Cost Overruns and Defense Contracting

Jennifer Leotta

Outline

- Introduction
- Contracting Basics
- Optimal Share Ratio: The Weitzman Model
- Two Cases: CPIF and CPFF
- Implications
- Conclusions

Introduction

- US Government spent $439.3B on Defense systems in FY2007
- Almost twice the amount that the EU spends on defense ($292.7B)
- Spent more than 8X the official military budget of China

DoD Contracting Basics

- Contract Vehicle
  - Cost Reimbursable
  - Fixed Cost
- Fee structure
  - Fixed Fee
  - Incentive Fee

Cost Reimbursable	Fixed Cost
Cost Plus Fixed Fee (CPFF)	Firm Fixed Price (FFP)
Cost Plus Incentive Fee (CPIF)	Firm Price Incentive Fee (FPIF)

See Federal Acquisition Regulation (FAR) 5000.2 for more details

DoD Contracting Basics (Cont.)

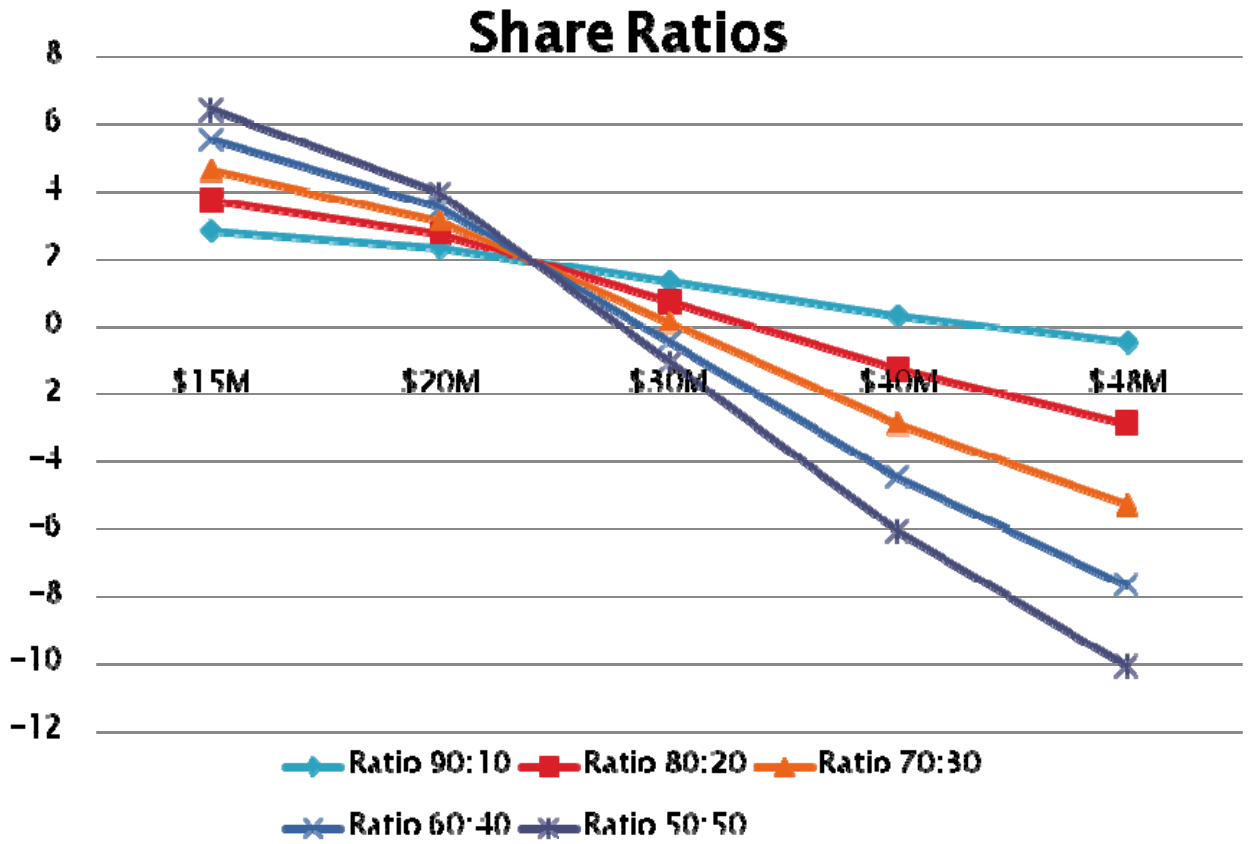
- Payout for Incentive Fee Contracts:

$$AP = K + (1-s)\,X$$

- Where:
  - AP= Adjusted Profit
  - K= Base Profit
  - s = Contractor's share ratio
  - X = Final Project Cost

- **When s = 0; Cost Plus**
- **When s = 1; Fixed Price**

DoD Contracting Basics (Cont.)



- Share ratios "share" the risk of cost overruns between the contractor and the government
  - Lower the share ratio the more risk the contractor takes on, more potential reward

Optimal Share Ratio

- Weitzman Model (March 1980; Quarterly Journal of Economics)

- Uses the following inputs:
  - Contractor Risk Profile (ϕ)
  - Government Risk Profile (ψ)
  - Elasticity (responsiveness of final cost in changes to share ratio) (α)
  - "Noise" measurement (σ/θ)
  - Probability of different states of the world (ρ)

Optimal Share Ratio (Cont.)

- Optimal Share Ratio Equations

$$s = \frac{\alpha}{\alpha - 1 + \mu}$$

$$\mu = 1 + \frac{\sqrt{\rho(1-\rho)}\,(\phi - 1)}{1 + \rho(\phi - 1)}\,\frac{\sigma}{\theta} + 1 + \frac{\sqrt{\rho(1-\rho)}\,(\psi - 1)}{1 + \rho(\psi - 1)}\,\frac{\sigma}{\theta}$$

Optimal Share Ratio (Cont.)

- Weitzman's Assumptions
  - Government is risk-neutral ($\psi=1$)
  - Contractor is risk-seeking ($\phi > 1$)
  - Elasticity is 10% ($\alpha=0.1$)
  - Noise level is varied from 2.5% to 80% ($0.025<\sigma/\theta<0.80$)

Optimal Share Ratio (Cont.)

- My Assumptions
  - Government is risk-adverse ($\psi < 1$)
  - Contractor is risk-seeking ($\phi > 1$)
  - Used Monte Carlo Simulation to determine elasticity (α) and "noise" (σ/θ)

Program X: CPIF Case

- Shipboard System
- Period of Performance 1995-1999 (47 month duration)
- SDD had a 50:50 share ratio and base profit of 8%
- Target Cost: $16.8M
- Final Cost: $34.1M

- **Total overrun in SDD= 203%**

Program X: CPIF Case (Cont.)

- Finding the Optimal Share Ratio
  - Varying the contractor and government risk measurements
  - Varying the probability (ρ)
  - $\alpha = 0.5866$ (at the 80% Confidence Level)
  - $\sigma/\theta = 0.4605$ (at the 80% Confidence Level)

Program X: CPIF Case (Cont.)

- Taking the average of the share ratios; the Optimal Share Ratio was 81.2%

- The government assumed the contractor was more risk-seeking than they were

Program Y: CPFF Case

- Unmanned Aerial System (UAS)
- Period of Performance 2006-present (21 month duration)
- Fixed fee contract with a profit of 8.5%
- Target Cost: $6.3M
- Final Cost: $9.5M

- **Total overrun in SDD= 151%**

Program Y: CPFF Case (Cont.)

- Finding the Optimal Share Ratio
  - Varying the contractor and government risk measurements
  - Varying the probability (ρ)
  - $\alpha = 0.302$ (at the 80% Confidence Level)
  - $\sigma/\theta = 0.3595$ (at the 80% Confidence Level)

Program Y: CPFF Case (Cont.)

- Taking the average of the share ratios; the Optimal Share Ratio was 74.8%

- The government assumed the contractor was less risk-seeking than they were

Program X and Program Y

- Different Fee structures; both had overruns
- Government misinterpretation of contractor's risk valuation?
- Or does fee structure not matter?

Fixed Fee Vs. Incentive Fee

- Looking at other DoD programs:

- Average overrun of 210%
- Both CPIF and CPFF programs had extreme overruns

Fixed Fee Vs Incentive Fee (Cont.)

- Take a broader look at 64 DoD contracts

- (from Office of Secretary of Defense (OSD) Cost Analysis Improvement Group (CAIG) Study)

- **Cost overruns are persistent across different services, phases, and contract type**

Implications

- What is the problem?

- Unstable Requirements
- Contractor has Other Incentives
- Unwillingness of Government to Cancel program

Implications (Cont.)

- Setting Stable Requirements:
  - Need to be able to tie the incentive to one aspect of the requirements
  - Variety of threats faced by DoD: Programs are prone to obsolesence
  - Length of contracting process

Implications (Cont.)

- Other Incentives:
  - Contractor's upper management incentives heavily tied into stock price of company
  - Executive Compensation (CEO) for 6 major defense contractors (blue is short term incentives and purple is long term incentives):

    - With options, stock is 47% of CEO pay

Implications (Cont.)

- Unwillingness of government to cancel program
  - Government wouldn't cancel programs because it needs them for national defense
  - Very few sources (companies) who can accomplish certain necessary programs (ex. Shipbuilding)
  - Job losses from plant closures
- Example of this: V-22 Osprey program

Conclusions

- The fee structure of the program has little to do with cost overruns
- More effective incentive would be to tie contract to the contractor's stock price
- Government must have stable contract requirements
- Government must be able to make a credible threat of program termination to really control cost overruns