

On-line Data Appendix for “Procurement Contracting with Time Incentives: Theory and Evidence”

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January 3, 2011

1 Data Sources

We compiled data from three main sources, and a single auxiliary source:

1. **Special Provisions:** For each contract that is let, Caltrans publishes in advance a set of special provisions for that contract. These augment (or replace, where indicated) the standard specifications that apply to all contracts. We obtained the special provisions for all non-emergency contracts let in the sample period. This is publicly available at

http://www.dot.ca.gov/hq/esc/oe/project_ads_addenda/

These are usually a pdf of approximately 200 pages. We converted these to text, and extracted the relevant sections (see Figure 1). Text parsing software allowed us to extract the provisions relating to time of completion and liquidated damages. Since the lane closure restrictions are depicted in graphical form (middle panel), for these and the re-opening penalties (bottom panel) we hand-coded this data for all A+B eligible contracts, and for a stratified random sample of 10% of the remaining standard contracts.¹ We imputed the data for the remaining contracts.² See the notes below for how the hand-coding of these variables worked.

¹(See main paper for the definition of “A+B eligible”).

²The imputed data is used only in the counterfactual simulations.

2. **Bid Summaries:** Sometime after the awarding of the contract, Caltrans publishes a summary of the bids for each contract. The data is available at

<http://www.dot.ca.gov/hq/esc/oe/planholders/bidsum.php>

This data includes the location and description of the project, the design engineer's estimate of the project cost, the engineer's estimate of the project duration, and bidder names, addresses and bids. It also includes the funding source, so we can classify a project as federal or not. A typical bid summary is shown in Figure 2. It is in pdf form, so we converted it to text and then used a text parsing algorithm written in Python to extract the relevant data.

3. **Payment Vouchers:** Throughout the contract, Caltrans makes payments to the contractor for parts of the work done. These payments are publicly available and are summarized in payment vouchers, available at

<http://www.dot.ca.gov/hq/asc/oap/payments/public/ctnums.htm>

Once a contract is complete, a final payment voucher is issued. This voucher summarizes all payments made during the contract, and this is what we use in the analysis. It is a text file, and again we extract the relevant variables by text parsing. The final payment files give a breakdown of the working days, weather days and other days over the course of the project, as well as the contract start and end date. This is shown in the top panel of Figure 3. They also show any deductions charged during the life of the contract, as in the bottom panel of Figure 3.

4. **Traffic Spreadsheets:** Caltrans' traffic office publishes annual traffic statistics measured at each of a number of road markers. We used the 2008 measures at

<http://traffic-counts.dot.ca.gov/index.htm>

to construct our traffic measures, and the 2007 measures at the same URL to construct the percentage of trucks at each location.

We extracted all the relevant data on the Caltrans website, and merged it using a contract-level identifier.³ We then narrowed down the data to a coherent sample frame, consisting of all contracts let between 2003 and 2008 (this is based on the date the bids were opened, a variable obtained from the bid summaries). We excluded contracts that were neither standard nor A+B contracts, such as those that used other forms of time incentives (e.g. lane rentals). We excluded contracts with missing engineer’s estimate, engineer’s days estimates or missing traffic. This was a small proportion of our data.⁴ We excluded contracts in the type of work categories ”other”, ”retrofit”, ”sealing” and ”new freeway”, because the A+B design was rarely used in those categories.⁵ We restricted our attention to the districts that frequently employ the A+B design (they are SF Bay Area (4), Fresno (6), Riverside/San Bernadino (8), San Diego (11) and Orange County (12)). This formed our dataset.

2 Notes on Variable Construction

Table 1 presents all the variables used in the analysis, with definitions and data sources. Some of the variables were more difficult to construct, and so we present detailed notes on their construction:

- (a) **Lane Closure Fraction and Re-opening Penalty** The charts shown in the middle panel of Figure 1 are typical: they outline, for each day of the week, how many lanes the contractor can charge at each hour of the day. To form the variable ”Lane Closure Fraction”, we pick a typical chart (if there are multiple charts), and look at the average number of lanes that may be closed during a Monday (in the example, 2). We then form an estimate of the total number of lanes on the highway, as the maximum of 2 (if a single-lane highway), 3 (if a multi-lane highway) and $\max(\text{lanes closed}) + 1$. The logic for the latter is that Caltrans would be unlikely to allow the whole highway to be closed, so if say 3 lanes could be closed at midnight, then there must be at least 4 lanes for 1 lane to be open. So in the example, we would code the Lane Closure Fraction as $2/3$ rd. The re-opening penalty is straightforward to code based on the language

³We were careful to drop instances where a bid letting was held but the contract was not actually awarded.

⁴We dropped 5% of the observations, overwhelmingly due to cases where we were unable to match contract location to traffic markers. This was often because contract location was missing in the bid summary.

⁵The exception is ”new freeway”, but in that case there was no externality of the type we consider in the paper (i.e. a delay to commuters on an existing freeway).

of the "late reopening of closures" clause (in this case a "1", since there is an explicit monetary penalty).

- (b) **Type of Work** The description of the contract work is given in the bid summary. For example, for the bid summary shown in Figure 2, it is "upgrade barrier". Using text-parsing methods, we automatically grouped each of the contracts into one of 11 categories (barriers, bridge repairs, bridge resurfacing, construction, new freeway, rehabilitation, retrofitting, sealing, slope work, widening and realignment and other). Only some of these categories were used in the analysis. For the A+B and A+B eligible contracts, all of these automatic assignments were manually checked.
- (c) **Working, Weather and Other Days** Contract, working, weather and other days are shown in the final payment file. For example, in the final payment voucher shown in the top panel of Figure 3 shows 197 contract days, 200 working days, 47 weather days and 3 other days. The resident/project engineers are responsible for entering these variables, and they are a little idiosyncratic in their data entry. For example, in this contract we know that no liquidated damages were charged (from the deductions). We deduce that the contract was on time and took 197 working days, implying that they included the 3 other days in the working days. To correct for these various differences in coding, we automated a procedure that calculated the mostly likely working days actually taken based on the observed working day, contract day, weather day, other day and contract-change order day information, as well as whether any liquidated damages were charged, and the start and end dates of the contract. In the case of the A+B and A+B eligible contracts this data was manually checked and corrected as necessary. In the main paper we only use this information for the A+B eligible contracts (in the program evaluation section), so all the relevant information has been manually checked.
- (d) **Quality Deductions** Deductions are recorded in the final payment file, as in the bottom panel of Figure 3. Not all deductions relate to the quality of the construction work — for example there are purely bureaucratic deductions for missing documentation, there are liquidated damages for late completion, and there are penalties for labor violations. We exclude all of these to focus in on those relating to cases where contractors have used too little or substandard materials, or failed other quality tests. For example, in the case shown in Figure 3, the contractor is charged for "failed compact tests" and out of specification contract. This data is again manually checked and entered.

Table 1: Sources and Definitions of Variables used in the Analysis

| Variable | Unit | Sample | Source | Definition |
|--------------------------|----------|--------|----------------------|---|
| Engineer's Estimate | \$ | All | Bid Summaries | Design engineer's estimate of the project cost. Advertised to bidders before bidding. |
| Bids | \$ | All | Bid Summaries | The total \$ bids placed by all bidders on a project. Is the basis for award in a standard contract, and forms the A-part of the score in an A+B contract. |
| Day Bids | Days | A+B | Bid Summaries | The days bids in an A+B contract. Is multiplied by the usercost to form the B-part of the score in an A+B contract. |
| Number of Bidders | Firm | All | Bid Summaries | Number of bidders who submit bids in the auction. |
| Engineer's Days Estimate | Days | All | Bid Summaries | Design engineer's estimate of the project length, in working days (i.e. excluding weekends, holidays, weather and other days). Is the contract deadline in standard contracts, and is usually specified as an upper bound on the days bid in an A+B contract as part of the special provisions. Often missing in the bid summaries for A+B contracts, in which case we got it from the special provisions or payment files. |
| Daily Traffic | Vehicles | All | Traffic Spreadsheets | Average annual daily traffic (AADT) near the contract location. Obtained by taking a distance-weighted average of the AADT between the adjacent mile markers, where the AADT at the mile markers comes from the spreadsheet. |

| | | | | |
|-----------------------|-------------|-----------|-----------------------|---|
| Truck Percentage | Vehicles | All | Traffic Spread-sheets | Percentage of trucks near the contract location. Obtained by taking a distance-weighted average of the truck percentage between the adjacent mile markers, where the truck percentage at the mile markers comes from the spreadsheet. |
| Lane Closure Fraction | Lanes | All | Special Provisions | The fraction of the total number of lanes on the highway that may be closed by the contractor during construction hours. See notes. |
| Reopening penalty | Binary | All | Special Provisions | A dummy variable indicating whether late reopening of a lane by the contractor (i.e. lane closure during hours prohibited by the contract) is penalized by contract suspension at the project engineer's discretion (coded as zero), or instead penalized by an explicit monetary period per period of time, usually 10-15 minutes (coded as a one). See notes. |
| Usercost | \$ | A+B | Bid Summaries | The weight on the days bid in the A+B scoring rule. |
| Type of Work | Categorical | All | Bid Summaries | Type of work, based on the project description in the bid summary. See notes. |
| Contract Days | Days | Completed | Final Payment | Total number of working days allowed for contract completion. See notes. |
| Working Days | Days | Completed | Final Payment | Working days actually taken during contract. See notes. |
| Weather Days | Days | Completed | Final Payment | Weather days allowed during contract. See notes. |
| Other Days | Days | Completed | Final Payment | Other days allowed during contract. See notes. |

| | | | | |
|--------------------|--------|-----------|---------------|--|
| Quality Deductions | \$ | Completed | Final Payment | Deductions charged for infractions relating to quality of materials, procedures etc. See notes. |
| Distance | Miles | All | Bid Summaries | Distance from contract site, in miles. Generated by calculating the straight-line distance between the bidder's address and the contract location (both from the bid summaries), by first geocoding the addresses and then applying the Haversine formula. |
| Firm Capacity | \$ | All | Bid Summaries | Capacity is defined by first summing up the total value of all contracts held at any point by a particular contractor (depreciating contract value linearly, so a \$10M contract that is 50% complete counts as \$5M), and then taking the maximum total value over our sample period. |
| Instate Contractor | Binary | All | Bid Summaries | Binary variable indicating whether the firm is located in California or not. Based on the address given in the bid summary. |
| Federal Contract | Binary | All | Bid Summaries | Is a binary variable indicating whether the contract is federally funded or not. Based on the funding source in the bid summary. |

SECTION 4. BEGINNING OF WORK, TIME OF COMPLETION AND LIQUIDATED DAMAGES

Attention is directed to the provisions in Section 8-1.03, "Beginning of Work," in Section 8-1.06, "Time of Completion," and in Section 8-1.07, "Liquidated Damages," of the Standard Specifications and these special provisions.

The Contractor shall begin work within 15 calendar days after the contract has been approved by the Attorney General or the attorney appointed and authorized to represent the Department of Transportation.

The work shall be diligently prosecuted to completion before the expiration of the **NUMBER OF WORKING DAYS BID** beginning on the fifteenth calendar day after approval of the contract.

The Contractor shall pay to the State of California the sum of \$7,300 per day, for each and every calendar day's delay in finishing the work after expiration of the number of working days bid.

| Chart No. 1 Multilane Lane Requirements | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|------|---|---|---|---|---|---|---|---|---|----|----|------|---|---|---|---|---|---|---|---|---|----|----|----|
| Location: Northbound/Southbound Route 280 – From Santa Clara County Line to Larkspur Drive Undercrossing in Millbrae | | | | | | | | | | | | | | | | | | | | | | | | | |
| FROM HOUR TO HOUR | a.m. | | | | | | | | | | | | p.m. | | | | | | | | | | | | |
| | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Mondays through Thursdays | 2 | 2 | 2 | 2 | 2 | 2 | | | | | | | | | | | | | | | 2 | 2 | 2 | 2 | |
| Fridays | 2 | 2 | 2 | 2 | 2 | 2 | | | | | | | | | | | | | | | 2 | 2 | 2 | 2 | |
| Saturdays | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | | | | | | | | | | | 2 | 2 | 2 | |
| Sundays | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | | | | | | | | | | | 2 | 2 | 2 | |
| Day before designated legal holiday | | | | | | | | | | | | | | | | | | | | | | | | | |
| Designated legal holidays | | | | | | | | | | | | | | | | | | | | | | | | | |
| Legend: | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 Two adjacent lanes open in direction of travel. | | | | | | | | | | | | | | | | | | | | | | | | | |
| No lane closure allowed. | | | | | | | | | | | | | | | | | | | | | | | | | |
| REMARKS: | | | | | | | | | | | | | | | | | | | | | | | | | |

LATE REOPENING OF CLOSURES

If a closure is not reopened to public traffic by the specified time, work shall be suspended in conformance with the provisions in Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications. The Contractor shall not make further closures until the Engineer has accepted a work plan, submitted by the Contractor, that will insure that future closures will be reopened to public traffic at the specified time. The Engineer will have 2 working days to accept or reject the Contractor's proposed work plan. The Contractor will not be entitled to compensation for the suspension of work resulting from the late reopening of closures.

For each 10-minute interval, or fraction thereof past the time specified to reopen the closure, the Department will deduct \$1300 per interval from moneys due or that may become due the Contractor under the contract.

Figure 1: **Special Provisions.** Clauses in the special provisions of contract number 04-270834 relating to time of completion and liquidated damages (top panel), which lanes could be closed at which times (middle panel) and the penalties for late lane re-opening (bottom panel).

STATE OF CALIFORNIA
 BID OPENING DATE 11/14/06
 CONTRACT NUMBER 04-270834
 LOCATION 04-SM-280-R0.0/R18.3

B I D S U M M A R Y
 IN SAN MATEO COUNTY FROM
 SANTA CLARA COUNTY LINE TO LARKSPUR
 DRIVE UNDERCROSSING IN MILLEREA

DEPARTMENT OF TRANSPORTATION
 BID245
 PAGE 1
 11/15/06
 CONTRACT CODE 'B'
 36 CONTRACT ITEMS

FEDERAL AID ACIM-280-1(110)E

UPGRADE BARRIER

DB GOALS: DISADVANTAGED BUSINESS ENTERPRISE - 0.0%
 PROPOSALS ISSUED 12 FUND TOTAL HA27 23,027,000 TOTAL NUMBER OF WORKING DAYS 197
 NUMBER OF BIDDERS 3 ENGINEERS EST 20,975,174.00 AMOUNT UNDER 5,077,855.00 PERCENT UNDER EST 24.21
 PROGRAM ELEMENTS PAS

| BID RANK | BID TOTAL | BIDDER ID | BIDDER INFORMATION (NAME/ADDRESS/LOCATION) |
|----------|-----------------|-----------|---|
| 1 A) | 15,897,319.00 | 3 | O C JONES AND SONS INC 510 526-3424 00750729 |
| B) | 197 DAYS X 7300 | | 1520 FOURTH STREET FAX 510 526-0990 |
| A+B) | 17,335,419.00 | | BERKELEY CA 94710 |
| 2 A) | 16,560,730.00 | 1 | R AND L BROSAMER INC 925 627-1700 00700218 |
| B) | 160 DAYS X 7300 | | 1777 OAKLAND BLVD STE 300 FAX 925 944-9860 |
| A+B) | 17,728,750.00 | | WALNUT CREEK CA 94596 |
| 3 A) | 18,150,777.00 | 2 | CALIFORNIA ENGINEERING CONTRACTORS INC 925 461-1500 00274632 |
| B) | 170 DAYS X 7300 | | 20 HAPPY VALLEY ROAD FAX 925 461-0510 |
| A+B) | 19,391,777.00 | | PLEASANTON CA 94566 |
| 4 A) | 18,261,864.00 | 5 | R G W CONSTRUCTION INC 925 606-2400 00591940 |
| B) | 266 DAYS X 7300 | | P O BOX 2910 FAX 925 961-1925 |
| A+B) | 20,203,664.00 | | LIVERMORE CA 94551 |
| 5 A) | 25,611,650.00 | 4 | DIABLO CONTRACTORS INC 925 552-8250 00732283 |
| B) | 300 DAYS X 7300 | | 7 CROW CANYON COURT STE 100 FAX 925 552-8254 |
| A+B) | 27,801,650.00 | | SAN RAMON CA 94583 |

Figure 2: Bid Summary. The first page of the bid summary for contract number 04-270834, showing the bids, engineer's estimate, contract description and location.

| PROGRAM CAS145 | | STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | | | | PAGE 4 | |
|--|--|--|-----------------|--------------------|------------------------|---------------------------------|-----------------------------------|
| DATE 04/07/08 | | | | | | 04-270834 | |
| TIME 01:18 PM | | | | | | ESTIMATE NO. 13 | |
| BID OPENING 11/14/06 | | PROJECT RECORD - ESTIMATE | | | | WORK PERFORMED THROUGH 12/21/07 | |
| R.E. NAME: LAYMOUN MOAID | | | | | | DATE OF THIS ESTIMATE 04/07/08 | |
| ITEM NO. | ITEM DESCRIPTION | UNIT | CONTRACT PRICES | ORIGINAL AUTH. AMT | THIS ESTIMATE QUANTITY | \$ AMOUNT | TOTAL ESTIMATE QUANTITY \$ AMOUNT |
| | SUBTOTAL CONTRACT ITEMS WITHOUT MOBILIZATION | | | | | 73,428.40 | 14,050,230.54 |
| | ADJUSTMENT OF COMPENSATION | | | | | 0.00 | 5,900.00 |
| | EXTRA WORK | | | | | 6,809.12 | 179,643.12 |
| | SUBTOTAL AMOUNT EARNED WITHOUT MOBILIZATION | | | | | 80,237.52 | 14,235,773.66 |
| 56 | MOBILIZATION | LS | 1585,000.0000 | 1,585,000.00 | | | 1.000 1,585,000.00 |
| | ORIGINAL CONTRACT AMOUNT | | | 15,897,319.00 | | | |
| | TOTAL WORK COMPLETED | | | | | 80,237.52 | 15,820,773.66 |
| | MATERIALS ON HAND ON SITE | | | | | | 0.00 |
| | MATERIALS ON HAND ELSEWHERE | | | | | | 0.00 |
| | DEDUCTIONS | | | | | 0.00 | 0.00 |
| | TOTAL | | | | | 80,237.52 | 15,820,773.66 |
| ITEMS FOR WHICH CONTRACT PRICE EXCEEDS MAXIMUM VALUE | | | | | | | |
| N O N E | | | | | | | |
| DATE CONTR APPROVED | CONTRACT DAYS | DATE WORK STARTED | BEGIN CONSTR | JOB COMPLETED ON | WORKING DAYS | WEATHER NON-WORKING DAYS | C.C.O. DAYS |
| 12/08/06 | 197 | 12/26/06 | 12/26/06 | 12/21/07 | 200 | 47 | 0 |
| OTHER DAYS 3 | | | | | | | |
| PERCENT COMPLETED 100% | | | | | | | |
| PERCENT TIME ELAPSED 100% | | | | | | | |
| LAYMOUN MOAID | | | | | | | |
| RESIDENT ENGINEER | | | | | | | |
| PROGRAM CAS145 | | | | | | | |
| DATE 04/07/08 | | | | | | | |

| | | | | | |
|-----------------------|--|--|------------------------|---------|----------------|
| PROGRAM CAS145 | | | SCHEDULE OF DEDUCTIONS | | PAGE NO. 1 |
| DATE 04/16/09 | | | EST. NO.61 | | |
| TIME 09:38 AM | | | | | |
| R.E. NAME: HSU, PAUL | | | 11-080914 | | |
| DEDUCTION DESCRIPTION | | | AMOUNT | EST NO. | THIS ESTIMATE |
| | | | | | TOTAL ESTIMATE |
| ADMINISTRATIVE | | | | | |
| CIDH PILE ANOMALIES | | | -1,600.00 | 11 | |
| CONC OUT-OF-SPEC | | | -1,103.10 | 11 | |
| OUT-OF-SPEC STR. CON | | | -1,371.60 | 19 | |
| OUT-OF-SPEC CL 2 AGG | | | -5,851.68 | 20 | |
| SHORT PILES | | | -800.00 | 25 | |
| SURVEY STAKE CHGS | | | -340.00 | 25 | |
| SURVEY STAKE CHARGES | | | -680.00 | 26 | |
| ASPH CONCRETE TYPE A | | | -51,620.60 | 28 | |
| CL II AGG BASE | | | -14,850.00 | 28 | |
| PCC PAVEMENT DEDUCT | | | -1,411.74 | 28 | |
| FAILED COMPACT TESTS | | | -1,248.32 | 36 | |
| NOPC 14 DRB REPORT | | | 5,580.20 | 36 | |
| OUT-OF-COMPL. EST 20 | | | 466.20 | 37 | |
| OUT-OF-COMPL. EST 28 | | | 318.00 | 37 | |
| ASPH CONC TYPE A | | | -846.40 | 47 | |
| AC STABILITY, COMP. | | | -4,688.21 | 52 | |
| CLASS II AB | | | -648.65 | 52 | |
| CONC THCKNS,CLNESS | | | -6,695.71 | 52 | |
| MATL OUT OF COMPLIAN | | | -693.03 | 58 | |
| CONC THCKNS, CLNESS | | | 5,630.42 | 60 | |
| | | | | | 0.00 |
| | | | | | -82,454.22 |

Figure 3: **Final payment Vouchers.** The top panel shows the bottom of the final payment voucher for contract number 04-270834, indicating contract days, working days etc. The bottom panel shows the top of the final payment voucher for contract number 11-080914, a contract in which many deductions relating to the quality of the work being done were charged.