Renegotiation of Public Contracts: An Empirical Analysis

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Abstract

We exploit a large dataset of contracts for public works awarded in Italy between 2000 and 2007 to document two empirical facts about time and cost renegotiations. First, although both types of renegotiations are systematic, their correlation is nearly zero. Second, several factors typically suggested to explain renegotiations have different, and in certain cases opposite, effects on price and time renegotiations. Moreover, the estimates confirm that, as suggested by the literature, the type of awarding procedures and the complexity of the job are associated with renegotiations, but they also provide evidence in favor of an important role for the linkage between the project design stage and renegotiations during the project execution.

JEL: L22, L74, D44, D82, H57.

Keywords: Procurement, Auctions, Renegotiations, Delays, Overruns

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I Introduction

Public procurement is a fundamental area of the economy representing on average 19 percent of GDP in developed countries. The majority of public contracts are procured via auctions, but, contrary to other auction markets, auctions for contracts typically only set an initial bid that might differ from what is effectively delivered by the contractor.

This paper presents an empirical analysis of this phenomenon by studying price and time renegotiations in a large dataset of contracts for public works. We operationalize them as the percentage change of the final price paid to the contractor relative to the awarding price and the percentage change of the number of days taken to complete the work relative to the original contractual length of the job.

Our analysis reveals two main empirical facts. First, both price and time renegotiations are systematic, but they are nearly uncorrelated. Our dataset is particularly appropriate to establish this fact because it was constructed by the Italian Authority for Public Contracts to monitor the universe of contracts for public works above €150,000. In the sample period 2000-2007, price renegotiations larger than 5 percent involve 46 percent of the contracts, while time renegotiations larger than 5 percent involve 83 percent of the contracts. Renegotiations are economically relevant averaging around 6 percent for prices and 70 percent for time. Surprisingly, however, the association between the two measures is very weak: their linear correlation is only 4.5 percent and no evidence of a nonlinear relationship is present.

Consistent with the previous result, the second empirical fact presented is that the two renegotiation measures are associated in different, and sometimes opposite, ways with a few likely determinants of renegotiations (contract awarding procedure, characteristics of the contract and the procurer). Although we do not aim to establish the presence of a causal effect for all of them, we analyze their relative importance. The most relevant finding is a statistically significant association with features of the design stage, namely whether the winning firm is in charge of both the design and the execution of the project. We explore the role of design & build contracts (D&B) further, finding evidence suggestive that using this type of contract causes shorter time renegotiations and greater cost renegotiations.

Literature - This paper contributes to a small literature that looks at renegotiations from an empirical perspective. Possibly because of the lack of data, only a handful of earlier studies (Ashenfelter, Ashmore and Filer (1997) and Cameron (2000)) analyze renegotiations in competitively procured contracts. A renewed interest, however, is showed by two recent works focusing the attention respectively on time renegotiations, Lewis and Bajari (2011), and price renegotiations, Bajari, Houghton and Tadelis (2014). Decarolis (2014) exploits an instance of change in the awarding procedure in Italy to quantify its effects on both price and time renegotiations. The same data on Italian contracts is used by other authors to study renegotiations. Coviello and Gagliarducci (2010) find that time renegotiations are larger the longer the mayor is in office. Coviello and Mariniello (2014) and Moretti and Valbonesi (2015) study, respectively, the effects of tender publicity and mandatory subcontracting on renegotiations without finding supporting evidence. D'Alpaos et al. (2013) and Coviello et al. (2013) analyze firm's strategic behavior with respect to time overruns in public procurement.

Relative to this literature, this study is less focused on quantifying the causal effect of a specific determinant of renegotiations and, instead, uses a larger dataset than the ones previously used to describe some broad patterns in the data.[1] Nevertheless, we also present the first step of a causal analysis focusing on the relationship with the project design stage, that appears to be important but whose relevance has not been previously quantified.[2]

II Data and Empirical Strategy

II.1 Data

The database of the Italian Authority for Public Contracts covers the awarding and the completion stages of the universe of contracts for public works with a reserve price above €150,000 awarded

[1] Relative to other studies that have looked at renegotiations in the same market, this paper uses a more complete version of the data. For instance, Guccio, Pignataro and Rizzo (2012) looks only at the period 2000-2004 and focuses exclusively on price renegotiations. Both Decarolis (2014) and Coviello, Guglielmo and Spagnolo (2014) look at both types of renegotiations but in narrowly defined subset of the data.

[2] Our research was initiated on behalf of the Bank of Italy. See Decarolis and Palumbo (2011) (in Italian) for a more in depth discussion of the regulatory aspects. For these aspects, see also D'Alpaos et al. (2013) and Coviello et al. (2013).

in Italy. Our sample includes all contracts awarded between 2000 and 2007 and allows us to assess the final price and time as long as the contract was completed by August 2011.

Table 1 presents summary statistics dividing the sample between complete (left panel) and incomplete (right panel) data. We perform the rest of the analysis on the former subset of data that we indicate as Analysis Sample. Although the statistics in Table 1 are quite similar for the two groups of data, the possibility of selection issues requires interpreting the descriptive analysis that follows as conditional on the contracts being part of the Analysis Sample and is a major caveat for our preliminary causal analysis of D&B.

II.2 Empirical Strategy

Our descriptive analysis of the two renegotiation measures uses both a graphical and a regression-based approach. The latter entails estimating by OLS separately for each of the two renegotiation measures the model:

$$Y_{ist} = a + b_t + c\mathbf{X}_{ist}^{Job} + d\mathbf{X}_{ist}^{Procedure} + e\mathbf{X}_{st}^{Procurer} + \varepsilon_{ist},$$

where the index i indicates the auction, s the procurer and t the year. The goal is to compare the signs and magnitudes of the conditional correlations across the two variables when the set of covariates includes controls for the type of job ($\mathbf{X}^{Job}$), award procedure ($\mathbf{X}^{Procedure}$) and procurer characteristics ($\mathbf{X}^{Procurer}$).

In particular, based on the previous literature, we included in $\mathbf{X}^{Job}$ the (log of the) reserve price, a dummy for whether the job entails a new construction or the maintenance of an existing structure, the type of construction (i.e., roadworks, buildings, etc.), whether it is a D&B or exclusively a building contract and whether part of the project design was contracted outside the government agency. In $\mathbf{X}^{Procurer}$ we include an indicator analogous to that of Bandiera, Prat and Valletti (2009) for the degree of centralization of the government agency: high - for agencies depending from the central government -, medium - for local administrations -, and low - for semi-autonomous entities like universities. Finally, $\mathbf{X}^{Procedure}$ is a set of dummy variables for the type of awarding procedure: negotiations and three types of auctions: economically most advantageous tender, first price and

average price. Furthermore, to assess the robustness of the estimates we estimate a model inclusive of fixed effects for either the procurer or the winner of the contract.

Finally, we present the results obtained through a matching estimator as a first step of a causal analysis of the effect of D&B on the renegotiation measures. This estimator matches every D&B with the M closest traditional (i.e., non-D&B) contracts and vice versa. The closeness is measured as a weighted distance between contract characteristics. This allows us to compare the renegotiations in each contract i, Y_i, with the average outcome of the matched contracts $\hat{Y}_i$, and estimates the average effect of D&B as the average of these comparisons:

$$\hat{\tau}_Y = \frac{1}{T^{DB}} \sum_{i:Design\&Build} (Y_i - \hat{Y}_i) + \frac{1}{T^{TR}} \sum_{i:Traditional} (\hat{Y}_i - Y_i),$$

where T^{DB} and T^{TR} are the number of D&B and traditional contracts.

III Results

The first empirical fact that we show is presented in Figure 1. The figure reports the scatterplot of the price and time renegotiations measures and it reveals a number of interesting features regarding these measures. Although there are clear mass points at zero along both dimensions, both types of renegotiations are systematic and the size of the time renegotiations is particularly large. The presence of negative renegotiations suggests that there is something truly random and uncontrollable by the contractor. Finally, the most striking feature is the very low correlation between the two measures, which occurs across the entire range of values of both variables and is not merely a lack of linear correlation.

The second empirical fact presented consists of the conditional correlations between renegotiations and some of their likely determinants. Table 2 presents a set of baseline estimates: Columns 1 and 3 use the largest sample allowed by data availability, while columns 2 and 4 impose the same sample for both regressions. The coefficients in this table indicate that for all variables the correlations with both renegotation measures are statistically significant and have opposite signs: a positive (negative) correlation with extra costs is associated with a negative (positive) correlation with extra time. The comparison between columns 1-2 and 3-4 shows that this result is not due to

different samples.

Next, we repeat the analysis using specifications inclusive of fixed effects. Table 3 reports the estimates involving the extra time: odd numbered columns do not include the FE and are analogous to the specification used for model 1 in Table 2, but with different samples. Even numbered columns include fixed effects: for the procurer (column 2) and for the firm winning the contract (column 4). Table 4 performs the same analysis for the extra time. These latter two tables indicate that the signs of the correlations are often not opposite between the two renegotiation measures, since several covariates lose statistical significance for one of the two measure. Interestingly, however, the D&B dummy is the only regressor that preserves both statistical significance and a large coefficient across all model specifications. Moreover, for this variable the presence of an opposite effect between price and time renegotiation is preserved after the inclusion of fixed effects.

We explore further the possible causal nature of the use of D&B dummy via matching estimation. We focus on a subset of the data including a time range where the option to use D&B instead of traditional build-only contracts is a free choice for all contracts below €200,000. Above this threshold, D&B can be used only for certain types of works (essentially, these are high complexity works). Table 5 reports the matching estimates obtained focusing on contracts with a reserve price below €300,000. The results in the first and third columns confirm the positive effect on price renegotiations and the negative effect on time renegotiations. The magnitudes are large amounting in both cases to about half of a standard deviation of the dependent variable. The free choice of D&B below €200,000 suggests the possible presence of selection in the set of contracts. We deal with it in the second and fourth column where we repeat the previous analysis excluding from the sample the cases of D&B above €200,000 and of traditional contracts below €200,000. These latter results are qualitatively identical to the previous ones despite the substantially reduced sample size.[3]

[3] A different bias could result from government agency selection: if small agencies select D&B because they are unable to deal with the design stage and they are also also more prone to face renegotiations, then an omitted variable bias plagues the estimates of D&B. This, however, seems unlikely given the opposite effects of D&B on the two types of renegotiations. Moreover, when using population size as a proxy for the agency size we fail to detect statistically different population sizes among users of D&B and of traditional contracts. Indeed, including population among the matching variables leads to results qualitatively similar to those in Table 5.

IV Discussion and Conclusions

The results in the previous section are consistent with the previous literature in terms of the relevance of auction format and job complexity on renegotiations. Some variables show correlations of opposite sign between the two renegotiation measures. Yet, explanations are likely to be different in different cases: the reserve price might be negatively associated with extra time because penalties for delays are proportional to the contract value. Its positive association with price renegotiations, instead, might be due to the fact that, since bargaining over cost overruns is typically in the form of the percentage of the contract value to renegotiate, it is more appealing for contractors to renegotiate larger contracts.

A different explanation likely applies to D&B. Its opposite effects on renegotiations could be driven by less project specification detailing during the tender which facilitates future price renegotiations, while, on the other hand, reducing delays at the execution stage because the firm can better tailor the project to itself. Moreover, the opposite effects of externalizing the design to a third party (either appointed or competitively selected) relative to D&B are suggestive that when more parties are involved in the design the delays increase, but the cost overruns decline (especially when the third party designing the project is competitively selected).

The results on the relevance of the design stage are particularly interesting because they have not been explored in the previous literature. Our preliminary work in this area suggests a possible avenue for further research. In addition to a more accurate causal analysis, it would be relevant to include the time and price of the project design stage to evaluate the overall impact of D&B.

Finally, from a policy perspective the differences between the two renegotiation measures suggests the importance, but also the difficulty inherent to designing policy reforms able to effectively deal with both types of renegotiations.

Table 1: Descriptive Statistics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Analysis Sample				Incomplete Data			
	Mean	SD	p50	N	Mean	SD	p50	N
Extra Cost	7.22	13.3	3.95	23,855	5.76	16.2	3.30	16,842
Extra Time	70.7	78.1	46.5	23,855	69.6	91.8	40	38,512
Reserve Price	522	957	305	23,855	998	6,259	344	116,263
Negotiation	0.15	0.35	0	23,855	0.20	0.40	0	90,059
Design & Build	0.11	0.31	0	16,546	0.11	0.32	0	52,931
External Design	0.091	0.29	0	23,855	0.074	0.26	0	124,265
Repairs	0.26	0.44	0	23,699	0.24	0.43	0	118,979
Municipality	0.52	0.50	1	23,855	0.45	0.50	0	124,265

The left hand side of the table reports summary statistics for the analysis sample where both extra cost and extra time are available. The right hand side of the table reports statistics for all remaining auctions in the dataset that were not used for the analysis due to missing or incomplete data. The value of the reserve price is expressed in €1,000.

Table 2: Baseline Estimates: Extra Cost and Extra Time

	(1) Extra Cost	(2) Extra Cost	(3) Extra Time	(4) Extra Time
Log(Reserve Price)	0.389**	0.339*	-12.03***	-12.50***
	[0.174]	[0.187]	[0.916]	[1.029]
Repairs	1.429***	1.415***	-6.284***	-5.518**
	[0.318]	[0.350]	[1.822]	[2.183]
Design & Build	2.254***	2.461***	-17.28***	-17.86***
	[0.519]	[0.603]	[2.360]	[2.804]
External Design: Appointed	-0.263	-0.106	5.550***	4.508**
	[0.264]	[0.284]	[1.510]	[1.760]
External Design: Auctioned	-0.820**	-0.598*	9.594***	9.446***
	[0.328]	[0.347]	[2.238]	[2.534]
Procedure: AB Auction	-2.938***	-3.866***	12.90**	10.22
	[1.128]	[1.287]	[5.750]	[6.544]
Procedure: SR Auction	1.053	0.384	13.02	8.446
	[2.722]	[3.038]	[8.840]	[9.922]
Procedure: Negotiation	-3.041**	-3.919***	24.55***	24.46***
	[1.204]	[1.365]	[6.259]	[7.103]
PA Type: Local Admin.	-2.476***	-2.199***	11.77***	14.18***
	[0.590]	[0.625]	[3.617]	[4.127]
PA Type: Semi Autonomous	-1.843***	-1.475**	4.475	7.559*
	[0.671]	[0.717]	[3.846]	[4.425]
Constant	19.87***	21.14***	221.2***	242.6***
	[5.898]	[6.037]	[15.64]	[33.32]
Observations	10,392	9,082	12,188	9,082
R-squared	0.032	0.034	0.068	0.071

Significance: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis. All estimates include region, year and work type category fixed effects. Odd numbered columns report use all available observations; even numbered columns use the largest common set of data available for both regressions.

Table 3: Fixed Effects Estimates: Extra Cost

	(1) Extra Cost	(2) Extra Cost	(3) Extra Cost	(4) Extra Cost
Log(Reserve Price)	0.177	-0.0462	0.902***	0.609
	[0.199]	[0.214]	[0.308]	[0.391]
Repairs	1.304***	0.726**	1.794***	1.207*
	[0.362]	[0.365]	[0.573]	[0.643]
Design & Build	2.174***	1.606**	3.167***	2.699***
	[0.554]	[0.653]	[0.986]	[1.034]
External Design: Appointed	-0.0998	-0.113	-0.402	-0.360
	[0.303]	[0.329]	[0.478]	[0.527]
External Design: Auctioned	-0.924**	-0.424	-1.217**	-1.231*
	[0.379]	[0.463]	[0.594]	[0.683]
Procedure: AB Auction	-2.945**	-2.144*	-2.984	-2.412
	[1.161]	[1.183]	[1.819]	[1.973]
Procedure: SR Auction	-1.741	0.325	2.679	2.283
	[2.920]	[3.150]	[5.942]	[5.932]
Procedure: Negotiation	-3.086**	-2.608**	-2.010	-2.326
	[1.263]	[1.285]	[1.987]	[2.155]
PA Type: Local Admin.	-2.198***	3.976*	-2.025	-2.371
	[0.640]	[2.193]	[1.483]	[1.709]
PA Type: Semi Autonomous	-1.885**	1.875	-2.341	-3.470*
	[0.740]	[1.849]	[1.626]	[1.898]
Constant	14.76***	11.07***	6.389	8.213
	[3.127]	[4.058]	[4.835]	[6.495]
Observations	8,032	8,032	3,225	3,225
R-squared	0.028	0.131	0.047	0.210

Significance: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis. All estimates include region, year and work type category fixed effects. Even numbered columns include fixed effects for the government agency (column 2) and the winning firm (column 4); odd numbered columns repeat the baseline estimates but using the same sample used for the estimates including fixed effects. In the fixed effect models, the analysis uses only data where at least three observations are available for the same government agency (column 2) or the same winning firm (column 4).

Table 4: Fixed Effects Estimates: Extra Time

	(1) Extra Time	(2) Extra Time	(3) Extra Time	(4) Extra Time
Log(Reserve Price)	-11.26***	-9.296***	-14.87***	-14.66***
	[0.995]	[1.044]	[1.582]	[1.952]
Repairs	-6.974***	-1.939	-1.147	1.708
	[1.959]	[2.121]	[3.152]	[3.580]
Design & Build	-19.53***	-16.26***	-17.72***	-15.37***
	[2.481]	[2.842]	[4.199]	[4.626]
External Design: Appointed	5.561***	3.104*	6.424**	6.855**
	[1.652]	[1.826]	[2.554]	[2.799]
External Design: Auctioned	7.502***	1.838	12.36***	14.40***
	[2.540]	[2.771]	[3.870]	[4.252]
Procedure: AB Auction	12.91**	1.146	20.06***	7.858
	[5.716]	[6.682]	[7.670]	[9.675]
Procedure: SR Auction	11.36	-4.764	15.04	-0.879
	[9.859]	[10.40]	[13.49]	[15.81]
Procedure: Negotiation	25.19***	10.50	32.90***	21.53**
	[6.390]	[7.402]	[8.684]	[10.71]
PA Type: Local Admin.	11.76***	-9.336	-5.342	-2.617
	[3.833]	[41.16]	[7.274]	[9.380]
PA Type: Semi Autonomous	5.502	-6.770	-9.540	-5.168
	[4.100]	[42.36]	[7.612]	[9.782]
Constant	230.9***	229.6***	276.4***	273.4***
	[16.34]	[42.83]	[26.63]	[33.37]
Observations	9,707	9,707	4,155	4,155
R-squared	0.061	0.172	0.089	0.243

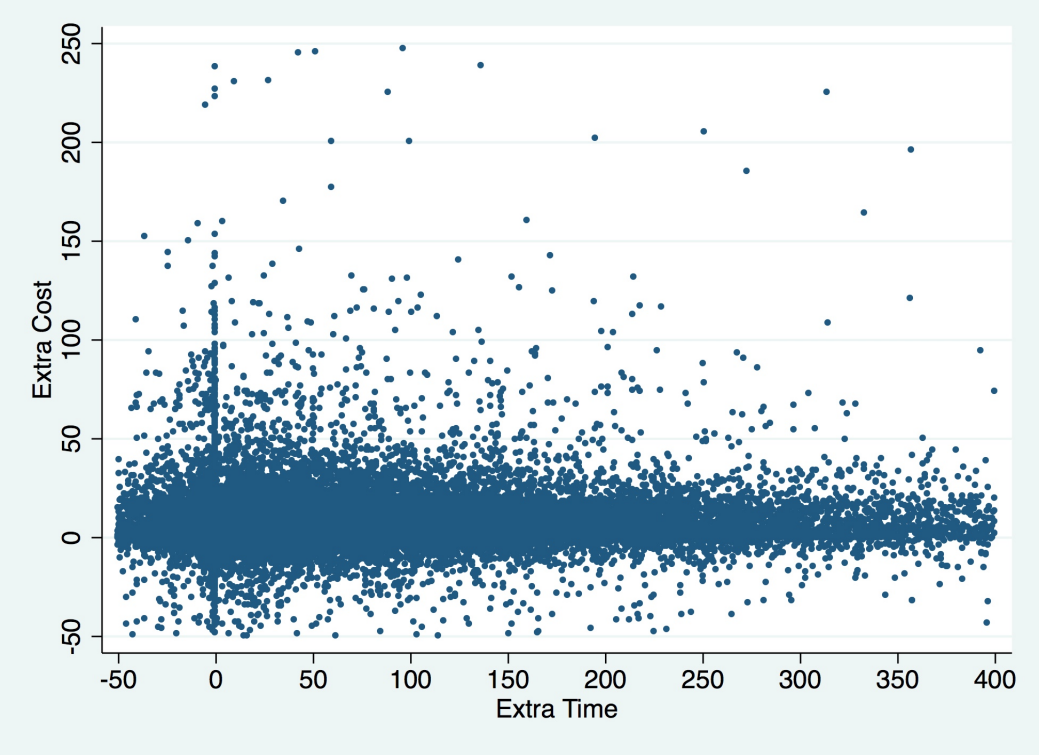
See Table 3.

Table 5: Effect of Design & Build on Renegotiations

	(1) Extra Cost	(2) Extra Cost	(3) Extra Time	(4) Extra Time
Design & Build	5.323***	6.964***	-25.56***	-32.75***
	[1.280]	[2.053]	[6.163]	[8.847]
Observations	1,003	460	1,205	552

Significance: *** p<0.01, ** p<0.05, * p<0.1. Average treatment effect (ATE) estimates using nearest neighbor matching with 4 matches and Abadie-Imbens robust standard errors. Columns 1 and 3 include all contracts between €150,000 and 300,000. Columns 2 and 4 eliminate from the sample used in columns 1 and 3 the cases of contracts below €200,000 awarded without using design & build contracts and those above €200,000 using this feature.

Figure 1: Extra Cost and Extra Time



Scatterplot of extra cost and extra time. Data from the Analysis Sample

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