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The Impact of Tender Procedures and Contract Types on Contract Prices in Public Works Procurement

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Highlights

- This paper focuses on effect of tender procedures on contract prices.
- This paper focuses on effect of tender procedures on competition.
- This paper focuses on effect of contract types on contract prices.

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Keywords

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Abstract

This study investigates the impact of tender procedures and contract types on contract prices in public works procurement in Türkiye. Using data from 350,894 tenders between 2005 and 2023, sourced from statistical reports published by Public Procurement Authority of Türkiye, the analysis focuses on three main procedures - open, restricted, and negotiated - and their effect on contract prices and competition, measured by the contract price/estimated cost ratio. Inflation-adjusted values were calculated using consumer price indices from Turkish Statistical Institute. Non-parametric and parametric statistical tests, including Kruskal-Wallis, Welch, and Mann-Whitney U, were applied based on data distribution characteristics. Results show that tender procedure type significantly affects both contract prices and the contract price/estimeated cost ratio. Negotiated tenders tend to result in higher contract prices and lower competition. Open Tenders demonstrate the highest competition, reflected by lower contract price/estimeated cost ratios. Additionally, contract type significantly influences pricing. Unit price contracts are generally associated with higher prices than turnkey lump sum contracts due to their use in large-scale infrastructure projects. The findings highlight the need to reassess the frequent use of negotiated tender procedures, especially under Article 21(b), to uphold the core principles of transparency and competition in public procurement. This study contributes to the growing literature on procurement efficiency and offers practical recommendations for improving tender processes.

1. INTRODUCTION

Public works tenders are of critical importance for the efficient implementation of state infrastructure projects and Public services. One way to achieve savings in public procurement is to find ways to increase the efficiency of public procurement through a competitive effect [1]. There are studies that competition is one of the most important elements in obtaining the best value at the lowest cost [2-5]. In this context, the selection of appropriate tender procedures and contract types becomes a strategic decision that can directly influence the outcome of public investments.Tender procedures dictate the process by which contractors are invited to bid for a project, while the contract type defines the allocation of risks and responsibilities between the client and the contractor, both of which have a cascading impact on pricing strategies [6]. Various tender procedures are outlined in the Public Procurement Law No. 4734 (the Law), each with different characteristics in terms of the fundamental principles such as competition and transparency [7]. Articles 18 to 21 of the law clearly state that open tender (OT) and restricted tender (RT) are the basic tender procedures and in case of special circumstances, negotiation procedures with or without announcement can be used. OT is the tender procedure with the highest competition and transparency while

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negotiated tender (NT) without announcement is the tender procedure that is the most criticized in terms of competition and transparency and should be used last by the administrations in terms of an ideal public administration. Restrictive tendering, conversely, narrows the bidder pool to pre-qualified contractors, assuring heightened competence and experience levels, but potentially foregoing the advantages of competitive pricing, as a smaller number of bidders might result in less aggressive bidding strategies and potentially higher contract prices [8].

According to the law, while all tenderers have the right to participate in OT procedures without any specific prerequisites, participation in RT is limited to those who are pre-qualified and shortlisted. OT may not be preferred if the nature of the work requires high specialization or advanced technology. In such cases, RT may be used. Furthermore, the RT procedure may be applied when the approximate cost of the construction work exceeds half of the threshold value, which is a common characteristic observed in RT tenders. These distinctions between OT and RT reveal a trade-off between broad accessibility and the depth of technical qualification, which must be carefully balanced to ensure fair competition.

The number of bidders participating in the tender changes according to the applied tender procedure and this affects the contract price with changing competition conditions. In particular, tenders conducted under NT are often not advertised, and it is sufficient for three bidders to be invited, with a single bidder submitting a bid. This situation has made NT the most criticized procedure in terms of competition, transparency, and corruption [9]. In previous years, uninvited bidders had access to the tender documents in tenders made with NT, but with the legal amendment made in 2012, these people were prevented from participating in tenders made with NT without obtaining the documents, thus significantly detracting from transparency and competition in the tender processes. This amendment has weakened competition and transparency by eliminating the legal basis for the operation of complaint and objection mechanisms.

The NT procedure is permitted only under the exceptional cases listed in Article 21 of the Law. These include (a) when no bidder participates in OT or RT tenders; (b) emergencies such as natural disasters, epidemics, or urgent threats to safety; (c) security-related urgencies; and (e) when the technical and financial features of the project are difficult to define due to complexity. In cases (b) and (c), announcements are not mandatory for NT tenders. Given the growing use of NT procedures in large-scale investments, there is a growing concern over their potential misuse in non-emergency contexts

The addition of the expression “or having a special feature in terms of construction technique” to subparagraph (b) of Article 21 of the Law in 2018 has expanded the application areas of NT; however, this situation has led to large investments being made with NT instead of OT. RT lags behind in price competition when compared to OT due to the fact that bidders who pass the qualification stage but cannot make it to the shortlist cannot submit a bid. These developments negatively affect the competitive structure of tender processes and necessitate the development of innovative and competitive strategies to ensure adequate participation in large projects.

One of the factors that increase participation in tender processes is the period between the tender announcement and the tender date. In tenders above the threshold value, tenderers are given a period of 28 days to submit their bids in tenders made with OT. This period encourages participation by allowing tenderers to carefully examine the tender documents and make the necessary preparations. Within the scope of RT, the provision of a pre-qualification application period of at least 14 days for the determination of the shortlisted tenderers provides an additional opportunity for potential tenderers to evaluate their qualifications. Candidates who pass the pre-qualification process are given a period of 35 days to prepare their bid prices.

In tenders carried out with NT, if an announcement is made, the announcement process must be initiated at least 25 days before the tender date. This period is of critical importance in terms of increasing Public awareness of the announced tender and ensuring the participation of more bidders. Whether or not an announcement is made significantly determines the impact of the tender processes on competition and transparency. When an announcement is made, more bidders are included in the process, which increases competition and allows for more affordable prices.

According to Pliatsidis, the duration of the tender notice period has a significant impact on the number of bids received in public procurement procedures in Greece. Analyzing 2,404 open tender procedures conducted between 2018 and 2021, the study finds that when the time limit for the receipt of tenders (Δt) exceeds the minimum threshold set by EU legislation (i.e., more than 35 days), contracting authorities tend to receive a greater number of bids. In contrast, tenders with shorter notice period stend to attract fewer participants. These findings suggest that allowing more time for bidders to prepare and submit proposals contributes to broader market engagement and potentially more competitive procurement outcomes [10].

In this study, the Contract Price/Estimated Cost (CP/EC) ratio is used to determine the level of competition. The fact that the Public Procurement Authority (PPA) does not publish data on the number of bidders participating in the tenders limits the analyses on this subject. However, CP/EC still serves as a practical proxy indicator of market competitiveness, especially in the absence of detailed participation metrics.

One of the important innovations brought by the Law article 5 is the prohibition of conducting tenders for works for which there is no budget. Determining whether sufficient budget is available is possible with a correct approximate cost calculation. Since the aim of the study is to measure the competition formed in the tender processes with the reduction from the approximate cost, an in-depth examination of approximate cost calculation methods has not been conducted.

The relationship between competition levels and contract types also deserves attention. In the Public Procurement Contracts Law No. 4735, three types of contracts are defined for construction works: TLS, UP, and mixed type (MT). TLS are used for projects with a design project, while UP contracts are used for works with a preliminary or final project. In MT, part of the work uses a design project, while other parts use either a preliminary or final project [11]. It is mandatory to receive a turnkey lump sum (TLS) offer for building works, while there is no such requirement for other types of works. However, if an implementation project has been prepared for a construction work, the TLS contract model must be used. In contrast, unit price contracts are often used for high-cost transportation and water infrastructure projects. In contrast, unit price contracts are often used for high-cost transportation and water infrastructure projects.

These contractual distinctions not only influence project execution strategies but also impact how risk is distributed between the client and contractor, thereby shaping bidding behavior and price competition. Since employer's and contractor's risks vary depending on type of contracts, it is expected that mean contract priceses also vary.

Recent studies, such as the work by Fountoukidis et. al. underscore the importance of market structure and bidder relationships in shaping competition. The study concludes that market conditions, influenced by the procurement process and structural features, significantly affect procurement outcomes. When competition is limited, it can lead to higher prices and lower-quality services. Conversely, when competitive conditions are healthy, procurement outcomes tend to be more cost-effective and result in higher-quality outputs [12]. This highlights the significance of competitive conditions, as shaped by tender procedures and contract types, in influencing procurement pricing and outcomes.

In the second section of this study, a comprehensive presentation of the data drawn from the public procurement statistics reports published by the Public Procurement Authority (PPA) of Turkey is provided. Additionally, the statistical methods and tests to be employed in the analysis are outlined in detail. The third section systematically presents the results of these tests, ensuring clarity in the presentation of findings. In the subsequent sections, the results derived from the statistical analyses will be discussed in depth, with a particular focus on the implications of these findings. This structure is designed to transparently communicate both the methodological framework and the analytical process of the study to the reader, thereby enhancing the rigor and clarity of the research approach.

2. MATERIAL AND METHOD

2.1. Data

The data utilized in this study were sourced from the public procurement statistics published annually by PPA. The dataset spans from 2005 to 2023 and encompasses a total of 350894 tenders. The study specifically focuses on three types of tender procedures: OT, RT, and NT, along with the corresponding contract prices. Table 1 presents the average contract prices for each year from 2005 through 2023, alongside the adjusted contract prices as of January 2024 [13]. The price adjustments were made using the consumer price index data published by the Turkish Statistical Institute (TÜİK) [14] and the document update tool available on the official EKAP platform [15]. For instance, in 2005, the Average Contract Price for OT was 1,311.71 TL. To calculate the Updated Average Contract Price as of January 2024, the following formula is used:

$$\text{Updated Average Contract Price} = \text{Average Contract Price} \times (1 + \text{Inflation Rate Factor}). \quad (1)$$

In this case, after adjusting for inflation based on the Consumer Price Index (CPI) from TÜİK using (1), the average price is updated to 23099.18 TL. The adjustment ensures that prices from previous years are accurately reflected in 2024 terms, allowing for meaningful comparisons.

Table 1. *Average contract prices according to tender procedures*

Year	Tender Procedure	Percent (%)	Average Contract Price (TL)	Updated Average Contract Price (TL)
2005	OT	95.41	1311.71	23099.18
	RT	1.64	5792.00	101997.12
	NT	2.95	758.23	13352.46
2006	OT	84.60	821.33	13404.12
	RT	2.84	8739.40	142627.01
	NT	12.56	2383.64	38900.94
2007	OT	90.96	1215.97	18020.60
	RT	2.99	24929.88	369460.75
	NT	6.05	2018.53	29914.61
2008	OT	85.80	1366.33	18718.69
	RT	7.03	38398.08	526053.65
	NT	7.17	3247.20	44486.69
2009	OT	84.30	1159.48	11339.74
	RT	7.70	29990.40	293306.11
	NT	8.00	1900.53	18587.21
2010	OT	77.71	1089.32	10653.60
	RT	10.39	22362.87	218708.85
	NT	11.90	3190.80	31205.99
2011	OT	84.14	1391.82	13612.04
	RT	11.99	32276.17	315660.94
	NT	3.87	1617.48	15818.97
2012	OT	67.12	2111.44	20649.86
	RT	23.60	59076.79	577770.99
	NT	9.28	5930.63	58001.57
2013	OT	76.98	2281.26	22310.72
	RT	15.44	72111.12	705246.78
	NT	7.58	5053.98	49427.95
2014	OT	85.72	2463.97	21436.51
	RT	10.72	61250.30	532877.64

	NT	3.56	1963.06	17078.66
2015	OT	82.45	2377.79	27939.05
	RT	9.18	72629.72	853399.22
	NT	8.38	4093.31	48096.35
2016	OT	72.88	3165.76	36026.39
	RT	9.24	167298.55	1903857.45
	NT	17.88	11107.23	126400.29
2017	OT	54.85	3756.71	37078.76
	RT	17.01	313905.89	3098251.11
	NT	28.14	17031.95	168105.31
2018	OT	64.94	3743.98	30738.11
	RT	5.81	225994.88	1855418.00
	NT	29.25	14014.74	115060.98
2019	OT	61.40	3436.60	21925.48
	RT	3.62	260187.29	1659994.88
	NT	34.98	12647.74	80692.58
2020	OT	62.89	3791.24	22937.02
	RT	0.33	45568.00	275686.40
	NT	36.78	14086.66	85224.28
2021	OT	63.64	6675.27	29170.94
	RT	2.19	1145733.67	5006856.12
	NT	34.18	25815.30	112812.87
2022	OT	58.58	13141.25	24705.56
	RT	0.55	251993.63	473748.02
	NT	40.88	53720.76	100995.03
2023	OT	45.98	31688.36	42462.40
	RT	1.10	1103596.50	1478819.31
	NT	52.92	192238.05	257598.98

Table 2 shows the ratios (CP/EC) according to the tender procedures formed each year from 2005 to the end of 2023 [13].

Table 2. *CP/EC ratios according to tender procedures*

Year	Tender Procedure	CP	EC	CP/EC
2005	OT	9458357	12963998	0.729586
	RT	217015	250262	0.867151
	NT	518633	593862	0.873322
2006	OT	2601156	3477926	0.747904
	RT	87394	93178	0.937925
	NT	386149	415111	0.930231
2007	OT	6068883	7646015	0.793732
	RT	199439	158232	1.260421
	NT	403706	451233	0.894673
2008	OT	6096553	8003630	0.761723
	RT	499175	583451	0.855556
	NT	509811	545205	0.935081
2009	OT	4925484	6789289	0.725479
	RT	449856	623296	0.721737
	NT	467531	510130	0.916494
2010	OT	6356185	9075964	0.700332
	RT	849789	1203084	0.706342
	NT	973193	1082083	0.899370
2011	OT	10647456	16475287	0.646268

	RT	1516980	2359644	0.642885
	NT	490097	567241	0.864001
2012	OT	14279655	22622696	0.631209
	RT	5021527	8255553	0.608261
	NT	1974900	2278897	0.866603
2013	OT	17613609	26683800	0.660086
	RT	3533445	4749939	0.743893
	NT	1733516	2034516	0.852053
2014	OT	16166084	22509595	0.718186
	RT	2021260	2726858	0.741241
	NT	671368	801945	0.837175
2015	OT	18431998	26856468	0.686315
	RT	952958	1290541	0.738417
	NT	2474671	2751215	0.899483
2016	OT	24195875	34058216	0.710427
	RT	3393827	4308573	0.787692
	NT	2373296	2748519	0.863482
2017	OT	31022916	42279648	0.733755
	RT	9324919	10518017	0.886566
	NT	12873818	15377640	0.837178
2018	OT	34029118	44245261	0.769102
	RT	4412381	5023233	0.878395
	NT	15573748	18158242	0.857668
2019	OT	12910565	16691528	0.773480
	RT	1677317	1958929	0.856242
	NT	7050019	8216549	0.858027
2020	OT	15274006	21484416	0.710934
	RT	104590	107828	0.969971
	NT	7555634	8994608	0.840018
2021	OT	39910756	54503109	0.732266
	RT	-	-	-
	NT	19613516	24010895	0.816859
2022	OT	60285442	68214094	0.883768
	RT	748408	938887	0.797122
	NT	34117283	38093951	0.895609
2023	OT	460780444	511130154	0.901493
	RT	11035965	11467206	0.962393
	NT	530384768	557794847	0.950859

Table 3 shows the average contract prices by contract type formed each year from 2005 to the end of 2023, and the average contract prices updated with reference to January 2024 [13]. For instance, in 2005, the average contract price for the UP contract type was 745.47 TL. Using the CPI-based inflation factor and (1) to adjust this figure to January 2024 values, the updated average contract price becomes 18226.84 TL.

Table 3. *Average contract prices by contract type*

Year	Contract Type	Quantity	Total Amount (TL)	Average Contract Price (TL)	Updated Average Contract Price (TL)
2005	UP	5574	4155272	745.47	18226.84
	TLS	10214	6032150	590.58	14439.60
	MT	48	6583	137.15	3353.22
2006	UP	6248	4370117	699.44	15674.51

	TLS	12036	6791541	564.27	12645.27
	MT	121	22285	184.17	4127.33
2007	UP	7482	12260242	1638.63	34280.17
	TLS	13216	11428560	864.75	18090.61
	MT	-	-	-	-
2008	UP	8530	14070749	1649.56	29609.61
	TLS	13453	11972207	889.93	15974.22
	MT	-	-	-	-
2009	UP	5827	9119002	1564.96	28810.85
	TLS	11489	10693459	930.76	17135.22
	MT	-	-	-	-
2010	UP	6815	10354972	1519.44	25602.54
	TLS	10327	8357827	809.32	13637.01
	MT	-	-	-	-
2011	UP	8816	19081407	2164.41	33266.93
	TLS	12924	13305694	1029.53	15823.93
	MT	101	672062	6654.08	102273.20
2012	UP	8432	25186984	2987.07	42506.02
	TLS	12131	17750826	1463.26	20822.21
	MT	103	866699	8414.55	119739.09
2013	UP	9539	29501481	3092.72	43050.70
	TLS	12819	21531799	1679.68	23381.13
	MT	115	2049081	17818.10	248027.89
2014	UP	6681	20651219	3091.04	38668.87
	TLS	9801	17957494	1832.21	22920.95
	MT	76	844905	11117.17	139075.81
2015	UP	9106	35197369	3865.29	45417.21
	TLS	10607	16902700	1593.54	18724.12
	MT	113	1707937	15114.49	177595.22
2016	UP	9338	52240281	5594.38	63664.00
	TLS	10209	24853108	2434.43	27703.83
	MT	127	2600591	20477.09	233029.34
2017	UP	9941	86224349	8673.61	85608.52
	TLS	11290	37906564	3357.53	33138.87
	MT	138	6915078	50109.26	494578.40
2018	UP	9024	56983860	6314.70	51843.69
	TLS	10443	40081059	3838.08	31510.63
	MT	203	4029061	19847.59	162948.72
2019	UP	4676	29139315	6231.68	39758.09
	TLS	5665	17322870	3057.88	19509.25
	MT	50	3800942	76018.84	485000.20
2020	UP	6218	31683416	5095.44	30827.38
	TLS	7111	33861630	4761.87	28809.29
	MT	44	4081203	92754.61	561165.41
2021	UP	8189	80137962	9786.05	42765.04
	TLS	8830	74398985	8425.71	36820.34
	MT	59	2730069	46272.36	202210.20
2022	UP	9377	197417923	21053.42	39580.43
	TLS	9787	157273307	16069.61	30210.87
	MT	101	14333094	141911.82	266794.22
2023	UP	8721	327129881	37510.59	50264.19
	TLS	8453	542450324	64172.52	85991.18
	MT	136	132620971	975154.20	1306706.63

2.2. Methodology

In the study, independent groups were created for each research topic using data obtained from public procurement statistics published by PPA. Then SPSS (Version 27) software was used to implement the following steps as shown in Figure 1:

Step 1: Normality Check
Are the data normally distributed? Test whether the data follows a normal distribution (e.g., using a normality test like Shapiro-Wilk or some methods proposed by researchers [13-17].

Step 2: If data is normally distributed
Check if the variances across the groups are equal using Levene's test.
If homogeneity of variances is met, use ANOVA to compare the means of the three independent groups.
If homogeneity of variances is not met, use Welch's Test, which adjusts for unequal variances.
Post-hoc tests for Welch's: If Welch's Test is significant, use Mann-Whitney U test for pairwise comparisons.

Step 3: If data is not normally distributed
Use Kruskal-Wallis Test (a non-parametric alternative to ANOVA) to test for differences between the groups.
Post-hoc tests for Kruskal-Wallis: Use Mann-Whitney U for pairwise comparisons.

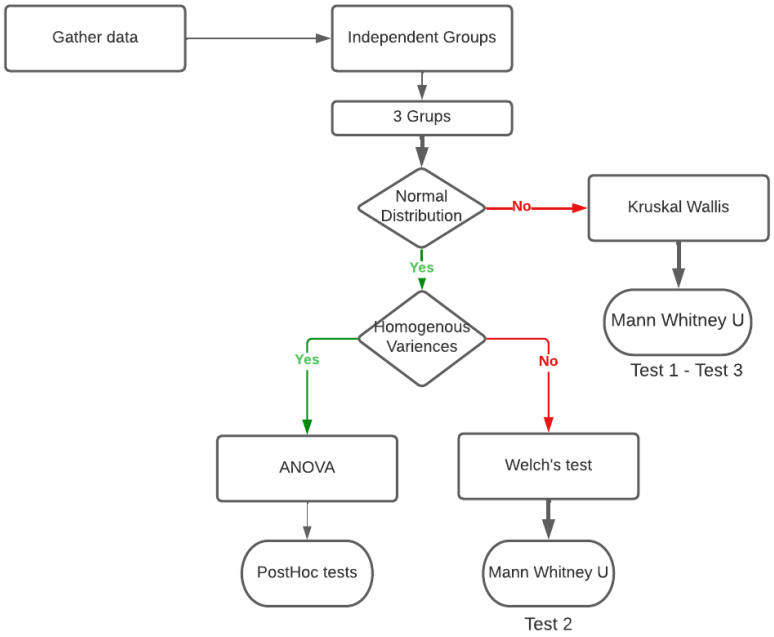


Figure 1. *Statistical analysis workflow*

2.2.1. Data distribution and normality analysis

The statistical models used in this study are based on certain assumptions about the data being analyzed [16]. Parametric statistical tests, as the name suggests, are based on the assumption of certain parameters regarding the data being tested and the conditions under which they were obtained [17]. Violation of these assumptions may lead to invalid or inappropriate conclusions, thereby hindering accurate inferences about the underlying reality [18]. For parametric tests to be valid, the data must follow a normal distribution, and the groups being compared must exhibit homogeneity of variance (i.e., equal variances)

The significance of normal distribution is undeniable, as it underpins many statistical methods [19]. As suggested by Pallant, the assumption of normality was tested using formal statistical procedures such as the

Kolmogorov-Smirnov and Shapiro-Wilk tests, both of which are available in SPSS. The Shapiro-Wilk test, in particular, is recommended for small sample sizes [20]. Initially, the Shapiro-Wilk test was limited to samples of size 50 or fewer. However, studies have shown that the Shapiro-Wilk test is more sensitive than the Kolmogorov-Smirnov test, particularly with the sample sizes typical of the present study [21,22]

Normality is generally assumed when skewness and kurtosis fall within the ranges of -1.0 to +1.0 [23,24], -1.5 to +1.5 [25], or -2.0 to +2.0 [26]. Additionally, normality can be assumed when the skewness and kurtosis values, divided by their standard errors, fall within the range of -1.96 to +1.96 [27]. If the assumption of normality was not met, the Mann-Whitney U test was applied to assess differences between two groups, while the Kruskal-Wallis test was applied for comparing three or more groups.

2.2.2. Homogeneity of variance assumption

If the normality condition was met, the Levene test was applied to test the assumption of homogeneity of variances. The null hypothesis in the Levene test posits that the variances were equal. If the p-value in this test was greater than 0.05, the null hypothesis was retained, suggesting that the variances were homogenous. Conversely, if the p-value was less than 0.05, the null hypothesis was rejected, indicating that the variances were significantly different [28,29].

2.2.3. Test for differences between groups

In cases where the normality assumption was met but the assumption of homogeneity of variances was violated, the Welch test was used instead of the traditional ANOVA. The Welch test is considered more robust when there is heterogeneity of variance. When a One-Way ANOVA is conducted with two groups, the Welch test provides the same level of significance as the unequal variance t-test [30]. In situations where the assumption of homogeneity of variances is not satisfied, particularly with unequal sample sizes, the Welch test offers a reliable alternative for performing ANOVA analysis. The Welch test is also known as the ANOVA Welch test.

If the assumptions of One-Way ANOVA for Independent Groups were not met, the Kruskal-Wallis test was used to determine whether there was a statistically significant difference between the scores of three or more independent groups [31]. The Kruskal-Wallis test ranks the data on a minimum ordinal scale, ordering all data from smallest to largest, regardless of their group membership, and assigns them ordinal numbers starting from 1. This process involves converting the data from a minimum interval scale to an ordinal scale. Next, the data are divided into the groups to be compared, and the mean rank (average of the ordinal numbers) for each group is calculated.

In the first analysis, where the impat of tendering procedures on contract price was examined, the Kruskal-Wallis test, a nonparametric alternative to the ANOVA test, was applied due to the violation of the normality assumption. After rejecting the null hypothesis in the Kruskal-Wallis test, the Mann-Whitney U test was performed between the paired groups to identify the source of the difference.

In the second analysis, where the impat of tendering procedures on the (CP/EC) ratio was examined, the Welch test was applied because the normality assumption was met, but the assumption of homogeneity of variances was not satisfied. After rejecting the null hypothesis in the Welch test, the Mann-Whitney U test was performed between the paired groups to identify the source of the difference.

In the third analysis, where the impat of contract type on contract price was examined, the Kruskal-Wallis test was applied because the normality assumption was not met within the groups. After rejecting the null hypothesis in the Kruskal-Wallis test, the Mann-Whitney U test was performed between the paired groups to identify the source of the difference.

3. ANALYSIS

3.1. Impact of Tender Procedures on Contract Price

The groups consisted of 19 data sets for OT, RT, and NT. The mean, skewness, and kurtosis values of the samples are presented in Table 4, while the Shapiro-Wilk test results are provided in Table 5.

Table 4. *Descriptive statistics*

Tender Procedure		Statistic	Std. Error
OT	Mean	23485.7247	2015.15301
	Median	22310.7200	
	Variance	77155991.792	
	Std. Deviation	8783.84835	
	Minimum	10653.60	
	Maximum	42462.40	
	Skewness	.529	.524
	Kurtosis	-.145	1.014
RT	Mean	1073144.2289	284171.82128
	Median	532877.6400	
	Variance	1534318856159.164	
	Std. Deviation	1238676.25155	
	Range	4904859.00	
	Skewness	2.145	.524
	Kurtosis	5.037	1.014
NT	Mean	74303.2484	14325.24488
	Median	49427.9500	
	Variance	3899040174.975	
	Std. Deviation	62442.29476	
	Skewness	1.583	.524
	Kurtosis	2.939	1.014

Table 5. *Results of Shapiro-Wilk test*

Tender Procedure	Shapiro-Wilk		
	Statistic	df	Sig.
OT	.956	19	.499
RT	.734	19	.000
NT	.847	19	.006

Based on the Shapiro-Wilk test results, no significant difference was found between the distribution of contract prices for works tendered with OT and a normal distribution ($p = 0.499 > 0.05$). However, significant differences were observed between the contract prices for works tendered with RT and NT, compared to the normal distribution ($p = 0.000$ and $p = 0.006$, respectively, both < 0.05). According to George and Mallery [26], if the skewness and kurtosis values fall between +2.0 and -2.0, it is considered that there is no significant deviation from a normal distribution. In this context, the average contract prices resulting from tenders conducted with NT and RT do not follow a normal distribution. As a result, parametric tests cannot be used for comparing the three samples, and thus the Kruskal-Wallis test was applied. The null and alternative hypotheses for this analysis are as follows:

H0: There is no difference between the average contract prices according to the tender procedures.

H1: There is a difference between the average contract prices of at least two groups according to tender procedures.

The results of the Kruskal-Wallis test are presented in Table 6. According to these findings, the null hypothesis is rejected, indicating a statistically significant difference at the 0.05 significance level in the distribution of mean contract prices among at least two of the groups based on tender procedures ($p = 0.000 < 0.05$).

Table 6. *Results of Kruskall Wallis test*

	Contract Price
Chi-Square	40.805
df	2
Asymp. Sig.	.000

To find out which groups there is a difference between, the Mann Whitney U test was applied between the paired groups and the results are given in Table 7.

H_0: There is no statistically significant difference between the two groups.

H_1: There is a statistically significant difference between at least two groups.

Table 7. *Results of Mann Whitney U test*

	Contract Price
Mann-Whitney U	.000
Wilcoxon W	190.000
Z	-5.270
Asymp. Sig. (2-tailed)	.000
Exact Sig. [2*(1-tailed Sig.)]	.000[b]

a. Grouping Variable: Tender Procedure
b. Not corrected for ties.

The Mann-Whitney U test result between the OT and RT groups was found as $U = 0.0000$, $p = 0.0000$. These findings show that the contract prices formed as a result of the tenders where RT was applied are significantly higher than the contract prices formed as a result of the tenders where OT was applied. The median contract price in OT was calculated as 22310.72 (Thousand) TL, and the median contract price in RT was calculated as 532877.64 (Thousand) TL.

The Mann-Whitney U test result between the OT and NT groups was found as $U = 69.0000$, $p = 0.001133$. These findings show that the contract prices resulting from tenders where NT was applied are significantly higher than the contract prices resulting from tenders where OT was applied. The median contract price in OT was calculated as 22310.72 (Thousand) TL, and the median contract price in NT was calculated as 49427.95 (Thousand) TL.

The Mann-Whitney U test between the RT and NT groups found $U = 8.0000$, $p = 0.000000$. These findings show that the contract prices resulting from tenders where RT was applied are significantly higher than the contract prices resulting from tenders where NT was applied. The median contract price in RT was calculated as 532877.64 (Thousand) TL, and the median contract price in NT was calculated as 49427.95 (Thousand) TL.

3.2. Impact of Tender Procedures on CP/EC Ratio

The ratio of (CP/EC) is an important parameter that shows how effective the competition is in the tender. Therefore, it would be more appropriate to use the CP/EC ratio instead of the average prices formed in the contracts in order to determine the level of competition.

Groups consisting of 19 data were obtained for the OT, RT and NT groups. The null hypothesis and alternative hypotheses used in this analysis are as follows:

H_0: There is no difference between the averages of the (CP/EC) ratios according to the tender procedures.

H_1: There is a statistically significant difference between at least two groups.

The mean, skewness and kurtosis values of the groups are given in Table 8, and the results of the Shapiro-Wilk tests are given in Table 9.

Table 8. *Descriptive statistics*

Tender Procedure		Statistic	Std. Error
OT	Mean	.7509	.01506
	Median	.7296	
	Variance	.004	
	Std. Deviation	.06564	
	Skewness	1.295	.524
	Kurtosis	1.813	1.014
RT	Mean	.8169	.02734
	Median	.8160	
	Variance	.014	
	Std. Deviation	.11919	
	Skewness	-.177	.524
	Kurtosis	-.135	1.014
NT	Mean	.8751	.00779
	Median	.8733	
	Variance	.001	
	Std. Deviation	.03397	
	Skewness	.597	.524
	Kurtosis	-.193	1.014

Table 9. *Results of Shapiro-Wilk test*

Group	Shapiro-Wilk		
	Statistic	df	Sig.
OT	.875	19	.018
RT	.986	19	.988
NT	.956	19	.490

According to the Shapiro-Wilk test results, the (CP/EC) ratios formed in the works tendered with OT do not have a normal distribution. The ratios formed in the works tendered with RT and NT have a normal distribution. When the skewness and kurtosis values are examined, it is seen that the distribution of the CP/EC ratios formed in the works tendered according to OT is compatible with the normal distribution. Since all 3 groups have a normal distribution, the Levene test was applied to determine whether ANOVA or Welch tests will be applied and the results are given in Table 10.

Table 10. *Results of Levene test*

Levene Statistic	df1	df2	Sig.
9.455	2	54	.000301

As a result of Levene test, F = 9.455, p = 0.000301 was found. This result shows that the variances are not homogeneous between the groups since the p value is less than 0.05. Due to the inhomogeneity of the variances, Welch test was applied instead of ANOVA test and the results are given in Table 11.

Table 11. *Results of Welch test*

	Statistic[a]	df1	df2	Sig.
Welch	26.895	2	30.140	.000000

a. Asymptotically F distributed.

A Welch test was applied to compare the means of CP/EC ratios between OT, RT, and NT results. The Welch test yielded F = 26.895 and p = 0.00000. Since the p value is less than 0.05, this indicates a statistically significant difference between the groups.

To identify which groups differ, Mann-Whitney U tests were conducted between the pairwise groups, and the results of these tests are presented in Table 12.

Table 12. *Results of Mann-Whitney U tets*

Grup		U	p
OT	RT	114.000	0.052204
	NT	32.0000	0.000015
RT	NT	127.0000	0.118307

According to the results of the tests, there is a significant difference between the reductions in tenders where OT is applied and in tenders where NT is applied. The reductions in tenders where OT is applied are more than the reductions in tenders where NT is applied.

3.3. Impact of Contract Types on Contract Prices

Using the statistics published by PPA, groups consisting of 19 data for UP and TLS types, and groups consisting of 13 data for MT were obtained. Basic statistics regarding average contract prices according to contract types are given in Table 13. According to contract types, the average contract price for unit-priced works was calculated as 39969.76 (Thousand) TL, while it was calculated as 25646.76 (Thousand) TL for turnkey lump sum works. When the normal distribution is evaluated based on the skewness and kurtosis values, it is concluded that none of the groups have a normal distribution.

Table 13. *Descriptive statistics*

Contract Type		Statistic	Std. Error
UP	Mean	39969.7679	3670.94983
	Median	39580.4303	
	Variance	256041580.606	
	Std. Deviation	16001.29934	
	Skewness	1.213	.524
	Kurtosis	2.746	1.014
TLS	Mean	25646.7638	3735.31081
	Median	20822.2120	
	Variance	265098390.285	

	Std. Deviation	16281.84235	
	Skewness	3.063	.524
	Kurtosis	11.200	1.014
MT	Mean	300441.658604	83904,49668
	Median	202210.195400	
	Variance	105599468458.083050	
	Std. Deviation	324960.718331	
	Skewness	2.340	.580
	Kurtosis	6.598	1.111

However, according to the Shapiro-Wilk test results given in Table 14, the average contract prices in the works carried out with UP are compatible with the normal distribution (p=0.101; p>0.05). As a result, according to the Shapiro-Wilk test results, only the average contract prices in the works carried out with UP are compatible with the normal distribution, while the distributions in other contract types are not compatible with the normal distribution. Based on the normality assessment criteria outlined by Büyüköztürk et al., Hair et al., Tabachnick and Fidell, and George and Mallery, the distributions of the data within these groups also deviate from normality and therefore cannot be considered normally distributed [23-26].

Table 14. *Results of Shapiro-Wilk test*

Group	Shapiro-Wilk		
	Statistic	df	Sig.
UP	.917	19	.101
TLS	.654	19	.000
MT	.744	15	.001

Therefore, the Kruskall-Wallis test was applied to determine whether there was a statistically significant difference between the groups and the results are given in Table 15.

Table 15. *Results of Kruskall-Wallis test*

	Updated mean contract prices
Chi-Square	23.020
df	2
Asymp. Sig.	.000

a. Kruskal Wallis Test
b. Grouping Variable: Tender Procedure

According to the Kruskall Wallis test result, there is a difference between the groups and the Mann Whitney U test was applied between the paired groups to find out which groups there is a difference between and the results are given in Table 16.

Table 16. *Results of Mann Whitney U test*

Grup	Grup	U	p
UP	TLS	64.0000	0.000671
	MT	38.0000	0.000289
TLS	MT	38.0000	0.000289

The Mann-Whitney U test result between UP and TLS groups was found as U= 64.000, p= 0.000671. These findings show that the average contract prices formed in contracts using UP are significantly higher than

the average contract prices formed in contracts using TLS. The median contract price in TLS was calculated as 20822.21(Thousand) TL, while the median contract price in UP was calculated as 39580.43 (Thousand) TL.

The Mann-Whitney U test result between UP and MT groups was found as U= 38.0000, p= 0.000289. These findings show that the average contract prices formed in contracts using MT are significantly higher than the average contract prices formed in contracts using UP. The median contract price in UP was calculated as 39580.43 (Thousand) TL, while the median contract price in MT was calculated as 202210.20 (Thousand) TL.

As a result of the Mann-Whitney U test conducted between the TLS and MT groups, U = 38.0000, p = 0.000289. These findings show that the average contract prices formed in contracts using TLS are significantly higher than the average contract prices formed in contracts using KS. The median contract price in MT was calculated as 202210.20 (Thousand) TL, while the median contract price in TLS was calculated as 20822.21 (Thousand) TL.

4. FINDINGS

The analysis conducted to examine whether significant differences exist between the average contract prices, formed according to the different tender procedures, led to meaningful insights. To investigate these differences, the Kruskal-Wallis test was applied. This specific test was selected due to the fact that the distribution of average contract prices from tenders conducted with the RT procedure did not follow a normal distribution, indicating that parametric tests would not be suitable for this data. The Kruskal-Wallis test revealed statistically significant differences between the groups, suggesting that the type of tender procedure does have a significant impat on the contract prices. Following this, to identify the specific groups responsible for the observed differences, Mann-Whitney U tests were carried out. The results of these post-hoc tests indicated that there were statistically significant differences between each group, with all comparisons showing a significance level of 0.05, reinforcing the initial findings.

When further exploring the CP/EC ratio in relation to tender procedures, the Welch test was chosen for analysis. This test was particularly appropriate because, although all the groups met the assumption of normality, the assumption of homogeneity of variances was violated, indicating unequal variances across groups. The Welch test is well-suited for such cases, where the assumption of equal variances is not met, making it an ideal choice for comparing group means. Upon performing the Welch test, significant differences were observed between the groups, suggesting that the tender procedures have a meaningful impact on the CP/EC ratio. To pinpoint the source of these differences, additional Mann-Whitney U tests were conducted. These post-hoc tests revealed statistically significant differences between the OT and NT groups, particularly, with a p-value of less than 0.05, suggesting that the type of tender procedure plays an important role in shaping the CP/EC ratio. This result implies that certain tender procedures (such as NT) lead to notably different outcomes in the CP/EC ratio when compared to others, emphasizing the need to consider the procedure type in pricing strategies.

Lastly, in evaluating the impat of contract type on contract prices, the Kruskal-Wallis test was again employed. This choice was made because, similar to the previous analyses, none of the three independent groups met the normality assumption, necessitating the use of a non-parametric test. The results of the Kruskal-Wallis test revealed significant differences between the groups, suggesting that the contract type indeed influences contract prices. To further investigate which specific groups were driving these differences, Mann-Whitney U tests were performed. The post-hoc analysis revealed statistically significant differences between each pair of groups, indicating that contract type is a key determinant in shaping the final contract price. These findings underscore the importance of contract type in influencing financial outcomes, suggesting that different contract arrangements may lead to varying price structures. The summary of results are given in Table 17.

Table 17. *Summary of the Results*

Null Hypothesis	Test (p)	Results	Post Hoc Test (p)	Results
There is no difference in the mean contract prices based on the tender procedures	Kruskall-Wallis (0.000000)	There is a difference between the mean contract prices of at least two groups based on tender procedures.	Mann-Whitney U (0.000000; 0.001133; 0.000000)	There are statistically significant differences between each group
There is no difference in the mean CP/EC ratios based on the tender procedures	Welch (0.000000)	There is a difference in the mean CP/EC ratios between at least two groups based on the tender procedures	Mann-Whitney U (0.052204; 0.000015; 0.118307)	There is statistically significant difference between OT and NT
There is no difference in the mean contract prices based on the contract types	Kruskall Wallis (0.000000)	There is a difference in the mean contract prices between at least two groups based ob contract types	Mann-Whitney U (0.000671; 0.000289; 0.000289)	There are statistically significant differences between each group.

5. DISCUSSION

The impact of tender procedures and contract types on contract prices has been a long-standing topic of discussion in the literature. This study explored these impats, examining the influence of tender procedures on contract prices and the CP/EC ratio through parametric tests where appropriate, and nonparametric tests when the assumptions for parametric tests were not met. The results provide valuable insights into the influence of various tender procedures and contract types on contract prices, offering critical guidance for improving the management of tender processes. Additionally, these findings supply essential data that should be considered in the development and refinement of current tender practices.

In the first analysis, which investigated the impat of tender procedures on contract prices, it was found that each tender procedure had a statistically significant impact on the contract price. Specifically, in tenders conducted using the RT method, where the approximate costs were predominantly above half of the threshold value, it was expected that the average contract prices would be higher compared to other tender methods. However, a noteworthy result emerged when comparing the contract prices between OT and negotiated tenders NT, which are typically used in special cases. Recent trends have seen large construction projects, often spanning more than one year, being awarded through NT procedures without advertising. Historically, these same projects were tendered through OT, which allowed for greater competition through the participation of a larger pool of bidders.

One of the key indicators of competition in tender processes is the CP/EC ratio, which is based on the assumption that the estimated cost is accurately calculated. This ratio is a critical data point published by the Public PPA. In the test involving three independent groups, the results revealed that tender procedures significantly affected the CP/EC ratio, as indicated by the Welch test, which was applied due to the normal distribution of the data but non-homogeneous variances across groups. Notably, the Mann-Whitney U test revealed that there was no significant difference between RT and NT in terms of the CP/EC ratio, with a borderline significance value. This finding is significant because, in RT tenders, only the bidders included in the prequalification shortlist are allowed to submit price offers, thereby reducing competition. Similarly, NT tenders are typically concluded with three price offers without prior advertisement. In contrast, OT procedures allow an unrestricted number of bidders to participate, which is why the Mann-Whitney U test showed a significant difference between OT and NT in the CP/EC ratio. Specifically, the results indicated

that NT tenders involved lower deductions from the estimated cost compared to OT tenders, reflecting reduced competition. Despite the absence of a formal requirement, administrations often invite only three bidders to submit offers within a short timeframe in NT tenders, which undermines the expectation that contract prices will significantly fall below the estimated cost.

Based on the CP/EC ratio, it is evident that OT is the most competitive tender procedure, followed by RT and NT, which are closely aligned in terms of competitiveness. Therefore, NT should only be used when specific legal conditions are met, and the practice of limiting the number of bidders to three in NT tenders should be reconsidered.

In the final set of tests, which examined the impat of contract types on contract prices, both Kruskal-Wallis and Mann-Whitney U tests were applied. The results confirmed that the impat of each contract type on contract prices was statistically significant at the 0.05 level. The contract types primarily analyzed were UP and total lump sum TLS. The findings corroborated the fact that large infrastructure projects, such as those in transportation, water supply, and energy, are typically contracted using unit-priced contracts. Consequently, UP contract works tend to have higher contract prices than those based on TLS.

A previous study, based on 11 years of data and focusing on a similar topic, yielded comparable results, although there were differences regarding price updates and data volume. While the earlier study, conducted by Kocaman et al., analyzed prices between 2007 and 2017, this study used data from 2005 to 2023, with an independent group size of 19. They employed the dollar exchange rate to account for the inflation effect on contract prices, whereas this study utilized TÜİK indices based on inflation calculations, given the global inflationary environment following the COVID-19 pandemic. Additionally, while Kocaman et al. relied on non-parametric tests due to the failure to meet the prerequisites for parametric tests in their analysis, this study employed the Welch test, a parametric method, to examine the impat of tender procedures on the CP/EC ratio. Furthermore, both studies found that tender procedure significantly affects contract price, with NT creating a statistically significant difference in the CP/EC ratio. Lastly, similar to the findings in this study, Kocaman et al. also concluded that contract type has an impact on contract price [32].

6. CONCLUSION

This study examined the impact of tender procedures and contract types on contract prices, as well as the impat of tender types on the CP/EC ratio, utilizing public procurement statistics published by PPA. To account for inflationary effects, TÜİK indices were applied. Three independent group datasets were analyzed for each research question.

In the first research question, it was found that the choice of tender procedure influenced the contract price, with NT resulting in higher contract prices compared to OT. Moreover, although RT yielded the highest contract prices, this outcome can be attributed to the fact that tenders for construction works exceeding half of the legal threshold are conducted via RT, where only a limited number of bidders, selected through a pre-qualification process, are eligible to submit price offers.

When this finding was examined in conjunction with the second research question, which investigated the impat of tender procedures on the CP/EC ratio, it was evident that NT led to a higher contract price compared to OT. This was due to the relatively lower deductions from the approximate cost in NT tenders, which, in turn, contributed to reduced competition and higher prices.

The third research question revealed that UP contracts generally resulted in higher contract prices compared to TLS contracts. This result aligns with the legislative framework, as large-scale infrastructure projects are predominantly conducted under unit-priced contracts due to their suitability for such complex projects.Based on these findings, it can be concluded that Article 21, paragraph (b) of the Law, which

governs the NT procedure, should be reconsidered and revised to better align with the core principles of the Law. This revision is warranted considering the observed outcomes, particularly the tendency for NT procedures to lead to higher contract prices and diminished competition.

This study provides valuable insights, but it is also recommended that future research be conducted periodically, as the availability of public procurement data increases and new data types are published. Expanding the scope of the study to include larger datasets would enhance the robustness of the findings. Additionally, future research could compare the results of this study with other investigations, particularly by examining whether there are variations in the number of bidders participating in tenders depending on the type of tender procedure employed.

CONFLICTS OF INTEREST

No conflict of interest was declared by the authors.

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