Chapter 1

Mechanisms

Having established positive and significant treatment effects of experience on outcomes in the market for public construction projects, we seek to investigate how does experience operate in practice to produce improved outcomes in the treated firms. Our objective is to provide evidence of some of the changes that might have taken place within firms which could help to achieve a higher rate of success in the market.

We start presenting the following working hypothesis regarding the benefits of experience among firms. Each details one way in which a firm might have experienced improvements that led to increased success in the market. This chapter objective is to test fully or partially these hypothesis with the data we have avalaible.

First we present our hypothesis. Then, for each one, we present the data, empirical strategy and results obtained.

1. H1: experience produces improvements in cost measures in the firm, keeping constant the type of project. This improvement in cost operates either via economies of scale, since after winning the project the firm is bigger than before; or via adjustments in the production function itself, for example, by changing the relative inputs to produce.

2. H2: experience allows the firm to produce at a higher quality than before, constant the cost of the works. This improvement operates because the firm, having performed certain tasks once, is able to better predict potential problems.

Note that in the bidding phase this could be reflected in a better proposals.

3. H3: experience increases the pool of projects that a firm can perform. Experience can allow the firm to produce either bigger or more complex projects, due to increased human and organizational capital.

Our first can be easily studied because or main dataset of interest includes bid amounts. we can investigate the second hypothesis pa

The following sections study these hypothesis.

1.1 Bids and experience

This section investigates whether experience causes improvements in cost measures for treated firms. We do this by examining how do firm's bids evolve after the firm has been treated, i.e. after it has acquired experience. We assume that bid amounts are a non-decreasing function of bids' costs, which seems a plausible assumption.

The relationship between bids and several firms characteristics has been investigated several times in the construction and economics literature. Relevant to the current investigation, we first mention.

The next section details briefly the data, empirical strategy and results, since most of the the empirical strategy and data is analogous to the analysis performed in the previous chapter.

1.1.1 Data

Our base dataset is the same as in the previous chapter, i.e. a set of bids submitted by firms in auctions for public construction projects. However, instead of aggregating firm's experience and outcomes in time slices, our observations are the bids themselves, so we keep the original unit of observation for outcomes. We still employ aggregation to compute experience at each point in time for every firm. As before, we filter for outcome analysis those contracts where experience is employed in the awarding factors of the contract.

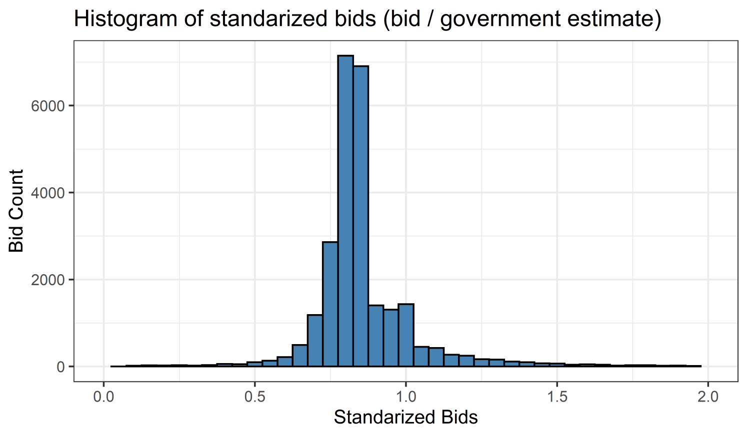

Figure 1-1: Histogram of standarized bids

Furthermore, we filter the first year in the data for our regression sample, since all firms have zero experience at this point and keeping it would introduce noise in the estimates due to spurious treatments set to zero . We do however employ all the avalaible years in the data to compute experience, as in the previous section.

Our data includes two key variables: bid amounts and a government estimate of how much the project "should" cost, called the official estimate, which is prepared by the government unit in charge of the auction. It is of interest for the government to produce a reasonable estimate, since if the winning bid is below a certain fraction of this estimate, the government unit must undergo additional administrative steps to justify the awarding decision.

We produce comparable bid amounts across different contracts by dividing each bid amount by the corresponding government estimate which we call standarized bid. This procedure helps to prevents some heteroskedastic effects. It also reflects that most effects in our regression are expected to act "per-dollar" unit of a contract. We filter from the dataset standarized bids less than 0.1 and over 5.0, since they could correspond to outlier cases and not to a regular auctioning procedure or project, or could show a very bad initial estimate from the government. This only eliminates 217 contracts. Figure 1-1 show a histogram of standarized bid amounts (we only show the interval for convenience).

Table 1.1 shows descriptive statistics of the observations employed in the analysis

Table 1.1: Sample descriptive statistics for bid analyisis

name	N	mean	std	max	min
Bid (all)	37100	7.76e+08	6.88e+09	2.54e+11	1e+07
Winning Bid	9656	4.25e+08	4.54e+09	2.47e+11	1e+07
Difference between 1st bid and 2nd (%)	9656	0.0681	0.0848	0.754	0
Number of Bidders per Contract	9656	3.36	2.37	20	1
Year	9656	2015	2.81	2021	2011
Offers made by Firm	7320	5.07	9.44	258	1
Win prob. by Firm	7320	0.232	0.325	1	0
Offers won by Firm	7320	1.32	2.99	62	0

sample for this section. Note that there are modifications with respect to Table 1.1, given by the extra filtering steps employed in this section.

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1.1.2 Empirical Strategy

In this section, our main strategy is perform a regression of the form:

$$BID_{ijt} = \alpha + \beta EXP_{i,(t-1)} + X_j + FIRST_{ij} + \varepsilon_{it} \tag{1.1}$$

Here, the outcome variable BID_{ijt} is the standarized bid submitted by firm i at time t to contract j. Our treatment variable is experience, either in binary form $EXP > 0$ or linear form EXP. We compute experience by summing all contracts won up to t. Each row of our main dataset (after the filtering steps detssailed above) is an observation in the regression. We add controls X_j corresponding to the region of the contract and its year. Finally, we add an indicator variable $FIRST_{ij}$ which is 1 if firm i is on its first year in the market when bidding for contract j.

Similarly as before, we expect to have unobserved cost variables, specific to each firm, which might bias estimates upwards due to positive correlation with experience. We repeat the same strategy as before to produce consistent estimates, using closely won bids to produce random variation in total experience. The setting is an IV regression where we instrument EXP_{it} with $EXPCLOSE_{it}$, the number of close wins by a firm up to time t. Wins are labeled as close wins if they fulfill the conditions established in the chapter. Table **??** shows a comparison of bids identified as close wins (both by price and rank) againts the rest of the sample.

Our estimation strategy relies in validity and relevance assumptions. The first one requires uncorrelatedness between close wins and cost measures. The second requires that our instrument does produce variation in the independent variable. Developing a regression of bids won on bids closely won (by price) we find an F-statistic of only 0.33 (recall that here, contrary to the previous section, we are not aggregating any data). A regression of wins on close wins (by rank) shows instead an F-statistic of 7,746. Based on these results, we abandon our first instrument (clos wins by price) and we only keep the second alternative (close wins by rank).

Table 1.2: Comparison between close and non-close wins

Variable	Mean (close win - rank)	Mean (all)	Mean (close win - price)
N	2550	137013	21763
Bid (all)	7.23e+08	1.56e+10	2.22e+08
Winning Bid	2.62e+08	2.65e+08	1.92e+08
Difference between 1st bid and 2nd (%)	0.079	0.0664	0.00219
Number of Bidders per Contract	3.04	3.23	3.93
Year	2015	2016	2015

1.1.3 Results

We show graphical results in Figure **??**. Left plot shows standarized bids againsta all bids and firms in the sample. It can be seen that the average bid for firms without experience (0.8877) is higher than the average of firms with any amount oexperience. The right plot shows only firms with either one close win or zero wins. Notably, firms with one close win (and no regular bids) submit bids that are on average almost 9 percentage points lower that those firms without experience. Note that this equals almost half of the standard deviation of standarized bids (0.21).

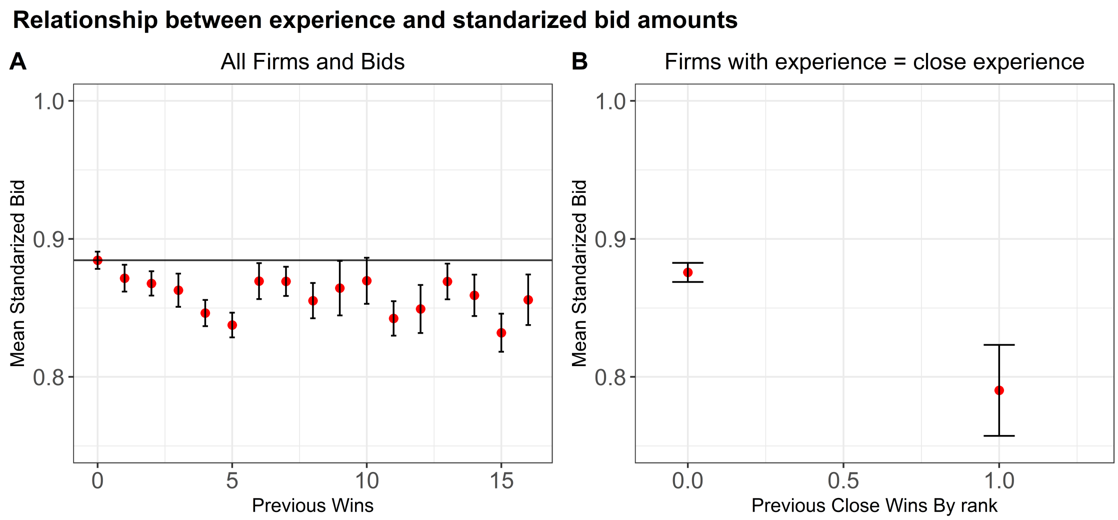

Figure 1-2: Relationship between experience and standarized bid amounts

We perform four regressions between experience and standarized bids. The first two are the OLS adn IV results employing a binerymeasure of experience; and the third and fourth are the OLS and IV employing linear experience. Table 1.3 presents our main results. The OLS estimates of the effect of having experience on bid amounts is around three percentage points. Altough this is less than 10% of the standard deviation of standarized bids, given that the average difference between the lowest and second lowest bid is around eight percentage points, the effect (if it were close to the causal one) would be significant.

Altough we obtain significant IV estimates at p=0.01 with our rank strategy, we have considerable standard errors that prevents us from obtaining precise estimates of the level of the treatment effects. We advance a possible explanation of this result based on our empirical srategy. Since now we examined experience cumulatively, after 10 years we might have extremely highly experienced firms which produce too much standard deviation in the independent variable, while the link between both experience and bids and close and regular wins diminishes. Among highly experienced firms, it is probable that the effect of experience is not relevant anymore and close wins do not have as a close relation with outcomes.

Notwithstanding the size of the standard error, our main hypothesis of interest, which was that experience produces cost advantages among treated firms, seems to

Table 1.3: Regression of bid amounts to experience

	Dependent variable:			
	Standarized Bid			
	OLS	*instrumental variable*	*OLS*	*instrumental variable*
	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)
exp >0	-0.031^{***}	-0.044^{***}		
	(0.003)	(0.011)		
exp			-0.0005^{***}	-0.001^{***}
			(0.0001)	(0.0003)
indFirstYear	-0.020^{***}	-0.015^{***}	-0.011^{***}	-0.002
	(0.003)	(0.004)	(0.003)	(0.004)
Constant	0.884^{***}	0.876^{***}	0.861^{***}	0.846^{***}
	(0.010)	(0.011)	(0.010)	(0.012)
Fixed effects By Period and Region	Yes	Yes	Yes	Yes
Observations	37,084	20,235	37,084	20,235
R^2	0.021	0.020	0.020	0.020
Residual Std. Error	0.209 (df = 37056)	0.201 (df = 20207)	0.209 (df = 37056)	0.201 (df = 20207)
Note:				*p<0.1; **p<0.05; ***p<0.01

be substantiated by the results. Altough we cannot speak with certainty about the levels of the effect, we can conclude that experience does allow firms to submit lower bids as a source of competitive advantage.

1.2 Quality and Experience

In order to test hypothesis number two, in this section we study if experience treatments causes firms to submit higher quality proposals. We do this by employing a step in the auctioning process aimed at controlling some basic quality conditions of a proposals, namely, formal requirements and qualifications.

Note that quality is explicitly evaluated in many contracts by including an item in the awarding criteria labeled as "technical specifications" or just "quality of the proposal". Our estimation is that around % include some measure of technical evaluation in the awarding criteria. Ideally, we would test the hypothesis that experience improves the quality of a firm's proposals by employing the score that each firm obtained in the technical or quality item of the evaluation criteria of the project. However, since our data has not this item avalaible by firm, we employ an alternative strategy,which focuses on measuring quality across a different but related dimension: the formal acceptance rate of the proposals.

Recall that, for each auction, firm proposals are analyzed in two steps. The first step only examines if the proposal fulfills all the formal requirements in the process. Formal requirements include the inclusion of legal documents, submitting each of the technical documents asked for in the bidding documents, etc. In essence, the first stage verifies that all proposals can be evaluated at an equal footing and that minimum bidding legal requirements are fulfilled. Clearly, whether a proposal was accepted is a measure of its quality, albeit an imperfect one. Altough it leaves out a significant part of the variation that would be expected in proposal's qualities, it is nonetheless an interesting measure of quality because formal acceptance is a necessary condition to win a project.

Our research design, detailed below, will test whether experienced firms have a higher formal acceptance rate than unexperienced firms at the formal revision step of the procuurement process. To our knowledge, ity has not been studied in the previous literature factors infleuencing formal acceptance of bid proposals.

1.2.1 Data

We employ our bid dataset similarly as the previous section. Each observation is a bid submitted by a firm to an auction held by the government. Since we are analyzing the formal revision part of the auction, and not scoring itself, we think that on principle we could skip the filtering of contracts that do include experience as an awarding factor. However, due to possible self-selection, we will examine both possibilities. We again filter the first year of the data in our analysis sample to prevent confounding effects.

We show some descriptive statistics of acceptance rates in table and Figure 1-3. We can already see that the fraction of firms getting all proposals rejected decreases with more than one proposal, which could be either due to revealed preferences or to the effect of learning about formal requirements after the first completed bidding process.

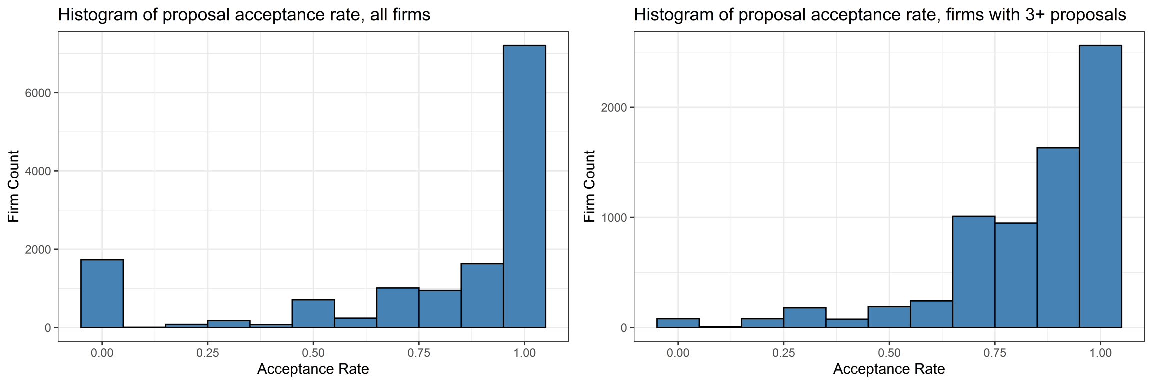

Figure 1-3: Acceptance rate for proposals sent by firms to auctions for public construction project.

We end up with a dataset where each observation is a bid submitted by a firm to an auction of a public construction project, which includes as variables of interest wether the proposal was formally accepted, the experience of the firm at the time of the auction (both regular, annualized and close wins), and several auxiliary variables that characterize the contract itself.

1.2.2 Empirical Strategy

We test wether experience leads to a higher rate of formal proposal acceptance employing the following regression:

Here, is and indicator variable that equals 1 if the firms' i proposal for contract j at time t was accepted and zero if it was not. EXP is our treatment variable, both in binary and linear functional forms. X_j is a set of contract-specific controls, which include year, region, and the government body in charge of the auction. We include the controls for the possibility that government units in different geographical regions have different levels of stringency when evaluating proposals for similar projects.

We are less worried about endogeneity with unobserved cost factors since formal revision does not relate to economic aspects of the proposal. However, it is possible that there are different levels of baseline levels of proposal-makeing abilities among firms, so we repeat our usual instrumentation of experience with close wins.

We perform four regressions. The first two are OLS regressions and the second two

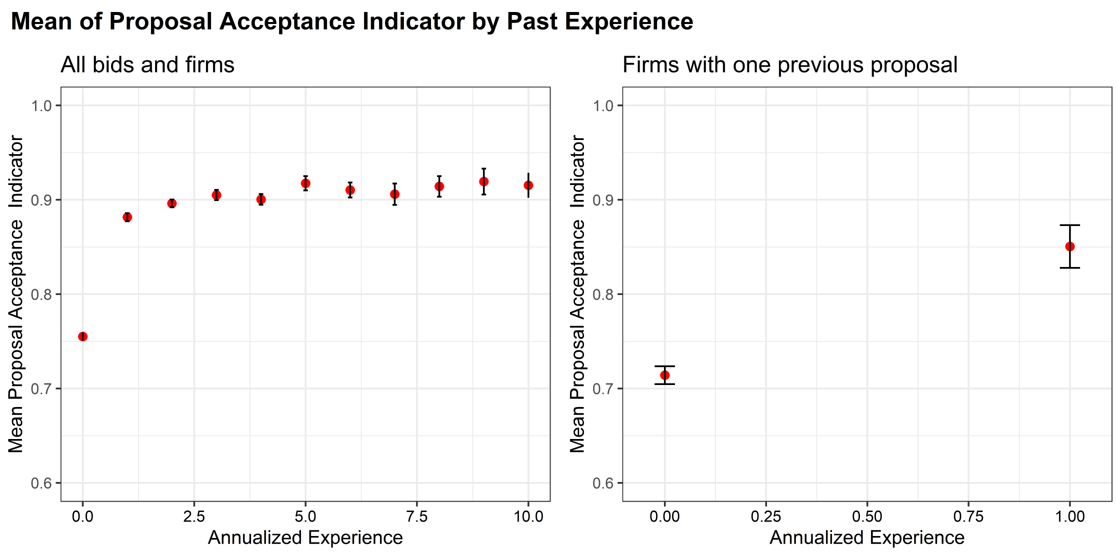

Figure 1-4: Acceptance rate for proposals sent by firms to auctions for public construction project.

are IV regressions, employing closely won contracts to instrument total experience. For each type, we develop one regression where the treatment is the binary of previous experience and the second is annualized past experience.

1.2.3 Results

Table 1.4: Regression of proposal acceptance on experience

	Dependent variable:			
	Standarized Bid			
	OLS		*instrumental variable*	
	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)
annualexp >0	0.155*** (0.002)			
annualexp		0.006 (0.025)		0.071*** (0.027)
exp >0			0.441*** (0.101)	
Constant	0.855*** (0.328)	0.955*** (0.192)	0.511*** (0.072)	0.270 (0.207)
Fixed effects By Period, Region	Yes	Yes	Yes	Yes
Fixed effects By Government Body	Yes	Yes	No	No
Observations	137,001	137,001	137,001	137,001
R^2	0.122	0.100	−0.061	−1.039
Residual Std. Error	0.328 (df = 136078)	0.332 (df = 136078)	0.359 (df = 136973)	0.498 (df = 136973)
Note:				*p<0.1; **p<0.05; ***p<0.01