Online Appendix

Contract Duration and the Costs of Market Transactions

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Additional Appendices

Note: Appendices A and B are included with the main text.

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C Efficiency and Allocation of Rights

In this section, I explore the relationship between optimal and efficient contract duration. It should be noted that the analysis here is not restricted to the special case of the duration-setting problem, rather, any transaction characteristic that has a "scale" effect (as duration does on transaction costs) can be related to this framework. One of the natural extensions is to bundling, where T is the size of a bundle (determined by the buyer or seller) and δ is the transaction cost for the bundle.

C.1 A Framework Relating Optimal and Efficient Contract Duration

In contrast to the buyer, whose problem was presented in Section I, the social planner's concern is minimizing expected costs.[1] Let $\overline{C}$ denote the ex ante expected cost conditional on $(T, \boldsymbol{x}, \boldsymbol{m})$, so that $\overline{C}(T, \boldsymbol{x}, \boldsymbol{m}) = \sum_{n=1}^{\mathbb{N}} (E[C(n, T, \boldsymbol{x}, \boldsymbol{m})] \cdot \Pr(N = n | T, \boldsymbol{x}, \boldsymbol{m}))$.

For ease of exposition, assume that T is continuous and $\beta = 1$. Thus, the ex ante efficient $\tilde{T}$ contract is given by

$$\tilde{T} = \arg\min_{T \in \mathbb{T}} \overline{C}(T, \boldsymbol{x}, \boldsymbol{m}) + \frac{\delta}{T} \tag{1}$$

with the first-order condition

$$\frac{d\overline{C}(T, \boldsymbol{x}, \boldsymbol{m})}{dT}|_{T=\tilde{T}} = \frac{\delta}{\tilde{T}^2}. \tag{2}$$

In general, $\frac{d\overline{C}(T,\boldsymbol{x},\boldsymbol{m})}{dT}|_{T=\tilde{T}} \neq \frac{d\overline{P}(T,\boldsymbol{x},\boldsymbol{m})}{dT}|_{T=\tilde{T}}$, which will result in an inefficiency when the contract is determined by the buyer. As long as interior solutions exist (see Proposition 2), we have the result that the efficient contract $\tilde{T}$ will be longer than the buyer-optimal contract T^* when $\frac{d\overline{C}(T,\boldsymbol{x},\boldsymbol{m})}{dT}|_{T=\tilde{T}} < \frac{d\overline{P}(T,\boldsymbol{x},\boldsymbol{m})}{dT}|_{T=\tilde{T}}$

Defining the expected seller surplus as $E[\pi(T, \boldsymbol{x}, \boldsymbol{m})] = \overline{P}(T, \boldsymbol{x}, \boldsymbol{m}) - \overline{C}(T, \boldsymbol{x}, \boldsymbol{m})]$, we have the following result:

Proposition 1. *When interior solutions to the buyer's problem and the social planner's problem exist, the efficient contract will be longer than the equilibrium (buyer-optimal) contract if and only if the expected seller surplus is increasing at $\tilde{T}$:*

$$\begin{aligned} \tilde{T} > T^* &\iff \left(\frac{d\overline{P}(T, \boldsymbol{x}, \boldsymbol{m})}{dT}|_{T=\tilde{T}} - \frac{d\overline{C}(T, \boldsymbol{x}, \boldsymbol{m})}{dT}|_{T=\tilde{T}} \right) > 0 \\ &\iff \frac{dE[\pi(T, \boldsymbol{x}, \boldsymbol{m})]}{dT}|_{T=\tilde{T}} > 0 \end{aligned}$$

The existence of interior solutions depends on the concavity of the expected price function.

[1] In this setting, I assume the social planner is limited by information constraints; in this setting the social planner cannot observe the private information about sellers' costs. This reflects the idea that the mechanism (and the associated transaction costs) are important to the truthful revelation of information. A third party with full information would solve a different problem, awarding the contract to the lowest-cost seller at every instant and switching when the net savings outweigh the transaction cost.

Proposition 2. *Interior solutions to the buyer's problem and social planner's problem exist as long as the first-order conditions can be satisfied and $\overline{P}(T, \boldsymbol{x}, \boldsymbol{m})$ and $\overline{C}(T, \boldsymbol{x}, \boldsymbol{m})$ are not too concave. In particular,* $\frac{d^2\overline{P}(T,\boldsymbol{x},\boldsymbol{m})}{dT^2}|_{T=T^*} > -\frac{2}{T^*}\frac{\overline{P}(T,\boldsymbol{x},\boldsymbol{m})}{dT}|_{T=T^*}$ *and* $\frac{d^2\overline{C}(T,\boldsymbol{x},\boldsymbol{m})}{dT^2}|_{T=\tilde{T}} > -\frac{2}{\tilde{T}}\frac{\overline{C}(T,\boldsymbol{x},\boldsymbol{m})}{dT}|_{T=\tilde{T}}$. *These are the second-order conditions to ensure that first-order conditions achieve a minimum.*

C.2 Numerical Illustration

To illustrate the difference in contracts, we replicate the illustrative example from section I.B. The social planner's problem is similar to the buyers problem, except that the social planner will choose a long-term contract if

$$E[\tilde{c}_{1:N}] - E[c_{1:N}] < \frac{\delta}{2}.$$

Thus, the social planner's decision depends on the first-order statistic of cost draws, rather than the second-order statistic that generates the expected price. For $N > 3$, these order statistics have similar qualitative behavior, so the comparative static predictions follow for the efficient case. However, the efficient contract will not necessarily coincide with the buyer-optimal contract, raising the question of the allocation of rights to non-price terms of the transaction.

Figure C1 provides a comparison of the buyer-optimal and the efficient contract. Panel (a) displays the marginal impact on the price to the buyer of a longer contract with a blue line. The orange line displays the marginal impact on supply costs. Once N is large enough ($N > 5$ in the example), longer contracts have a greater marginal effect on price than cost. This is intuitive, as the first-order statistic approaches the lower bound faster than the second-order statistic.

Panel (b) plots the efficient contract with an orange dashed line. It has similar qualitative features to the buyer-optimal contract, displaying the inverse U shape. The efficient and buyer-optimal contract coincide only when $N \in \{6, 7\}$. When $N = 4$, the buyer would choose a long-term contract when the short-term contract is efficient, and when $N \in 8, ..., 21$ the buyer would choose a short-term contract when a long-term contract is efficient. Thus, the buyer-optimal contract may be longer or shorter than the efficient contract. Information rents from private costs drive a wedge between the buyer-optimal contract and the efficient contract.

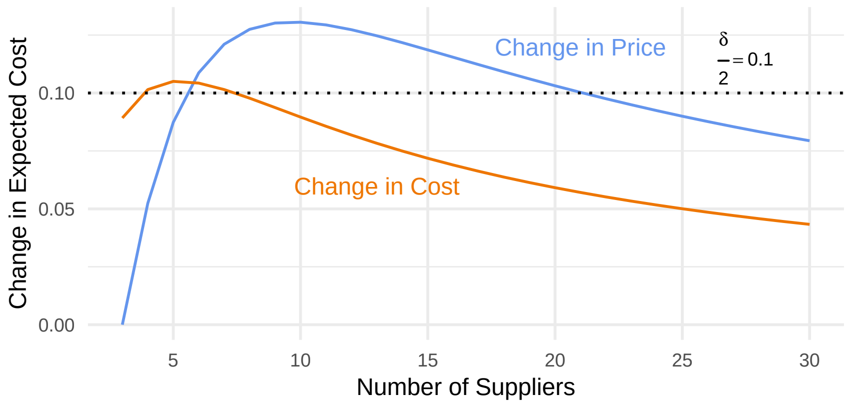
Reflecting Proposition 1, the buyer-optimal contract is (weakly) shorter than the efficient contract when seller surplus is increasing with the longer contract, i.e., when the blue line is above the orange line in panel (a).

C.3 Allocation of Term-Setting Rights

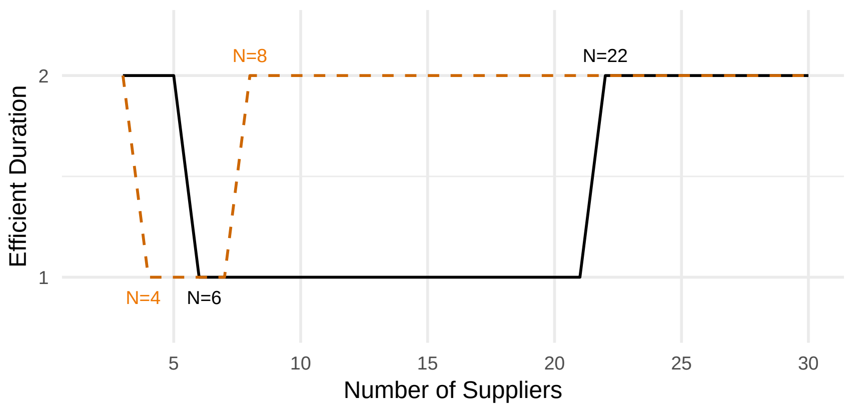
Given the general model, we can identify settings in which inefficiency arising from market power over contract length may be of first-order importance. In this section, I provide some intuition and a heuristic guide to the assignment of term-setting rights to limit such inefficiencies.

Figure C1: Comparing Buyer-Optimal and Efficient Contracts

(a) The Marginal Costs of Longer Contracts



(b) Efficient versus Optimal Contracts



Notes: The figure shows the relationship between competition, the marginal costs of longer contracts, and the effect on buyer-optimal and efficient durations. The blue line in panel (a) shows the marginal cost to the buyer of a two-period contract and is equivalent to the blue line in Figure 1. The orange line shows the increase in marginal social costs of a longer contract. The dash line reflects a transaction cost of 0.20 amortized over two periods. For values of N where the blue line is above the dashed line, $N \in \{6, ..., 21\}$, the buyer would prefer to issue one-period contracts, as the increase in price is greater than the savings in transaction costs. This range does not coincide with the efficient contract, which is plotted with the orange dashed line in panel (b). One-period contracts are efficient for $N \in \{4, .., 7\}$. The buyer will select the efficient contract in this example only if $N \in \{6, 7\}$.

The buyer's problem can be written in the following form:

$$\begin{aligned} & \min_T \overline{P}(T, \boldsymbol{x}, \boldsymbol{m}) - \overline{C}(T, \boldsymbol{x}, \boldsymbol{m}) + \overline{C}(T, \boldsymbol{x}, \boldsymbol{m}) + \frac{\delta}{T} \\ = \ & \min_T E[\pi(T, \boldsymbol{x}, \boldsymbol{m})] + \overline{C}(T, \boldsymbol{x}, \boldsymbol{m}) + \frac{\delta}{T} \end{aligned}$$

Notice that when $\frac{dE[\pi(T,\boldsymbol{x},\boldsymbol{m})]}{dT} = 0$, this problem is equivalent to the social planner's problem. Therefore, when the buyer sets the duration of the contract, these contracts will be efficient when the seller surplus does not change with the length of the contract. The more sensitive buyer surplus is to the duration of the contract, the greater the potential for inefficiency.

What about assigning contract term-setting power along with the transaction costs to the sellers? Sellers solve the problem:

$$\begin{aligned} & \max_T \overline{P}(T, \boldsymbol{x}, \boldsymbol{m}) - \overline{C}(T, \boldsymbol{x}, \boldsymbol{m}) - \frac{\delta}{T} \\ = \quad & \min_T -\overline{P}(T, \boldsymbol{x}, \boldsymbol{m}) + \overline{C}(T, \boldsymbol{x}, \boldsymbol{m}) + \frac{\delta}{T} \end{aligned}$$

Sellers solve the social planner problem when $\frac{d\overline{P}(T,\boldsymbol{x},\boldsymbol{m})}{dT} = 0$. Therefore, if price is not sensitive to contract duration, it is efficient to let the sellers determine the length of the contract.[2]

If either price or buyer surplus changes with the duration of the contract, there is potential for inefficiency arising from market power. A simple heuristic to mitigate efficiency loss is to let sellers determine contract duration when the duration affects price more than buyer surplus, and to let buyers determine contract duration otherwise.

These heuristics, combined with Proposition 1, provide insight into which settings may allow for substantive inefficiencies and whether the efficient contract is longer or shorter. Below, I provide a simple example to illustrate how changing the allocation of rights over non-price terms, such as duration, may lead to vastly different outcomes.

Example: Markup Pricing Suppose sellers in equilibrium follow a simple markup pricing rule, $P = \mu C$. Then the buyer's problem is

$$\min_T \mu\overline{C}(T, \boldsymbol{x}, \boldsymbol{m}) + \frac{\delta}{T}$$

and the seller's problem is

$$\min_T (1-\mu)\overline{C}(T, \boldsymbol{x}, \boldsymbol{m}) + \frac{\delta}{T}$$

As $\mu \geq 1$ in equilibrium, the seller's problem reverses the sign that expected costs enter in the objective function. By increasing costs, sellers increase total profits. In this setting, the buyer should determine the duration. The greater the markup, the more that the equilibrium contract will diverge from the efficient contract.

C.4 Achieving Efficiency with a Tax

The efficient contract can be achieved with a per-transaction tax (or subsidy) when either side of the transaction holds the term-setting rights. When the buyer determines the length of the

[2] Sellers have an equivalent rule to Proposition 1: $t_S > \tilde{T} \iff \frac{d\overline{P}(T,\boldsymbol{x},\boldsymbol{m})}{dT}|_{T=\tilde{T}} > 0$. This means that either 1) $t_S \geq \tilde{T} \geq t$, 2) $t \geq \tilde{T} \geq t_S$, or 3) $t_S \geq \tilde{T} \cap t \geq \tilde{T}$. The case where both the buyer-optimal and seller-optimal contract are shorter than the efficient contract is ruled out by the fact that per-period costs must be increasing at the efficient contract for an interior solution.

contract, the efficient per-transaction tax τ_B solves

$$\tau_B = \tilde{T}^2 \frac{dE[\pi(T, \boldsymbol{x}, \boldsymbol{m})]}{dT}|_{T=\tilde{T}}$$

This tax equates the buyer's problem with the social planner's problem. Note below how the tax causes the externality on the seller to drop out at the efficient contract.

$$\begin{aligned}
\tilde{T} &= \arg\min_T E[\pi(T, \boldsymbol{x}, \boldsymbol{m})] + \overline{C}(T, \boldsymbol{x}, \boldsymbol{m}) + \frac{\delta + \tau_B}{T} \\
&= \arg\min_T E[\pi(T, \boldsymbol{x}, \boldsymbol{m})] + \frac{\tau_B}{T} + \overline{C}(T, \boldsymbol{x}, \boldsymbol{m}) + \frac{\delta}{T} \\
&= \arg\min_T \overline{C}(T, \boldsymbol{x}, \boldsymbol{m}) + \frac{\delta}{T}
\end{aligned}$$

Analogously, the efficient tax on the seller (when the seller has term-setting rights) is given by

$$\tau_S = -\tilde{T}^2 \frac{d\overline{P}(T, \boldsymbol{x}, \boldsymbol{m})}{dT}|_{T=\tilde{T}}$$

In general, $\tau_S \neq \tau_B$. A policymaker has a choice between two efficient taxes, with different effects on tax revenue.

D Dataset Details

D.1 Sample Construction

To construct this dataset, I combined detailed location, price, and vendor information maintained in the Federal Procurement Data System (FPDS)[3] with contract-specific documents downloaded from the Federal Business Opportunities (FedBizOpps) website (USAspending.gov, 2000-2017; FedBizOpps, 2003-2017). By law, the FPDS keeps public records of all contracts for the U.S. federal government. The FedBizOpps website is the most common posting location for competitive contracts, which must be posted publicly. From October 2003 through May 2017, I identified 11,210 unique solicitations in the FPDS data and 7,984 unique solicitations in the FedBizOpps data that matched either PSC S201 ("Housekeeping: Custodial Janitorial") or principal NAICS code 561720 ("Janitorial Services"). I was able to merge 4,119 of these contracts. Unique contracts were identified in FPDS from the variables IDVPIID and PIID.

From the solicitations found in both systems, I selected competitive, non-zero value contracts in the United States that had documents with relevant cost information (i.e., square footage).[4] I obtained the relevant contract documents (request for proposal, cleaning frequency charts, maps, etc.), and constructed detailed contract information directly from the documents. The resulting 1,427 contracts were further processed by hand to construct key variables, including the square footage of the site to be cleaned, the frequency of service,[5] and the facility type. Contracts that were restricted to economically disadvantaged businesses were removed from the sample. After identifying contracts for regular cleaning service, I restricted the sample to contracts that received more than one bid and had an annual price of less than $1 million. Table D1 summarizes the construction of the dataset. Replication files are available from the AEA Data and Code Repository (MacKay, 2020).

I matched the contract-specific dataset with auxiliary datasets of (1) government contracting expenditures at the same location in related products and (2) local labor market conditions. Local labor market conditions include county-level unemployment from the Local Area Unemployment Statistics (Bureau of Labor Statistics, 2000-2017) and the number of NAICS-code level establishments in the same 3-digit ZIP code from the County Business Patterns data (Census Bureau, 2004, 2012).

Because contract characteristics (square footage and cleaning frequency) are important control variables, I am unable to construct a larger dataset using the FPDS data alone. It also proved very difficult to identify repeat contracts for the same facility in the data, for which it might be reasonable to impute characteristics without observing the contract. Two reasons made this challenging. First, ZIP codes change frequently, so it is difficult to link contracts over time (see

[3]These data were obtained from USAspending.gov.

[4]The candidate solicitations were identified with a computational text analysis of documents from all matched contracts.

[5]Cleaning frequency is encoded as the maximum required weekly frequency.

Table D1: Construction of Sample

	Criterion	Observations	Portion
(1)	FedBizOpps Solicitation IDs	7,984	
(2)	FPDS Solicitation IDs	11,210	
	Matched (1) and (2)	4,119	
(3)	In United States	3,818	0.93
(4)	Competitive Procurement	3,584	0.94
(5)	Non-Zero FPDS Value	4,064	0.99
(6)	Square Footage Indicators	1,654	0.40
	Intersection of (3)-(6)	1,427	0.35
(7)	US, Excluding Territories	1,409	0.99
(8)	Regular Cleaning Service	1,392	0.98
(9)	Measurable Square Footage	1,301	0.91
(10)	No Economic Disadvantage Preference	1,289	0.90
(11)	Single Auction, More Than 1 Bid	1,339	0.94
(12)	Annual Price Less Than $1,000,000	1,338	0.94
	Estimation Sample Intersection of (7)-(12)	1,046	0.73

Notes: The table describes the construction of the estimation sample from two data sources for facility cleaning contracts for the U.S. federal government. The relevant range is from October 1, 2003 through May 1, 2017 for the Federal Procurement Data System and though February 3, 2017 for FedBizOpps. After cleaning identification variables, 4,119 of the solicitations were matched. Of these, 1,046 met the criteria needed for analysis, including the availability of square footage data, which is a key cost indicator, non-zero value, and receiving more than one bid from the solicitation.

the set of identified follow-on contracts in Section IV.D). Second, these contracts last for several years, so there are only a handful of contracts for each facility that hypothetically exist in the FPDS. A longer panel and supplemental facility identifiers would facilitate the construction of a larger dataset.

D.2 Count of Sites by Location Type and Government Agency

Table D2: Count of Sites by Contracting Agency

Agency	Count	Percent
Defense	389	37.2
Agriculture	347	33.2
Veterans Affairs	80	7.7
Commerce	78	7.5
Homeland Security	45	4.3
Interior	43	4.1
GSA	40	3.8
Energy	5	0.5
Labor	5	0.5
Transportation	4	0.4
EPA	2	0.2
State	2	0.2
National Archives	2	0.2
CNCS	1	0.1
Health And Human Services	1	0.1
OPIC	1	0.1
Railroad Retirement Board	1	0.1
Total	1,046	100.0

Notes: The table lists the count of contracts in the estimation sample by government department or agency.

Table D3: Count of Contracts by Location Type

Category	Sub-Category	Count
Office (424)		
	Office	221
	Recruiting Office	203
Field Office (270)		
	Ranger District Office	171
	Field Office	46
	Ranger Station	43
	Work Center	7
	Reserve Fleet	3
Research (111)		
	Weather Station	43
	Laboratory	28
	Research Center	28
	Plant Materials Center	12
Medical (61)		
	Clinic	36
	Medical Center	25
Services (59)		
	Service Center	38
	Vet Center	21
Visitors (41)		
	Recreation Area	18
	Cemetery	9
	Visitor Center	7
	Restroom	4
	Museum	3
Airport (30)		
	Airport	30
Technical (19)		
	Power Plant	14
	Surveillance Center	4
	Data Center	1
Accommodations (18)		
	Housing	14
	Dormitories	4
Industrial (13)		
	Equipment Center	6
	Warehouse	5
	Gym	2
Total		1,046

Notes: The table lists the count of contracts in the estimation sample by facility type. Types were hand-coded after reading the contract documents.

D.3 Summary Statistics by Department

Table D4: Summary Statistics by Department

Department	Duration		Price	Square Footage	Count
	Mean	S.D.	Mean	Mean	
Defense	4.1	1.3	38,782	27,517	389
Agriculture	3.9	1.2	18,685	13,285	347
Veterans Affairs	4.6	1.2	61,040	24,647	80
Commerce	4.7	0.8	15,846	9,578	78
Homeland Security	4.8	0.4	93,738	21,746	45
Interior	4.1	1.4	28,746	15,709	43
GSA	4.6	1.1	222,045	144,749	40
Other	4.5	1.1	160,972	58,578	24

Notes: The table displays summary statistics for the contract characteristics of the estimation sample grouped by federal department. The mean and standard deviation for contract duration are provided, along with the mean annual price and the mean square footage. The final column reports the count of contracts in each department.

D.4 Contract Documents

The following page is an example first page from a building cleaning service contract. The subsequent pages contain an example description of the required services and their respective frequencies.

CONTRACT DOCUMENTS, EXHIBITS OR ATTACHMENTS

C.1 SCOPE OF CONTRACT
Description of Work: The intent of this contract is to secure services (inclusive of supplies) for normal custodial (janitorial) and routine maintenance service at the Georgetown Ranger District of the Eldorado National Forest.

2 Project Location & Description
Location: The project is located on the Georgetown Ranger District, 7600 Wentworth Springs Road, Georgetown, CA 95634.

Description: The headquarters office of the Georgetown Ranger District is located at 7600 Wentworth Springs Road, Georgetown, California. Winter working hours are 6:00 a.m. through 5:30 p.m. Monday through Friday from November through May. Summer hours are 7:00 a.m. through 6:00 p.m. Sunday through Saturday.

The office building contains approximately 6,376 gross square feet of space. The office is carpeted throughout, expect for restrooms and front reception area. There are 6 restrooms in the building.

Any prospective contractor desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must request it in writing from the Contracting Officer soon enough to allow a reply to reach all prospective contractors before the solicitation closing date. Oral explanations or instructions given before the award of a contract will not be binding.

3 Estimated Start Date & Contract Time
Start: January 1, 2010
Time: 9 Months

4 Cleaning Schedule
Work Days and Hours. Work shall be performed during Monday through Friday, provided that no work is performed between 7 a.m. and 4:30 p.m. on normal Federal workdays. Regularly scheduled twice weekly work will not be on consecutive days. The contractor may work in the building on weekends and Federal holidays without restrictions to hours.

Quarterly cleaning items will be performed the first week (preferably on Friday) of December, March, June, and September. Annual cleaning shall be performed during the first 2 weeks of May.

5 Licenses and Insurance
Contractor shall provide proof of Workman's Compensation. If the contractor is working alone, with no employees, no Workman's Compensation is required.
.

6 Contractor-Furnished Materials and Services
6-1. The Contractor shall provide everything--including, but not limited to, all equipment, supplies (listed below), transportation, labor, and supervision--necessary to complete the project, except for that which the contract clearly states is to be furnished by the Government.

18. TECHNICAL SPECIFICATIONS

The janitorial services shall be performed in accordance with the following specifications at the frequencies prescribed.

1. Services Performed Daily - Bid Item #0001

   a. Restrooms
      - Clean and sanitize all surfaces including sinks, counters, toilet bowls, toilet seats, urinals, etc.
      - Clean and sanitize tile walls adjacent to and behind urinals and water closets.
      - Clean and sanitize sanitary napkin receptacles and replace liners.
      - Sweep, mop and sanitize tile floors.
      - Clean and polish mirrors, dispensers and chrome fixtures
      - Empty, clean and sanitize all wastebaskets.
      - Spot clean all other surfaces and dust horizontal surfaces including tops of partitions and mirrors.
      - Re-stock restroom supplies.

   b. Front Foyer and Doors
      - Wash inside and outside of all glass surfaces on entrance doors. Remove dust and soil from metal frames surrounding entrance glass doors.
      - Vacuum rugs.
      - Sweep and mop tile floors and clean baseboards.

   c. Reception Area
      - Vacuum all reception carpeted areas and rugs including edges.
      - Clean and polish all counter surfaces.

   d. Drinking Fountains
      - Clean and sanitize drinking fountains.

   e. Breakroom Waste Receptacles
      - Empty all waste receptacles, wash if needed with a sanitizing cleaner.

2. Services Performed Weekly – Bid Item #0002

   a. Waste Receptacles
      - Empty all waste receptacles unless needed more frequently. Wash if needed with a sanitizing cleaner. Change liners only if needed.

   b. Breakroom
      - Sweep and mop, use a cleaner that doesn't require rinsing and is a sanitizer and will not damage the wax. Mop under table, chairs, coffeemaker cabinet, trash can and wheeled carts.
      - Clean Formica countertops.

- Spot clean walls and doors.

c. Back Door Foyers
   - Sweep and mop, use a cleaner that doesn't require rinsing and is a sanitizer and will not damage the wad. Vacuum rug and clean baseboards.
   - Spot clean walls and doors.

d. Hallways
   - Vacuum all carpeted areas, including wall edges.
   - Spot clean anytime a stain or soiled area needs cleaning.
   - Tile floors sweep and mop, use a cleaner that doesn't require rinsing and is a sanitizer and will not damage the wax.
   - Spot clean walls, doors and partitions that appears to be soiled.

e. Outdoor Waste Receptacles
   - Empty all outdoor waste receptacles and ash trays at the front entrance and two back entrances**.** Wash if needed with a sanitizing cleaner. Change liners if needed.

f. Conference Room
   - Clean and polish conference room tables.
   - Vacuum all carpeted areas, including wall edges and around the edges of all furniture which is not easily moveable, this includes under desks, tables, chairs etc. All light weight furniture must be moved and vacuumed under. All electrical cords must be picked up and vacuumed under.
   - Spot clean anytime a stain or soiled area needs cleaning.
   - Vacuum chalk dust out of chalk tray. Wash chalkboard only if it has been erased by the Forest Service.

g. Copy Machine and Mail room area
   - Vacuum all carpeted areas, including wall edges and around the edges of all furniture which is not easily moveable, this includes under desks, tables, chairs etc. All light weight furniture must be moved and vacuumed under. All electrical cords must be picked up and vacuumed under.
   - Spot clean anytime a stain or soiled area needs cleaning.
   - Clean and polish table and counter tops.

3. <u>Services Performed Monthly - Bid Item #0003</u>

a. Dusting
   - Dust below a 5 foot level. Dust all horizontal and vertical surfaces including but not limited to furniture, baseboards, wood molding, windowsills, bookcases, ledges, signs, wall hangings, photographs, fire alarm boxes, exhibits, top edge of privacy partitions, excluding desktops and computers.

b. Offices
   - Vacuum all carpeted areas, including wall edges and around the edges of all furniture which is not easily moveable, this includes under desks, tables,

chairs etc. All light weight furniture must be moved and vacuumed under. All electrical cords must be picked up and vacuumed under.

- Spot clean anytime a stain or soiled area needs cleaning.
- Tile floors sweep and mop, use a cleaner that doesn't require rinsing and is a sanitizer and will not damage the wax.

c. Outside Foyer and Adjacent Areas

- Sweep outside area around all outside doors and adjacent area.
- Pick up any trash laying within 100 feet on the outside of the office building and parking area. This includes all the bushes and trees.

4. Services Performed Annually - - Bid Item #0004

a. Dusting above 5 feet

- All horizontal and vertical dust catching surfaces shall be kept free of obvious dust, dirt, and cobwebs. Dust furniture in all offices above the 5 foot level, including, but not limited to tops of high bookcases and top edge of privacy partitions.

b. Windows

- Clean all windows and screens inside and outside of building, with an appropriate glass cleaner. Removing screens on windows that have screens for cleaning.

c. Blinds

- Dust, clean and/or vacuum all window blinds. Vinyl blinds may require a liquid cleaner and blinds with fabric may require vacuuming. Clean in accordance with manufacturer's recommendations by type of fabric or material.

d. Chairs

- Vacuum all upholstered chairs.
- Clean all vinyl covered chairs with an appropriate cleaner for vinyl.
- Clean chair legs and/or pedestal bases on all the chairs in the office.
- Wood chairs use an oil, such as lemon oil.

e. Door and Door Frames

- Clean with appropriate wood/metal cleaner and apply a good penetrating oil to the wood doors.

E Measurement Error in FPDS

Though the FPDS data are broadly appealing for research, there is measurement error in the data. Examining the stream of entries under each contract suggests that user input error can be significant. For example, the initial entry for the contract may report the completion date to be equal to the start date of the contract, even though a later entry shows that the contract was for a longer period. Likewise, there are inconsistencies in how the dollar values of the contract are reported across entries. As most contracts have multiple entries and multiple indicators of duration and value within each entry, different assumptions about data quality could lead to widely different measures of price. As I obtained high-quality measures of price and duration from a second data source, FedBizOpps, I was able to cross-validate the data and construct preferred measures from the FPDS.

E.1 Cross-Validating Initial Entries in FPDS with Realized Contracts

Obtaining a quality measure of initial contract value is important. In this paper, I examine how this value shifts with contract duration. As another example, recent papers study cost overruns, or charges over and above the initial contract value (see, e.g., Decarolis et al., 2020). In my sample, I have found the initial measures of total contract value taking directly from the FPDS to be unreliable. This is likely due to entry error, as FPDS data are not automatically generated directly from the signed contracts.

To account for this potential measurement error, I obtained a sample of 75 realized contracts from FedBizOpps that had finalized terms for price, duration, and total contract value. By comparing the terms on the contract to what is reported in FPDS, I am able to to get a sense for the degree of measurement error.

Each entry in FPDS has three measures of value: dollars obligated, base and exercised options value, and base and all options value. The first corresponds to the accounting amount owed at the time of the action, the second should correspond to the total value of future payments for the options that have been exercised, and the third should correspond to the full value of all options on the contract. The third measure is the greatest of the three (except for additional input error), so, as a conservative measure, I consider this the initial reported value in FPDS.[6] Using the other two measures exacerbates the measurement error I show below.

Comparing the initial entries to actual contract terms shows that the initial contract value reported in FPDS does not accurately measure the initial contract value. Figure E1 shows the initial reported contract value in FPDS plotted against the actual initial value obtained directly from the contract. The plot is in log terms, and the 45-degree red line indicates an exact correspondence between the two values. Points lying below the red line indicate underreporting. 45

[6] Instructions from the FPDS user manual corresponding to this variable: "Enter the mutually agreed upon total contract or order value including all options (if any). For modifications, this is the change (positive or negative, if any) in the mutually agreed upon total contract value." https://fpds.gov/wiki/index.php/FPDS-NG_User_Manual

Figure E1: Measurement Error in FPDS Initial Entries

Notes: Figure displays the (log) contract value according to the initial entry in the Federal Procurement Data System (FPDS) versus the actual initial (log) contract value. The actual initial contract value was obtained for a sample of 75 completed contracts from the analysis sample. Roughly three-quarters of the points lie below the 45-degree line (plotted in red), which indicates systematic underreporting in the FPDS relative to the true contract value. The initial measure from the FPDS corresponds to "Base And All Options Value", which is the largest of the three measures reported in each FPDS entry.

of the 75 contracts show underreporting in the initial entry in the FPDS. The median (mean) difference is -1.099 log points, corresponding to a 67 percent difference.

Examining each of the 75 contracts shows that measurement error arises from a variety of inconsistencies in how data are entered into FPDS. One error that occurs with some frequency is that the user enters only the contract value for that fiscal year, rather than the full value of the contract. In the sample of 75 contracts, the median duration is 3 years, so applying this error across all the contracts would result underreporting of 67 percent as above. Because the typical building cleaning contract is 3 to 4 times longer that the average service contract, this error may be of more importance for this category relative to other service contracts; however, other forms of entry error could also lead to systematic underreporting.

Another common entry error is that the user enters the amount of dollars obligated across all three of the variables for contract value, rather than indicating the total value of the contract using base and all options value. Table E1 provides an example of the first five entries in FPDS corresponding to a single contract. The entry for the total value is equivalent to the dollars obligated in the first entry ($10,740), as well as in all following entries. According to the posting on FedBizOpps on January 26, 2010, the total value of the five-year contract ("Contract Award Dollar Amount") was $54,300. This is equal to the sum of dollars obligated across all 13 entries in FPDS for the contract. The amounts entered in FPDS in these cases are best interpreted as accounting measures for past and current payments, rather than future obligations that capture

Table E1: Entries in FPDS for an Example Contract

modnumber	reasonformodification	effectivedate	ultimatecompletiondate	dollarsobligated	baseandalloptionsvalue
0		1/1/2010	12/31/2014	10740	10740
1	C: FUNDING ONLY ACTION	12/8/2010	12/8/2010	2700	2700
2	M: OTHER ADMINISTRATIVE ACTION	4/14/2011	9/30/2011	900	900
3	C: FUNDING ONLY ACTION	5/6/2011	9/30/2011	4500	4500
4	C: FUNDING ONLY ACTION	10/18/2011	3/31/2012	5415	5415
...	...	...	...	...	...

Notes: Table displays the first five entries in FPDS corresponding to contract PIID AG0276P100005. This contract illustrates a typical entry mistake in FPDS, where the user enters the same amount for dollars obligated and the total value of the contract (base and all options value). On the FedBizOpps website, a posting dated January 26, 2010 states the total value of the five-year contract ("Contract Award Dollar Amount") of $54,300. The total of dollars obligated across all 13 entries in FPDS is equal to this value.

total contract value.

E.2 Constructing Accurate Measures of Contract Value

Though the initial entry is not reliable for estimating the total contract value, additional measures can be obtained from the FPDS that perform well. For example, if the same value of dollars obligated are reported in consecutive years, then that value likely represents the annual price of the contract. In supplemental work, I detail the steps to cross-check the data and different candidate measures for price and duration. These comparisons result in the following recommendations:

Duration *The maximum observed date in the contract, minus the start date in the first entry within a contract.*

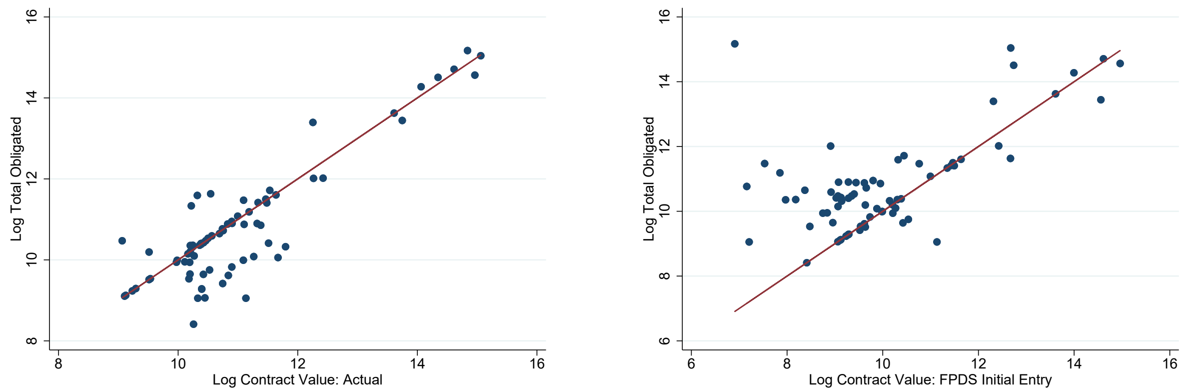
Price *The price is the value of obligated dollars if it is the same (or within 10 percent) in consecutive years. If this is not observable, use the maximum value of the three (summed) measures of dollar amounts for the total value of the contract. Divide this by the duration measure above to obtain the price.*

Any missing values of price or duration in the FedBizOpps data are imputed with the above values constructed from FPDS. Researchers interested working with the FPDS data may contact the author for additional details about the measurement error in the FPDS data and the accuracy of variables constructed under alternative assumptions. Though these measures are not completely free from measurement error, the cross-validation exercise suggests that they are centered on the true value, as opposed to being systematically underreported. These measures are most applicable to fixed-price contracts, where the ex post payments are not subject to the same degree of uncertainty as, for example, cost-plus contracts.

Figure E2: Cost Overruns or Measurement Error?

(a) Total Obligated vs. Actual Contract Value

(b) Total Obligated vs. FPDS Initial Value



Notes: Figure displays the (log) total payments on a contract (total obligated) vs. two different measures of initial contract value. Total payments are calculated from summing up dollars obligated across entries in the FPDS. Panel (a) compares total payments to the actual value obtained for a sample of 75 completed contracts. Panel (b) compares total payments to the initial reported contract value in the FPDS for the same sample. Points lying above the 45-degree line (plotted in red) correspond to inferred cost overruns. The median implied overrun in panel (a) is 0. The median implied overrun in panel (b) is 0.242 log points, or 27 percent. The fact that many of the points (61 percent) lie above the 45-degree line in panel (b) arises from the measurement error in the initial FPDS entry, which is captured in Figure E1.

E.3 Is There Evidence of Cost Overruns?

Examining the initial contract value from a sample of contracts provides further evidence that ex post incentive concerns may not be first-order for building cleaning services. One indicator of ex post incentive problems is the presence of cost overruns, or payments above and beyond the initially agreed-upon amount.

By calculating the total amount paid on an individual contract and comparing it to the total amount, we can examine whether the buyer (the government) ends up paying more in cost overruns. The sample of 75 contracts used to benchmark these figures all finished before the end of the data, so the total amounts reflect the full time series of payments.

Figure E2 examines cost overruns by plotting the (log) total amount obligated on the contract against measures of the initial value of the contract. The red 45-degree line indicates exact correspondence between the initial value and the total payments. Panel (a) compares the total payments to the actual initial value of the contract. The total payments follow the initial value of the payments quite closely. A regression of (log) total obligated on (log) initial contract value returns a coefficient of 0.99. The median cost overrun in the sample, defined as the difference between the two logged values, is zero.

Panel (b) compares the total payments to the total value according to the initial entry in FPDS. The median implied overrun is 0.242 log points, or 27 percent. The majority of points

(61 percent) lie above the 45-degree line, suggesting a substantial degree of cost overruns. Likewise, the 75 percentile of implied overruns is 1.27 log points, compared to only 0.05 log points when using the actual initial value in panel (a). The fact that this panel suggest cost overruns is a direct result of measurement error in the initial entry in FPDS. The underreporting showing in Figure E1 translates to implied cost overruns. Measurement error is further captured by a regression of (log) total obligated on (log) contract value according to the initial entry in FPDS. The coefficient estimate is only 0.57, compared to 0.99 when a more accurate measure of initial value is used.

Thus, a comparison of payments made to actual initial contract value demonstrates that cost overruns are not a significant concern for this product category (building cleaning services with an annual price less than $1 million). This provides suggestive evidence that ex post incentive concerns are not first-order in this market.

F A Model with Microfoundations

In the empirical application of this paper, I employ a "reduced-form" approach to a capturing how the distribution of private costs changes with T. Here, I provide a model of underlying costs that generates both the distribution of costs and how duration affects the distribution. Suppose that instantaneous costs follow an Ornstein-Uhlenbeck diffusion process. The continuous-time cost process X_t is governed by the differential equation

$$dx_t = \theta(\mu - x_t) + \gamma dW_t$$

where W_t is a Wiener process. This process is stationary over t. That is, any contract with duration T will have the same unconditional distribution as any other contract with duration T. Define the average cost over time T as

$$c_T = \frac{1}{T}\int X_t dt$$

Then c_T is Gaussian with mean μ and variance $\sigma^2 = \frac{1}{T^2}\frac{\gamma^2}{\theta^3}\left(\theta T + e^{-\theta T} - 1\right)$. When costs are Gaussian, $E[c_{1:N}(\sigma)] = E[z_{1:N}]\sigma + \mu$, where z is a standard normal.

First, consider the efficient contract. Let $\xi(T) = \sigma = \sqrt{\frac{1}{T^2}\frac{\gamma^2}{\theta^3}\left(\theta T + e^{-\theta T} - 1\right)}$. For ease of exposition, assume $\beta = 1$. The efficient contract T solves

$$\min_T E[z_{1:N}]\xi(T) + \mu + \frac{\delta}{T}.$$

As $E[z_{1:N}]$ is negative and the variance of c_T is decreasing with T, the average expected supply cost $\mu + E[z_{1:N}]\xi(T)$ is increasing with T. In this microfounded model, the increasing supply costs over many periods is due the idiosyncratic variation over time. The mean expected supply cost for each bidder, μ, is constant over time.

Likewise, the same analysis applies to the buyer-optimal contract when $N > 3$. The buyer solves the same problem where the second-order statistic $E[z_{2:N}]$ is substituted for $E[z_{1:N}]$. For $N \in \{2, 3\}$, $E[z_{2:N}] > 0$.

F.1 Relating Competition to Contract Duration

The first-order condition from the problem above is

$$\begin{aligned} E[z_{1:N}]\xi'(T) &= \frac{\delta}{T^2} \\ -\xi'(T)T^2 &= -\frac{\delta}{E[z_{1:N}]}. \end{aligned} \tag{3}$$

In this case, we obtain a monotonic relationship between the number of bidders and the optimal duration, as N has a monotonic effect on the right-hand side. Unlike the U-shape models, the microfounded model here does not have a lower bound on costs.

Proposition 3. *The efficient duration is decreasing in the number of bidders.*

Proof. $\frac{d}{dT}\left(-\xi'(T)T^2\right) = -2T \cdot \xi'(T) - T^2\xi''(T)$. Combining the second-order conditions and first-order conditions, we obtain.

$$\begin{aligned} E[z_{1:N}]\xi''(T) &> -\frac{2}{T}E[z_{1:N}]\xi'(T) \\ \implies T^2 \cdot \xi''(T) &< -2T\xi'(T) \end{aligned}$$

An increase in N increases the RHS of equation 3. As $\frac{d}{dT}\left(-\xi'(T)T^2\right) < 0$, the optimal T falls. □

We now turn to the buyer-optimal contract, which solves the same problem where the second-order statistic $E[z_{2:N}]$ is substituted for $E[z_{1:N}]$.

Proposition 4. *The buyer-optimal duration is decreasing in the number of bidders. It is optimal for the buyer to issue a permanent contract for $N \in \{2,3\}$.*

The permanent contract result follows from the fact that the second-order statistic is greater than zero with a small N.

Additionally, we have that $E[z_{1:N}] < E[z_{2:N}]$. Therefore,

Proposition 5. *The efficient duration is less than the buyer-optimal duration.*

G Likelihood Function

For estimation, we obtain the likelihoods for Y_n and N given by

$$f_{Y_n|N,X,T,M} = \int f_{B_n|T,N}(\frac{y}{U}\frac{1}{h(\boldsymbol{x})})\frac{1}{U}\frac{1}{h(\boldsymbol{x})} f_{U|N,T,\boldsymbol{x},\boldsymbol{m}}(U)dU$$

$$\Pr(N = n|T,\boldsymbol{x},\boldsymbol{m}) = \int \Pr(N = n|U,T,\boldsymbol{x},\boldsymbol{m}) f_{U|T,\boldsymbol{x},\boldsymbol{m}}(U)dU$$

For estimation, I make the assumption that $U \perp\!\!\!\perp (X, M)$. As U is not observed by the buyer when setting T, $U \perp\!\!\!\perp (T,\boldsymbol{x},\boldsymbol{m})$. This simplifies the problem so that $f_{U|T,\boldsymbol{x},\boldsymbol{m}}(U) = f_U(U)$. The conditional distribution of U used in the likelihood of Y_N is given by $f_{U|N,T,\boldsymbol{x},\boldsymbol{m}}(u) = \frac{\Pr(N=n|U,T,\boldsymbol{x},\boldsymbol{m})f_U(u)}{\Pr(N=n|T,\boldsymbol{x},\boldsymbol{m})}$. This simplifies so that the joint contribution is given by

$$\begin{aligned} f_{Y_n|N,X,T,M}(y_n) \cdot \Pr(N = n|T,\boldsymbol{x},\boldsymbol{m}) &= \left(\int f_{B_n|T,N}(\frac{y}{u}\frac{1}{h(\boldsymbol{x})})\frac{1}{u}\frac{1}{h(\boldsymbol{x})} f_{U|N,T,\boldsymbol{x},\boldsymbol{m}}(u)du\right) \Pr(N = n|T,\boldsymbol{x},\boldsymbol{m}) \\ &= \left(\int f_{B_n|T,N}(\frac{y}{u}\frac{1}{h(\boldsymbol{x})})\frac{1}{u}\frac{1}{h(\boldsymbol{x})} \frac{\Pr(N = n|u,T,\boldsymbol{x},\boldsymbol{m})f_U(u)}{\Pr(N = n|T,\boldsymbol{x},\boldsymbol{m})}du\right) \Pr(N = n|T,\boldsymbol{x},\boldsymbol{m}) \\ &= \int f_{B_n|T,N}(\frac{y}{u}\frac{1}{h(\boldsymbol{x})})\frac{1}{u}\frac{1}{h(\boldsymbol{x})} \Pr(N = n|u,T,\boldsymbol{x},\boldsymbol{m})f_U(u)du. \end{aligned}$$

With the assumption that the shock ε is independent of $(U,T,\boldsymbol{x},\boldsymbol{m})$, we have the following expression for conditional probability of N.

$$\begin{aligned} \Pr(N = n|U,T,\boldsymbol{x},\boldsymbol{m}) &= F_{\ln\varepsilon}\left(\ln E[\pi_n|T] + \ln h(\boldsymbol{x}) + \ln U - \ln k(\boldsymbol{m})\right) \\ &\quad - F_{\ln\varepsilon}\left(\ln E[\pi_{n+1}|T] + \ln h(\boldsymbol{x}) + \ln U - \ln k(\boldsymbol{m})\right) \end{aligned}$$

I use the joint likelihood of Y_n and N to obtain estimates for cost and entry parameters.

G.1 A Computational Innovation

In this setting, there is a symmetric equilibrium in which each bidder has a monotone bid function $\beta(\cdot;n)$ mapping private costs to the submitted bid. The density of an observed bid is given by

$$f_b(b;n) = f_c(\beta^{-1}(b;n))\frac{1}{\beta'(\beta^{-1}(b;n))}$$

In maximum likelihood estimation of the cost distribution, it is necessary to invert the bid function to calculate the density. This can be computationally intensive when β does not have a closed-form solution.

In the presence of unobserved heterogeneity, the density of the observed bid $\tilde{B} = B \cdot U$ is given by the convolution when $B \perp\!\!\!\perp U$.

$$\begin{aligned} f_{\tilde{b}}(\tilde{b}) &= \int_{\underline{u}}^{\overline{u}} f_b\left(\frac{\tilde{b}}{u}\right)\frac{1}{u}f_u(u)du \\ &= \int_{\underline{u}}^{\overline{u}} f_c\left(\beta^{-1}\left(\frac{\tilde{b}}{u};n\right)\right)\frac{1}{\beta'\left(\beta^{-1}\left(\frac{\tilde{b}}{u};n\right)\right)}\frac{1}{u}f_u(u)du \end{aligned}$$

Here, the computational burden increases greatly. Integrating out the unobserved heterogeneity means that the bid function must be inverted for each value of u within the integral in order to calculate $\beta^{-1}\left(\frac{\tilde{b}}{u};n\right)$. As the inverse bid function has an analytic solution for only a few specialized cases, in practice this computation relies on a non-linear equation solver or an approximation. Thus, the calculations are constrained by the efficiency and accuracy of such an approach.

One easy-to-implement solution that makes maximum likelihood significantly more tractable is to use a change-of-variables to calculate the density. Instead of integrating out the unobserved heterogeneity by integrating over u, replace u with $u = \frac{\tilde{b}}{\beta(c)}$ and integrate over c. The density then becomes:

$$\begin{aligned} f_{\tilde{b}}(\tilde{b}) &= \int_{\underline{u}}^{\overline{u}} f_c\left(\beta^{-1}\left(\frac{\tilde{b}}{u}\right)\right)\frac{1}{\beta'\left(\beta^{-1}\left(\frac{\tilde{b}}{u}\right)\right)}\frac{1}{u}f_u(u)du \\ &= \int_{\psi^{-1}(\underline{u})}^{\psi^{-1}(\overline{u})} f_c\left(\beta^{-1}\left(\beta(c)\right)\right)\frac{1}{\beta'\left(\beta^{-1}\left(\beta(c)\right)\right)}\frac{\beta(c)}{\tilde{b}}f_u\left(\frac{\tilde{b}}{\beta(c)}\right)\left(-\frac{\tilde{b}}{\beta(c)^2}\beta'(c)\right)dc \\ &= \int_{\underline{c}}^{\overline{c}} f_c\left(c\right)f_u\left(\frac{\tilde{b}}{\beta(c)}\right)\frac{1}{\beta(c)}dc \end{aligned}$$

Note that in this form, there is no need to invert the bid function. As the general form for the symmetric equilibrium bid function is

$$\beta(c) = c + \frac{\int_c^{\infty}[1-F(z)]^{n-1}}{[1-F(c)]^{n-1}},$$

the primary computational cost is a numerical integration routine. Therefore, the model is computationally tractable for a vast class of parametric distributions of C and U, as well as nonparametric approximations such as B-splines. This innovation can also apply to models with additively separable unobserved heterogeneity as well. When $\tilde{B} = B + U$, then

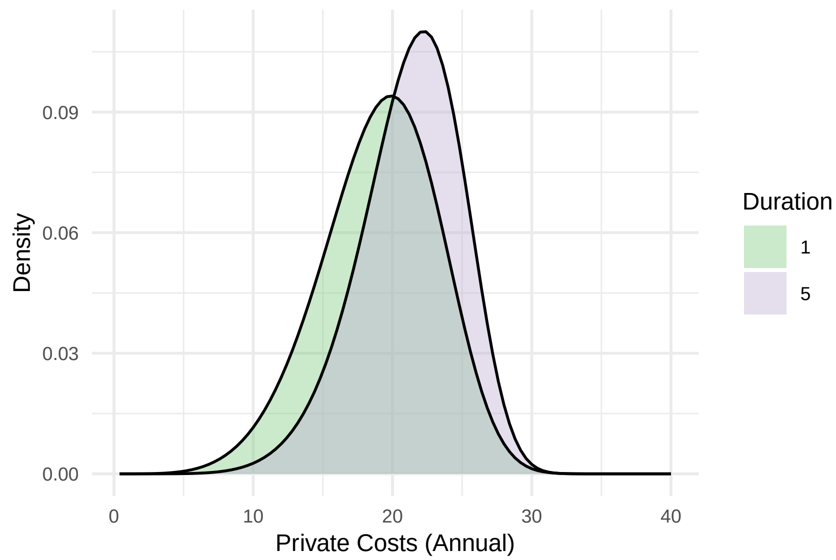
$$f_{\tilde{b}}(\tilde{b}) = \int_{\underline{u}}^{\overline{u}} f_c\left(\beta^{-1}\left(\tilde{b}-u\right)\right)f_u(u)du = \int_{\underline{c}}^{\overline{c}} f_c\left(c\right)f_u\left(\tilde{b}-\beta(c)\right)\left(-\beta'(c)\right)dc.$$

H Supplemental Empirical Results

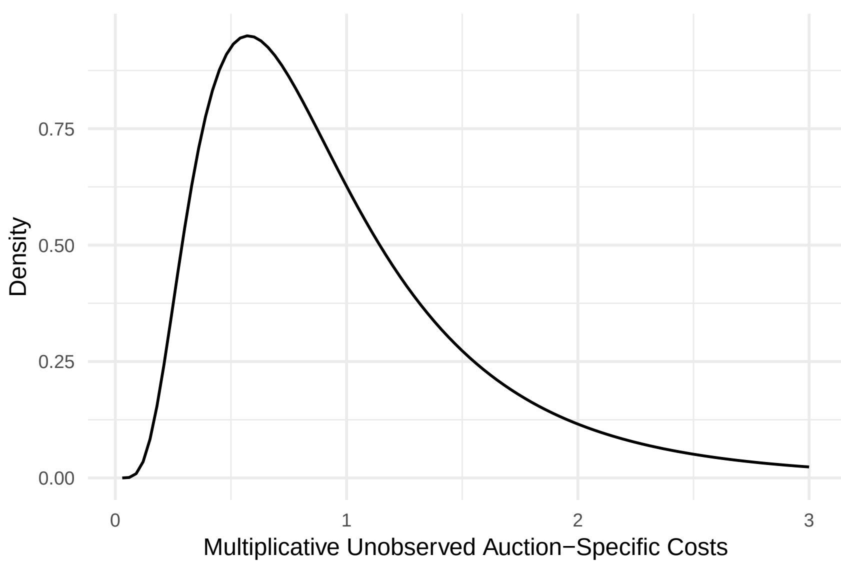
H.1 Distributions of Bidder Costs

Figure H1: Distribution of Bidder Costs

(a) Duration-Dependent Private Costs



(b) Unobservable Auction-Specific Heterogeneity



Notes: The figure plots the distributions of the unobservable components of bidder costs. Private costs are displayed in panel (a), and the density of unobserved auction-specific heterogeneity is displayed in panel (b). In panel (a), the density is plotted for a one-year contract and a five-year contract. The estimated parameters indicate an increasing mean and a decreasing variance in private costs with contract duration. The density shifts smoothly between these functions for intermediate values of duration.

H.2 Projecting Transaction Costs on Location Type and Agency

Table H1: Dependent Variable: ln(Transaction Costs)

	(1)		(2)	
Location Type: Accommodations	1.436	(0.278)	0.249	(0.219)
Location Type: Airport	0.414	(0.264)	0.543	(0.203)
Location Type: Field Office	0.027	(0.125)	0.068	(0.095)
Location Type: Industrial	1.150	(0.325)	0.331	(0.254)
Location Type: Medical	1.530	(0.256)	0.294	(0.201)
Location Type: Office	0.000	(.)	0.000	(.)
Location Type: Research	0.371	(0.157)	0.232	(0.120)
Location Type: Services	0.180	(0.207)	0.005	(0.158)
Location Type: Technical	1.403	(0.272)	0.285	(0.212)
Location Type: Visitors	0.784	(0.196)	0.319	(0.152)
Department: Agriculture	0.309	(0.123)	−0.183	(0.096)
Department: Commerce	0.559	(0.177)	0.292	(0.137)
Department: Defense	0.000	(.)	0.000	(.)
Department: GSA	1.577	(0.240)	0.418	(0.189)
Department: Homeland Security	1.645	(0.217)	0.650	(0.171)
Department: Interior	0.440	(0.193)	−0.095	(0.149)
Department: Other	1.071	(0.252)	0.256	(0.195)
Department: Veterans Affairs	0.177	(0.235)	0.404	(0.180)
ln(Square Footage)			0.601	(0.026)
ln(Weekly Frequency)			0.431	(0.059)

Notes: The table displays results for regressions of estimated (log) transaction costs on location type and department, with additional controls in specification (2). $N=1{,}046$. Standard errors in parentheses.

H.3 Incumbency and Asymmetries

In this section, I present regressions for the dependent variables of price and the number of bids, including an indicator for whether or not a single incumbent bidder was identified from a previous contract. That is, the indicator equals one if building cleaning services for the same agency and 9-digit ZIP code were performed by a single supplier in the previous year. The coefficient on this variable is not significant, and its inclusion does not meaningfully impact the estimated coefficients.

Table H2: Descriptive Regressions: Incumbency Check, Price

	IV-1 (a)	IV-1 (b)	IV-1 (c)	IV-2 (a)	IV-2 (b)	IV-2 (c)
Number of Bids	−0.053	−0.052	−0.052	−0.047	−0.046	−0.046
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Duration (Years)	0.043	0.043	0.043	0.033	0.033	0.033
	(0.016)	(0.016)	(0.016)	(0.015)	(0.015)	(0.015)
ln(Square Footage)	0.689	0.688	0.688	0.687	0.686	0.686
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
ln(Weekly Frequency)	0.467	0.467	0.467	0.407	0.407	0.407
	(0.041)	(0.041)	(0.041)	(0.040)	(0.040)	(0.040)
ln(2004 Unemp.)	0.080	0.080	0.080	0.060	0.060	0.060
	(0.019)	(0.019)	(0.019)	(0.018)	(0.018)	(0.018)
High-Intensity Cleaning	0.559	0.559	0.559	−0.076	−0.076	−0.077
	(0.075)	(0.075)	(0.075)	(0.125)	(0.125)	(0.125)
Follow-On Contract		0.018			−0.003	
		(0.053)			(0.050)	
Incumbent Winner			0.012			−0.008
			(0.106)			(0.100)
Site Type FEs				X	X	X
Observations	1046	1046	1046	1046	1046	1046
R^2	0.69	0.69	0.69	0.73	0.73	0.73

Notes: The table displays regression results for regressions of log annual price on auction characteristics and local market characteristics. Specifications IV-1 (a) and IV-2 (a) are two-stage least squares regressions and are identical to the descriptive regressions in Table 2. The (b) specifications include an additional regressor indicating whether the contract is a follow-on contract and the (c) specifications include an indicator for whether the contract was won by an incumbent bidder in a follow-on contract. Standard errors in parentheses.

Table H3: Descriptive Regressions: Incumbency Check, Number of Bids

	(1)	(2)	(3)	(4)	(5)	(6)
Duration (Years)	−0.002	−0.005	−0.009	−0.002	−0.005	−0.009
	(0.099)	(0.099)	(0.099)	(0.100)	(0.100)	(0.100)
ln(Square Footage)	0.834	0.835	0.840	0.825	0.824	0.829
	(0.106)	(0.106)	(0.106)	(0.112)	(0.112)	(0.112)
ln(Weekly Frequency)	0.009	0.014	0.010	0.137	0.146	0.141
	(0.253)	(0.253)	(0.253)	(0.257)	(0.258)	(0.257)
ln(2004 Unemp.)	−0.794	−0.809	−0.813	−0.793	−0.808	−0.811
	(0.238)	(0.239)	(0.239)	(0.238)	(0.238)	(0.238)
ln(Unemployment)	1.420	1.432	1.436	1.356	1.366	1.370
	(0.231)	(0.231)	(0.231)	(0.231)	(0.231)	(0.231)
ln(Num. Firms in Zip3)	0.257	0.248	0.250	0.276	0.267	0.269
	(0.148)	(0.148)	(0.148)	(0.147)	(0.147)	(0.147)
Generic Set-Aside	1.134	1.125	1.131	0.987	0.982	0.985
	(0.350)	(0.350)	(0.350)	(0.361)	(0.361)	(0.361)
High-Intensity Cleaning	−0.294	−0.303	−0.305			
	(0.475)	(0.475)	(0.475)			
Follow-On Contract		−0.351			−0.353	
		(0.326)			(0.326)	
Incumbent Winner			−0.836			−0.814
			(0.650)			(0.646)
Site Type FEs				X	X	X
Observations	1046	1046	1046	1046	1046	1046
R^2	0.17	0.17	0.17	0.19	0.19	0.19

Notes: The table displays regression results for regressions of number of bids on auction characteristics and local labor market variables. Specifications (1) and (4) are equivalent to the descriptive regressions (3) and (4) in Table 3. The additional specifications included indicators for whether the contract is a follow-on contract or whether the contract was won by an incumbent bidder in a follow-on contract. Standard errors in parentheses.

H.4 Detailed Impacts of Standardized Duration

Table H4: Percent Impact of Uniform Term Policies

$\bar{T}$	Affected	Price	Trans. Cost	Total Cost	Count
1	All	−11.2	317.1	33.7	1046
	$T > \bar{T}$	−11.8	334.2	35.5	995
	$T < \bar{T}$	1.5	−36.6	0.6	23
2	All	−7.5	108.5	9.0	1046
	$T > \bar{T}$	−8.7	125.4	10.0	930
	$T < \bar{T}$	4.1	−50.5	2.3	62
3	All	−3.9	39.0	2.9	1046
	$T > \bar{T}$	−6.3	61.8	3.4	761
	$T < \bar{T}$	5.1	−42.6	2.7	146
4	All	−0.4	4.3	1.3	1046
	$T > \bar{T}$	−3.2	24.0	0.7	686
	$T < \bar{T}$	6.0	−39.1	2.9	306
5	All	3.1	−16.6	1.5	1046
	$T > \bar{T}$	−2.0	12.2	0.3	18
	$T < \bar{T}$	6.9	−36.8	3.3	478

Notes: The table displays the average percent changes (by contract, not in aggregate) in total costs, prices, and annualized transaction costs when all contracts are issued in standardized durations corresponding to $\bar{T}$. For a uniform duration policy of 4 years or less, the average price paid decreases and the amount spent on transaction costs increases. The final column lists the count of the affected contracts. The first column indicates the group affected by the policy. Rows corresponding to $T > \bar{T}$ pertain to all contracts that see a reduction in duration, and the reported effects are equivalent to a policy that caps duration at $\bar{T}$.