

Publicity and Competition in Federal Procurement

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December 2019

Public Procurement and Competition

- Public procurement: 12% of GDP and 29% public spending in OECD countries
- Governments strongly favor the use of competition:
 - *“Contracting officers shall promote and provide for full and open competition in soliciting offers and awarding Government contracts”* (US Federal Acquisition Regulation, Part 6)
- Goals: lower procurement costs, improve quality, prevent favoritism
- A direct way of promoting competition is by publicizing contract opportunities

Competition for Incomplete Contracts

- Large share of public contracts are for goods or services hard to specify in advance
 - Often leads to costly ex-post adaptations (Bajari, Houghton & Tadelis, 2014)
- Competition may “backfire” in the context of incomplete contracts
 - Negotiation may be preferable to competitive bidding (Bajari, McMillan & Tadelis, 2008)
 - Attracting new participants may generate adverse selection on non-contractible dimensions
 - Selectively informing a subset of known contractors may help sustain relational contracts (Calzolari and Spagnolo, 2009)
- Ideally, officers could exercise discretion in when and how to promote competition
 - One way of doing this is by choosing when to publicize contract opportunities
 - But are officers choices aligned with the government's goals?

This Paper

- We study the interplay between publicity requirements, competition, and procurement outcomes, in the context of US defense procurement
- Using a Regression Discontinuity, we estimate the effect of advertising contracts on:
 - Competition: number of bidders
 - Characteristics of awarded vendor: location, past experience with the contracting office
 - Contractor performance: delays, cost overruns
- We then embed these estimates in a choice model to learn about the main drivers of officers' behavior:
 - Goal is to estimate how much weight they put into:
 - Promoting competition,
 - Keeping a relation with incumbent contractors, and
 - Post-award performance?

Preview of Findings

- We find evidence that publicized contracts:
 - Attract more offers
 - New offers are *competitive*. Selected contractor more likely to be:
 - Geographically distant from contracting office
 - With less previous history with office
 - Publicized contracts result in *more* cost overruns and delays
 - Driven by contracts for goods and services that are relatively “complex”
- From our model, we conclude that:
 - Officer's choices are positively correlated with enhanced competition and incumbent-contractor relations
 - There is little evidence of selection on contracts' ex-post performance

Related Literature

1. Auction entry and competition

- Samuelson (1985), Levin and Smith (1994) Li and Zheng (2009, 2012), Coviello and Mariniello (2014)

2. Competition for incomplete contracts

- Procurement mechanism: Bulow and Klemperer (1996); Bajari, McMillan and Tadelis (2008); Leffler et al. (2007)
- Competition and relational contracts: Banerjee and Duflo (2000); McLeod (2007); Calzolari and Spagnolo (2009), Machiavello and Morjaria (2015, 2019)

3. The value of discretion

- Kelman (1990); Coviello, Guglielmo and Spagnolo (2018); Duflo, Greenstone, Pande and Ryan (2018); Bandiera, Best, Khan and Prat (2019); Kang and Miller (2018); Carril (2019)

Background on US Federal Contracting

- Federal Acquisition Regulation (FAR Part 5) mandates “publicizing contract actions” to:
 - *“Increase competition”*
 - *“Broaden industry participation in meeting Government requirements”*
 - *“Assist small business concerns (... and various other minority businesses...) in obtaining contracts”*
- In particular, contracting officers are required to “synopsise” contracts expected to exceed \$25,000 in <http://FedBizOpps.gov> [Website](#)

Data

- Federal Procurement Data System: **universe of federal contracts**
- Observe:
 - Product/service code, contracting office, contractor, expected award amount, solicitation procedures, type of contract pricing, applicability of a variety of laws, ...
- Do not observe (for now, we hope):
 - Price and quantity separately, just total amounts
 - Good “outcome” measures (e.g. quality)
- Analysis sample:
 - Non-R&D, *stand-alone* contracts in FY2011-FY2017
 - Expected amount between \$10K to \$40K
 - Army, Navy, and Air Force

Summary statistics

	Mean
<i>Contract Characteristics</i>	
Expected Award Amount	22,070
Expected Duration (days)	55.15
Fixed-Price Contract	0.999
Competitively Awarded	0.614
Set Aside Award	0.357
Simplified Procedure	0.728
<i>Competition</i>	
Number of Offers	2.452
One Offer	0.530
<i>Contracting Office Characteristics</i>	
Navy	0.422
Army	0.402
Air Force	0.134
Other	0.043
<i>Awarded Firm Characteristics</i>	
Foreign	0.092
Within-State Firm	0.741
Small Business	0.620
Womam Owned Business	0.137
<i>Sample</i>	
No. of Contracts	240,514
No. of Contracting Offices	760
No. of Firms	59,697

Top product categories

Rank	Goods		Services	
	Name	N Contracts/year	Name	N Contracts/year
1	ADP Equipment and Software	3,005	Maintenance/Repair of Equipment	2,430
2	Medical Equipment and Supplies	2,998	Support Services (Professional)	1,187
3	Laboratory Equipment	1,643	Utilities And Housekeeping	1,096
4	Electrical Equipment Components	1,593	Transport, Travel, Relocation	854
5	Communication/Coherent Radiation	1,202	ADP and Telecommunications	806
6	Furniture	810	Lease/Rent Equipment	753
7	Power Distribution Equipment	697	Maintenance of Real Property	688
8	Ship And Marine Equipment	574	Education And Training	560
9	Hardware And Abrasives	530	Construct Of Structures/Facilities	335
10	Construction And Building Material	459	Social Services	286

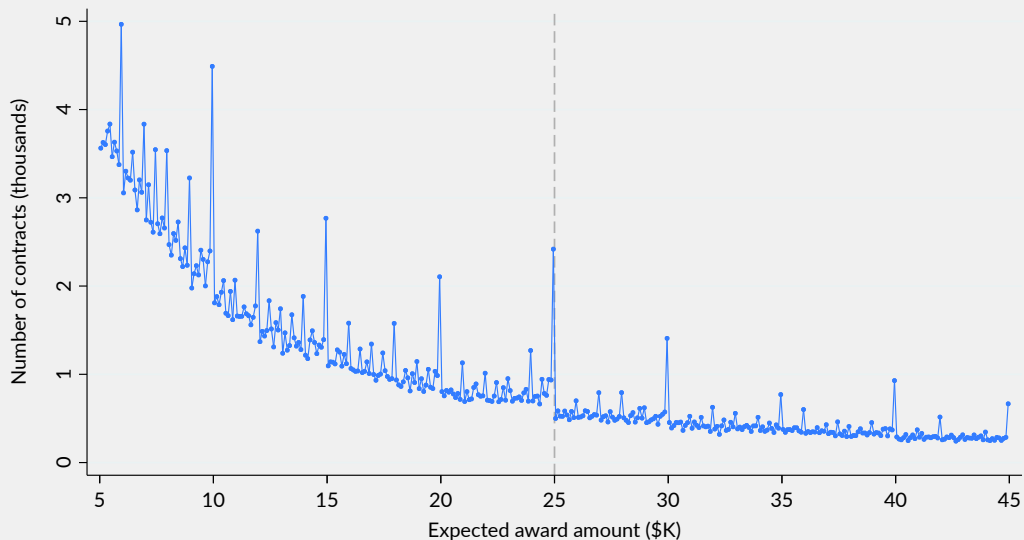
Note: Products are classified with one of 1,918 codes, which can be aggregated into 101 categories.

Identification

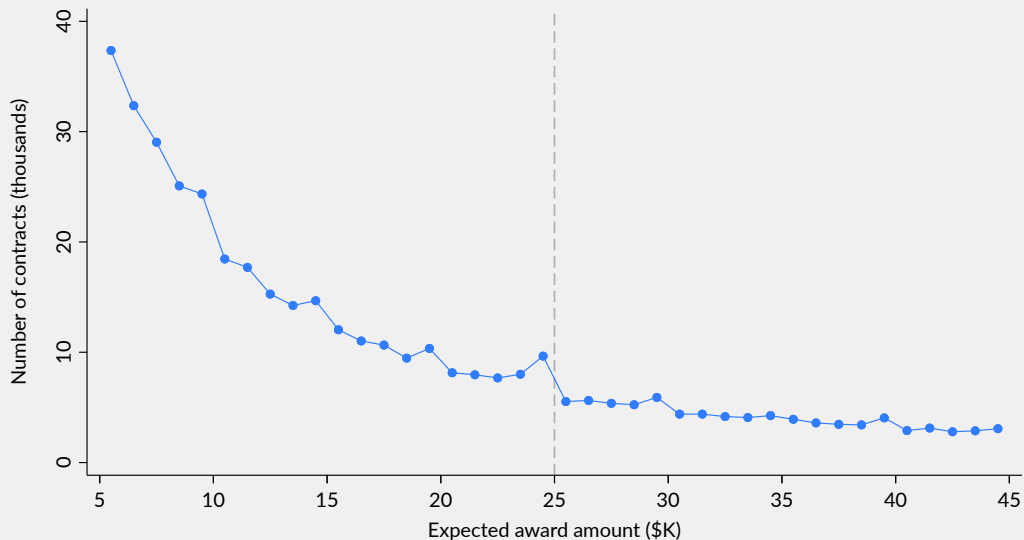
- RDD requires that treatment assignment is “as good as random” at the threshold for treatment
- 2 possible threats:
 1. Differences in contract design on either side of the threshold
 2. Manipulation of the size of contracts (running variable)

Solicitation Characteristics

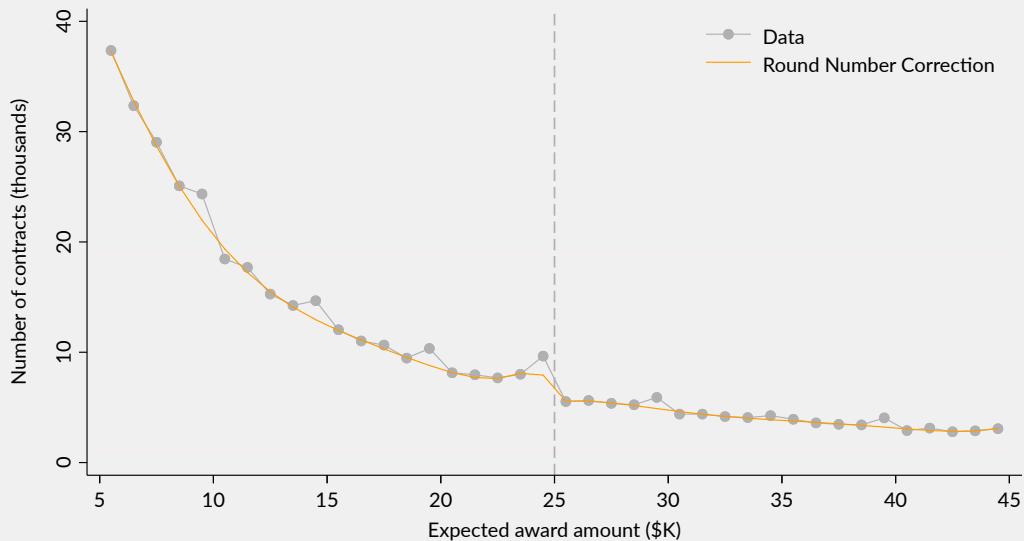
Distribution of expected award amounts



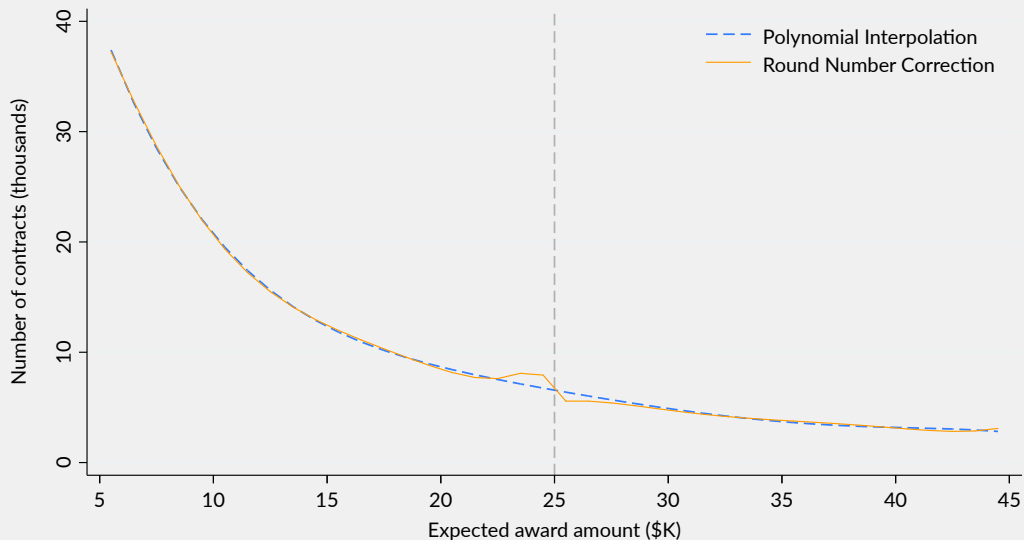
Distribution of expected award amounts



Distribution of expected award amounts



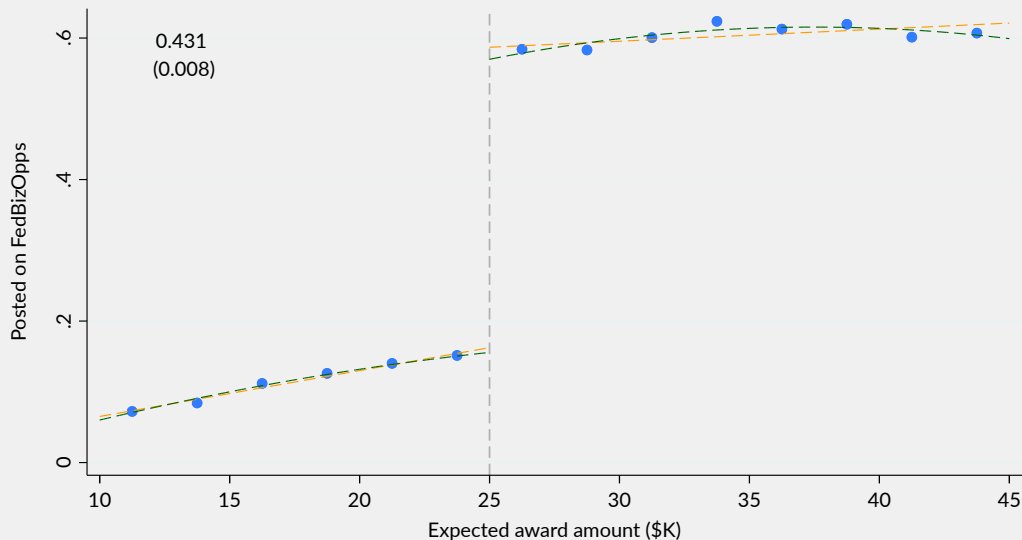
Distribution of expected award amounts



Distribution of expected award amounts

- RDD partially identified even in the presence of (small) manipulation (Gérard, Rokkanen and Roth, 2019)
- Bounds likely to be tight (net-of-round-numbers bunching looks small)
- We will ignore these points for today

First Stage: Share of contracts posted on FedBizOpps



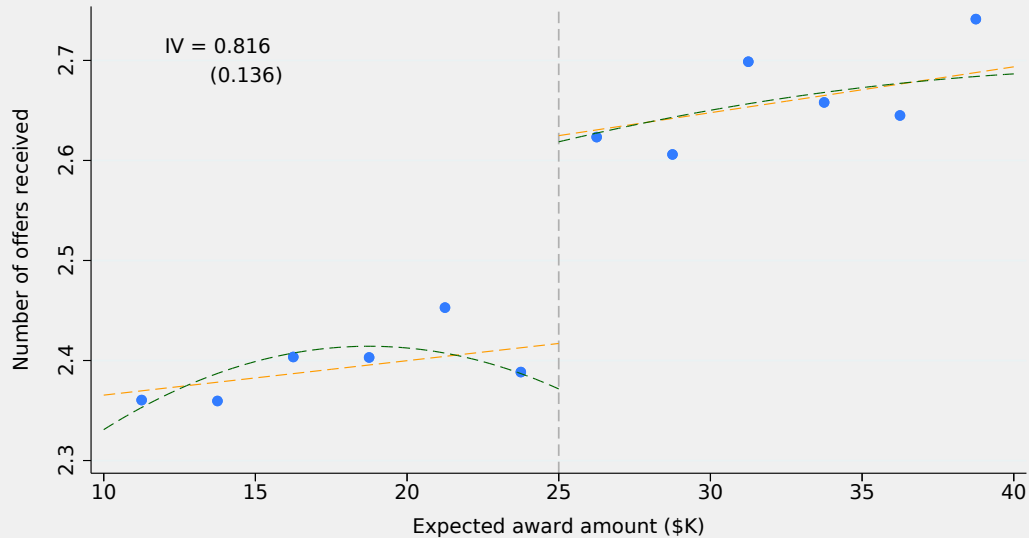
RDD: outcomes

- We now look at the effect of posting a solicitation on a series of outcomes
- Different outcomes speak to different specific questions
 - Does extending information diffusion increase competition for public contracts?
 - Number of offers
 - Do characteristics of the awardee change?
 - Geographic location
 - Firm's previous history
 - How does publicity affect ex-post contract performance?
 - Rough performance: *delays* and *cost-overruns*

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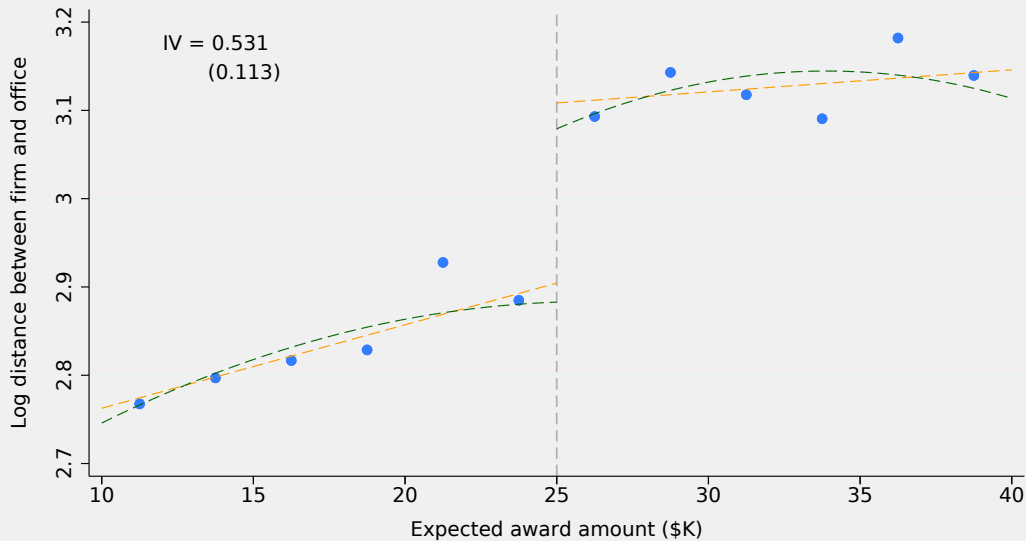
Competition: Number of offers received



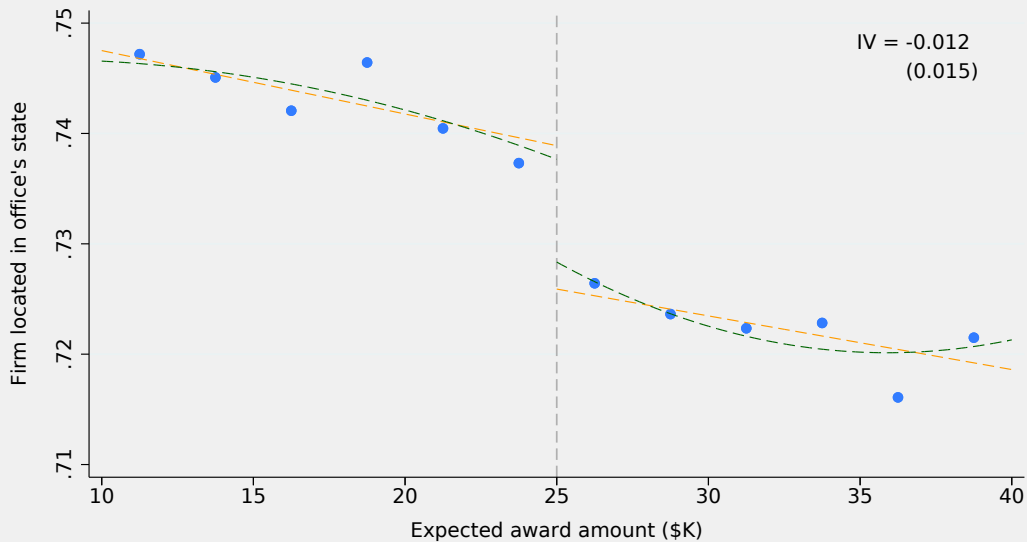
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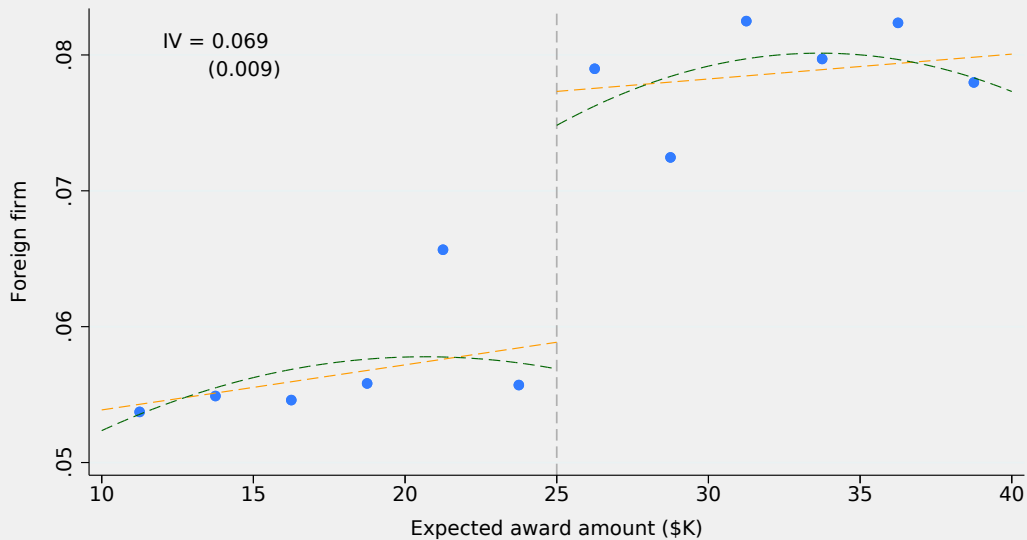
Geographic location: log-distance



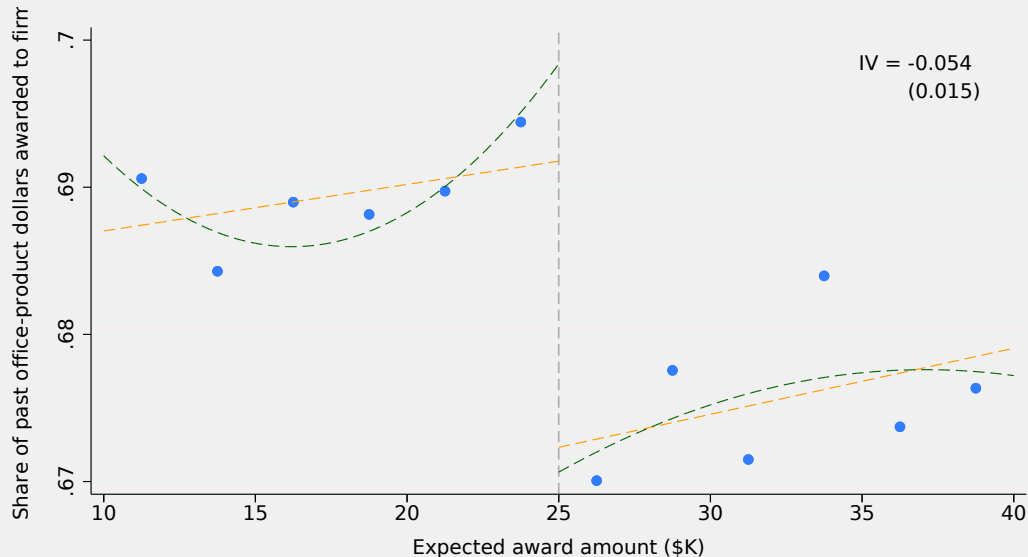
Geographic location: within-state firm



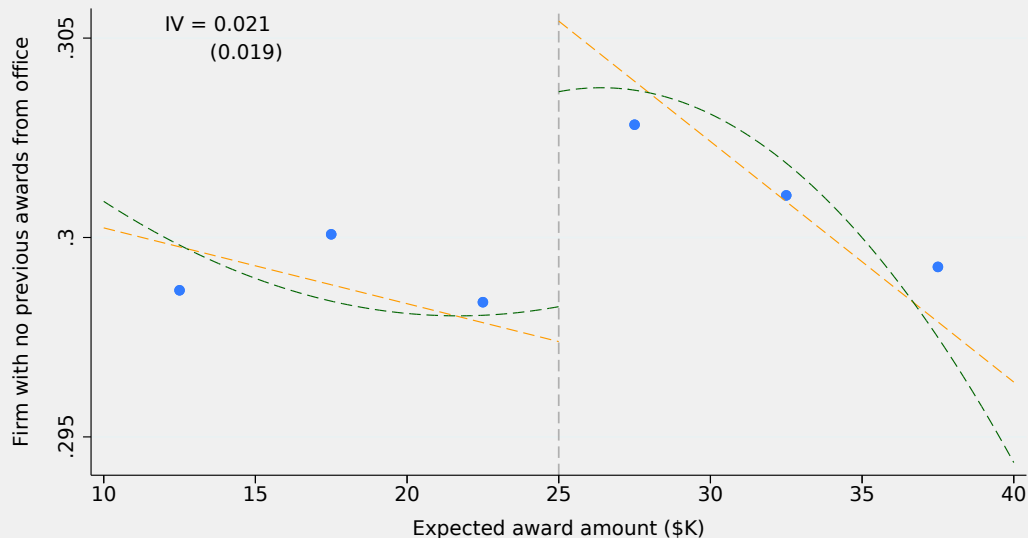
Geographic location: foreign firm



Firm's history with the office: share of previous dollars



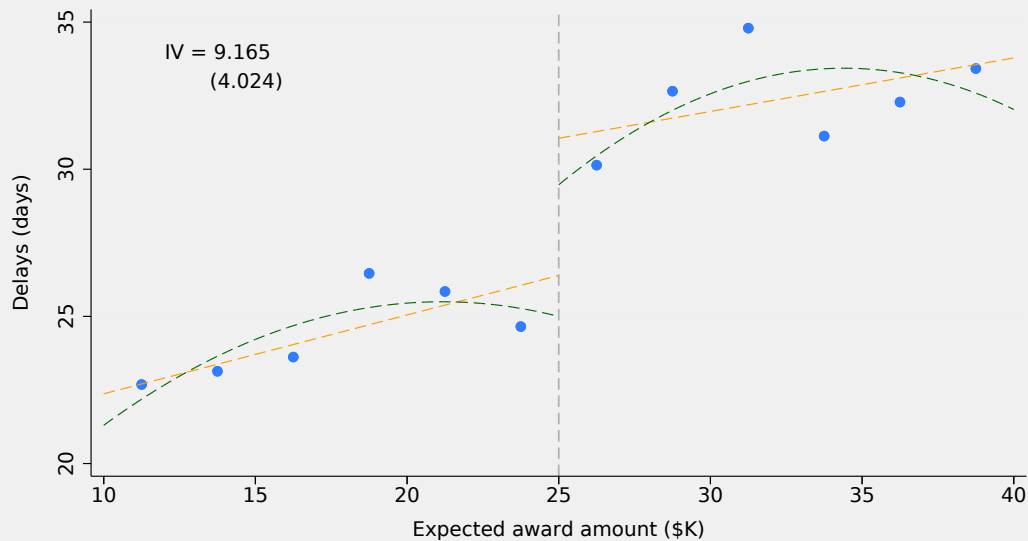
Firm's history with the office: “new” contractor for the office



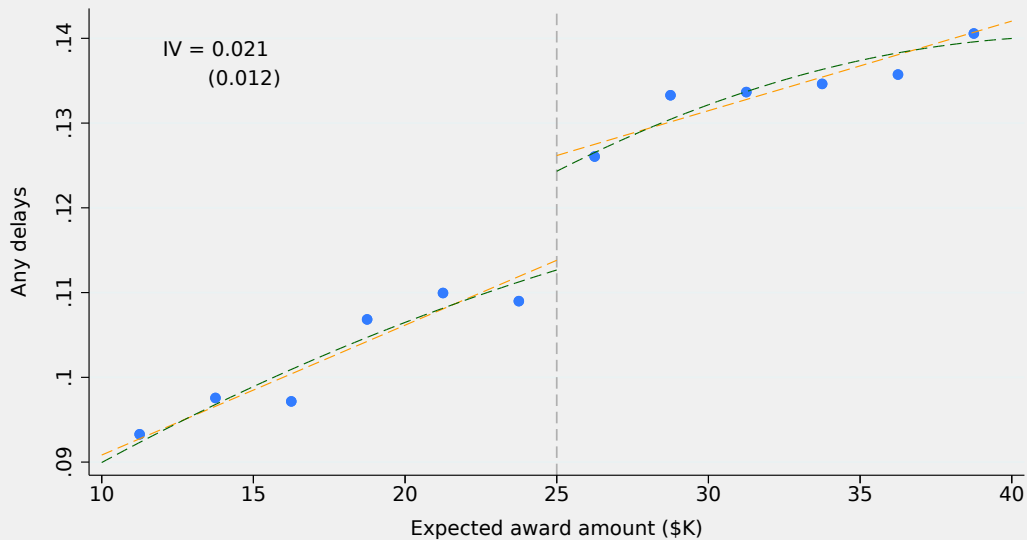
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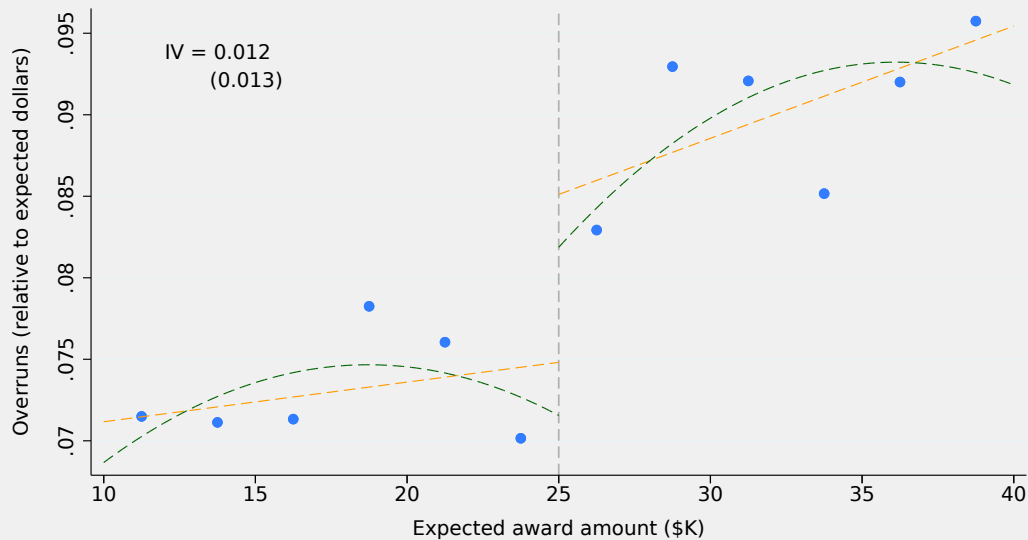
Performance: “delays”



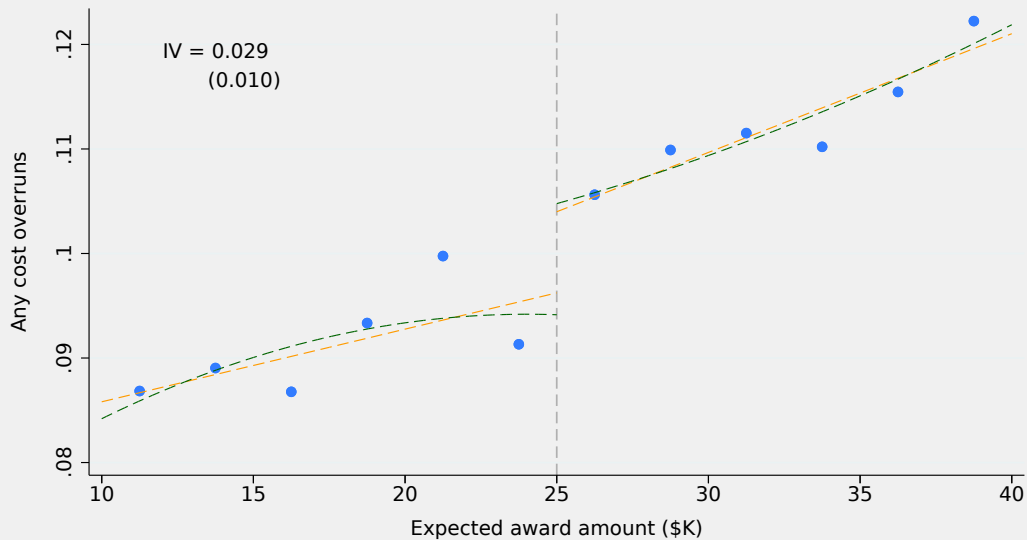
Performance: “delays”



Performance: “cost overruns”



Performance: “cost overruns”



What's driving the negative effects on contract performance?

- Two explanations:
 - Heterogeneity on contractors "type" (Adverse Selection)
 - Contractors modify their behavior depending on the relation with the the buyer (Moral Hazard)
- The existing literature on incomplete contracts assume the pool of bidders and/or the bidders incentives are fixed
- Possible test for Moral Hazard:
 - Controlling for contractors' average performance (type): Do their contract performance differ between buyers (with and without publicity)?

What's driving the effects on contract performance?

Table: RD Estimates on "Any Cost Overruns"

VARIABLES	(1) All	(2) Good	(3) Service	(4) Good	(5) Service
RD_Estimate	0.0305*** (0.0100)	0.00491 (0.00787)	0.102*** (0.0280)	0.0128 (0.00864)	0.0217 (0.0276)
Mean Dep Var Left	0.093	0.055	0.166	0.053	0.183
Firm FE	No	No	No	Yes	Yes
Original N Obs	243395	167388	76007	147467	58163
Effective N left	41027	39212	10011	24785	7259
Effective N right	25698	22755	6269	15410	4507

Standard errors in parentheses

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

What drives buyers' behavior?

- Multiple papers studying the effect of competition policies on procurement outcomes
 - Athey, Coey and Levin 2013, Krasnokutskaya and Seim 2011, Li and Zheng 2009, 2012
- Scant evidence on how competition is endogenously promoted: i.e., **buyers' preferences** over the extent of competition and for particular sellers
 - Kang and Miller 2017, Bandiera, Prat and Valletti, 2009
- We combine buyers' (revealed) choice for publicity with estimates of its' effects on different margins to make inference on their underlying preferences
 - Generalized Roy Model: Heckman and Honore 1990, Eisenhauer et al. 2015
 - Applications: Walters, 2018, Abdulkaroglu et al. 2019 (school choice), Van Dijk, 2019 (housing program), Chandra, Finkelstein, Sacarny, and Syverson (hospital selection)

Publicity Choice

- A buyer i decides whether to publicize a contract for product j in period t maximizing her expected utility:

$$\begin{aligned}P(D_{ijt} = 1) &= P\left(E(U_{ijt}^P) > E(U_{ijt}^{NP})\right) \\&= P\left(\beta_i' y_{ij}^P + \varepsilon_{ijt}^P > \beta_i' y_{ij}^{NP} + \varepsilon_{ijt}^{NP}\right) \\&= P\left(\beta_i' \Delta y_{ij} > -\Delta \varepsilon_{ijt}\right)\end{aligned}$$

- Δy_{ij} is the effect of publicity on variable y .
- Goal:**
 - Do buyers decide to publicize contracts based on its anticipated effect on different variables?
 - How do they weight different variables?

Heterogeneous Effects

- We need an estimate of the average treatment effect of publicity for *buyer-product* combinations
- Our non-parametric RD estimates are estimated only over the group of *compliers* (local average treatment effect)
 - If publicity adoption is correlated with outcomes → we would expect different effects among non-compliers (*never-takers* and *always-takers*)
- The treatment effect heterogeneity among never-takers and always-takers are obtained by extrapolating from instrument-implied local average treatment effects
 - Heckman and Vytlacil, 2005; Kline and Walters, 2019

Example Extrapolation

Effect of Publicity

- We instrument the publicity adoption by $Z_{ijt} = \mathbf{1}\{above\}$

$$\begin{aligned}D_{ijt} &= \kappa_i + \kappa_j + (\gamma_i + \gamma_j)Z_{ijt} + \Gamma'X_{ijt} + \eta_{ijt} \\y_{ijt} &= (\theta_{1i} + \theta_{2j})D_{ijt} + \sigma_1\hat{\eta}_{ijt} + \sigma_2\hat{\eta}_{ijt}D_{ijt} + \Lambda'X_{ijt} + \varepsilon_{ijt}\end{aligned}\tag{1}$$

- The inclusion of $\hat{\eta}_{ijt}$ accounts for endogeneity, and $\hat{\eta}_{ijt}D_{ijt}$ for heterogeneous effects
 - Since $\hat{\eta}_{ijt}$ is included linearly, the extrapolation is also linear (Olsen, 1980, Garen, 1984)
- The estimation of (1) produces a vector of $I + J$ different unbiased estimators of the ATE of publicity on the outcome variable y :

$$\underbrace{(\hat{\theta}_{11}^y, \dots, \hat{\theta}_{1I}^y)}_{I\text{-buyers}}, \underbrace{(\hat{\theta}_{21}^y, \dots, \hat{\theta}_{2J}^y)}_{J\text{-products}}'$$

- **Sample:** Universe of contracts $\in [\$15,000, \$35,000]$, $I = 17$, $J = 97$

Effect of Publicity

- Each coefficient $\hat{\theta}_{1i}^y$ and $\hat{\theta}_{2j}^y$ are unbiased but noisy measures of the underlying specific distribution θ_1^y and θ_2^y respectively
- We apply the standard shrinkage techniques of the empirical Bayes literature (Morris, 1983) to adjust for measurement error in our buyer or product-specific estimates
 - Chetty et al., 2014, Angrist et al., 2017 Finkelstein et al., 2017, Abdulkadiroglu et al. 2019

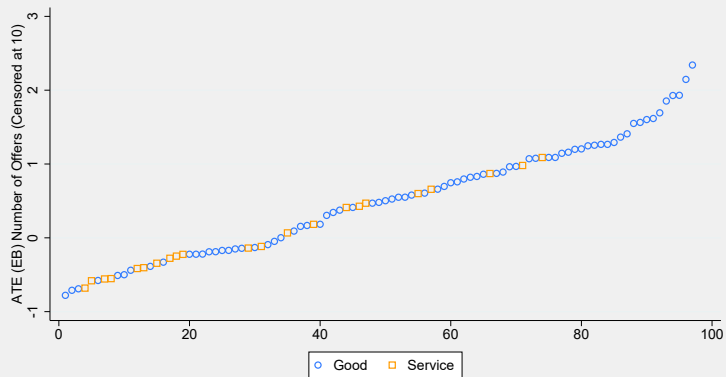
Empirical Bayes Adjustment

- Finally, we assume the effect of publicity for particular ij combination is the addition of the “corrected” coefficients θ_{1i}^* and θ_{2j}^* :

$$\theta_{ij}^* = \theta_{1i}^* + \theta_{2j}^*$$

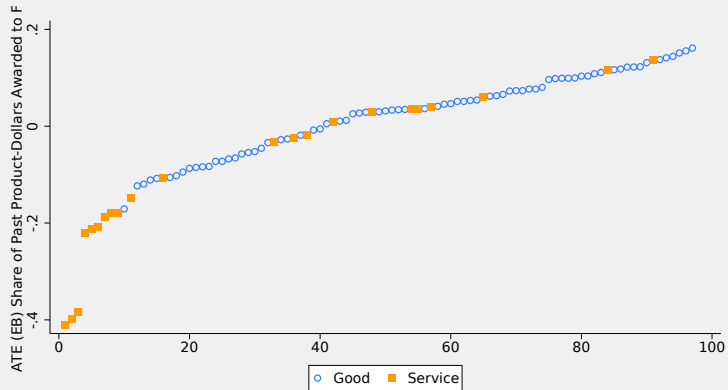
Effects by Product

Figure: Number of Offers



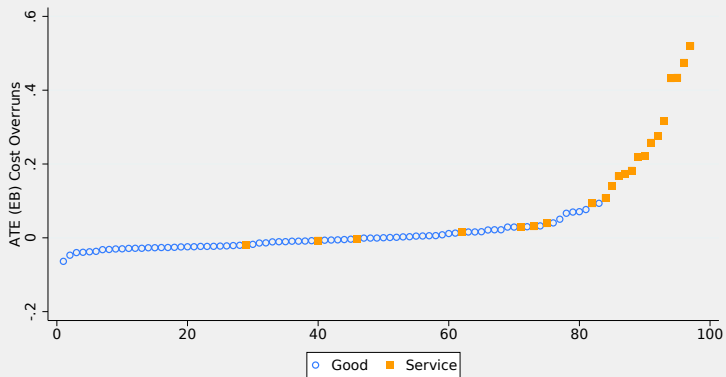
Effects by Product

Figure: Share of Past Dollars Awarded to Contractor



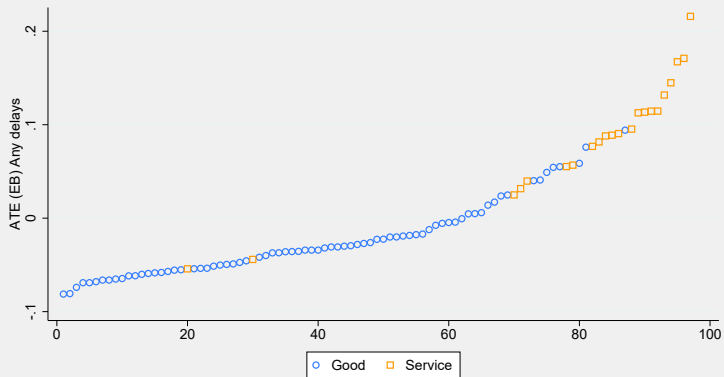
Effects by Product

Figure: Cost Overruns



Effects by Product

Figure: Any Delays



Correlation Matrix of Effects

Table: Services

	N Offers	Overruns	Past Contracts
N Offers	1		
Overruns	-0.339	1	
Past Contracts	-0.030	-0.644	1

Table: Goods

	N Offers	Overruns	Past Contracts
N Offers	1		
Overruns	-0.387	1	
Past Contracts	-0.192	0.077	1

Estimating Preferences

- Let U_{1ij} denote buyer i 's utility for publicizing contract for product j

$$U_{1ij} = \delta_{ij} + \varepsilon_{1ijt}, U_{0ij} = \varepsilon_{2ijt}$$

- The parameter δ_{ij} is the mean utility of publicizing a contract (relative to not publicizing)
- We model unobserved tastes $\varepsilon_{1ijt}, \varepsilon_{2ijt} \sim_{iid} EVI$. If the buyer decides to publicize maximizing her utility, we have:

$$P[D_{ijt} = 1 | \delta_{ij}, X_{ijt}] = \frac{\exp(\delta_{ij} + \Gamma' X_{ijt})}{1 + \exp(\delta_{ij} + \Gamma' X_{ijt})} \quad (2)$$

- We allow for flexible heterogeneity in tastes, by estimating by Maximum Likelihood a preference parameter $\hat{\delta}_{ij}$ separately for each ij combination

Estimating Preferences

- The mean utility parameter $\hat{\delta}_{ij} = \log \left(\frac{S_{ij|x}}{1-S_{ij|x}} \right)$, where $S_{ij|x}$ is the conditional share of publicized by buyer i for product j
- We relate the preferences for publicity with its effects on:
 - competition (N bidders, only one bidder)
 - contractor relation (share of past contracts, distance)
 - performance (delays and overruns)
- We regress separate regressions for buyer-product mean utilities separating by services/good:

$$\hat{\delta}_{ij} = \tau_j + \rho_1^k \theta_{ij}^{comp} + \rho_2^k \theta_{ij}^{rel} + \rho_3^k \theta_{ij}^{perf} + \xi_{ij}, \quad k \in \{\text{service, good}\} \quad (3)$$

- ρ_1^k represents the marginal effect of competition on the log odds ratio of publicity (conditioning on the relation and performance)
 - There are 160 and 355 buyer-service and buyer-good combinations, respectively. The observations are weighted by the inverse of sampling variation $\hat{\delta}_{ij}$ and the SE are clustered at buyer level

Estimating Preferences - Contracts for Services

Table: Preference for Competition, Performance and Contractor Relation

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<u>Competition:</u>								
Number of Offers (Censored at 10) (SD)	1.481 (1.056)							
More than 1 Offers (SD)		2.828** (1.030)			2.824** (0.998)	2.833*** (0.923)	2.401** (0.902)	2.508*** (0.845)
More than 2 Offers (SD)			2.492** (1.015)					
More than 3 Offers (SD)				1.835* (0.980)				
<u>Relation with Contractor:</u>								
Log Distance to Awarded Firm (SD)					-0.263 (0.569)			
Share of Past Product-Dollars Awarded to Firm (SD)						1.287** (0.488)	0.980 (0.591)	1.100** (0.510)
<u>Performance:</u>								
Any Cost Overruns (SD)							0.710 (0.767)	
Any delays (SD)								0.636 (0.899)
N	160	160	160	160	160	160	160	160

Robust standard errors in parentheses

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

Estimating Preferences - Contracts for Goods

Table: Preference for Competition, Performance and Contractor Relation

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<u>Competition:</u>								
Number of Offers (Censored at 10) (SD)	0.856 (0.846)							
More than 1 Offers (SD)		1.602** (0.705)			1.349* (0.668)	1.418* (0.715)	0.878 (0.623)	0.860 (0.624)
More than 2 Offers (SD)			1.097 (0.956)					
More than 3 Offers (SD)				0.997 (0.828)				
<u>Relation with Contractor:</u>								
Log Distance to Awarded Firm (SD)					0.617 (0.452)			
Share of Past Product-Dollars Awarded to Firm (SD)						-0.792 (0.840)	-1.163 (0.709)	-0.914 (0.656)
<u>Performance:</u>								
Any Cost Overruns (SD)							1.350** (0.527)	
Any delays (SD)								1.825** (0.749)
N	355	355	355	355	355	355	355	355
Robust standard errors in parentheses								
*** p<0.01, ** p<0.05, * p<0.1								

Discussion

- Competition:
 - Buyers dislike having only one bidders (monopoly). Buyers' preference for more competition is attenuated as they receive more bids
 - 1σ reduction in probability of having only one bid increases the likelihood of publicizing the contract by $\rho_1^{serv} s(1-s) \approx 0.45$, $\rho_1^{good} s(1-s) \approx 0.22$
- Relation with contractors:
 - Buyers' dislike awarding a contractor with less history. The preference for contractors is negatively correlated with low performance
 - Once controlling for contract performance, they relation preference decreases, however is still relevant
- Performance:
 - Keeping the contractor relation fixed, the preference relation becomes positive (although insignificant and small)

Recap and other results

- Publicizing solicitations online:
 - Increases the number of firms participating
 - Changes characteristics of the winning firm:
 - Geographically more distant, with less previous history with the office
 - Affects contract performance: increases cost-overruns and delays
 - These effects are mostly focused on relatively “complex” products and services
 - Welfare effects are unclear
 - Results present for all agencies, and for goods and services
 - Ex-ante contract characteristics are smooth at the threshold
- The buyer decisions are positively correlated with competition and contractors' relation, the correlation is weaker with performance

Agency Heterogeneity

Characteristics

Next steps

- Incorporate key outcomes: Actual paid unit prices and additional contract quality measures
- Use preference coefficients to study policy counterfactuals
 - How would buyers behave if we gave them more discretion?
- Derive implications for optimal policy

Thank you!



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Blanket Purchase Agreement for Aspraisala, TX, LA, & NM W9126G19R0042 R -- Professional, administrative, and management support services	Department of the Army U.S. Army Corps of Engineers USACE District, Fort Worth	Presolicitation (Modified) / Total Small Business	Feb 13, 2019
NOTICE OF INTENT TO AWARD SOLE SOURCE CONTAINERIZED RESTROOMS N66001_SNNOTE_00106D4A	Department of the Navy Space and Naval Warfare Systems Command SPAWAR Systems Center Pacific	Special Notice	Feb 13, 2019
Athletic Socks W90VNB-19-R-0008 84 -- Clothing, individual equipment & insignia	Department of the Army Army Contracting Command, CSBs 411TH CSB (W90VNB) RCC CAMP HUMPHREYS	Combined Synopsis/Solicitation	Feb 13, 2019
Base Operations and Support Services (BOS) at Homestead AFB, FLA FA664819R0001 R -- Professional, administrative, and management support services	Department of the Air Force Air Force Reserve Command HQ AF Reserve Command	Solicitation (Modified) / Service-Disabled Veteran-Owned Small Business	Feb 13, 2019
W-FY19 Vehicle Lease Agreement MRF-0, Darwin, Australia N6274219T6078 W -- Lease or Rental of equipment	Department of the Navy Naval Facilities Engineering Command NAVFAC Pacific, Site Thailand	Award	Feb 13, 2019
AFICA/AFGSC Technical Order Library and Maintenance Data Support (TOL MDS) (formerly FA6800-18-R-0032) FA6800-18-R-A001 D -- Information technology services, including telecommunications services	Department of the Air Force AFICA AFICA - CONUS	Combined Synopsis/Solicitation (Modified) / Total Small Business	Feb 13, 2019
C-IDIQ CONTRACT FOR ARCHITECT-ENGINEER SERVICES FOR ARCHITECTURAL PROJECTS AT VARIOUS LOCATIONS UNDER THE COGNIZANCE OF NAVAL FACILITIES ENGINEERING COMMAND, HAWAII N6247819R5029 C -- Architect and engineering services	Department of the Navy Naval Facilities Engineering Command NAVFAC Hawaii	Presolicitation (Modified)	Feb 13, 2019
Sewing Services for Kahala Training Academy W91QVN19R0073 J -- Maintenance, repair & rebuilding of equipment	Department of the Army Army Contracting Command, CSBs 411TH CSB (W91QVN) RCC YONGSAN	Combined Synopsis/Solicitation (Modified)	Feb 13, 2019

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Athletic Socks

Solicitation Number: W90VN8-19-R-0008

Agency: Department of the Army

Office: Army Contracting Command, CSBs

Location: 411TH CSB (W90VN8) RCO CAMP HUMPHREYS

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Original Synopsis

Feb 13, 2019

9:54 pm

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Solicitation Number:

W90VN8-19-R-0008

Notice Type:

Combined Synopsis/Solicitation

Synopsis:

Added: Feb 13, 2019 9:54 pm

This RFP/RFQ is for the purchase of Athletic socks, see solicitation for requirements and additional details.

Please consult the list of [document viewers](#) if you cannot open a file.

W90VN8-19-R-0008

Type: Other (Draft RFPs/RFIs, Responses to Questions, etc.)

Posted Date: February 13, 2019

[W90VN8-19-R-0008 Solicitation Athletic Socks .pdf](#) (382.70 Kb)

Description: Solicitation

Contracting Office Address:

Unit #15289

APO, Non-U.S. 96205-5289

Korea, South

Place of Performance:

ALL FILES

[W90VN8-19-R-0008](#)

Feb 13, 2019

[W90VN8-19-R-0008_Sol...](#)

GENERAL INFORMATION

Notice Type:

Combined Synopsis/Solicitation

Posted Date:

February 13, 2019

Response Date:

Feb 20, 2019 11:59 pm Eastern

Archiving Policy:

Manual Archive

Archive Date:

-

Original Set Aside:

N/A

Set Aside:

N/A

Classification Code:

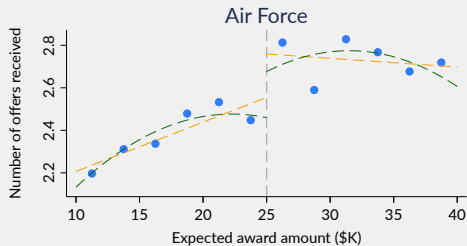
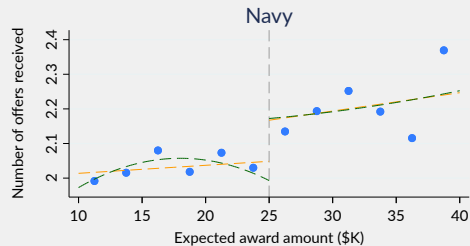
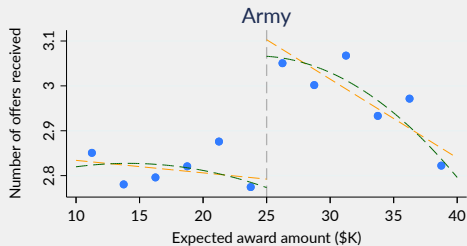
84 -- Clothing, individual equipment & insignia

NAICS Code:

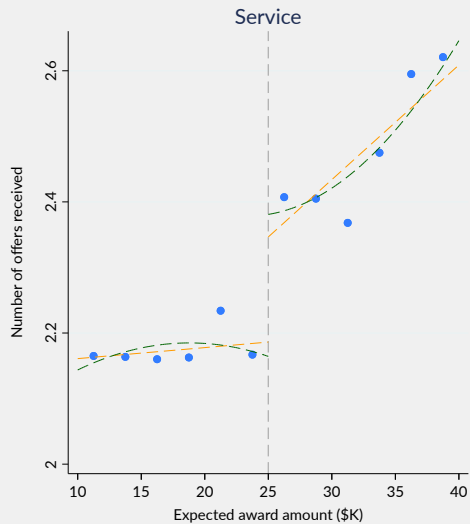
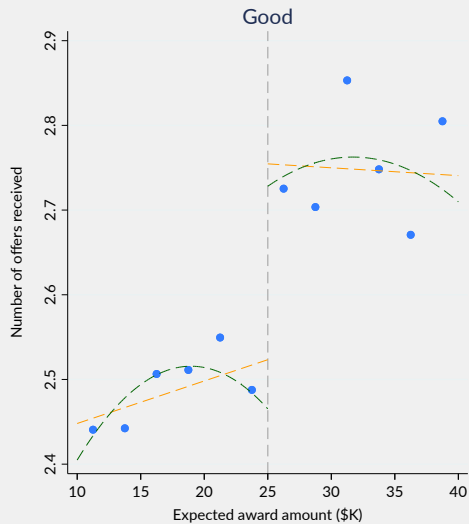
316 -- Leather and Allied Product Manufacturing/316210 -- Footwear Manufacturing

Back

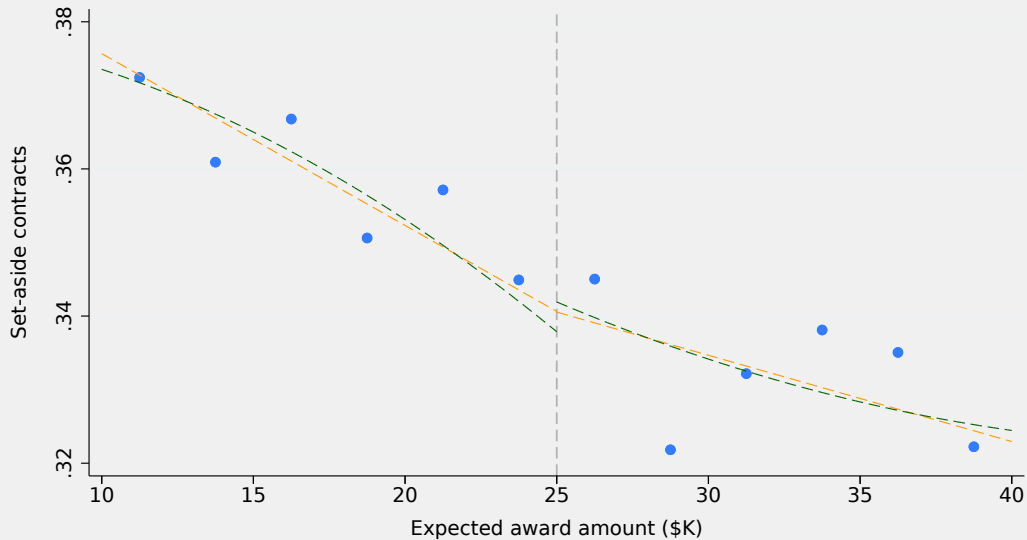
Heterogeneity by agency



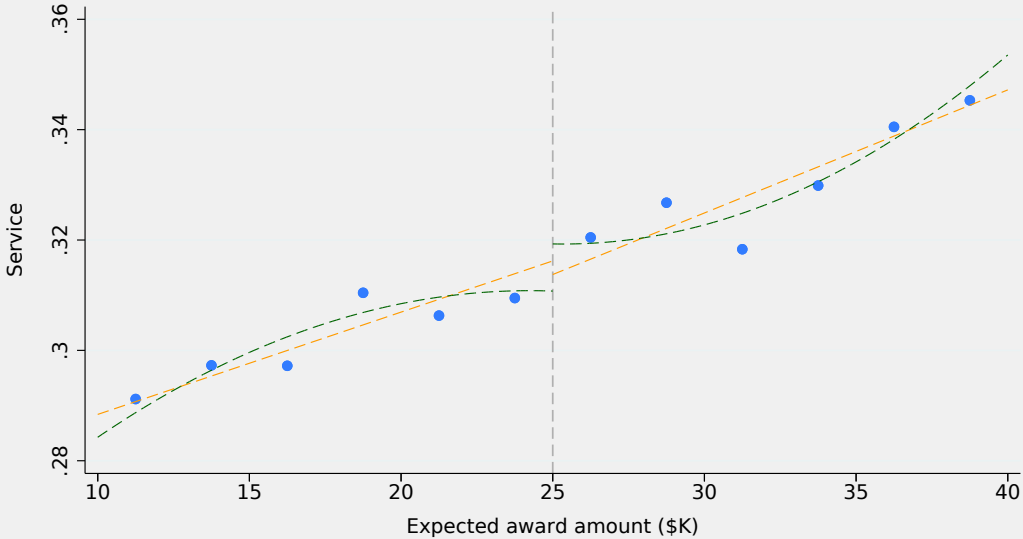
Heterogeneity: good vs services



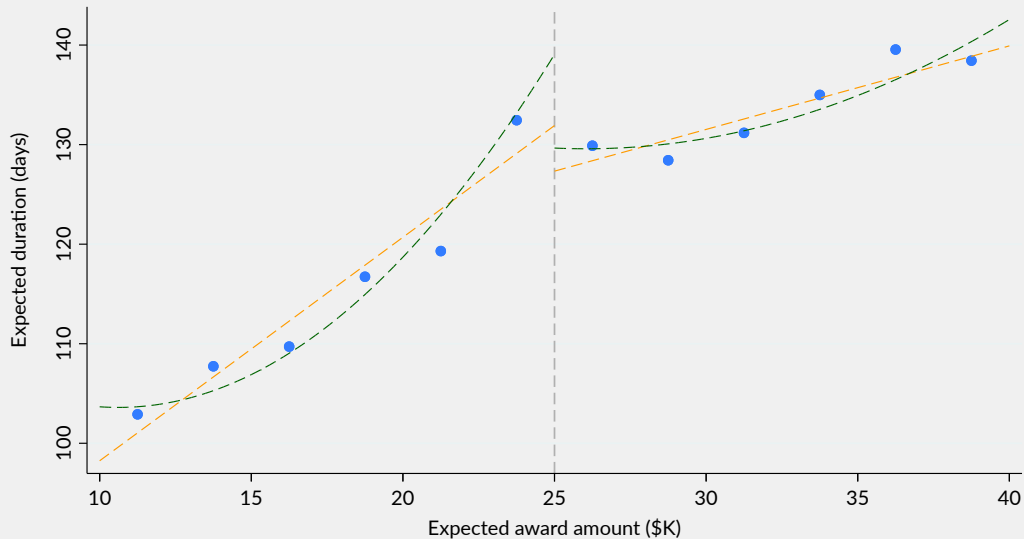
Contract characteristics: set-aside



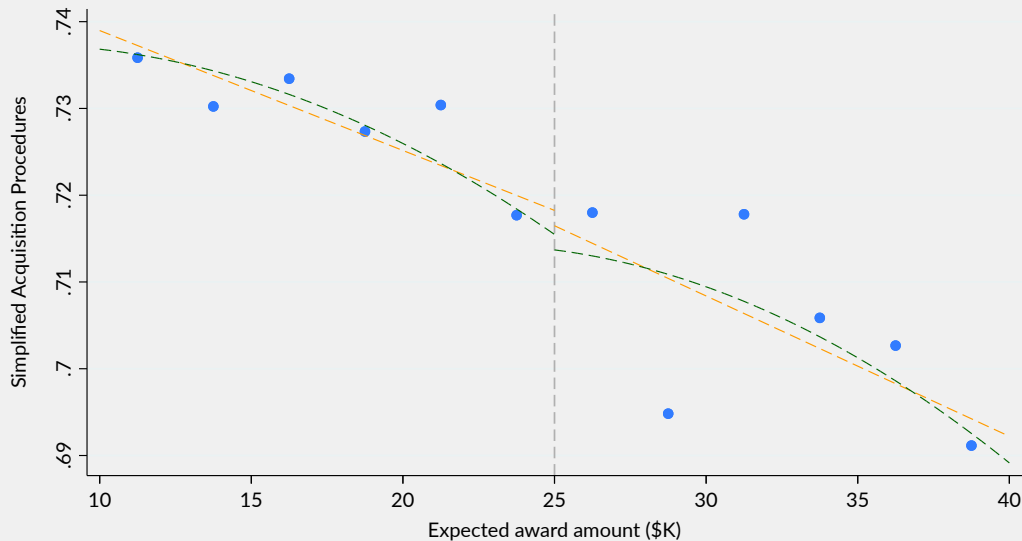
Contract characteristics: good vs. service



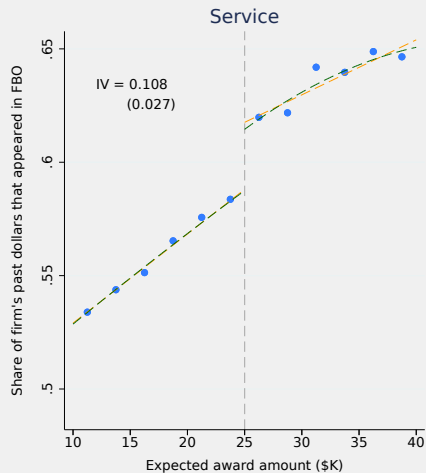
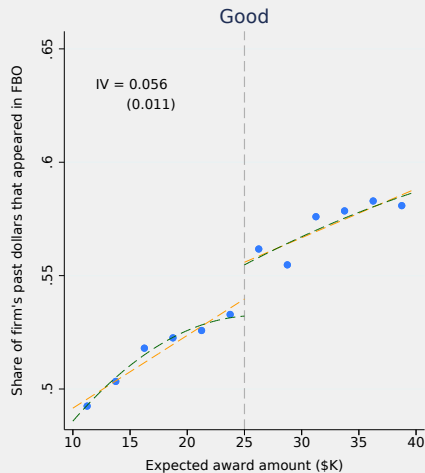
Contract characteristics: expected duration



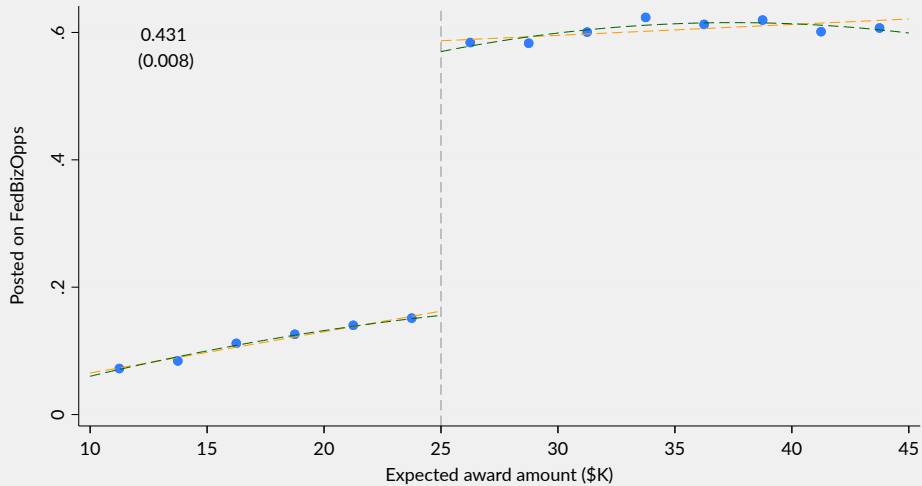
Contract characteristics: simplified procedures



Fraction of contractor's past contracts that appeared in FBO

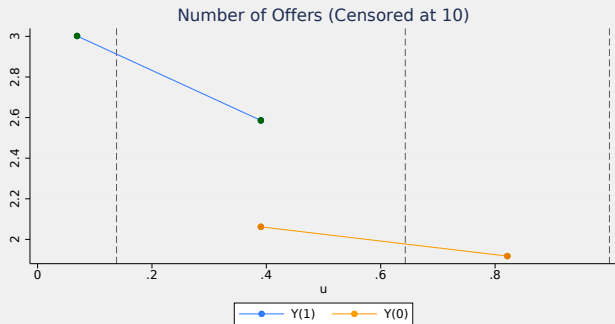


Adoption of Publicity



Heterogeneous Effects Extrapolation

- $D_i = \mathbf{1}\{\gamma_0 + \gamma_1 Z_i > U_i\}$, where $U_i \sim (0,1)$ is the selection error.
- We extrapolate by adopting a functional form of U_i : $E(Y_i(t)|U_i) = \alpha_t + \delta_t g(U_i)$, e.g., where $g(U_i) = U_i$ in the linear selection model, $g(U_i) = \Phi^{-1}(U_i)$ Heckit model



Empirical Bayes Adjustment

- The coefficients are unbiased but noisy measures of the underlying specific parameters. We recover the distribution of δ_j and δ_i using the following hierarchical model:

$$\begin{aligned}\hat{\delta}_k | \delta_k &\sim N(\delta_k, \Omega_k) \\ \delta_k &\sim N(\mu_\delta, \Sigma_\delta)\end{aligned}\tag{4}$$

- Where Ω_k is the sampling variance of $\hat{\delta}_k$, $\mu_\delta, \Sigma_\delta$ are the parameters of the distribution of the latent parameters across k contracts (“hyperparameters” describing a prior distribution for δ_k)
- This hierarchical model can be used to improve estimates of parameters for individual k contracts.
- The Empirical Bayes (EB) posterior mean for δ_k is:

$$\delta_k^* = \left(\hat{\Omega}_k^{-1} + \hat{\Sigma}_\delta^{-1} \right)^{-1} \left(\hat{\Omega}_k^{-1} \hat{\delta}_k + \hat{\Sigma}_\delta^{-1} \hat{\mu}_\delta \right)\tag{5}$$

Estimating Preferences - Contracts for Services (using IV Estimates)

Table: Preference for Competition, Performance and Contractor Relation

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Number of Offers (Censored at 10) (SD)	1.481 (1.056)					
Only 1 Offer (SD)		-2.828** (1.030)	-2.824** (0.998)	-2.833*** (0.923)	-2.401** (0.902)	-2.508*** (0.845)
Log Distance to Awarded Firm (SD)			-0.263 (0.569)			
Share of Past Product-Dollars Awarded to Firm (SD)				1.287** (0.488)	0.980 (0.591)	1.100** (0.510)
Any Cost Overruns (SD)					0.710 (0.767)	
Any delays (SD)						0.636 (0.899)
N	160	160	160	160	160	160

Robust standard errors in parentheses

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

Estimating Preferences - Contracts for Goods (using IV Estimates)

Table: Preference for Competition, Performance and Contractor Relation

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Number of Offers (Censored at 10) (SD)	0.856 (0.846)					
Only 1 Offer (SD)		-1.602** (0.705)	-1.349* (0.668)	-1.418* (0.715)	-0.878 (0.623)	-0.860 (0.624)
Log Distance to Awarded Firm (SD)			0.617 (0.452)			
Share of Past Product-Dollars Awarded to Firm (SD)				-0.792 (0.840)	-1.163 (0.709)	-0.914 (0.656)
Any Cost Overruns (SD)					1.350** (0.527)	
Any delays (SD)						1.825** (0.749)
N	355	355	355	355	355	355

Robust standard errors in parentheses

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