On the allocation of contracts for the pavement of streets in Mexico.

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Abstract

This paper studies the allocation patterns of construction contracts for the pavement of the streets in Mexico. The preferred allocation procedure, as suggested by law, is to follow a procurement auction to choose the most efficient construction firm. Nevertheless, exceptions in the law allow the government to bypass the auction procedure and to directly allocate a project to the firm of the government's preferences. This study is a first description of the patterns of allocation of contracts by both direct allocation and auction procedures. In this paper the size of the contracts by allocation procedure are compared, the timing of their allocation, as well as the characteristics of the firms receiving projects by each procedure. A reduce form analysis suggest that firms that receive projects by direct allocation are the ones who bid lower in procurement auctions, nevertheless, there exists little data to analyze how they behave when they receive a project by direct allocation. Finally, the allocation of contracts for the pavement of small streets, regardless of the procedure used to choose a construction firm, does not seem to follow a strong pattern of a political cycle.

1. Introduction

How to control for the efficient use of public funds is a much-discussed point of debate among policy makers. Hence, laws and rules are thought to make the exercise of public funds less reliant on the discretion of public officials. In this regard, in a country like Mexico where corruption in the administration of resources is a perennial concern, especially in the case of public construction contracts, the use of procurement auctions is intended to enhance transparency in the choice of firms and to foster competition. Nevertheless, exceptions in the Law of Public Works and Related Services (LPWRS) allow the government to bypass the procurement auction procedure and to assign a project directly to the firm of the government's preferences.

The use of direct allocations has been the subject much public discussion, but few academic studies have compared this procedure with an auction in Mexico. In this paper, I will focus on the specific case of the pavement of streets with hydraulic concrete, and will seek to provide, to my knowledge, a first exploratory analysis of the patterns of the direct allocation of these projects. Once the pattern of allocation is described, a second objective of this paper is to provide an exploratory analysis of the characteristics of the firms that receive contracts by direct allocation, and to the extent possible, compare their performance to the rest of the firms who have not been directly granted a project. An important feature of this comparison is that I compare their performance conditional on project and municipal characteristics.

Finally, we are not only interested in who is receiving projects by direct allocation, but also the timing of these projects is of concern. A problem in the investment in infrastructure is that it may be politically biased (Crain, 1995), and recent finding for Mexico suggest that this is the case for investment in highways (Selod and Soumahoro, 2019). Hence, a final objective is to complement the previous findings by looking at the timing of the allocation of projects at a more local level, and to test whether the allocation of contracts follows an electoral cycle.

The rest of the paper is organized as follow. I first describe the institutional framework, where I describe how the construction contracts are awarded. Second, I describe the data and I focus on the availability of information on the construction contracts, the geographical distribution of these, and finally the timing of their allocation. I then perform a reduced form analysis to explain the level of the bids and the choice of allocation procedure, conditional on the project characteristics. A discussion of the results follows, along with the conclusions.

2. Institutional framework

The governmental procurement auctions are made through a system called CompraNet, which is the system through which the government administers and implements all their acquisitions, and the contract of products and services. This system is a means to achieve greater transparency by both providing a clear system for the implementation of an auction, and by providing a historical account of the contracts acquired by the government.

For the case of public construction contracts, the government awards projects to construction firms through three procedures:

(i) by a public auction,
(ii) by invitation to three or more firms to an auction,
(iii) by direct allocation of a contract.

Of the three procedures, by law[1], the government should seek the procedure that delivers the lowest costs, hence, it should opt first for the public auction and then the other two procedures. In the case of pavement auctions, the format used is a first price sealed bid auction. Nevertheless, the law also details exception in the law that allow the government to bypass an auction procedure. The most salient exception pertaining construction works are:

- There are circumstances that could cause significant losses or additional costs, duly justified.
- Due to a major force, it is not possible to execute the works by means of the public tender procedure in the time required to attend to the eventuality in question, in this case they should be limited to what is strictly necessary to deal with it.
- The respective contract has been rescinded for reasons imputable to the contractor. In this case, the state can give the project to the second best offer.
- If no one went to the public auction.
- If the service required is of maintenance, restoration, reparation, or demolition.
- If it requires rural labor, or if the project is in a marginalized urban area.

State and municipal governments can use these exceptions to choose a contractor of their own preference. Of all the exceptions, the first two are or special concern because of their lack of specificity.

[1] According to the “Law of Public Works and Related Services”.

For the contracts analyzed in this study, I have found little evidence of the last four, and hence I assume that whenever I see a project directly allocated, that it is given on the basis one of the first two exceptions.

3. Data

I describe in this section the main patterns of the bidding data and project characteristics. I put special attention first, on the availability of information that should be publicly available, second, whether there exists any bias in the transparency of the contract information, third, on the distribution of contracts per state, and finally, on the timing of the allocation of the pavement of contracts.

The auction data is divided in two parts, the bids and the project characteristics of each bid. Both pieces of information are gathered through CompraNet for the period of 2010 to 2018. The starting point of 2010 is driven by data availability. Although the bid information is available from 2002 onwards, the project characteristics data was only available from 2010.

In Table 1 I present the general summary statistics by procedure of the winners of the projects. The types of procedure differ by size, with the smallest projects given by direct allocation, followed by invitation to three or more firms (I3P), and the bigger projects awarded by public auction. The same order is reflected in the size of the bids, although we observe large standard deviations. The most frequent procedure is I3P, which represents 71 percent of the data, followed by public auction, with 16.95 percent, and then direct allocation with 12.04 percent. Of these types of procedures, the one with better availability of data is the public auction format, with complete information on 67.14 percent of their projects. Here, the low availability of the directly allocated contracts sticks out, with only 10.04 percent of their projects with full availability of data. Here, I interpret full availability of data when I the information on all the bids and value of the contract is available, as well as all the project characteristics as described by a document known as the "catalog of concepts" of a project. For a list of the project characteristics see Table A2 in the appendix, and for a map of an average contract that costs 2 million Mexican pesos Figure 1A, also in the appendix.

I now compare the data only looking at the auctions at large, where I consider both I3P and the public auction procedure. I distinguish between two types of firms when analyzing the auctions. Type 1 bidders are those that at some point during the studied period, have received a project by direct allocation, type 0 are the complement. Notice here that we are comparing all the bids observed, not only of the winners.

Table 1: Summary statistics by allocation procedure

Procedure	Number of Contracts	Pct. in sample	Pct. of type of procedure with complete data	Winner bid: mean	Winner bid: std	Avg. M3 of Pavement
Direct	448	12.05	10.04	1.32	2.06	128.75
I3P	2,639	71	49	2.27	1.92	295.89
Public Auction	630	16.95	67.14	5.55	4.31	607.63
Total	3,717	100				

The key differences are that type 1 firms bid lower on average, they participate in firms with less competition, although they participate in a higher number of auctions. Interestingly, when looking at the size of the firms, there is no differences between the types of firms. Finally, they win more, are disqualified less, and have a higher probability of having an overlapping project, that is, they are more likely to be working at least in two projects at a time.

The raw means of the data seem to suggest that type 1 firms are more experienced, which would be consistent with their higher proportion of projects won, the lower incidences of getting disqualified, higher average of overlapping projects and the higher number of participations in different auctions. Nevertheless, they seem to be overly represented in the I3P procedure, which may be driving down their average bid.

3.1 Availability of contracts.

A more in-depth analysis of the availability of the data is presented in Figure 1, where we see availability by procedure. In general, we see that there is little availability of data for the projects that have been directly allocated, whereas close to 50 percent of the auction data, independent of the format, have complete data.

For each of the 3717 contracts, CompraNet provides the amount of the winning bid (or the value of the contract if the project was awarded by direct allocation), nevertheless, in order to access the information on all the bidders, it should further provide a document describing the opening of the sealed bids. Additionally, it should provide a separate document with a catalog of the items the project requires. Hence, I separate the data on whether I only have the bidding data, whether I have the project characteristics, and whether I have both types of information or neither. On Panels A and C, we observe

the frequency of each of these categories, and the distribution of each category among the types of information. The important observation is that we do observe the bids and project characteristics for most part of the contracts, but the directly allocated projects represent only a small proportion of these. A more precise estimation of the proportion of the availability of the data by procedure can be seen in panels B and D.

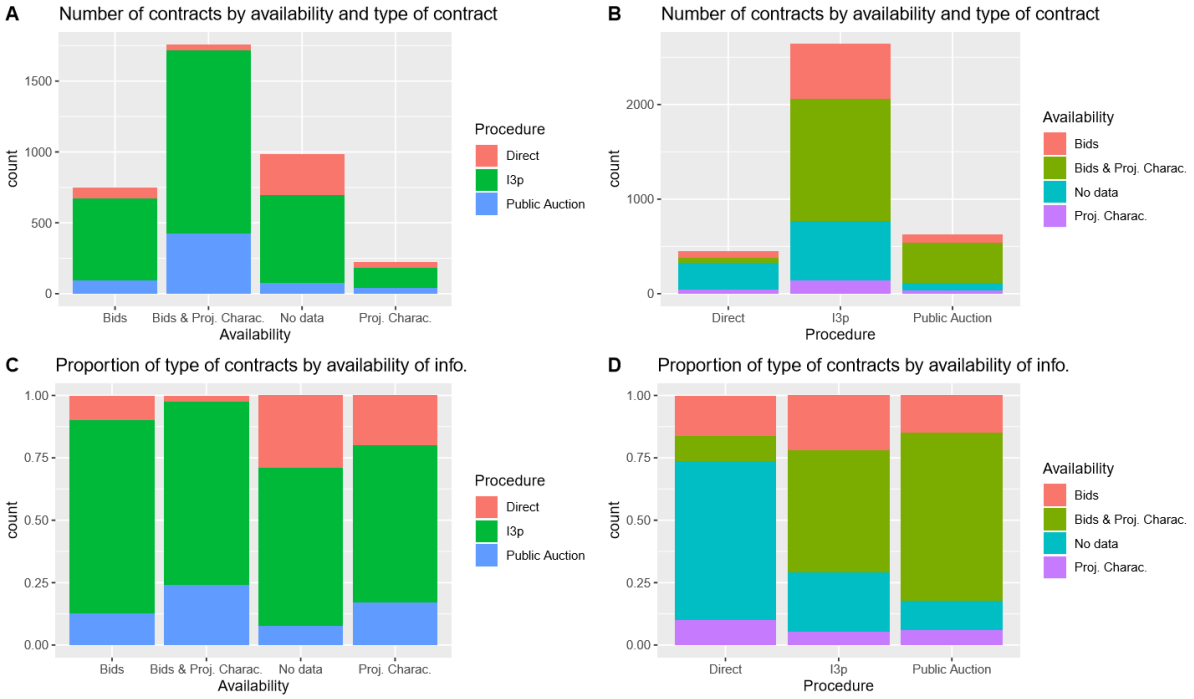
Table 2: Summary statistics by type of bidder

	Type		Diff
	0	1	
Bid	3.986	2.707	-1.278***
	(3.902)	(2.659)	(0.205)
Number of firms in auction	7.199	4.933	-2.266***
	(7.195)	(5.110)	(0.378)
Avg. number of participations	3.275	5.853	2.577***
in different auctions	(3.148)	(3.730)	(0.169)
Municipality project	0.804	0.874	0.070***
	(0.397)	(0.332)	(0.021)
Size of firm is medium or	0.422	0.437	0.015
large*	(0.494)	(0.497)	(0.030)
I3P	0.567	0.791	0.224***
	(0.495)	(0.407)	(0.026)
Disqualified from auction	0.144	0.094	-0.051***
	(0.352)	(0.292)	(0.019)
Firm has overlapping project	0.093	0.362	0.287***
	(0.291)	(0.481)	(0.025)
Winner	0.242	0.394	0.152***
	(0.428)	(0.489)	(0.023)
N	6493	373	6866

* Lower data set

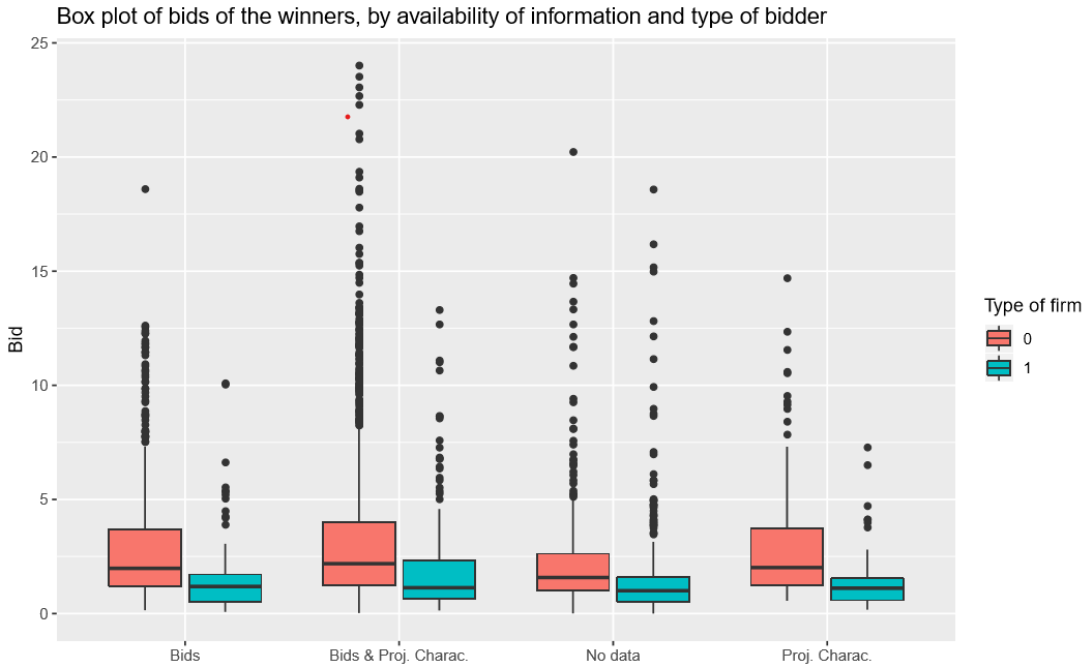
An important question is whether the missing data is random, or if there is a selection on which projects report the required data. Since we do know at least the value of the contract for all projects, we can compare the values for the different categories of the availability of the data. In Figure 2 I present the box plot of the bids by availability of the data and by type of firm. Interestingly, the distribution of the bids does not seem to vary by the availability of the information, nor by the type of firm. And although we do observe more variability for the projects with both the bids and project characteristics, this is expected given the larger sample size of this category.

Figure 1: Availability of Data



I further test the randomness of the availability of the data by various project characteristics, where I report the difference of each category by whether the full information is fully available (i.e., that we have information on the bids and project characteristics). The full table can be found in Appendix A. We observe that on average, projects that completely report all information are on average 0.98 million Mexican pesos more expensive. Nevertheless, this relation is not causal since it is mainly due to differences in the availability of data by the type of allocation procedure, and due to a higher variance in the bids of the projects that fully report the contract information. Finally, it seems that municipalities with a higher number of projects report more of the needed information.

Figure 2: Bids by availability of data.



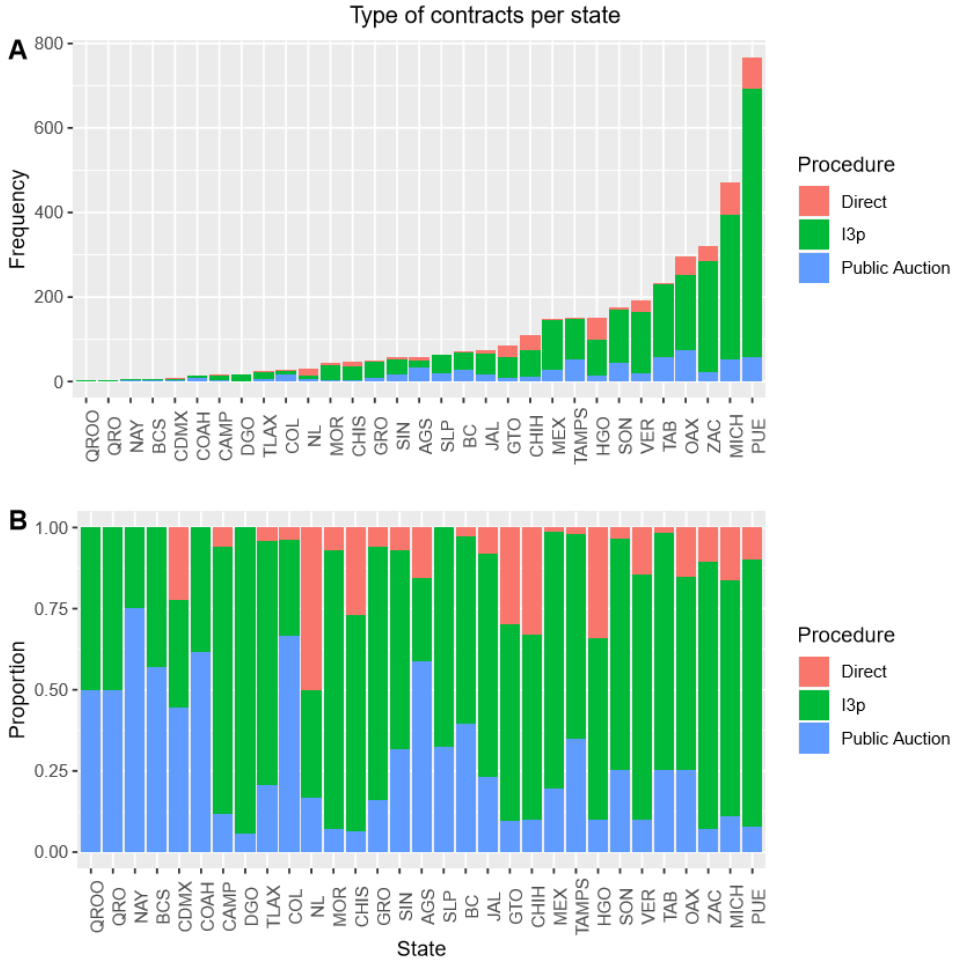
3.2 Type of procedure and number of contracts per state

In the previous section we saw that there is little information on the projects that are being directly allocated. A second question of interest is to know if these types of contracts are more prevalent in specific states. In Figure 3, the top panel A reports the frequency of the pavement of contract by state and procedure of allocation. As a first observation, we see a high variability in the number of contracts per state, with almost half of the states reporting very few pavement constructions projects of small streets, and with only five states accounting for most of all contracts.

Second to notice is the proportion of the procedure by each state, which can be found in panel B. The order of the states by the frequency of the contracts has been preserved. It is important to notice that there does not seem to be a clear pattern that relates the type of allocation procedure and the number of contracts, which is counterintuitive. We could have expected that given a high number of contracts in a state, that capacity and time constraints would lead to a higher proportion of contracts to be directly allocated. Which is not the case. The story of one of the exceptions in the law, which is effectively that

time constraints may allow the government to bypass the auction procedure, does not seem to broadly apply for the case of pavement of streets[2].

Figure 3: Frequency of contracts per state



3.3 Pattern through time

In understanding the general patterns of the allocation of pavement contracts, a further question concerns their timing. In Figure 4 I plot the frequency of contracts by month and type of firm, where zero denotes the starting period, 2010. Several patterns emerge. There seems to be a yearly cycle, and the number of contracts is increasing through time. Furthermore, when looking at the differences by the type of firm, we see that the series follow a similar pattern, with spikes in the data that coincide. This would

[2] In the Appendix B I also provide a graph by state of the availability of the data. Again, the number of contracts does not seem to be correlated with a certain pattern on the availability of information.

seem to suggest that there are no clear times of the year where type 1 firms are being allocated relatively more projects than at other times. The cycle observed could be led by various factors, such as weather, economic or political cycles.

I further investigate the bid distribution across time; hence I present the box plot of the bids by year. Although the number of projects is increasing through time, the size of the projects seems to remain similar across the years[3]. Also, with some exceptions, type 1 firms bid lower than type 0 across time and their bids have lower variance.

To inquire on the influence of the political cycle on the allocation of contracts, I plot the boxplot of the number of contracts per state, and further display their distribution by their proximity to municipal elections. The names of the outliers are annotated, where specially the state of Puebla stands in panel A. Panel B is the same graph but truncating the observations to 25 or less contracts per state and quarter.

From the unconstrained graph A, the states that have relatively more projects, Puebla and Michoacan, allocate the contracts when they are six to five quarters away from the closest election, a pattern that counters the suspicion of an electoral cycle effect, where we would expect to see higher allocation of projects closer to elections. When looking at the constrained boxplot in panel B, what it stands out is the lack of a cycle or pronounced differences at a specific period.

[3] Although not shown, the proportion of the type of procedure does not change significantly over the years.

Figure 4: Timing of contracts

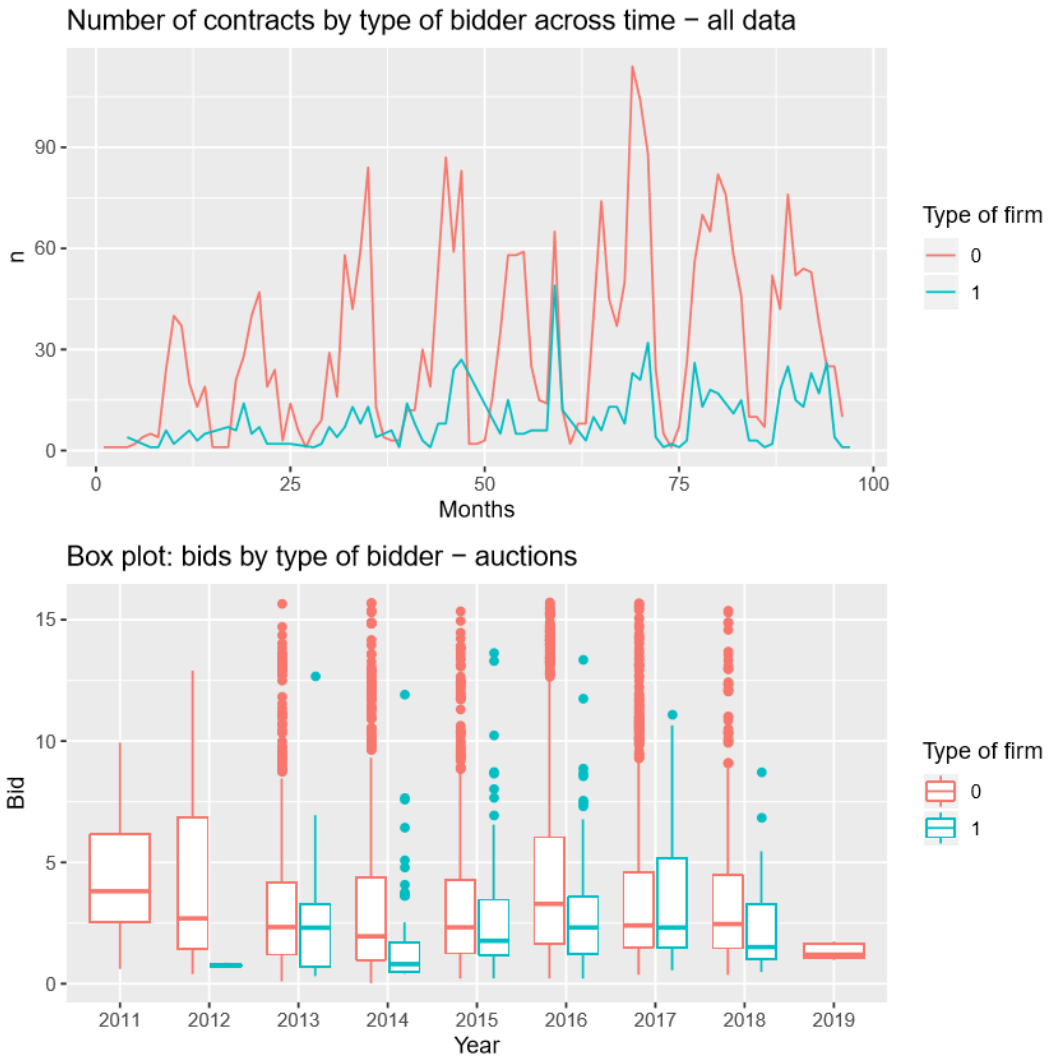
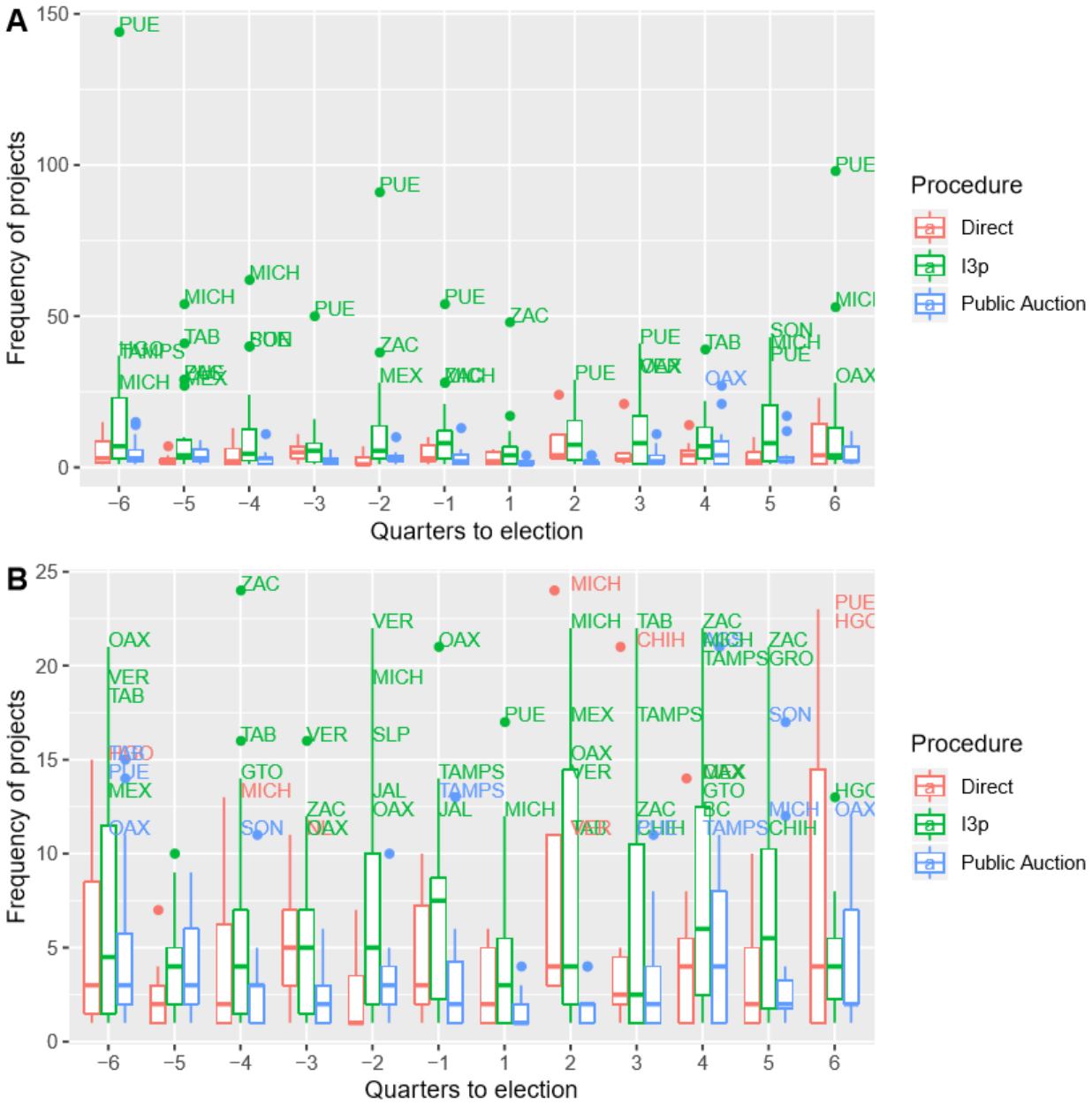


Figure 5: Box plot of the number of contracts by proximity to local elections



1. Reduced form analysis

In this section, I present a reduced form analysis to study both the level of the bids and the choice of allocation procedure, while considering the project characteristics of each auction. The level of the bids is fitted with an ordinary least squares regression (OLS) while the choice of procedure with a probit. By and

large, I find that the project characteristics have a high predictive power when explaining the bid's level and in a lesser extent, the choice of allocation procedures.

4.1 Explaining bids

I explore the prediction of bids controlling for observable characteristics of the projects and firms[4]. In Table 3 I present the results of an ordinary least squares regression, where the dependent variable are the bids. In the first two columns, we can compare the allocation procedures where I only used data of the winners of contracts, and in columns three and four, we can instead compare the types of firms, and hence I use the bids of all participants in the auctions. Note that in the last two regressions I exclude the observations from the projects directly allocated.

When comparing the procedures, once controlling for project characteristics, the procedure I3P is not distinguishable from the direct allocation. Nevertheless, the public auctions are still higher on average by 2.08 million Mexican pesos. One possible explanation is that the public auctions are mainly used for bigger and more complex projects, but that such complexity is not being properly captured by the observables here. Notice though that the R2 in each equation are high and improve much when adding the project controls. Another explanation may be that the government is selecting the most efficient firms either to participate in an auction by invitation, or to be allocated a project directly. Nevertheless, the results must be taken with caution, since the public auction contracts only represent 16.9 percent of all contracts. The most important comparison is between the I3P procedure and direct allocation.

When we now study only the auction data, we observe the participation of all bidders, winners and losers. First, we notice that the firms of type 1 bid lower, even when considering the project characteristics. Likewise, the bids under an I3P format are lower than in a public auction, even when adding the project controls. The fact that a firm has an overlapping project does not seem to influence their bidding behavior, which points to the fact that the capacity constraints from the point of view of the firms to accept more jobs, is not binding.

Counterintuitively, the number of firms in an auction is positively correlated with the bids, but again, this is mainly driven by the fact that bigger projects use a public auction procedure, which in turn have a higher number of firms participating in an auction. Finally, the availability of information seems to be correlated with smaller bids.

[4] For a list of the project characteristics observed, see the Appendix Table A2.

It is important to point out that the project characteristics have a high explanatory power. When adding the project controls, the R-square jumps from 0.36 to 0.71 when comparing the procedures, and from 0.41 to 0.79 when comparing the type of bidders.

Table 3: OLS explaining bids

	Comparing allocation procedures: data from winners		Studying auctions: data from all bidders	
	Without project characteristics	With project characteristics	Without project characteristics	With project characteristics
Variables	(1)	(2)	(3)	(4)
Firm = Type 1	-0.254*	-0.273	-0.288***	-0.268*
	(0.138)	(0.179)	(0.0991)	(0.144)
I3P	0.707***	0.258	-3.654***	-1.146***
	(0.170)	(0.268)	(0.108)	(0.126)
Public Auction	4.163***	2.088***		
	(0.247)	(0.362)		
Firm has overlapping project	-0.218**	-0.0150	-0.0861	0.0724
	(0.0993)	(0.123)	(0.0823)	(0.0942)
Number of times the firm	-0.0134	-0.00234	-0.0401***	-0.00793
participated in different auctions	(0.0125)	(0.0151)	(0.00792)	(0.00765)
Number of firms in auction	-0.00242	-0.0292	0.0258***	0.0276***
	(0.0260)	(0.0206)	(0.00892)	(0.00686)
Municipality project	-1.121***	-0.595***	-1.494***	-0.0102
	(0.178)	(0.225)	(0.114)	(0.159)
Information on proj. characteristics	-0.0231		-0.146**	
and all bidders available	(0.0952)		(0.0626)	
Observations	3,717	1,761	9,852	4,081
R-squared	0.361	0.717	0.413	0.791
Municipality FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Proj. characteristics	No	**Yes**	No	**Yes**
Data	All data	Information complete	All auctions	Information complete

Robust standard errors in parentheses

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

4.2 Explaining the type of contract.

The choice of the allocation procedure is much harder to predict. In Table 4 I present the results of a probit model, where the dependent variable is a dummy equal to one when a contract is directly allocated. The data analyzed is of the winners of the contracts. In the first two columns I do not control for project characteristics, whereas such controls are added in the last two.

In columns one and two we preliminary explore possible explanatory factors for choosing to directly allocate a project. Firms that have an overlapping project are four percent more likely to being allocated a project. This may be because a public administrator may choose a firm that already knows or with whom is already working. This result reinforces the previous observation of a lack of biding constraints from the point of view of the firm to receive another project. This is mainly because most firms do not work on too many projects at a time.

Further explanatory factors tested are the proximity to elections and the political party of the mayor of the municipality at which the project took place. The political parties included are PAN and PRD, and the left-out party is PRI. There are no statistically significant effects of the political affiliation of the mayor, and when looking at the importance of the timing of the project, there is a two percent higher probability that a project may be directly allocated during the first year in office of the mayor, in contrast to his second year in office[5]. The third and last year in office (1 year before elections) is not distinguishable from the second year. Finally, I also consider a public state fund for infrastructure FISE and the number of contracts in each municipality. A higher fund (measured in millions of pesos) is positively correlated with higher direct allocations, but interestingly, the total number of projects in a municipality is not significant, which confirms the exploratory graphical analysis in Figure 3. The results suggest that the government is not using direct allocations as a measure of last resort because of time constraints when they have too many projects, but rather that other factors are leading this choice.

Now, all the above results turn not significant once we control for the project characteristics, and the Pseudo R2 rises almost by 50 percent. These results suggest that it is the size and complexity of the project what is primarily driving the choice of allocation procedure.

[5] The length of the administration of a mayor is of 3 years.

Explaining the type of contract.
Probit: dependent variable Dummy = 1 if procedure is by direct allocation.

	Without project characteristics	Without project characteristics	With project characteristics	With project characteristics
Variables	(1)	(2)	(3)	(4)
Number of times the firm participated in different auctions	-0.00137	-0.000731	-9.55e-05	1.88e-05
	(0.00145)	(0.00142)	(0.000376)	(0.000346)
Firm has overlapping project	0.0414***	0.0379***	0.00326	0.00272
	(0.0121)	(0.0118)	(0.00456)	(0.00354)
Municipality project	-0.138***	-0.145***	-0.0241	-0.0114
	(0.0217)	(0.0224)	(0.0274)	(0.00988)
Project started 1 year before elections		0.0159	0.00457	0.00667
		(0.0115)	(0.00601)	(0.00485)
Project started 1 year after elections		0.0464***	-0.00419	0.00510
		(0.0121)	(0.00638)	(0.00424)
Fund FISE		0.000776***	1.52e-05	-1.21e-05
		(0.000150)	(6.53e-05)	(9.06e-06)
PAN		0.00246	0.00445	0.00317
		(0.0125)	(0.00656)	(0.00424)
PRD		0.0259	0.0148	-0.00411
		(0.0195)	(0.0274)	(0.00376)
Number of contracts in municipality		-4.10e-05	-6.80e-06	-2.83e-06
		(3.42e-05)	(1.19e-05)	(8.35e-06)
Pseudo R2	0.12	0.14	0.28	0.19
Observations	3,609	3,596	688	1,356
State FE	Yes	Yes	Yes	No
Year FE	Yes	Yes	Yes	Yes
Proj. characteristics	No	No	Yes	Yes
Data	All data	All data	Info complete	Info complete

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5 Conclusion

With the available information, the reduced form evidence suggests that the firms that have received projects by direct allocation, do bid lower in general and are more experienced. Also, when comparing procedures, there is no clear evidence that the public auction procedure outperforms the direct allocation. Nevertheless, there are clear limitation in this comparison given the lack of data transparency,

specially for the case of projects directly allocated. The previous observation is done after comparing only ten percent of the projects directly allocated against 50 percent of the auction data. Severe selection bias of the available data might be present.

The lack of data and transparency in directly allocated projects is concerning and an indirect approach to learn about the firms who receive this kind of projects seems fitting. For future analysis, an indirect way to learn about their behavior can be achieved by observing how the firms behave while bidding, but considering an auction model as in Flambard and Perrigne (2006). The fitting of an auction model would allow the comparison of the cost distributions of the firms that have received a project by direct allocation, with the firms that have not. Such cost distribution would allow to study, by region, the relative cost efficiency of the firms.

References

Crain, W. W., & Oakley, L. K. (1995). The politics of infrastructure. The Journal of Law and Economics, 38(1), 1-17.

Flambard, V., & Perrigne, I. (2006). Asymmetry in Procurement Auctions : Evidence From Snow Removal Contracts. The Economic Journal, 116 (October), 1014–1036.

Selod, H., & Soumahoro, S. (2019). Highway Politics in a Divided Government Evidence from Mexico. World Bank Working Paper 8710 (January).

Appendix

Figure A1: Map of street that costs 2 Mexican million pesos.

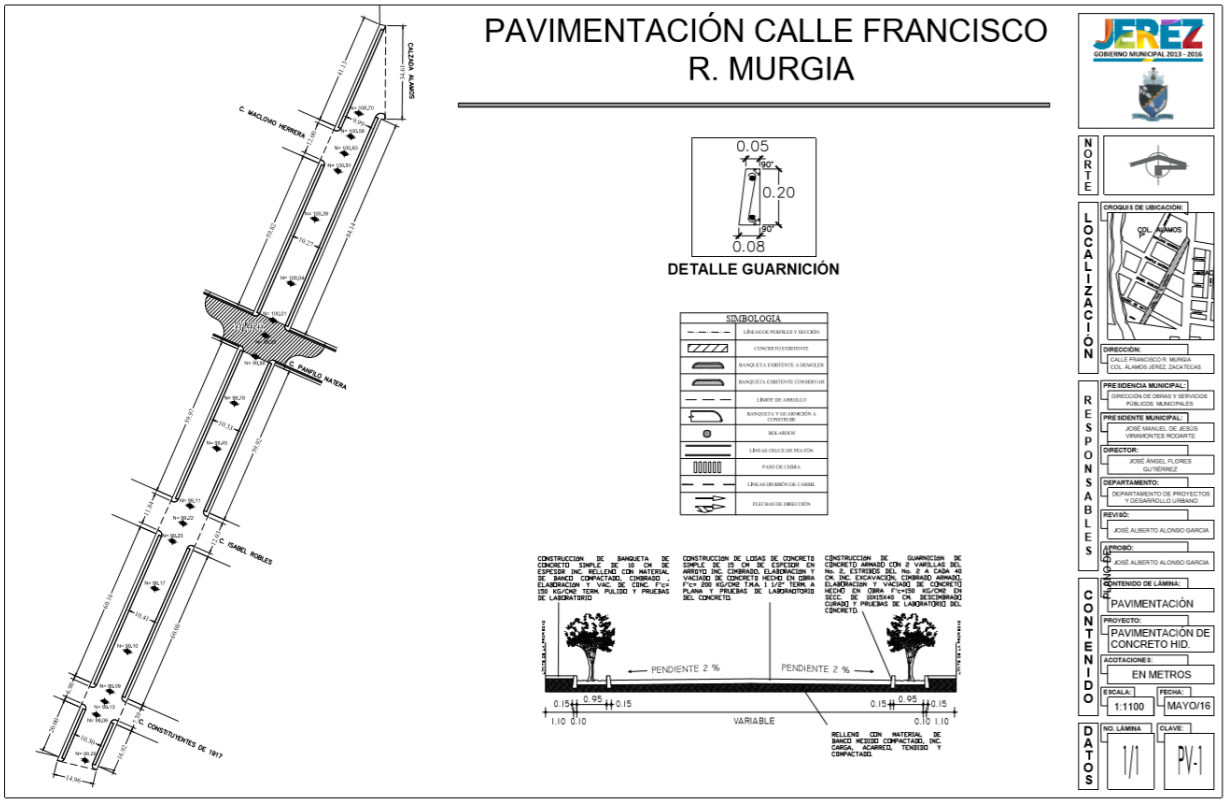


Table A1: Randomness of the availability of data

Variable	Coef. availability of data
Bid	0.955***
	(0.098)
Year	0.702***
	(0.071)
Direct allocation	-0.226***
	(0.011)
I3P	0.112***
	(0.016)
Public auction	0.114***
	(0.013)
Number of contracts in state	-15.593
	(18.116)
Number of contracts in municipality	39.018***

	(6.237)
State project	0.089***
	(0.012)
Municipality project	-0.097***
	(0.012)
N	3717

Table A2: Project characteristics.

Variables	**Measurement unit**
Work with concrete	
Concrete for pavement of street	m3
Side wall	m3
Sidewalk	m3
Garrisons	m3
Ramp	m3
Complementary wall	m3
Miscellaneous	
Specific information on construction procedures	Dummy
Street signs	Number
Posts	Number
Trees	Number
Street painting	m2
Additional work	
Sewerage	Dummy
Water intake	Dummy
Drinking water system	Dummy

Figure A1: Availability of information per state