# Contract Design, Supply Chain Complexity, and Accountability in Federal Contracts

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# Purpose



- Supply chains are fundamentally complex (Vachon and Klassen, 2002; Galbraith 1973)

- Are supply chains managed differently based upon the susceptibility of the supply chain to
  - Endogenous disruptions?
  - Exogenous disruptions?

- Contract design as a risk management strategy

# Supply Chain Risk



- Endogenous
  - Supply risks
    - Resource related
  - Demand risks
    - Market related
  - Complexity of the product, number of exchange partners exacerbates risk (Flynn and Flynn 1999)
  - Might be decreased by the firm (Folta 1998)
- Exogenous
  - Discrete events (Trkman and Mccormack 2009)
    - Unpredictable shocks
  - Continuous risks
    - More stable e.g., political environment
  - Largely unaffected by firm actions (Folta 1998)

# Risk Management Strategies



- Endogenous risk management
  - *Supply risks:* Hedge (multiple suppliers), internally produce
  - *Demand risks:* Postpose production, maintain inventory (Manuj, Esper, and Stank 2014)
  - Share information with SC partners

- Exogenous risk management
  - Assume and internalize risk
  - Mutual understanding of risks among partners to lower transaction costs as much as possible (Weber and Mayer 2014)
  - Flexibility in contract, contingency plans (Brown, et al 2015)

# Public Sector Supply Chains



- Public managers tend to be more externally focused (Frumkin and Galaskiewicz 2004)
- Inefficient SC can thrive if valued by/benefit powerful actors (Kim and Brown 2010; Eckerd and Snider 2016)
- Public sector SC behave more/less like private sector depending upon exogenous disruption
- Contract design as a risk management strategy

| | Low exogenous risk | High exogenous risk |
|---|---|---|
| **Low endogenous risk** | Fixed price | Idiosyncratic to product |
| **High endogenous risk** | Cost reimbursement | Incentive/award fee |

# Hypotheses



1) Fixed price contracts will be favored over other contract types when both *endogenous risk and exogenous risk are low*.

2) Cost reimbursement contracts will be favored over other contract types when *endogenous risk is high and exogenous risk is low*.

3) Award/incentive fee contracts will be favored over other contract types when both *endogenous risk and exogenous risk are high*.

# Data



Source: FPDS-NG

22 product/service contracts FY2000-2014

Sample size: 274,440 contracts

| Product Category | PSC | NAICS | Number of Contracts | Product complexity |
|---|---|---|---|---|
| Solid waste collection | S205 | 562111 | 17,907 | 3.08 |
| Landscaping | S208 | 561730 | 37,774 | 3.16 |
| Laundry and dry cleaning | S209 | 812320 | 8,051 | 3.26 |
| Janitorial service | S201 | 561720 | 47,058 | 3.30 |
| Court reporting | R606 | 561492 | 19,940 | 3.51 |
| Warehousing and storage | S215 | 493110 | 2,104 | 3.61 |
| Security guard and patrol | S206 | 561612 | 25,522 | 3.77 |
| Advertising | R701 | 541810 | 5,445 | 4.43 |
| Auditing | R704 | 541211 | 2,682 | 4.77 |
| Legal service | R418 | 541110 | 9,732 | 4.97 |
| Professional and management training | U008 | 611430 | 12,816 | 5.02 |
| Equipment maintenance and repair | J099 | 811310 | 5,971 | 5.22 |
| Program management and support | R408 | 541611 | 12,401 | 5.62 |
| Logistics support | R706 | 541614 | 3,175 | 5.63 |
| Program review and development | R409 | 541611 | 615 | 5.87 |
| Engineering | R425 | 541330 | 55,822 | 6.76 |
| Computer system development | D302 | 541512 | 4,196 | 7.58 |
| Weapons-basic research | AC51 | 541710 | 578 | 7.60 |
| Defense aircraft - basic research | AC11 | 541710 | 880 | 7.94 |
| Defense aircraft - engineering development | AC14 | 541330 | 122 | 8.46 |
| Weapons - applied R&D | AC52 | 541710 | 659 | 8.60 |
| Defense aircraft - applied R&D | AC12 | 541710 | 990 | 8.66 |

Source: Kim, Roberts, and Brown 2016

# Measures and Method



**Dependent variable**

- *Contract pricing type:* 1 Fixed price, 2 Incentive/award fee, 3 Cost reimbursement, 4 Time and material

**Explanatory variables**

- *Endogenous risk:*
  - *Product complexity*
- *Exogenous risk:*
  - *Contract value*: total dollars obligated (log)
  - *Market competition*: number of offers received (log)
  - *Competitive limitation*: coded 1 if the contract is a set aside

**Control variables**

- *Contract length*: total length of contract in years
- *Unrestricted competition:* coded 1 if full and open
- *DOD*
- *FY dummies*

**Method**

- Multinomial logistical regression, robust SE, clustered at IDV level

# Results



| Hypotheses | Findings |
|---|---|
| *H1*: Fixed price contracts will be favored over other contract types when both *endogenous risk and exogenous risk are low.* | Partial Yes<br>Complexity (-)<br>Contract value (-) |
| *H2*: Cost reimbursement contracts will be favored over other contract types when *endogenous risk is high and exogenous risk is low.* | Partial Yes<br>*Complexity (+)*<br>Contract value (+FP/-AI) |
| *H3*: Award/incentive fee contracts will be favored over other contract types when both *endogenous risk and exogenous risk are high.* | Partial Yes<br>Complexity (+FP/-CR)<br>*Contract value (+)* |

# Discussion



- Endogenous risk
  - Fixed price more likely for less complex products/services
  - Cost reimbursement more likely for most complex products/services

- Exogenous risk
  - If characterize high dollar value as a proxy for political attention, then incentive/award fee most likely
  - If characterize market strength as a proxy for political attention, then results are not clear

- Findings suggest relationship between varying types of SC risk and contract design choices

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