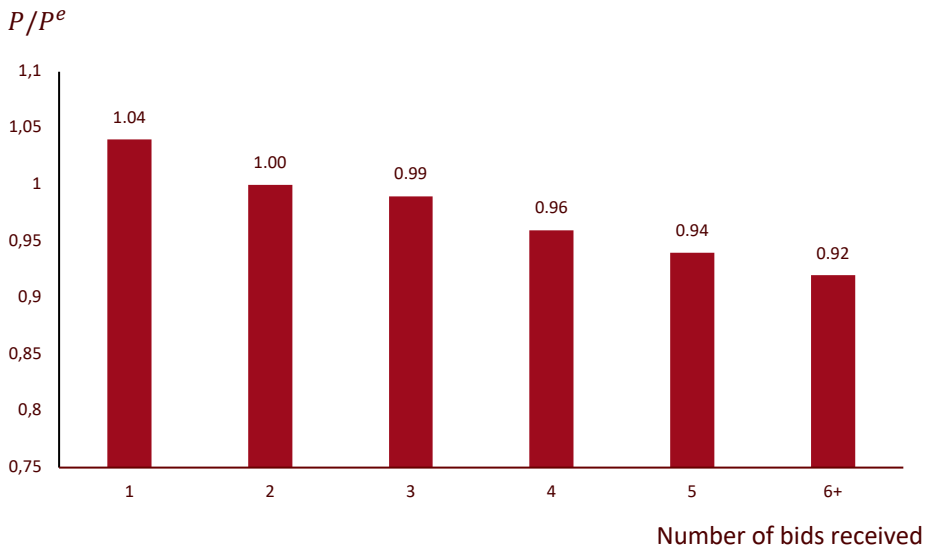
[5] Open procedures are "standard" procurement procedures in an auction-like setting. Negotiated procedures are typically used for specific needs that are not covered by standard goods, while restricted procedures allow the contracting authority to set a limit on the number of bidders. Read more about procurement procedures in Chapter 5 of the Danish Competition and Consumer Authority's guide on procurement rules.: https://www.kfst.dk/vejledninger/kfst/dansk/2016/20160129-udbudsloven-vejledning-om-udbudsreglerne/

authority specifies the expected contract value in the tender documents before any bids are received. The expected contract value can be seen as a reflection of the contracting authority's anticipated price for the contract, which may be based on previous similar tenders, calculations or potential budget constraints.

This normalization allows for the inclusion of a variety of different tenders in the analysis. Additionally, it indirectly accounts for price developments over time. This approach follows the standard practice in the literature on this subject, as seen in studies such as Onur and Tas (2012, 2019) and Iimi (2006).

There is a clear tendency for the ratio between the awarded contract value and the expected contract value to decrease with the number of bidders in the respective tenders, as shown in Figure 2. This means that the price of the contract, measured against the expected price, decreases as the number of bidders increases. On average, the awarded contract value is higher than the expected contract value when only one bid is submitted, but significantly lower when, for example, six bids are submitted.

**Figur 2. Distribution of contract value relative to expected contract value**




Note.: The Y axis shows the contract value, $P$, relative to the expected contract value, $P^e$. A value above one indicates that the price of the awarded contract is higher than expected.

Source: The Danish Competition and Consumer Authority.

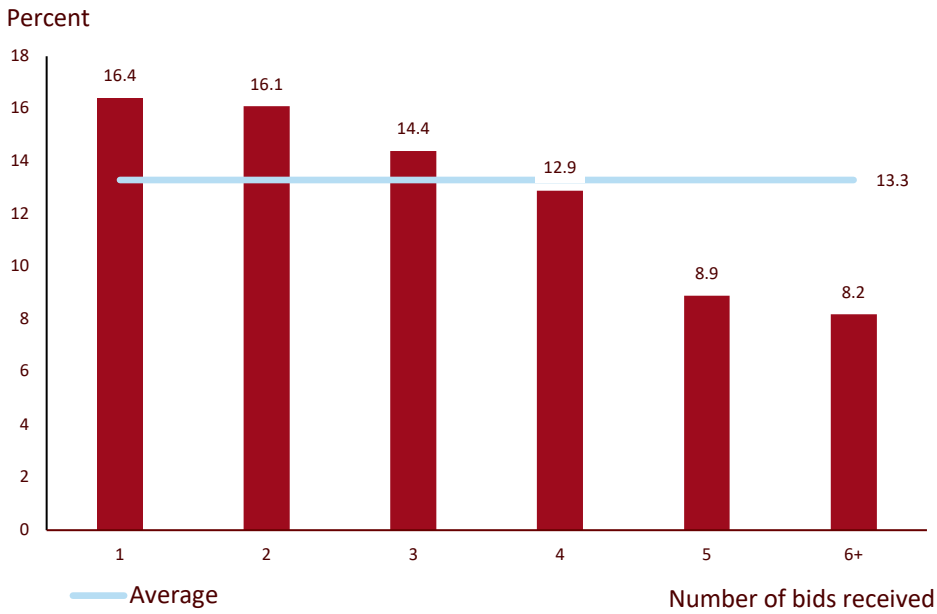
Hence, Figure 2 suggests that increased competition, in the form of more bids, is associated with a lower price. The following sections will further examine whether

this difference is statistically significant and whether it can be interpreted as a causal relationship.

Increased competition, measured by the number of bidders, also yields another beneficial effect, namely that the risk of receiving an "expensive" winning bid decreases as the number of bidders increases. Stronger competition can therefore be seen as "safeguarding" against the risk of awarding a contract that may be unsatisfactory from the contracting authority's perspective.

This is illustrated in Figure 3, which shows the proportion of winning bids that are categorized as expensive when different numbers of bids are received. An expensive winning bid is defined as entering a contract with a price at least 20% higher than the expected price. The analysis shows that the risk of ending up with an expensive winning bid is nearly halved if five bids are received instead of just one. Specifically, the risk decreases from just over 16% (with one or two bids) to just under 9% when there are five bidders.

**Figure 3. Share of tenders with expensive winning bids**




Note: A winning bid is defined as expensive if the final contract value exceeds the expected contract value by more than 20%

Source: The Danish Competition and Consumer Authority.

## 3. Model

Two linear regression models are used to describe the relationship between the number of bids received and the contract price. Similar models have also been used in previous studies examining the effect of the number of bids on the final contract value, see for example Onur and Tas (2012 and 2018) and Macdonald (2002).

Model 1 assumes a constant price effect when the number of bids changes (e.g., the same effect when increasing from one to two bids as from three to four bids), while Model 2 allows for the price effect to vary depending on the number of bidders.

Model 2 is generally considered to be more accurate, but it requires estimating more parameters, which can be challenging when there are few observations. Therefore, Model 1 is used in several supplementary estimations, where only specific types of tenders are considered, and fewer observations are available. In both models, the expected contract value is used to normalize the prices of different tenders.[6]

Model 1 is specified as

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

where $P_i$ is the contract price (i.e. the offer from the winning bidder) of tender $i$ and $P_i^e$ is the expected value of $P_i$ anticipated by the contracting authority prior to the tender. Hence the left-hand side in (1) is a measure of the final price relative to the expected. The vector $X_{j,i}$ is a set of control variables indexed by $j$, including the award criteria, type of contracting authority, type of contract, procurement procedure, municipality type, geographical region, and calendar time.[7] Finally, $N_i$ denotes the number of received bids in tender $i$.

Likewise, Model 2 is specified as

$$ln\frac{P_i}{P_i^e} = \delta_0 + \delta_1 X_{j,i} + \delta_2 D_2 + \delta_3 D_3 + \ldots + \delta_6 D_6 + \epsilon_i. \quad (2)$$

The difference between Model 1 and Model 2 is that in Model 2, the number of bids is represented by five dummy variables. The first dummy variable takes the value 1 if the number of bids in the tender is 1, and so on. The grouping is capped at six or more bids. More generally, this can be written as follows: $D_n = 1$, when $N_i = n$, for $n = 1, \ldots 5$, and $D_6 = 1$, when $n \geq 6$.

In contrast to Model 1, Model 2 allows the marginal effect of an additional bid to vary.

[6] Alternative model specifications have been tested, where the expected contract value is estimated as right-hand control variable instead of being used to normalize the dependent variable. This does not change any conclusions.

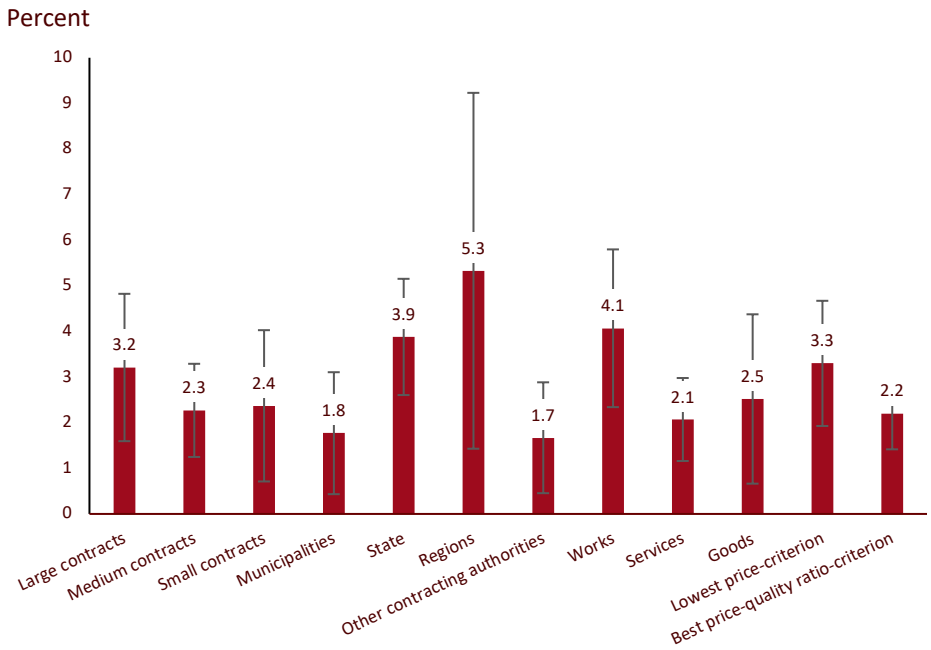
[7] See Appendix 2 (model regressions) for a detailed explanation of the control variables.

## 4. Analysis

The estimation of Model 1 shows that, on average, an additional bid is accompanied by a 2.5% decrease in the price of the contract. The estimate is statistically significant at the 1% level, see Appendix 2. A closer inspection also reveals that more bids are associated with lower prices across all contract sizes, types of contracting authorities, types of contracts, and regardless of whether the award criterion is lowest price or best price-quality ratio, see Figure 4.

Specifically, the results show that, all else being equal, an additional bid is accompanied by a 3.2% decrease in the contract price for a large contract, while the price decrease is 2.4% for a small contract. The price differences are also relatively large for contracts tendered by the state, works contracts, and when the award criterion is lowest price rather than best price-quality ratio.

**Figure 4. Price reductions with one additional bid**




Note: Large contracts refer to the top fifth of contracts in the dataset with the highest contract values. Similarly, small contracts refer to the bottom fifth with the lowest contract values, while "medium" refers to contracts that are neither small nor large. The thin black lines indicate confidence intervals (5% significance level). Model 1 is used.

Source: The Danish Competition and Consumer Authority.

Furthermore, the price difference is relatively large for contracts tendered by regions; however, this result is based on a small number of observations, which may contribute to greater uncertainty in the estimate. The price reduction is slightly below the 2.5% average for contracts tendered by municipalities and other contracting authorities.

To validate the estimates across different tender categories, a supplementary regression analysis with interaction terms was conducted to identify potentially overlapping effects.[8] An example of an overlapping effect could occur if large contracts are typically works contracts. In such cases, it would be more difficult to determine whether the greater price effect should be attributed to the size of the contract (in terms of value) or the fact that it involves construction and engineering work (works contract). The results from the estimation with interaction terms are presented in Appendix 3 and support the finding of stronger effects for state contracts and works contracts. However, the greater price difference for large contracts seems to diminish when interaction terms are accounted for.

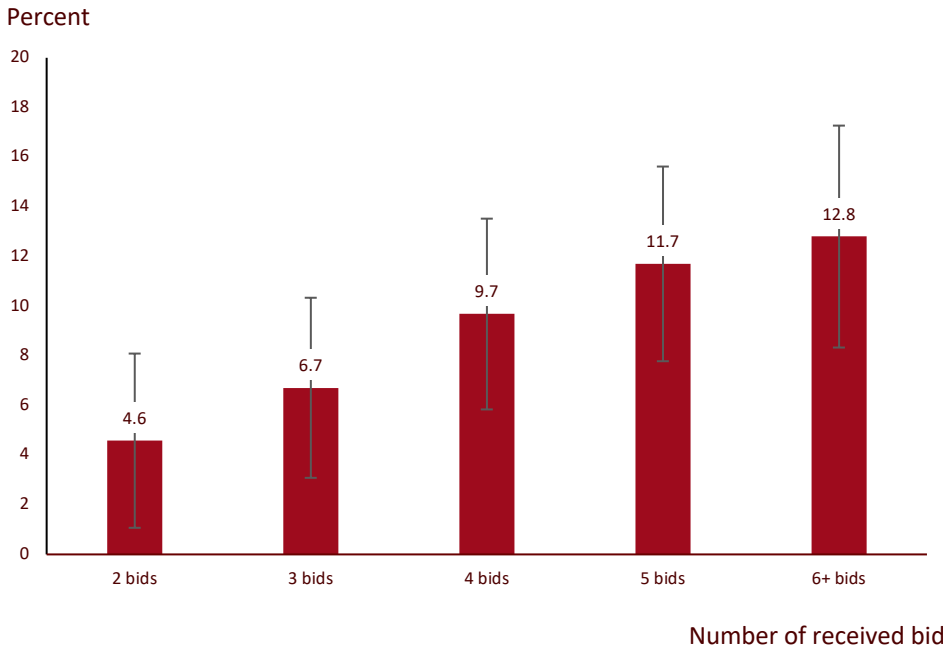
The results from Model 2 are presented in Figure 5, with the bars indicating the price reduction compared to receiving only a single bid. For instance, with two bids received, the contract price is 4.6% lower than if the same tender had only received one bid.

There is a particularly large price difference between receiving two bids instead of just one. With four bids received, the contract price is 9.7% lower compared to having received one bid. It is also evident that the price is, for example, approximately 5.1% lower if the contracting authority receives four bids instead of two (9.7% - 4.6%).

The results thus show that the price decreases as the number of bids increases, but the size of the price reduction by an additional bid diminishes as more bids are received.

[8] Regression with interaction terms seperates the effect of receiving more bids from the combined effect of additional bids and specific tender characteristics. For example, the total effect of receiving one additional bid and the fact that it is a state tender is measured in one parameter estimate, while the effect of one additional bid alone and the fact that it is a state tender alone are measured in seperate parameter estimates. This approach allows for an easier interpretation of isolated effects; see Appendix 3 for further explanation.

**Figure 5. Price reduction compared to receiving one bid**




Note: The thin black lines indicate confidence intervals (5% significance level). Model 2 is used.

Source: The Danish Competition and Consumer Authority.

## 5. Discussion

The presented results primarily show that tenders with greater competition, in the form of more bidders, have lower contract prices. This result appears consistent across all observed types of tenders. It aligns with standard economic theory and suggests a causal relationship, where effective competition, in the form of more bidders, leads to lower prices for the tendered contracts.

However, the results also indicate that the competition effect only applies up to a certain point, as the effect diminishes with an increasing number of bidders.

**On Causality**

Although the results indicating that more bids lead to lower prices appear theoretically plausible and are supported empirically across different types of tenders, the causal interpretation from the number of bidders to lower prices may be challenged by endogeneity issues.

One specific concern is that the number of bids may depend on the expected contract value. Consider a contracting authority without full insight into the actual

scope or workload of the contract, announcing an expected contract value significantly higher than what potential bidders, with better insight into the task at hand, consider profitable to supply. If each of these potential bidders believe that they themselves are best suited to win the contract, it may lead all of them to submit a bid with a higher price than they would in a situation where they perceived the competition as stronger. This could introduce a bias in the estimate of how the number of bidders affect the final price.

It is not theoretically possible to determine how such a bias would affect the estimate. On the one hand, a high expected contract value would mechanically lead to overestimating the price-reducing effect of the number of bids. On the other hand, to the extent that bidders respond by submitting bids with relatively high prices due to the announcement of a high expected contract value, this would tend to underestimate the effect.

It is also difficult to determine causality empirically. However, for certain types of tenders, the likelihood of bias in the estimation, such as simultaneity bias, is reduced. In *restricted tendering procedures*, it is the contracting authority that determines how many bidders can participate in the competition based on pre-qualification.

Unlike a tender conducted through the open tendering procedure, the restricted tendering procedure is characterized by the contracting authority initially setting a limit on the number of bidders that will be prequalified and subsequently evaluated.

If the contracting authority receives more applications for prequalification from interested bidders than the limit allows, only the number of bidders corresponding to the limit will be allowed to make a bid. The bidders given the opportunity to submit bids are selected based on predetermined selection criteria that do not reflect price or other evaluation criteria used to choose one bid over another. The selection criteria can for example be based on specific financial metrics or the bidder's experience with comparable contracts in the past five years.

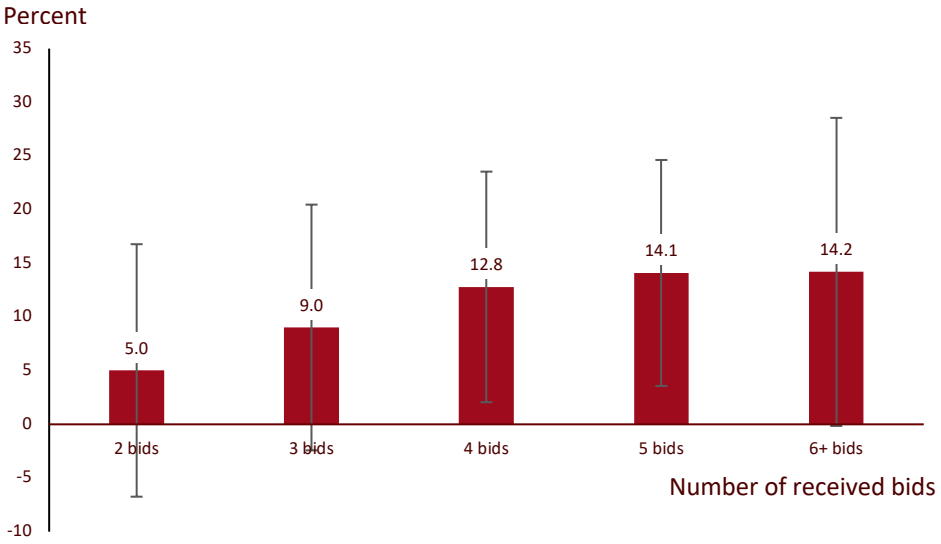
In other words, the contracting authority sets an upper limit on the number of bids, and the bidders often know in advance how many competitors they will face. This means that the number of bids cannot increase indefinitely, thus limiting the endogenous determination of the number of bids. In this case, the estimated parameter for the number of bids can presumably be more confidently interpreted as the effect of the number of bids on the contract value, i.e., a causal relationship.

When estimating Model 1 using only restricted tenders, one additional bid is associated with a 2.9% reduction in the contract price. This point estimate, based on restricted tenders, is therefore larger than when all tenders are included in the estimation (2.5%). This may suggest that a potential bias stemming from endogeneity may lead to an underestimation of the price effect of increased competition.

When data from restricted tenders alone are used in the estimation of Model 2, there are also indications that the price reduction from an additional bid decreases

with the number of bids, as shown in Figure 6. However, only a few of the estimated parameters are statistically significant, which should be considered in light of the smaller number of observations for restricted tenders and thus a somewhat weaker data foundation.[9]

**Figur 6. Restricted tenders: Price reduction compared to receiving one bid**




Note: The thin black lines indicate confidence intervals (5% significance level). Model 2 is used.

Source: The Danish Competition and Consumer Authority.

Contracting authorities may indicate expected contract values based on different principles and with varying degrees of precision, and a bias may therefore also have a systematic element if the expected contract value within different types of contracting authorities is systematically set incorrectly.

On this basis, fixed effects estimations have been conducted on all unique contracting authorities, and unique municipal contracting authorities.[10] The results are shown in Appendix 4. Here, it is accounted for that there may be systematic differences in how each contracting authority constructs the expected contract value. The results are significant at the 1% level for the price effect of additional bids in the

[9] In this sub-analysis, data from 471 restricted tenders were used. For comparison, the analyses in section 3 are based on data from 2,223 tenders (including the 471 restricted tenders).

[10] Fixed effects involve comparing observations from the same ID (in this case: unique contracting authority or municipality) over time. For example, if Odder Municipality systematically sets the expected contract value unrealistically high, the model will account for this and thereby mitigate bias. See Appendix 4 for further explanation.

model with all unique contracting authorities, and the magnitude of the price effect is almost unchanged. However, the significance is lower in the model with only municipal contracting authorities.[11] See Appendix 4 for further explanation.

Previous studies have employed various methods to address the challenges of endogeneity in the number of bids and systematically biased contract values, as shown in Table 1.

The overall finding is that the estimated price reduction from an additional bid tends to be higher when the authors attempt to control for potential endogeneity in the number of bids – a finding consistent with the analysis in this present paper when using restricted tenders. This is seen in Table 1, where columns two and three present results from several studies that have examined similar price effects in "ordinary" standard regressions (column 2) and regressions that address the endogeneity problem (column 3). In four out of five of the previous studies, a greater price reduction is found when controlling for endogeneity. Along with the supplementary analysis for restricted tenders, this suggests that the estimated effects in this analysis may be conservative. The table also shows that the estimated price effects from additional bids in other countries are comparable with, or greater than, the effects found in this analysis for Danish tenders.

The risk of an inaccurately stated expected price has been addressed in some of the analyses described in Table 1. In these cases, it has been possible to identify an accurate market price indicator for the contract in the form of a unit price. Naturally, this applies only if the analysis focuses exclusively on a homogeneous product, such as bus routes in London (price per kilometer driven) or a specific food item of a given quality (price per kilogram). The lower half of Table 1 summarizes the results from previous studies that use unit price as a measure of expected costs. It is evident that price reductions from additional bids are also found in the studies where the contract price is compared with actual unit prices. The estimated price reductions in these studies are comparable to, or greater than, the effects found in this analysis. Along with the supplementary analyses with fixed effects, this suggests that the use of expected contract value for normalization has not led to an overestimation of the price reduction from additional bids.

[11] The drawback of this analysis is that the effect is estimated solely based on variation in data within each municipality or type of contracting authority, and not across them, including the fact that there is a lower number of observations in the models for municipal contracting authorities.

**Table 1. Comparison with results from other studies**

| Paper | Effect of one additional bid, standard regressions* | Effect of one additional bid, endogeneity addressed* | Normalization of price | Tendered services | Geographical area |
|---|---|---|---|---|---|
| This paper | -2,5% | -2,9% (Restricted tenders) | Expected value | Various | Denmark |
| Onur & Tas (2019) | -6% to -8% | -10% to -18% (IV regression) | Expected value | Various | Turkey |
| Onur & Tas (2012) | -2,1% | -3,8% (IV regression) | Expected value | Various | Turkey |
| Iimi (2006) | -2,2% | N/A | Expected value | Development projects in developing countries | Japan/Developing counries |
| Amaral (2013) | -5% to- 12% | Slightly larger effect than in standard regression (Number of bidders in previous tenders) | Unit prices | Bus routes | England |
| Amaral (2006) | Significantly negative | N/A | Unit prices | Bus routes | England |
| Macdonald (2002) | -3% | Slightly larger effect than in standard regression (IV regression) | Unit prices | Food products | USA |
| Lobo (2001) | -12% (From one to two bids) | Smaller effect than in standard regression (First difference) | Unit prices | Waste collection | UK |

* The difference between columns two and three is whether the applied methods aim to address potential endogeneity challenges. The table shows that the effect is greater when controlling for endogeneity in four out of five studies with available results.

**Some potential challenges with the analysis**

The analysis shows that the apparent price reduction effect from recieiving additional bids are also found when bids are evaluated based on the criterion of best price-quality ratio. This suggests that competition leads to lower prices, even when tenders compete on both price and quality parameters.

However, the analysis focuses solely on the price effects of increased competition. More bidders may also lead to improved quality if the quality dimension is included in the evaluation criteria of the tender. The analysis does not capture such quality effects.

There may, of course, also be differences between the promised quality and the quality actually supplied from the winning bidder. If increased competition (i.e., more expected bidders) reinforces such a tendency, there could be a trade-off between the estimated price effect and the delivered quality, which is not directly accounted for in the analysis. Conversely, tender materials can also specify minimum requirements for the quality of what is delivered. Challenges with discrepancies between promised and delivered quality should, in any case, be addressed through mechanisms such as legal remedies or performance monitoring systems rather than by limiting the field of competition.

Transaction costs should also be considered.[12] As a starting point, the bidder-oriented transaction costs associated with participating in the tender are typically factored in by suppliers when submitting a bid. Thus, these costs are accounted for in the estimation of the price effect. Bidders who lose a tender must also bear this type of transaction costs. These bidders participate only because they expect a gain (or at least no loss) from doing so. Contracting authorities can generally help strengthen competition and obtain better bids by organizing tenders in a way that minimizes the transaction costs for potential bidders as much as possible.

When a tender receives more bids, the contracting authority incurs additional costs in evaluating them. The Danish Competition and Consumer Authority estimated in 2019 that the average transaction costs for contracting authorities amount to 1.4% of the contract value, cf. the Danish Competition and Consumer Authority (2019). However, the vast majority of these expenses arise from preparing the tender documents themselves and are therefore independent of the number of bids received. It is also worth noting that the 30% of tenders evaluated solely on price have very limited costs associated with bid evaluation.

## 6. Conclusion

The cost of public procurement tends to be lower when tendering processes are characterized by stronger competition, as measured by the number of bidders. This paper shows that this is the case when considering Danish EU tenders from 2015-2022 as a whole, as well as when analyzing them by type of contracting authority and type of purchased product or service.

The analysis thus suggests that there is a significant potential for price reductions by increasing the number of bids received.

[12] Transaction costs are the costs associated with participating in the tendering process. They can be either bidder-oriented or contracting authority-oriented.

The main conclusion of the paper is that the price of tendered contracts is reduced by 2.5-3% for each additional bid received, however with a tendency for price reductions to diminish as the number of bids increases. In the period 2015-2022, on average almost four bids per tender were received. This is estimated to lower the price by 10-13% compared to a situation with just one bid. For Danish EU tenders (with a yearly worth of €20-22 billion in total), this corresponds to a price reduction of approximately €2-3 billion each year.

This demonstrates the significant impact that effective tenders, which foster competition, can have. The price reductions that the public sector achieves amount to 0.5-0.7% of GDP, which can be translated into a fiscal sustainability effect of a similar magnitude. Normally, budgetary room for maneuver is created by increasing the labor force, reducing structural unemployment and to a lesser extent implementing savings or raising taxes. These results show that public tenders also contribute to this, highlighting the importance of maintaining strong competition for public contracts. Hence, it also highlights that pursuing additional objectives through procurement rules comes at a cost; imposing such requirements is likely to reduce the number of bidders, ultimately leading to higher prices due to diminished competition.

The calculation leading to price reductions of €2-3 billion may itself be conservative. If there were no competition for public procurement contracts, there would naturally be only one supplier involved, i.e. the one approached for the purchase. The price set by this supplier would likely be higher than the price with a single bid identified in a competitive situation, which is the observed reference point in the analysis. The natural reference point for evaluation is a situation without competition as in the example with the sole supplier. Thus, the observed reference point can be considered an upper bound for prices with no competition, leading to an underestimation of the real price reduction. The estimated price reductions of €2-3 billion should therefore be considered a conservative estimate.

There may be additional reasons why this could be a conservative estimate. The estimates from the identified international literature, for example, typically find larger effects when adjusting for endogeneity.

Finally, the results of this analysis concern only Danish EU tenders amounting to €20-22 billion annually. However, it seems reasonable to assume that the effects also, to a greater or lesser extent, apply to other areas of public sector purchasing, which amount to €43-44 billion. This includes, for example, smaller purchases and tendering procedures governed by the Danish Act on Tendering Procedures in the Construction Sector. The results thus indicate that there may be significant potential for price reductions by increasing competition for public procurement and generally fostering competition for more public procurement contracts.

The analysis reinforces the critical role of maintaining robust competition in the markets where public authorities engage, highlighting its impact on achieving more efficient and cost-effective procurement outcomes. For a contracting

authority to receive more bids in a tendering process, there must be multiple suppliers with the opportunity to submit a bid for the contract.

At the same time, an individual contracting authority can increase the likelihood of receiving non-expensive bids by organizing the tender process appropriately and conducting a thorough market dialogue.

In a market dialogue, contracting authorities discuss aspects of an upcoming tender with potential bidders. This helps the contracting authority to initially understand the market and thereby identify relevant requirements for its tender, which bidders and the proposed solutions must meet. Through market dialogue, the contracting authority can gain insight into whether the criteria in the tender might lead to some potential bidders being unnecessarily excluded from submitting a bid. This could occur, for example, if the criteria for the bidders' economic and technical capabilities are too high.

A contracting authority has several additional tools available to encourage more suppliers to submit bids for a tender. The length of the bid submission period, for example, affects whether the bidder can prepare their bid satisfactorily. If the bidder does not have sufficient time for the various components, they will often include a risk premium in the bid price. When determining the bid submission deadline, the contracting authority can also consider whether the market is experiencing a high demand for suppliers and if there is an overlap with other contracting authorities' bid submission deadlines for similar services. Similarly, the contracting authority may consider whether the bidding period coincides with holiday periods, during which potential bidders might face difficulties in coordinating with subcontractors and securing the necessary agreements. These considerations can help ensure that all potential suppliers have sufficient time (and availability) to submit competitive bids.

The complexity and "familiarity" of the tender also play a significant role in how easy it is for potential bidders to submit a bid for the contract. In other words, contracting authorities can increase competition by ensuring an appropriate bid submission deadline and making sure the tender documents are not unnecessarily complex.

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# Appendix 1. Distribution of observations

| *Shares of total number of tenders by column (percent)** | **All tenders**** | **Tenders without information on either the contract value or the expected contract value.** | **Tenders used in the regressions** | **Restricted tenders** |
|---|---|---|---|---|
| *Total number of observations (quantity)* | *5,001* | *2,778* | *2,223* | *471* |
| 1 bid | 12 | 10 | 14 | 4 |
| 2 bids | 21 | 20 | 22 | 9 |
| 3 bids | 21 | 20 | 22 | 13 |
| 4 bids | 17 | 17 | 17 | 24 |
| 5 bids | 18 | 19 | 16 | 45 |
| 6+ bids | 11 | 12 | 10 | 5 |
| Award criterion: Price only | 29 | 29 | 30 | 30 |
| Award criterion: Price only and quality | 71 | 71 | 70 | 70 |
| Municipality | 33 | 32 | 33 | 25 |
| Region | 8 | 10 | 7 | 8 |
| Other contracting authority | 43 | 48 | 36 | 46 |
| State | 16 | 10 | 24 | 20 |
| Services | 60 | 63 | 57 | 48 |
| Works | 18 | 15 | 23 | 46 |
| Goods | 21 | 22 | 20 | 6 |
| Restricted tender | 26 | 29 | 21 | 100 |
| Negotiated tender | 13 | 9 | 18 | 0 |
| Open tender | 61 | 61 | 61 | 0 |
| Option for extension = Yes | 50 | 53 | 47 | 35 |
| Option for extension = Unknown | 4 | 6 | 2 | 1 |
| Option for extension = No | 46 | 41 | 52 | 64 |
| Average contract value (million EUR) | 5.7 | 5.3*** | 6.6 | 6.8 |
| Average expected contract value (million EUR) | 6.4 | X**** | 6.8 | 6.9 |

*Values are expressed as percentage of the total number of observations in each column unless otherwise specified.

** All available tenders of the types "restricted tender," "negotiated tender," and "open tender." Framework agreements are not included.

*** Based on 2,329 tenders with available information.

**** Not shown due to very few observations.

*Note: "Tenders used in the regressions" (third column) represents the 2,223 observations used in the primary analysis in the article. The second column reflects the observations excluded from the analysis due to missing information on either contract value or expected contract value (average values for these are calculated based on the remaining observations that have information on one value but not the other). The first column combines the observations from the second and third columns, while the final column displays the distribution of the 471 tenders conducted under the restricted tender-procedure.*

# Appendix 2. Regressions

| | VARIABLE | (1) Model 1: All tenders | (2) Model 2: All tenders | (3) Model 1: Large contracts | (4) Model 1: Medium contracts | (5) Model 1: Small contracts | (6) Model 1: Municipa-lities | (7) Model 1: State | (8) Model 1: Regions | (9) Model 1: Other contrac-ting authorities | (10) Model 1: Works | (11) Model 1: Services | (12) Model 1: Goods | (13) Model 1: Lowest Price | (14) Model 1: Best quality-price ratio | (15) Model 1: Restricted tenders | (16) Model 2: Restricted tenders |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of recieved bids | **-0.025*** ** | | **-0.032*** ** | **-0.023*** ** | **-0.024*** ** | **-0.017** ** | **-0.039*** ** | **-0.055*** ** | **-0.018*** ** | **-0.041*** ** | **-0.021*** ** | **-0.025*** ** | **-0.033*** ** | **-0.022*** ** | **-0.029*** ** | **-0.022*** ** |
| | | (0.004) | | (0.008) | (0.005) | (0.008) | (0.007) | (0.007) | (0.020) | (0.007) | (0.009) | (0.005) | (0.009) | (0.007) | (0.004) | (0.010) | (0.004) |
| | 2 bids | | **-0.046** ** | | | | | | | | | | | | | | **-0.050** |
| | | | (0.018) | | | | | | | | | | | | | | (0.060) |
| | 3 bids | | **-0.067*** ** | | | | | | | | | | | | | | **-0.090** |
| | | | (0.018) | | | | | | | | | | | | | | (0.058) |
| | 4 bids | | **-0.097*** ** | | | | | | | | | | | | | | **-0.128** ** |
| | | | (0.020) | | | | | | | | | | | | | | (0.055) |
| | 5 bids | | **-0.117*** ** | | | | | | | | | | | | | | **-0.141*** ** |
| | | | (0.020) | | | | | | | | | | | | | | (0.054) |
| | 6+ bids | | **-0.128*** ** | | | | | | | | | | | | | | **-0.142** ** |
| | | | (0.023) | | | | | | | | | | | | | | (0.073) |
| | Award criterion: Price only | -0.034*** ** | -0.034*** ** | 0.000 | -0.037** ** | -0.040 | -0.020 | -0.047* ** | 0.033 | -0.044** ** | -0.058** ** | -0.025 | -0.012 | | | -0.055** ** | -0.057** ** |
| | | (0.013) | (0.013) | (0.023) | (0.018) | (0.032) | (0.023) | (0.026) | (0.078) | (0.021) | (0.024) | (0.019) | (0.028) | | | (0.024) | (0.025) |
| A | Municipality | 0.016 | 0.016 | 0.040 | 0.009 | 0.003 | | | | | 0.034 | 0.012 | 0.008 | 0.034 | 0.003 | 0.029 | 0.030 |
| | | (0.015) | (0.015) | (0.029) | (0.020) | (0.036) | | | | | (0.032) | (0.019) | (0.040) | (0.032) | (0.016) | (0.034) | (0.033) |
| | Region | 0.025 | 0.025 | 0.065 | 0.004 | 0.071 | | | | | 0.070 | 0.057 | -0.030 | 0.095** | -0.004 | 0.081 | 0.084 |
| | | (0.026) | (0.026) | (0.043) | (0.035) | (0.077) | | | | | (0.046) | (0.038) | (0.059) | (0.046) | (0.031) | (0.051) | (0.052) |
| | Other contracting authority (excluding state) | 0.041*** ** | 0.042*** ** | 0.056** ** | 0.048** ** | 0.008 | | | | | 0.089*** ** | 0.036* * | 0.003 | 0.062** ** | 0.032** ** | 0.070** ** | 0.072** ** |
| | | (0.014) | (0.014) | (0.027) | (0.020) | (0.035) | | | | | (0.029) | (0.019) | (0.037) | (0.029) | (0.016) | (0.032) | (0.032) |
| B | Services | 0.014 | 0.014 | -0.082 | 0.020 | -0.023 | -0.015 | -0.008 | 0.095 | 0.022 | | | | 0.010 | 0.014 | 0.011 | 0.015 |
| | | (0.015) | (0.015) | (0.091) | (0.020) | (0.033) | (0.027) | (0.030) | (0.079) | (0.025) | | | | (0.029) | (0.018) | (0.040) | (0.040) |
| | Works | 0.018 | 0.019 | -0.037 | -0.032 | -0.001 | -0.029 | -0.020 | -0.007 | 0.064** ** | | | | -0.035 | -0.046** ** | -0.007 | -0.003 |
| | | (0.018) | (0.018) | (0.093) | (0.027) | (0.080) | (0.036) | (0.040) | (0.089) | (0.027) | | | | (0.034) | (0.022) | (0.039) | (0.040) |
| C | Restricted tender | 0.030** ** | 0.032** ** | -0.002 | 0.016 | 0.028 | 0.034 | 0.019 | 0.069 | 0.019 | 0.058* * | 0.018 | 0.073* * | 0.043 | 0.025 | | |
| | | (0.014) | (0.015) | (0.028) | (0.021) | (0.033) | (0.028) | (0.028) | (0.075) | (0.024) | (0.030) | (0.020) | (0.037) | (0.028) | (0.017) | | |
| | Negotiated tender | 0.023 | 0.026* * | -0.033 | 0.012 | -0.080 | 0.052** ** | 0.011 | 0.068 | -0.009 | 0.060* * | -0.000 | 0.023 | 0.014 | 0.019 | | |
| | | (0.014) | (0.015) | (0.026) | (0.020) | (0.066) | (0.026) | (0.032) | (0.074) | (0.024) | (0.031) | (0.018) | (0.045) | (0.041) | (0.016) | | |
| | Constant | -0.010 | -0.020 | 0.042 | 0.110* * | 0.005 | 0.062 | 0.089 | 0.324* * | -0.084 | 0.352** ** | -0.015 | -0.071 | 0.036 | 0.035 | 0.238* * | 0.232* * |
| | | (0.055) | (0.055) | (0.146) | (0.059) | (0.115) | (0.073) | (0.122) | (0.184) | (0.074) | (0.150) | (0.063) | (0.131) | (0.080) | (0.065) | (0.133) | (0.131) |
| | Observations | 2,223 | 2,223 | 449 | 1,167 | 448 | 730 | 540 | 152 | 801 | 510 | 1.269 | 444 | 657 | 1,566 | 471 | 471 |
| | $R^2$ | 0.050 | 0.050 | 0.151 | 0.070 | 0.114 | 0.054 | 0.120 | 0.183 | 0.064 | 0.178 | 0.041 | 0.073 | 0.094 | 0.044 | 0.113 | 0.116 |
| | Dummies for year, month, region, municipality type & option for extension | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |

Robust standard errors in parentheses
*** p<0,01, ** p<0,05, * p<0,1

Note: The table shows the regression results for the estimated models presented in the analysis. For each category of tender characteristics, dummy variables are included, taking the value 1 if the characteristic matches the specific tender and 0 otherwise. The groupings are as follows: A: The tender is from a municipality, a region, or another type of contracting authority (reference: the state), B: The tender concerns services or works (reference: goods), C: The procurement procedure is conducted as a restricted tender or a negotiated procedure (reference: open tender). Additionally, there is a dummy variable indicating whether the award criterion for the tender is solely price (as indicated in the table) or if the contract is awarded based on the best price-quality ratio (reference). All models include dummy variables for year, month, region, municipality type, and option for extension.

# Appendix 3. Interaction terms

| | Dependent variable: $Y_i = \ln \frac{P_i}{P_i^e}$ | (1) Parameter estimate | (2) Total |
|---|---|---|---|
| $a_1$ | Number of bids received | -0.035*** | |
| | | (0.011) | |
| $b_1$ | Price criterion X Number of bids received | -0.012 | -0.047 |
| | | (0.008) | |
| $b_2$ | Large contract X Number of bids received | 0.001 | -0.034 |
| | | (0.009) | |
| $b_3$ | Small contract X Number of bids received | -0.005 | -0.04 |
| | | (0.009) | |
| $b_4$ | Municipality X Number of bids received | 0.019** | -0.016 |
| | | (0.009) | |
| $b_5$ | Region X Number of bids received | 0.012 | -0.023 |
| | | (0.016) | |
| $b_6$ | Other contracting authority X Number of bids received | 0.025*** | -0.01 |
| | | (0.009) | |
| $b_7$ | Services X Number of bids received | 0.007 | -0.028 |
| | | (0.010) | |
| $b_8$ | Constrution X Number of bids received | -0.021 | -0.056 |
| | | (0.013) | |
| $b_9$ | Restricted tender X Number of bids received | -0.001 | -0.036 |
| | | (0.010) | |
| $b_{10}$ | Negotionated tender X Number of bids received | -0.002 | -0.037 |
| | | (0.011) | |
| | Constant | 0.190*** | |
| | | (0.062) | |
| | Observations | 2,223 | |
| | $R^2$ | 0.076 | |
| | Dummies for year, month, region, municipality type & option for extension | JA | |

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Model: $Y_{i,t} = a_0 + a_1 N_i + aX_i + \mathrm{b}_1(\mathrm{N_i} * \mathrm{X_{1,i}}) + \cdots + \mathrm{b}_{10}(\mathrm{N_i} * \mathrm{X_{10,i}}) + \epsilon_i$

The estimated parameter for received bids ($a_1$) represents the effect of one additional bid, when the tender falls within the respective reference categories: state, goods, open tender, medium-sized tender, and with the evaluation criterion being best price-quality ratio.

The parameter estimates for the interaction variables ($b_1 - b_{10}$ ) reflect the additional effects of including the relevant categorical variable. The estimated effect of receiving one more bid on tenders with the award criterion "lowest price" is thus a price reduction of 4.7% (-0.035 + (-0.012) = -0.047).

Interpretation: It can be observed that tenders from municipalities and regions show significantly positive interaction effects with the number of bids. This indicates that the price reduction effect is strongest for state tenders, which serve as the reference point. Likewise, $b_8$ for works contracts suggests a greater price reduction in this category. However, there is no indication of a greater effect for large contracts ($b_2$).

# Appendix 4. Fixed effects

| Dependent variable: $Y_{i,t} = \ln \frac{P_{i,t}}{P^e_{i,t}}$ | (1) Municipalities (Model 1) | (2) Municipalities (Model 2) | (3) All observations (Model 1) | (4) All observations (Model 2) |
|---|---|---|---|---|
| Number of received bids | -0.014* | | -0.022*** | |
| | (0.008) | | (0.005) | |
| 2 bids | | -0.050 | | -0.051** |
| | | (0.033) | | (0.022) |
| 3 bids | | -0.055 | | -0.065*** |
| | | (0.040) | | (0.024) |
| 4 bids | | -0.096** | | -0.097*** |
| | | (0.039) | | (0.030) |
| 5 bids | | -0.062 | | -0.093*** |
| | | (0.040) | | (0.032) |
| 6+ bids | | -0.087* | | -0.120*** |
| | | (0.049) | | (0.032) |
| Award criterion: Price only | -0.023 | -0.024 | -0.022 | -0.024 |
| | (0.022) | (0.022) | (0.019) | (0.019) |
| Services | -0.012 | -0.014 | -0.002 | -0.002 |
| | (0.038) | (0.039) | (0.025) | (0.025) |
| Works | -0.006 | -0.008 | 0.030 | 0.029 |
| | (0.043) | (0.045) | (0.025) | (0.024) |
| Limited tender | 0.012 | 0.007 | 0.040 | 0.037 |
| | (0.033) | (0.032) | (0.027) | (0.030) |
| Negotiated tender | 0.041 | 0.045* | 0.045* | 0.048** |
| | (0.026) | (0.025) | (0.023) | (0.024) |
| Constant | 0.271*** | 0.278*** | 0.105 | 0.103 |
| | (0.061) | (0.070) | (0.068) | (0.069) |
| Observations | 730 | 730 | 2.223 | 2.223 |
| $R^2$ | 0.048 | 0.052 | 0.040 | 0.042 |
| Dummies for year, month, region, municipality type & option for extension | JA | JA | JA | JA |
| Antal unikke kommuner | 93 | 93 | | |
| Antal unikke ordregivere | | | 880 | 880 |

Robust standard errors in parentheses
*** p<0,01, ** p<0,05, * p<0,1
Note: Columns 1 and 2 are estimated using only observations from municipalities with unique municipalities as the ID. Columns 3 and 4, on the other hand, are estimated on all observations with the name of the contracting authority as the ID.

Model: $Y_{i,t} - \overline{Y_i} = a_0 + a_1\left(N_{i,t} - \overline{N_i}\right) + \mathrm{b}_1\left(X_{i,t} - \overline{X_i}\right) + (\mathrm{c_i} - \overline{c_i}) + (u_{i,t} - \overline{u_i})$.

Model explanation: The bar over a letter indicates the average across time. The estimation is based on the deviation of each observation from its time-averaged value within unique municipalities/contracting authorities. Essentially, the error term is seperated into two components: one that is time-invariant $(c_i)$ and one that varies over time $(u_{i,t})$. The fixed effects model thus eliminates $c_i$ controlling for any unobserved time-invariant factors, such as a municipality's/contractring authority's systemativ over- or underestimation of the expected contract value.

Interpretation: The estimated price reductions remain statistically significant (however, only on a 10% significance level in the case of municipalities) in the fixed effects estimation. At the municipal level, a slightly smaller effect is estimated, which can partly be attributed to the generally lower price reduction effects in municipal tenders. The difference between receiving four bids versus one bid is approximately 10% in both the municipal model and the model using all observations.