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Choice of Contract Type and Other Policy Initiatives for Reducing Contract Prices

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Executive Summary

In 2010, in the face of mounting budget pressure, Defense Secretary Gates tasked the Department of Defense (DoD) to seek top line cost efficiencies, primarily through the reduction of low-priority overhead expenses of up to 3 percent per year. Towards this end, the Director, Defense Procurement and Acquisition Policy (DPAP), Office of the Under Secretary of Defense (Acquisition, Technology and Logistics), planned to strengthen the cost efficiency incentives inherent in the contract type selection and profit guidelines used in buying goods and services. It was in this context that the Institute for Defense Analyses (IDA) performed analyses for DPAP of contract type choice and other policy levers to reduce contract prices to the government. The contract-type focus was on alternatives to Firm Fixed Price (FFP) contracts, particularly Fixed-Price Incentive Fee (FPIF) contracts.

Analysis Topics and Approach

IDA's analyses focused on three distinct but related subject areas:

1. Contract-type choice and savings incentives in the serial production of a major defense acquisition program (MDAP),
2. Incentives and other initiatives for reducing overhead (indirect) expenses, and
3. Issues associated with contracting for services including contract-type mixes and fee levels.

Our analyses built on existing literature and models. The literature included both theoretical and empirical economics as well as reporting of industry experience. The quantitative models treated the contractors' value maximizers. Given this and the incentives presented in different contracting scenarios, we conducted simulation experiments to gauge the sensitivities of outcomes to different assumptions. Our empirical analyses were focused on characterizing the choice of contract types across goods and service categories as well as the build-up of negotiated fees for goods and service categories and contract types.

Summary of Findings

We came away from our analyses with a number of findings of interest to DoD policy makers. We present the summary of findings according our three major topic areas.

Contract-type choice and savings incentives in the serial production for an MDAP

For a series of production contracts in which the system design is mature and stable, the best choice of contract type is FFP. The FFP contract provides the most incentive for the contractor to invest in cost-reducing innovations, as the contractor can keep more of the value of the cost savings in comparison to an FPIF contract.

Government-funded investments in cost saving appear to have limited value to the government relative to an FFP base case. There are potential benefits in limited (although possibly high-value) cases in which the government can pre-commit the contractor to savings over an extended number of contracts (e.g., a multi-year procurement case) and/or when FFP contracts are otherwise ill advised.

Incentives and other initiatives for reducing overhead (indirect) expenses

Given a portfolio of fixed price and cost type contracts, contractor incentives indicate an underinvestment in cost reductions for indirect costs. However, there are problems with targeting overhead costs directly. A more promising approach to addressing the underinvestment in indirect cost reductions would be to target total costs for the entire contract portfolio of a contractor or a business unit. To manage and incentivize cost reductions across such extensive portfolios would require modifications to the current approach to acquisition and contract management. We found a useful exemplar for such changes in the way the automotive Original Equipment Manufacturers (OEMs) manage their tier-one suppliers.

Issues associated with contracting for services

For service contracts, it is more difficult to specify and measure the quantity and quality of outputs. Services are more labor intensive and may be less susceptible to cost-reducing innovations. The challenges associated with government contracting are exacerbated for service contracts because of contract incompleteness and measurement problems. In our empirical investigation we found the general pattern of contract types across service categories was consistent with expectations. However, we did find a very low incidence of FPIF contracts relative to FFP contracts. There were two somewhat surprising empirical findings.

The first was the degree to which goods contracts had higher negotiated fees relative to service contracts, where the higher fees were only partially explained by the differences in objective values from the weighted fee guidelines. These variations could be explained by the degree of competition in each service category relative to goods. These findings are somewhat disturbing, as, on average, negotiated fees should be driven by the objective fee values and not by the market power of the contractors involved in negotiation.

The second surprise was related to the first. Even with the lower negotiated fees associated with services, an examination of financial data for large service contractors found margins similar to those for the large primes that are overrepresented in goods contracting. One explanation of this disconnect is that there are informational rents due to contract incompleteness and the measurement problem associated with service contractors; this would particularly be the case for FFP contracts.

Implications for Government Policy and Practice

- FFP contracts are most appropriate for series production of weapon systems with a stable design;
- Although Production Improvement Programs may not be appropriate for FFP contracts, there are specific instances such as multi-year procurements and/or incentive contracts in which they can be of value;
- To rein in overhead costs, the government should look for ways to incentivize cost reductions across portfolios of contracts;
- The apparent disconnect between negotiated fees and objective fee build-ups related to the market power of the contractors involved should be addressed;
- For service contracts, the low incidence of FPIF contracts relative to FFP contracts and the apparent existence of informational rents indicate that a shift from FFP to FPIF contracts may be beneficial to the government.[1]

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[1] The conditions that make FFP contracts superior to FPIF contracts in the series production of weapons systems would largely be absent in services contracting.

Contents

1. Introduction

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A. Analysis Topics and Approach

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Our analyses built on existing literature and models. The literature included both theoretical and empirical economics, as well as reporting of industry experience. The quantitative models assumed that contractors are motivated by value maximization. Given this and the incentives presented in different contracting scenarios, we conducted simulation experiments to gauge the sensitivities of outcomes to different assumptions. Our empirical analyses were focused on characterizing the choice of contract types across goods and service categories as well as the build-up of negotiated fees for goods and service categories and contract types.

The analyses looking at serial production for MDAPs (the first area above) were performed in the context of the "weapon system franchise" model that is primarily valid for contracting for equipment purchases where prices are negotiated based on costs. Analyses regarding indirect cost reductions (the second area above) are also relevant to the franchise model and series production, but also have broader application to most goods and services contracting. The franchise model is generally not relevant to service contracting (the third area), although an important part of our services analyses was the comparison of contract-type choices and negotiated fees between services and goods contracts. The more general challenge, arising from agency problems and transactions costs associated with government contracting, is relevant to all three subject areas. Both the franchise model and contract design are discussed in more detail below.

B. Theoretical Framework

1. The Weapon System Franchise Model

A useful description of the weapon system franchise case is provided in Dominy et al. (2011); the weapon system franchise:

> begins with "development" of the system, followed by serial production over a period that can continue for as long as 20 years. Typically, two (or very occasionally more) firms compete for an Engineering and Manufacturing Development (EMD) contract. The EMD process results in a detailed design of the system; design and production of the tooling and equipment, and sometimes facilities, needed to produce the system; and building of "production representative" units of the system for testing. Successive annual lots are then purchased using a series of separate negotiated contracts. Multi-year contracts (covering production of three to five annual lots) may be used in place of annual contracts once the system has reached maturity. These contracts ordinarily are firm fixed price and are typically placed with the firm that won the EMD contract on a sole-source basis. This is the most common case; it is typical, for example, of acquisition programs for aircraft, ships, tactical missiles, and combat vehicles.

The idea is that economic rents flowing from the series of sole-source FFP contracts will act as a "prize;" the existence of prizes provides an incentive for contractors to engage in innovation that provides them the highest probability of winning a franchise (Rogerson 1989).

2. The Agency Problem and Contract Design

The contract design literature is a rich set of analytical frameworks built on foundations of agency, auction, and transactions cost theories (Davis et al. 2013). Agency theory aims to help the principal—in this report, the government buyer—design a contract with the agent, i.e. the contractor seller, that counteracts information asymmetry and moral hazard. In the case of information asymmetry, the contractor has an information advantage regarding its cost efficiency. Unlike commercial items, DoD buyers cannot use markets to price an acquisition of military-unique goods or services. Information asymmetry can lead to informational rents accruing to the contractor, as the contract is priced too high relative to the contractor's cost level.

Moral hazard is created by a contract that cannot induce the contractor to put anything but the minimum effort towards delivering the desired contract outcome. It can be created independently of information asymmetry. For example, a cost plus fixed fee (CPFF) contract provides the contractor with its fee regardless of the outcome of the contract. The contractor has no incentive to exceed the minimum effort required to meet the contract specification, particularly with respect to reducing the contract cost. The CPFF contract is not structured to motivate execution at the lowest cost, since the fee is independent of contract outcome. An FFP contract allows the firm to receive all of the savings of reducing the cost. Under the FFP contract, however, the firm bears all of the cost risk, and if it is risk averse, this will not be acceptable.[1] It can be shown that to inhibit moral hazard, assuming symmetric information, the optimal contract is neither CPFF nor FFP, but rather one whose price is a complex function of the contract cost (Rogerson 1995).

In addition to risk transfer, the CPFF contract provides advantages in the case of high degrees of contract incompleteness and high transaction costs. Incomplete contracts occur when the range of material outcomes cannot be specified in the contract. In an FFP contract, a high degree of incompleteness could mean costly and disruptive cycles of renegotiation.

C. Organization of the Report

Chapters 2–4 treat the three analysis topics individually. In Chapter 2 the emphasis is on simulation modeling, where the main subject is the choice of FFP vs. FPIF contracts in the context of sole-source serial production. There is also a side analysis looking at the efficacy of government-funded investments to reduce costs. Chapter 3 examines the drivers of overhead costs in the context of both DoD and broader industry and formulates possible overhead cost reduction approaches that focus on total cost. Chapter 4 presents empirical analyses of contract-type mixes and negotiated fees that focus on services contracting with implications across goods and services contracting. Chapter 5 summarizes findings across the three topics, including policy implications.

[1] We ignore for now that the contractor might accept an FFP contract for a risky project if the cost includes sufficient provision for cost growth (i.e., management reserve). This type of pricing is complicated in the context of contracts subject to the Truth in Negotiations Act (TINA).

2. Incentives for Cost Reductions in Serial Production Contracts

A. Introduction

This chapter introduces and answers the question of which contract type is best for motivating firms to invest effort and financial resources to reduce the production cost in serial procurements and ultimately lower the price paid by the government. The analyses are within the context of the more general discussion of contract theory in Chapter 1. In a production procurement program, the government would like for its contractors to constantly seek lower-cost ways of producing goods or services; however, the contractor will only invest labor and capital in finding and implementing cost innovations if it expects to receive a suitable rate of return. Furthermore, while cost reductions that both the government and contractor know about can be incorporated into the contract price (and, if needed, the specification), it is not possible for the government to *specify* the contractor's direct effort towards further cost-reducing innovations. This is endemic to the agency problem. Motivating the firm in this direction requires explicit or implicit contract incentives.

This analysis will use quantitative modeling to predict the effectiveness of cost incentives in production contracts. Specifically, the cost reduction incentives in the most common types of fixed price contracts, FFP and FPIF, will be compared. The model uses theoretical insights presented in Chapter 1 to examine a simple question: after a contract is awarded, will the firm exercise its option to invest in one of the projects from its menu of cost-reduction projects?

One of the shortfalls of contract design theory is that it looks at the incentive effects in isolation of other factors such as the nature of the inter-temporal contracting relationship between the government buyer and seller. For example, a weapon system is developed under a cost reimbursable contract and produced under a series of fixed price contracts. The application of agency models to repeated contracts captures some of the effects of serial contracting relationships and is a key element of the model used in this study.

The focus in this chapter will be on the production phase of a weapon system acquisition program in the context of a weapon system franchise. Inter-temporal effects within the production phase are important and drive key aspects of the comparison. Other effects, such as competition, are not included in the model. Also not included are treatments of indirect costs in the context of a portfolio of contracts a firm may hold;

indirect cost issues are dealt with in Chapter 3. Though this study is a modeling effort without empirical verification, the analytical approach is simple enough and is aimed at developing testable findings that can be verified by examining contract cost data.

The agency model outlined in Chapter 1 focuses on a single contract; what happens when it is applied to a procurement program that is broken up into a series of procurement contracts? The optimal contract design for a single period would be an efficient design if the buyer could commit to the entire procurement with a single contract—for example, with price *P*. For many reasons, the government cannot commit to a long-term contract and must break up the total production acquisition into N yearly purchases of size *P/N*. Without full commitment, if the firm agreed to the price P/N and thereby revealed its cost level, the government would negotiate to a lower price in the next contract. Without renegotiation, information asymmetry can lead to informational rents accruing to the contractor as the contract could be priced too high relative to the contractor's cost level. Of course the firm knows that the government will not commit and will renegotiate once the firm's cost level is revealed, and thus will not agree to the first contract price of P/N. This is the so-called "ratchet effect," where firms are reluctant to reduce costs in dynamic contracting relationships since they fear that the buyer will insist on lower prices before the contractor has recovered its full return on investment.

In practice though, prices for sequential lots of weapon systems are often observed to decline. One explanation is that the decline is attributable to transient informational asymmetries that arise between the time actual costs are revealed and new contracts are negotiated. While this may not be by design in the weapons acquisition arena, in public utilities regulation this "regulatory lag" is a cost-reduction incentive. The regulator reviews the utility's costs and sets a price or rate of return that is in effect for some period of time—the "lag." During the intervening period the utility can invest capital and effort to reduce its costs, knowing that it will be able to retain all savings until the next regulatory review. Longer "regulatory lags" lead to higher profits on any cost-reducing innovation.

The preceding economic analyses lead to five key assumptions about contractor behavior towards its decision to invest capital and effort towards reducing costs:

- The government and firm agree to a negotiated contract cost that is believed to be close to what the actual cost will be.[2]

[2] This implies that the contractor will not agree to a contract cost that requires it to discover lower costs to make a profit equal to its contracted fee. This is reasonable given that the TINA attempts to keep the contract cost based as closely on actual costs as possible.

- The firm has the option to seek and implement cost reductions, and on FFP contracts can claim all residual profits that accrue due to these reductions for a given contract.
- The firm will only exert effort or spend capital on cost-reducing innovations if it expects to at least earn its required cost of capital on the action.
- The firm expects that the government will reduce the price of any future contracts by the amount indicated by cost savings revealed through cost reporting.
- The firm is aware of any lags between when future contracts are negotiated and costs are reported on the current contract and the resulting opportunity the reporting lag provides to earn extra profit from cost-reducing innovations on future contracts as well as the current contract.

It is taken for granted that cost reductions are not contractible, i.e., the amount of cost reduction cannot be a written requirement, because it is not possible to contract for effort that is not observable (asymmetric information). Thus, cost reductions are motivated through incentives either explicitly or implicitly embedded in the contract. The cost incentive is explicit in an FPIF contract while it is implicit in an FFP contract. In the latter type, the contractor has the right to claim all residual cost reductions as incremental profit. A side analysis was also performed examining the effects of direct government funding of cost-reducing investments. These investments are sometimes referred to as Production Improvement Programs (PIPs) or Cost Reduction Initiatives (CRIs),

The added variable with repeated procurements is the speed with which cost information is provided to the government. FPIF contracts require earned value management reporting which leads to fast reporting to the government, while for FFP contracts high-frequency reporting may not be standard. It should be noted that even if the government receives cost data in near real time, there still may be a lag because of the long cycle time associated with producing weapon systems. For example, if after a year into a contract no production items have been delivered, the cost data available may be too incomplete to be useful in negotiating the next contract in the annual cycle.

Thus, there are at least three factors within the contracting relationship that determine whether the government can successfully reap the benefit of contractor cost reductions:

- The first is the efficiency with which the contracting office accumulates cost and technical information relevant to the acquisition program and assimilates this information for negotiations on follow-up contracts.
- The second factor is whether the contract has sufficient incentive to motivate the contractor to allocate resources towards making production cost innovations.

- The third factor is how long it takes for the contractor's cost reductions to be revealed to the buyer.

In this chapter, services are not directly addressed, although the analysis applies to a service that is contractible to the same degree of completeness as a production good. Later in this report, the question of whether FFP contracts are appropriate for services will be addressed. The next section covers the modeling analysis in more detail.

B. Modeling Cost Reduction Incentives

This analysis makes the common assumption that the contractor is motivated to maximize its profits. There is a long- and short-term view to this behavior. A contractor might be willing to expend great effort, possibly in excess of the cost reimbursed by the government, to improve the outcome of a CPFF contract because it will lead to future high-profit opportunities in the future. Contractor behavior in repeated procurements of production items is more complicated due to the agency conflict described earlier. A contractor who is uncertain whether investment in cost savings will be recovered will be inhibited towards making what would otherwise be profitable investments.

The analysis is best explained through a procurement example. Consider the government's procurement of an MDAP such as a tactical aircraft. By developing a competition-winning design, the contractor earned the sole source role to produce the system in a series of procurement contracts that are negotiated each year (i.e., the weapon system franchise model). Assume that the contractor retained ownership of the design rights so that subsequent procurement lots are not open to competition from other aircraft producers. The procurements are still subject to competition, though mainly in the form of substitutes.

The comparison of different fixed price (FP) contract types centers around the full rate production phase after design and process verification is complete. For the lots procured through low rate initial production (LRIP), the contractor and government are usually making too many changes for the contractor to be willing to accept an FFP contract type or for the government to completely specify an FFP contract. Assume in this example that the design is complete and the main specification of the contract is the number of units of a good that can be completely specified.

1. A Single Period Model

At the beginning of the series of procurement contracts, under this scenario, the contractor has a list of cost-reduction projects in which it can invest in once the contract is signed. The contractor does not necessarily share the list with the government.[3] This is in contrast with cases in which the government and contractor have a shared list of cost-reduction initiatives funded in part by the former. It is more common that the contractor would be the sole owner of the list of projects.

Once the contract is signed (in the case in which each contract covers a single production period), the contractor is faced with the decision to invest in some, all, or none of the projects. The key decision variables are the project's investment (*I*), the projected per-period savings (*S*), the number of production periods/contracts in which the savings result in increased profits (*m*), and the loss to future profits when the cost savings are revealed and subtracted from future production-period profits (the fee rate *f* multiplied by *S*) as the cost basis is lowered in contract negotiation. The general setup is the same as in Bronson (2009). Mathematically at the i^{th} production period, of a total of N periods/contracts, the decision rule is to invest if its net present value (NPV_i) of the associated incremental cash flow is greater than zero:

$$NPV_i = -I_i + S_i \sum_{k=i}^{m} B^k - fS_i \sum_{k=i+m}^{N} B^k \quad (1)$$

NPV(cost savings project) = PV(incremental savings) – PV(lost fee on savings in future periods)-Project investment ≥ 0

In the formula, *B* is the discount factor, i.e., shorthand for 1/(1+discount rate). The first term is the investment made at the beginning of the i^{th} contract for the cost reduction S_i.[4] The second term calculates the present value of the contractor-realized cost reduction S_i that persists for *m* periods before it is recognized by the government in negotiation for future contracts.[5] The third term calculates the lost fee that results after *m* periods when the cost reduction S_i is negotiated out of the price of later contracts. Inherent in this model of contracting is that the initial fee is based on the estimated cost of the contract. If the fee rate is *f* and the cost is *C*, the contract fee is *fC*. A portion, fS_i, of the fee is lost from the next *N*-*m* contracts.

[3] This assumption appears to violate the TINA. However, the assumption could also be made that once the contract is signed the firm embarks on an intense quest to discover cost reduction projects. It is also not certain that the situation would change if the contractor gave the list of projects to the government as the contractor has control of which projects to put forward. This is treated in more detail in the analysis of PIPs.

[4] For simplicity, investments are made at the beginning of a period and savings are earned at the end of the period.

[5] Note that S_i becomes contractor profit in period *i* for a total of *m* contract periods—i.e., this savings is not shared with the government.

The minimum condition for accepting an incremental cost-reduction investment in period *i* is:[6]

$$\sum_{k=i}^{m} B^k - f \sum_{k=i+m}^{N} B^k \geq I_i/S_i. \quad (2)$$

This result has three interesting implications (beyond the trivial observation that projects with a lower investment for a given annual cost saving (I_i/S_i) will be more likely to be implemented): (1) a longer lag between project implementation and the availability of cost savings data for future contract negotiations (higher *m*) makes a cost reduction more valuable, as the savings are summed over more contracts; (2), the seller's value of a given investment decreases when the fee, *f*, increases, as lost future profits due to a cost reduction are higher;[7] and (3) as the number of remaining contracts, *N*-*m*-*i*, declines, short-term cost reductions become more valuable. Thus, cost reductions must either pay off quickly, i.e., within *m* periods, or they may not be implemented until late in the production program, if at all.

With an FPIF contract, (2) becomes (2′):

$$\delta \sum_{k=i}^{m} B^k - f \sum_{k=i+m}^{N} B^k \geq I_i/S_i, \quad (2')$$

where β is the cost share ratio. We see that for a given I_i/S_i, cost reduction projects will be less likely be adopted for an FPIF contract. There may be other benefits to using FPIF contracts. For one, if the contractor expects that the risk of cost increases is less than offset by opportunities to save, a cost sharing contract is more appealing than assuming all of the cost risk with an FFP contract. As an incentive for reducing cost, however, the FFP contract is the most potent.

In typical procurements, there is a lag between when the contractor implements cost savings projects and when cost savings are known to the government. In this case *m* is greater than 1, which allows the contractor to retain more of the cost reduction as higher earnings. For example, If there is a lag of one contract period (*m*=2), when negotiating Contract 3, the government will only have actual cost results from Contract 1. If the contractor implemented a cost reduction during Contract 2, the government would not be aware of the cost savings until it was time to negotiate Contract 4. This situation would be compliant with the TINA if the Contract 1 cost data was the latest certified cost report from the contractor.

6 The first order conditions are also when the net present value of the cost reduction is zero.

7 This not to say that a low fee will be acceptable to the contractor, but rather that the fee level, as a percentage of cost, may have a negative incentive effect on reducing long-run costs.

2. Extending the Model to Multiple Periods

The first order condition shown in (2) and (2′) are useful for illustrating the investment decision under static conditions. Using a numerical simulation, more realistic conditions can be added to the decision model in (1). Specifically, the simulator assumes that the contractor's investment is a reimbursable expense and is recovered once the cost reduction is revealed.[8]

Table 1 summarizes the procurement scenario assumptions.

Table 1. Assumptions Used in the Procurement Scenario

Number of Contracts	10
Number of Investment Projects	20
Investment/Annual Savings (I_i/S_i) Range for Projects	0.3-2.6
First contract cost base (all scenarios)	$2,609
First FFP contract price base	$3,000
FFP Fee rate (% of cost)	15%
First FPIF contract price base	$2,948
FPIF Fee rate (% of cost)	13%
FPIF share ratio	50%
Contractor discount rate	10%
Capital cost recovery period (years)	10

It was also assumed that the content for each of the 10 contracts is the same (e.g., the same number of aircraft, missiles, tanks, etc.).

The simulation is deterministic in that the number of contracts in the program, as well as their value, fee rate, discount rate, and reporting lag, are all set in the beginning of the simulation and do not change. Additionally, the cost savings project outcomes are also certain to occur. The contractor starts the simulation with a list of cost reduction projects and decides whether to adopt one of them at the beginning of the first contract period. Projects can only be implemented once. As the program iterates through each contract period, the contractor evaluates whether the remaining projects pass the first order conditions. This is accomplished by ranking the projects by their calculated NPV and choosing the one at the top of the ranked list. Although not strictly implemented as an optimization model, the effect is that of an optimization model, where the contractor maximizes NPV with the constraint that only one investment project per period can be implemented. Given the necessarily arbitrary values associated with the assumed cost reduction projects, and the purpose of the model to illustrate the relative effects of

[8] This assumption adds an additional term to equations (2) and (2′), but their overall implications remain intact.

different contracting scenarios, we thought the simplicity of this approach outweighed the drawbacks of its behavioral restrictions.

Figure 1 illustrates the list of 20 potential cost reduction projects used in the simulation. The projects listed require the investment at the beginning of the period and return the savings at the end of the period and every year of production. These values are defined by the left vertical axis, while the right vertical axis defines the ratio of investment to annual savings for each project. The example list was constructed to have a mix of highly profitable as well as moderately profitable projects.

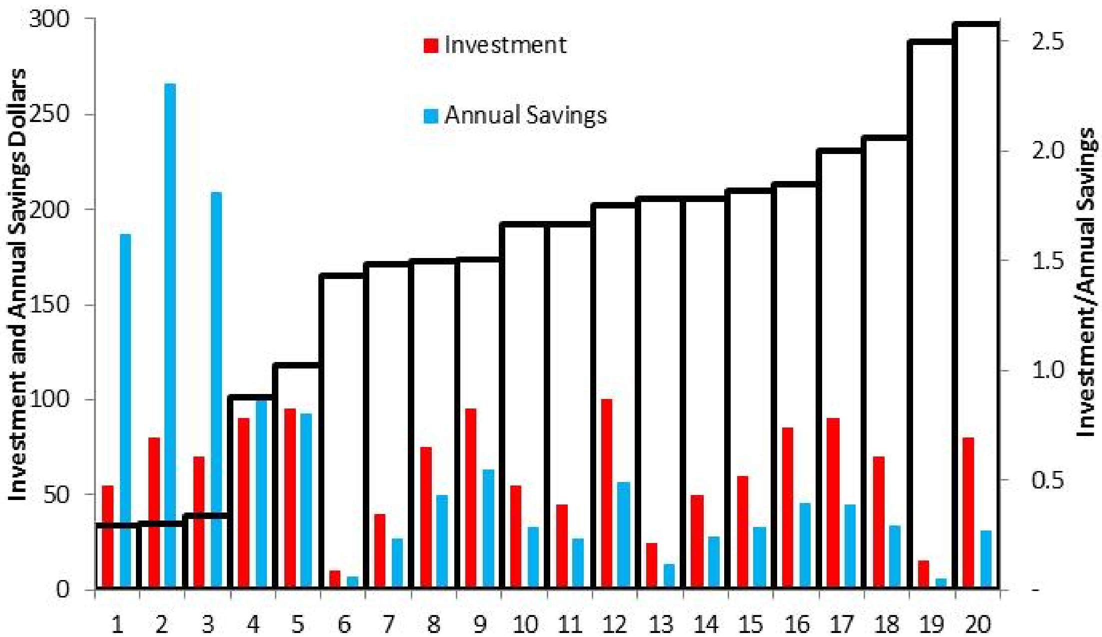


Figure 1. 20 Potential Cost Reduction Projects: Investment and Savings Metrics

We took this data and the assumptions presented in Table 1 and calculated NPV for each of the 20 projects for each contract period under three different contracting scenarios. The first two contracting scenarios are FFP and FPIF contracts with no reporting lag. The third type is an FFP with a one-year reporting lag. Figure 2 illustrates cash flows used to calculate the 13th project's NPV at the first period given the the FFP case with no lag.

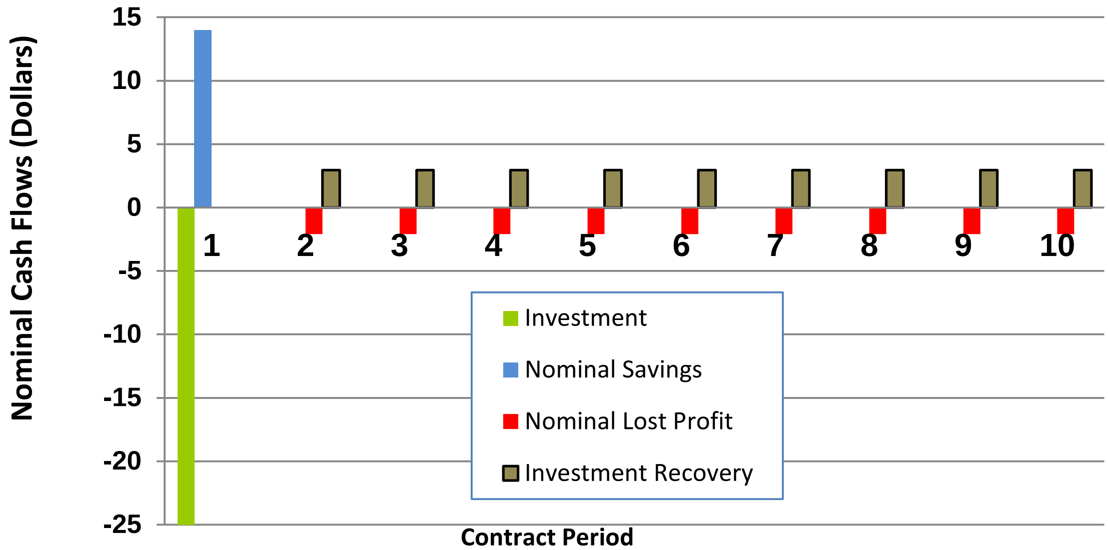


Figure 2. Incremental Cash Flows for the 13th Project in Period 1: FFP Contract with No Lag

The green bar is the initial investment of $25 while the blue bar is the savings at the end of two periods of $14. The red bars are the recurring $2.10 (15 percent of $14) in lost fee once the $14 is negotiated out of the price of future contracts. The gray bars are the incremental cost plus fee of $2.88 ($25/10 x (1+0.15)) as the $25 investment is reimbursed through the contractor's depreciation expense allocated to overhead. NPV of the project is -$7, and thus is not implemented in the first contract period. The lost fee is more than offset by the investment recovery, but it is spread out over the entire program and, combined with the immediate cost savings, is not enough in present value terms to outweigh the investment.

Figure 3 shows the same scenario but with a one-period reporting lag. Now instead of one blue bar for savings, there are two bars reflecting the additional time the contractor retains the profit from cost savings. Now the savings are more than enough to yield a positive NPV of $3.

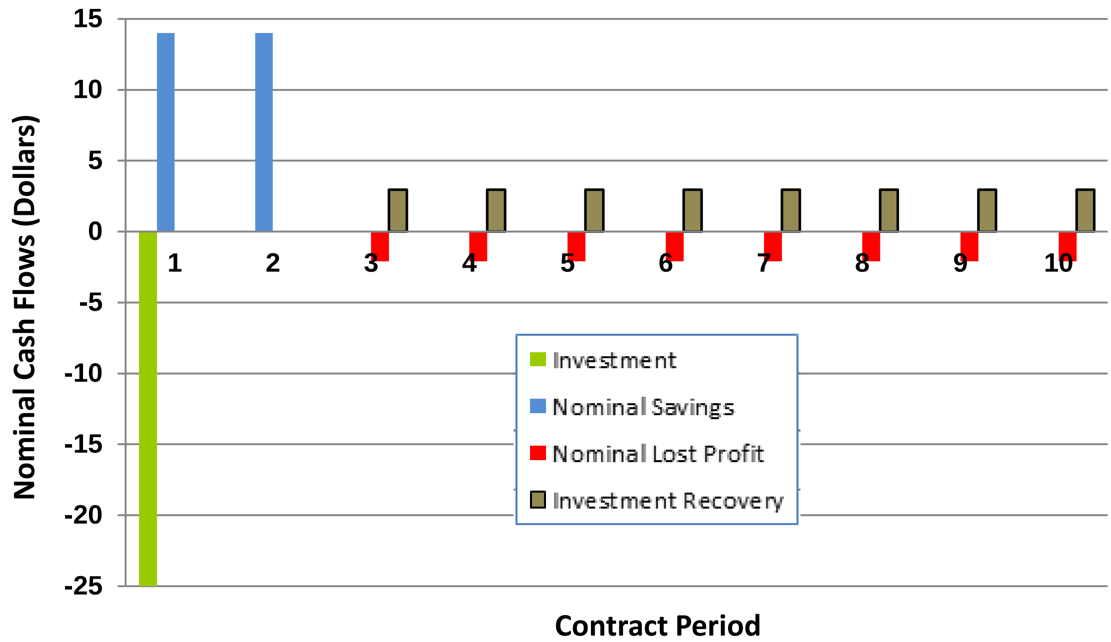


Figure 3. Incremental Cash Flows for the 13th Project in Period 1: FFP Contract with One-Year Lag

Figure 4 shows the NPV calculation results at the first period for all 20 projects.

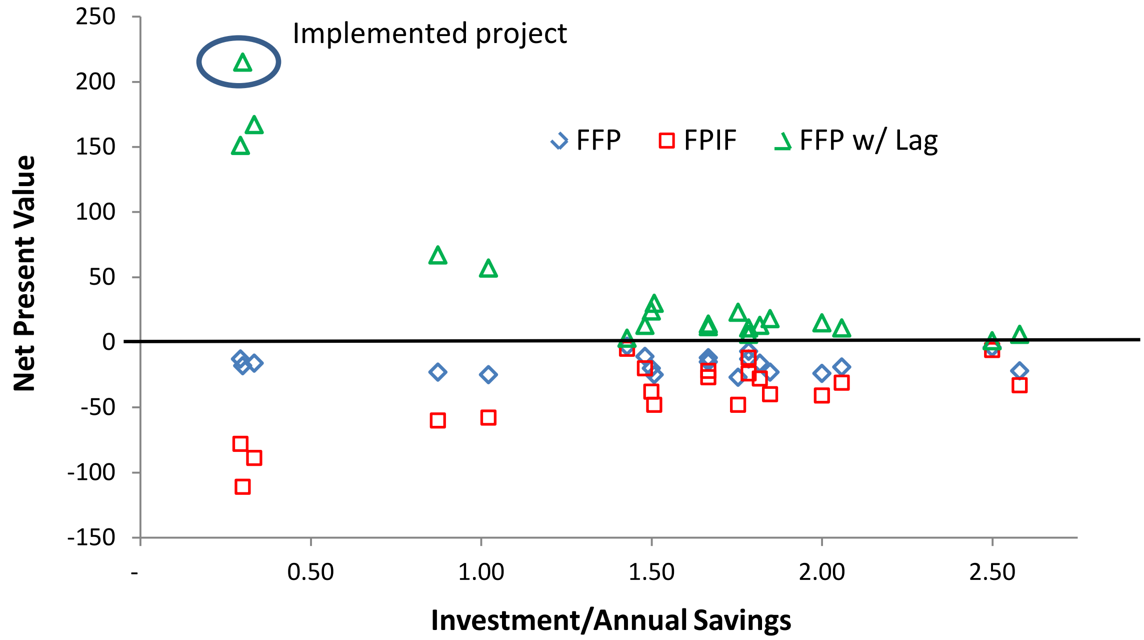


Figure 4. NPV for 20 Hypothetical Cost Reduction Projects for Three Contracting Scenarios: First Contract Period Calculations

At the first contract period, both the FFP and the FPIF contract scenarios have negative NPV calculations for all of the cost reduction projects. Only the FFP with the one-year reporting lag results in positive NPV projects; in our simulation, the contractor chooses to implement the highest valuation project, which is shown in Figure 4.

The simulation moves through each contracting period with additional projects implemented. As the number of years of lost profits due to cost savings decreases, projects for the FFP (no lag) and FPIF cases start to show positive NPV and are implemented. The NPV calculations at period 9 for the projects that have yet to be implemented are shown in Figure 5.

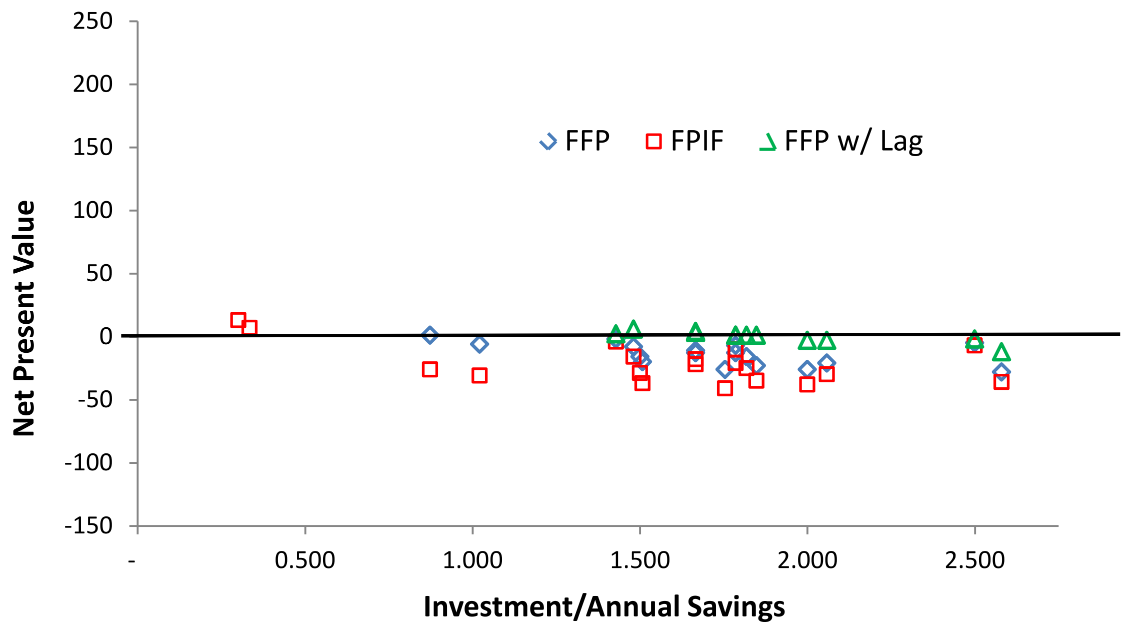


Figure 5. NPV for 20 Hypothetical Cost Reduction Projects for Three Contracting Scenarios: 9th Contract Period Calculations

The FFP contract with the reporting lag will implement a project in each period. The FFP contract with no informational lags will only implement four projects in total. In the FPIF contract, only two projects will be implemented. The figure also shows that our restriction that only one project can be implemented in a given period does not result in projects with high NPVs being excluded.

Several competing factors are working in the scenarios. The first is that the annual savings of the cost reduction must be very high to offset the negative factors. The other positive factor that augments the project's profitability is that the contractor's investment capital is reimbursed through its overhead expense. This expense, however, is assumed to be categorized as general equipment, reimbursed at a constant rate, and may not be fully recovered in the procurement program. Thus, investments made in the latter periods are not fully recovered.[9] Lost fee in future contracts with implemented savings weighs heavily early in the procurement program but diminishes with each succeeding contract period.

3. Comparison of Outcomes and Observations

In this section, the results presented in the last section are consolidated to show how the price to the government changes over the course of the procurement program for different contracting scenarios.

Figure 6 plots the change in contractor costs for each contracting scenario over the course of the ten contracts. Clearly the FFP scenarios with and without the lag provide the greatest price reductions for the government. These two scenarios lead to procurement program average contract price reductions of 20 percent and 14 percent, respectively.[10] The FPIF scheme only provides an average price reduction of 2 percent.[11] In the FPIF case the contractor has less incentive to implement cost-reducing projects because a portion of the savings must be shared with the government. In the FFP scenarios more cost-reduction projects are adopted, leading to substantially lower prices to the government even as the contractor's profit increases.

[9] Most investments of this sort are ultimately fully recovered by long-term defense contractors.

[10] Although the FFP no-lag case only implemented four projects vs. nine for the lagged case, those four projects had relatively high cost savings associated with them.

[11] Only the ranking of the contracting schemes' propensity for cost reductions can be generalized; the percentage savings are dependent on the average size of the cost savings projects relative to the contract price.

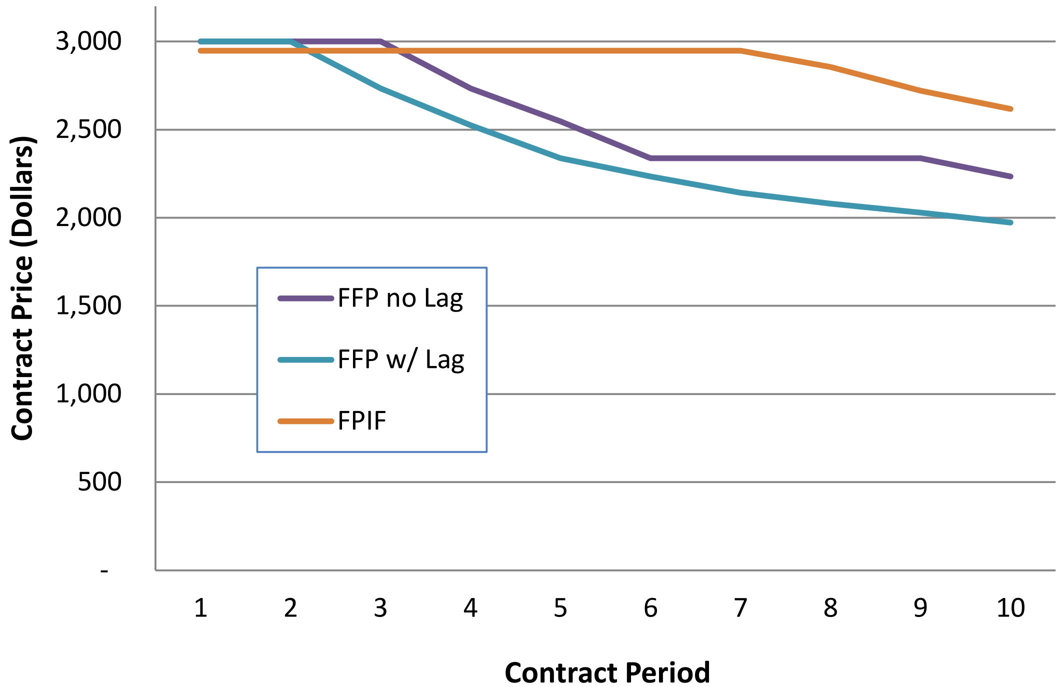


Figure 6. Incentive Effect Comparison for FFP and FPIF Contracts in Serial Procurement

This simple simulation analysis provides three key findings. First, the long-term prospect of losing fee on future costs is a strong disincentive to make cost-reduction innovations for short-term profits. This effect is blunted if contracting agencies are perceived to be slow in detecting lower costs or, if detected, fail to reduce the price of future contracts. Rapid conversion of cost savings into lower prices means that firms must recover savings before prices are reduced. This leads to the second finding: the longer the lag between price negotiation and reporting of actual costs, the more profitable are projects with smaller cost savings. Allowing contractors—whether or not intentionally—to retain savings as profits for longer periods will induce them to lower the hurdle-rate return on investment rate for cost-savings projects. The third finding is that FFP contracts provide a stronger incentive for a contractor to make cost reductions than an FPIF contract over a series of contracts, even though the prices for the first few FPIF contracts will be lower than for the equivalent FFP case.

A necessary ingredient for these savings to occur is that the contractor's profit margin increases over and above that from the fee. For large savings, profits will spike significantly with fixed price contracts. For example, for the FFP no lag case, the realized profits are 19 percent of costs vs. the 15 percent specified fee. Contractors with FPIF-type contracts see margin increases as well, even though they only see a share of the cost reduction. In spite of these profit spikes on behalf of the contractors, the government's prices decline more under FFP contracts. A critical assumption underlying these savings is that the contracting agency is immediately and fully exploiting the discovery of cost reductions into lower prices. This is expected no matter what the reporting lag.

The FFP scenario with the one-year reporting lag leads to significant price improvements relative to the FFP scenario with no reporting lags. Additional scenario simulations show that the two- and three-year reporting lag scenarios result in the same sequence of cost reduction projects. While longer lags substantially improve the profitability of these cost-reduction projects, in this case the price improvement is not as beneficial to the government as with only a one-year lag. This is due to the fact that the savings take longer to translate into lower prices. The resulting price improvement is unique to this set of cost-reduction opportunities. Had the cost-reduction projects had lower annual savings, the longer lag may have resulted in the contractors taking projects that otherwise would not have been executed.

It is premature to claim that this simulation predicts the price improvement curve that is commonly associated with learning in serial procurement. There are other influences that affect underlying costs and pricing other than the incentive features studied in this chapter. An empirical analysis could examine programs that observed price reductions and analyze whether they can be explained by information reporting lags and price negotiation strategies used by the contracting agency. It would also be instructive to examine programs that did not report price reductions with later lots to see if the attributes that provide cost-reduction incentives were in some way inhibited.

C. Government-Funded Investments – Production Improvement Programs

Even for FFP contracts, the contractor’s incentives for making cost-reducing investments are limited because the resulting cost savings will eventually lead to lower negotiated prices. One way to increase total cost-reducing investments is to have the government directly fund investments that the contractor would not otherwise undertake. Such PIP efforts have been evident in past procurements (sometimes referred to as cost-reduction initiatives or CRIs), but are not a standard part of the acquisition process.

We used a substantially different modeling framework to examine the effect of PIPs, although the basic incentives are the same as the simplified model described above. The model includes direct as well as indirect costs for a contractor with a portfolio of two contracts, one FFP and one CPFF, that share indirect costs. Investments reduce costs by adding to the accumulated capital of the contractor. The level of investment is chosen by the contractor to maximize NPV over a series of contract periods. The informational lag assumption is the same as for the FFP one year lag case above. Model parameters were calibrated using F-22 contract data. A detailed exposition of the model is included in Appendix A.

To enable analyses of the PIP question within this modeling framework requires specific assumptions regarding contractor and government behavior and associated information asymmetries. We assume that the contractor initiates PIP investments with the government's input limited to setting expenditure constraints. Although the government will have more transparency regarding cost reduction projects than in the typical case, the contractor is the only one with the information to formulate and propose the projects. Following from past PIP implementation, we restrict the investments to those affecting direct costs and assume the value of those investments go to zero at program end. These assumptions reflect the product-specific nature of PIP investments.

The assumed expenditure constraints take two forms. The first is a simple constraint on the total amount of PIP investment. This assumes only a limited amount of knowledge and control on the part of the government; the contractor is free to formulate PIPs in any way that maximizes its value. We consider this the most realistic case. The second version of the constraint assumes the government has greater knowledge and a higher level of control and enforcement. In this case, the government will only fund PIPs such that they result in government expenditures (all contracts for the program including the PIP investments) equal to or lower than the baseline without PIPs. Here the government has the knowledge to define specific goals and the control to hold the contractor to indicated price reductions across the entire sequence of contracts. We think the assumptions in which the government is dependent on the contractor to propose a PIP investment program are consistent with the range of plausible situations. Also remember that, like in the standard FFP cases, reduced costs on current contracts will mean lower fees in the future.

For the investment-constrained case, we found that overall government expenditures were changed little with results both above and below the baseline,[12] depending on the value of the constraint. For the scenario with the greatest net savings, total government expenditures were less than 1 percent below the baseline case. All investments were directed towards the FFP contract.

For the total expenditure-constrained case, feasible government expenditure savings were as high as 8.5 percent. This showed the substantial gains possible when the government can specify and enforce an expenditure constraint vice the case where only the level of PIP investments is determined. This scenario also resulted in investments directed toward the CPFF contract. However, we consider the set of assumptions associated with the total-expenditure-constrained case to be atypical for most contracting situations.

[12] The baseline government expenditure (i.e., contract prices with no PIP funding) corresponded to the model solution with only contractor self-funded investments. Thus, the PIP investments only augmented the investments the contractor would normally make.

Our analyses indicated that PIP investments may only be appropriate in a limited number of circumstances, but may still present opportunities for meaningful price savings. For a series of FFP contracts, the incentives that flow from regulatory lag mean that high-value investments in cost reductions will be made, regardless.[13] For FFP contracts, PIPs can only make a modest additional contribution to net expenditure reductions; even this is uncertain, given contractor incentives and information and other constraints on the government. There is more potential for cost-type or FPIF contracts where incentives for cost-reducing investments are otherwise reduced. (Although the CPFF contract is the limiting case in our numerical analyses, incentive contracts are also relevant.) However, this potential is limited by the government's ability to determine an appropriate level of PIP funding and gain long-term commitments to price reductions (i.e., enforce the expenditure constraint). The most promising application for PIPs may be incentive-type multi-year procurement (MYP) contracts in which a PIP investment plan and associated cost savings can be locked in prior to contract start and be in force for a substantial period of time. The first F/A-18E/F MYP contract and the Virginia class submarine MYP contracts were successful examples of FPIF contracts using this structure.

[13] A corollary to this is that PIP investment plans that predict cost improvements substantially below those normally expected may be double-counting cost reductions.

3. Concepts for Reducing Indirect Costs

This chapter examines incentives that have been or could be designed to induce contractors to reduce indirect costs. Tools for managing indirect costs for commercial firms have been developed and applied extensively over the last two decades. While these tools are applicable to defense contractors, setting up effective incentives for contractors to use them has been tricky. DoD has tried to induce contractors to reduce indirect costs before. For example, at the "last supper," following the end of the Cold War, DoD encouraged contractors to engage in mergers with the hope that "synergies" would be achieved and lead to reduced overhead costs. While this action had limited success (Deutch 2001), the question remains whether there are less severe ways to induce contractors to reduce indirect costs (Arnold et al. 2008). Incentives formulated to influence total costs, as opposed to an approach targeted specifically to overhead, will more likely yield the desired results.

A. Background

Contractors already face an array of direct and indirect incentives to reduce or incur costs as a consequence of their costs ultimately being reimbursable under sole source contracting. It is unlikely that efforts to curtail contractor overhead, such as not allowing it to be part of the cost basis in fee determination, will lead to decisive outcomes. This was already tried, and there are simply too many ways for contractors to react for the government to be effective at managing a contractor's cost structure (Arnold et al. 2008). In fact, several large contractors have shown a willingness to cut overhead costs without government direction. Lockheed[14] and Boeing,[15] for example, have cut their overhead about $2 billion over the last two years.

For the firm, inefficiencies lurk in direct as well as indirect costs, but the former tend to be easily identifiable as sales revenue declines, as they generally have a substantial fixed component. As the firm trims idled direct labor, indirect costs appear inefficient because they rise as a percentage of the firm's revenue as the business declines. However, portions of indirect costs that do not support current activities and are

[14] Earnings Call Transcript, Lockheed Martin Corporation, October 24, 2012 accessed from CapitalIQ on October 31, 2012.

[15] Boeing press release, "Boeing Rotates Several Executives in Defense, Space & Security Unit," November 7, 2012.

thought of as inefficient may contribute to the longer term goals of the firm and its customers.

There have been many studies of overhead costs and their many drivers. In the 1980s and 1990s, innovations in management accounting systems could better identify where efficiencies could be achieved in cost pools not directly sensitive to production volume. In practice, most of these *activity based accounting* concepts that are effective at identifying indirect cost drivers are usually too complicated to use as a basis for managerial accounting systems.

Variations in direct labor may provide some explanation of the variation in *variable* overhead costs. Other important drivers, particularly for fixed overhead costs, may be, for example, the number of suppliers managed by procurement staff, the number of products built in the facility, or the number of equipment setups. Activity-based accounting tools use metrics like these to more accurately measure the consumption of company resources and assets. The main value of these tools is in providing a strategic, snapshot analysis of the business' cost structure to assist in decision making and forecasting.

The late 1980s and early 1990s also saw the emergence of new management tools to help managers streamline both the direct and indirect functions of their firms. Womack et al. (2007) rediscovered and popularized what they called *lean manufacturing* as practiced by Japanese automotive producers. Primarily through the elimination of waste in the form of production defects, excess inventory, and design changes, the Japanese automobile industry had achieved a significant cost and quality advantage over their competition. Hammer and Champy (1993) popularized the extension of lean enterprise tools combined with advances in information technology towards business process re-engineering. This has been the basis for decades of corporate streamlining.

The next section reviews some literature and a selection of concepts that address the management of indirect costs. A firm's customer, such as the government, is at an informational disadvantage in understanding the dynamics of the seller's cost structure. Managerial tools such as lean manufacturing or activity-based accounting are geared for managing costs inside the firm, not for analyzing the cost of contracted goods or services. One promising approach presented is the process automotive firms use to manage material cost and to promote supplier productivity. This approach is simple in that it sets affordability targets for its contractors and does not seek to actively participate in how these efficiencies are achieved; however, it does require significantly more tracking of procurement costs and discipline towards making design changes.

B. The Trouble with Overhead Cost Reductions

Overhead costs are challenging for firms to manage effectively. It is not a matter of incentives for firms selling in competitive markets; the tight connection between cost savings and profit for most private firms provides clear incentives for managers to keep all types of cost low.[16] Often when revenue drops, inefficient indirect costs are cut, only to rise again once the business recovers. Costs associated with resources that are linked, even indirectly or non-linearly, to customer value creation cannot be sustainably cut without impairing the quality of sales. The longer-term risk is that failing to achieve sustainable cuts weakens the firm's resolve to deal with difficult issues and management credibility. Nimcoks et al. (2005), writing in *The McKinsey Quarterly*, found that only 25 percent of the firms surveyed managed to improve margins while expanding their business.

A firm in a competitive market often has no choice but to take the selling prices of its products, leaving it with keeping costs as low as possible as the only way to grow profits. In contrast, with sole source government contracting procurement, the price is heavily influenced by the allowable cost, giving the contractor conflicting incentives towards reducing cost. Scherer (1964) distinguished a defense contractor's short- and long-term perspective on cost minimization. In the short term, the contractor has the incentive to save costs attributable to fixed price contracts; however, the ability to allocate indirect cost to its portfolio of government contracts may inhibit its drive to seek cost reductions that could ultimately lead to lower fees in the future (Rogerson 1995). Contractors do reduce short-term costs, as reflected in recent contractor management comments concerning their cost reductions, mentioned in the last section.

Contractors also have the incentive to retain underutilized fixed labor and capital assets that are needed to win future business, since they can be reimbursed as overhead expenses when they are not reimbursed as a direct expense.[17] This is not inherently inefficient, since design teams are costly to dissolve and reconstitute according to the episodic demands for new development programs. On the other hand, a propensity to accumulate assets for the purpose of generating higher fees as a response to this not completely intended incentive is inherently inefficient.

In this section, we review indirect cost strategies through which contractors can increase profits. These strategies are indicative of the complex and often conflicting incentives government contractors face. The three strategies are:

- Effectively allocating indirect cost to cost reimbursable contracts and away from fixed price contracts (Rogerson 1992);

[16] An ongoing theme in this report is that government prime contractors should have a long-term view that more cost is better since fees are paid as a percentage of cost.

[17] In many cases these underutilized but valuable assets should be retained; however, to the observer, they appear to be indistinguishable from other unused assets that may not be needed anymore.

- Avoiding opportunities to reduce shared indirect costs when the contract portfolio has a significant fraction of cost reimbursable contracts; and
- Effectively subsidizing valuable, but underutilized, fixed labor or assets (Peck and Scherer 1962).

Each of these strategies is explained below in the context of firms' conflicting incentives affecting how they manage overhead costs. These conflicting incentives are problematic for contracting agencies trying to manage a contractor's costs on a contract-by-contract basis. By this illustration we hope to convey the difficulty, if not futility, of designing incentive mechanisms to discriminate for, and eliminate, excess indirect cost. The net effect of these conflicting incentives is that only cost reductions with high payoffs will be implemented.

1. Indirect Cost Allocation and Cost-Reduction Incentives

Rogerson (1992) has shown that firms have an incentive to shift costs away from fixed-price contracts into cost reimbursable contracts. That is because fixed-price contracts behave like competitive commercial products where the firm is a price taker and has a claim on any profits created by lower costs. CPFF contracts, conversely, offer a source of funding the firm's indirect activities with no negative effect on profits.[18] The problem of moral hazard with CPFF contracts also contributes to a lack of effort in reducing overhead costs. Rogerson's analysis, applied to direct costs, found decisions that could be influenced by the contract type. For example, a firm may elect not to invest in labor-saving capital projects on CPFF contracts. From the government's perspective, this effect drives undesired contractor behavior. This behavior implies that contractors may prefer not to cut overhead costs on fixed-price contracts since they fear reducing the allocated cost base for new CPFF contracts.

For example, a firm has two contracts, one FFP and the other CPFF. Assume the firm has a single indirect cost pool that is allocated to the two contracts through their direct labor cost. If the firm eliminates 10 percent of its cost, all from the indirect pool, the firm's revenue will decline by about 5 percent if half of its contracts are of the CPFF type. The firm's profit increases in proportion to the fraction of FFP contracts. If these contracts were stable recurring procurements, starting the year after the cost reduction, revenue and profit will decline 10 percent for the remaining contracts.

In Chapter 2, the disincentive against reducing costs for a cost reimbursable business was introduced. In such businesses, only cost reductions with short-term gains that exceed the present value of the long-term loss in fee will be executed. The problem with overhead cost reductions, however, is that they affect all of the contracts to which

[18] Profits stay the same as cost grows though the contractor's return on sales declines.

they are allocated. If the firm has mostly CPFF-type contracts, it has to pass on most of the savings as soon as they are realized. Firms with mostly FFP-type contracts are less biased against reducing indirect expenses, since they are able to keep more of the short-term savings.

Table 2 shows the results of simulating the contractor cost reduction decision rule, presented in Chapter 2, now applied to indirect costs. The table shows the directional net present value firm with the same revenue but three different contract mixes, with and without a one-year regulatory lag given the same random series of cost-reduction projects. The results show that expenses shared across a high fraction of CPFF-type contracts will not be as attractive to cut as expenses that are only attributable to an FFP-type contract. Because indirect expenses are shared, the existence of CPFF-type contracts amplifies the disincentive effect of lower long-term profits. Note that the effect goes away as the contract type mix is more than half FFP types, i.e., the NPV of the cost reductions become positive as the ratio of FFP- to CPFF-type contracts approaches and exceeds 50 percent.

Table 2. Simulation Results of Contractor Decision Rule for Cost-Reduction Projects

	Net Present Value of Overhead Cost Reductions ($)	
Contract Distribution %FFP: %CPFF	No Lag	I Year Lag
25:75	(-)	(+)
50:50	(~0)	(+)(+)
75:25	(+)	(+)(+)

This disincentive effect reduces the value of a given cost-saving project. However, there could be cost savings that are great enough given the investment and loss in future profits that the NPV could still be positive. This is effectively what a one-year regulatory lag does; even with 75 percent CPFF-type contracts, the set of cost-reduction projects has a positive NPV due to the extra year that the savings are not fully revealed.

Consider the case of Lockheed's recent record of cost reductions and its explanation of its economics from the 2012 third quarter results conference call with Wall Street analysts:[19]

Samuel J. Pearlstein

Wells Fargo Securities, LLC, Research Division

[19] Lockheed Martin Corporation, Earnings Call Transcript, October 24, 2012. Accessed from CapitalIQ on October 31, 2012.

> Chris, I wanted to go back to something you had said earlier in the call. You talked about $1.2 billion of overhead reduction in the last few years and on the docket for another $1.1 billion this year. I guess I'm trying to just understand, how much does it cost for you to actually accomplish that? What kind of returns do you get, and then how much of that do you actually get to keep as opposed to it ultimately going back to the customer?
>
> Christopher Eugene Kubasik
>
> Vice Chairman, President, Chief Operating Officer and Member of Executive Office of the Chairman
>
> Yes, Sam. That's a great question. It varies by business area. This is pretty much the overhead reduction. A lot of this ties to some of the facility. I gave you some numbers on the facility square footage that were taken out. We do a business case and a payback for all these affordability projects that we have. And generally, they pay back within the 12- to 18-month cycle. So when we do something like facility consolidation, we'll be moving the cost of consolidating as it relates to that. Right now, we're about 50% cost plus 50% fixed price. So half goes in back to the government, if you will. The other half generally is built into our forward pricing to some degree. It really depends on the backlog mix. But the investment to get these overhead savings are [sic] not that significant and generally results in both people and capital assets as the main driver. Of course, we're focused on processes and new systems and such, but it's a pretty quick payback.

Lockheed’s management is stating that it invests in projects to reduce overhead that have a 75 percent to 100 percent return on investment. Its management further indicates that half of the savings are retained for about two years before being revealed and forfeited to the government. The two-year lag comes from the fact that as of the end of the third quarter of 2012, Lockheed had an order backlog of about $80 billion, which is 1.7 times its annual revenue.[20] This is consistent with the data in Table 2, showing that firms with a reporting lag of one year or more with half or more fixed price contracts will have positive NPV on overhead cost reduction. The shared expense effect is an illustration of how the incentive to save cost may not necessarily translate into desired contractor behavior. A high fraction of cost contracts in the firm’s mix of contracts may inhibit the cost reduction incentive effect of individual contracts when applied to shared indirect costs. In practice, contractors with a richer mix of fixed-price contracts appear to be reducing their overhead when the incentive and returns are great enough.

[20] Data extracted from CapitalIQ on January 23, 2013.

2. Capital Accumulation Incentives

The accounting cost of capital equipment persists years after it is acquired and can be a significant contributor to overhead through depreciation, maintenance, and other expenses. Normally, contractors have little incentive to carry excessive levels of capital assets on their balance sheet, because contractors must pay for capital equipment and facilities up front and receive reimbursement through the depreciation expense and fee invoiced over many years of contracts. With the cost reimbursement nature of defense contracting, there is further disincentive to invest in labor-saving capital equipment that in turn reduces future contract fees on the lower cost base. To offset these natural disincentives to invest in capital, the Defense Federal Acquisition Regulation Supplement (DFARS) weighted guidelines *facilities capital employed* factor provides DoD with the option to pay contractors at the beginning of a contract to invest in capital equipment.[21] This factor is used to compute a fee based on the amount of capital to be employed in the performance of the contract. For example, if the contractor intends to employ $1 million in capital equipment during the execution of the contract, the normal fee element associated with facilities would be $175,000.[22] This fee element would be in addition to the fee associated with cost and performance risk.

The question this sub-section seeks to answer is whether the facilities capital employed factor is a contractor incentive to build up excessive contractor investment in capital equipment and ultimately excess overhead expense. Frazier et al. (1992) have shown in earlier studies that this factor has led to increases in the ratio of capital to labor employed in procurement contracts. The 1992 analysis did not assess whether capital was accumulated in excess of the need, although capital intensity in the defense aircraft industry was found to be consistent with benchmarks for industrial firms in the commercial sector.

Consider the counterfactual mechanism with which a contractor is paid in a Federal Acquisition Regulation (FAR) Part 15 contract where there is no facilities capital employed factor. A contractor that performs against a contract using only labor can be paid monthly through progress payments or vouchers, meaning only a bit more than a month of working capital and little or no facilities capital investment is required. Now suppose the contract could also be performed using automated equipment that reduces labor by a substantial amount. On a discounted cash flow basis, the all-labor alternative is better for the contractor since costs are recovered fast and requires little capital at risk. In contrast, investing in labor-saving capital equipment prior to contract execution results in

[21] Defense Federal Acquisition Regulation Supplement, Subpart 215.404-71-4 Facilities Capital Employed (Revised June 29, 2012).

[22] If the $1 million in capital were 10 percent of costs, this fee would be an additional 1.75 percent markup on cost.

slower cost recovery, and if the savings are revealed to the government, lower future fees as a result of lower labor cost. Thus not only does using new equipment put the contractor at a cash flow disadvantage relative to using only labor, but any resulting direct cost efficiencies potentially reduce future nominal fees.[23]

The “normal value” factor guidelines were reduced in 2002 from the peak of 35 percent (this is value relevant to the end state in Frazier et al.) to the present level of 17.5 percent. A later IDA study (Arnold et al. 2009) extrapolated from Frazier et al., indicating an approximately 20 percent decrease in capital intensity associated with the lower factor value. Our analysis of the investment incentive effect of the current factor value indicated that, at the present level of 17.5 percent, the incentive effectively screens for investments that will be recovered quickly, not large long-lived assets. This analysis models the factor as an offset to the negative present value of capital recovery and the lost fees (from serial procurement contracts) due to revealed labor savings. To make the contractor prefer capital investment, the factor must increase with higher labor savings, longer asset recovery periods, and program risk. Given this, the present factor does not appear to motivate excessive capital equipment investments.

There are likely other incentives driving contractors to hold capital equipment. For example, competitive forces may be pushing contractors to invest to win contracts or to build entry barriers (Dixit 1980). These assets may appear to be unnecessary indirect costs until they are needed to compete for, and/or execute, future contracts. The contractor may also perceive the assets to be valuable for capturing commercial or non-DoD business.

3. Retaining Valuable, but Underutilized Fixed Labor

For decades researchers have noted that defense contractors appear to retain more engineers than they need in order to fulfill contract requirements. Goldberg et al. (1990) found that contractors retained more engineers relative to the number indicated by cost minimization for current output. This is likely to be related to the problem of firms having alternating cycles of intensive product development and production. In periods of intensive production, the firm will have underutilized engineers and product designers who may be paid for out of indirect cost and allocated to the firm’s contracts. The firm that plans to develop products in the future will not perceive these underutilized engineers as unnecessary overhead. Cutting these engineers would create inefficient firing and then hiring expenses to rebuild the team to win and develop the next product.

The government contracting process provides an incentive for firms to restructure engineering and design teams as they transition from development to production. Under a

[23] The government would only prefer the substitution of capital for labor if the total cost declines.

design contract, these staff members are direct cost while, in production, some may transition to indirect cost pools. It is not unreasonable for a firm to want to keep its engineering resources even though they are not able to bill as a direct cost to the customer. Commercial firms that develop products internally are faced with the same problem as products transition from design to production. These firms are not able to charge customers directly for development. These firms are able to directly decide what products they develop and when, and possibly allocate teams to design tasks more efficiently than defense contractors that must win development contracts from the government.

4. Summary and Implications

The discussion so far outlines selected incentives, intentional or not, which can lead to unintended outcomes. Current incentives tend to result in underinvestment in indirect-cost reductions, particularly if the contractor's business base has a large portion of CPFF contracts. However, there may be other more valid reasons for contractors to have "excessive" indirect costs; these are associated with assuring the contractor's ability to perform future work for the customer. The recurring theme in this chapter is that government contractors are not always aimed at minimizing overhead costs as fully commercial firms might be. Even for commercial firms, by the very nature of the lack of direct linkage between overhead costs and revenue-generating activities, indirect costs often take several periods of observation before they can be adjusted to changes in business conditions. The implication is that the government faces great hurdles if it is to explicitly manage contractor overhead.

Even the metrics used to potentially do this could be misleading. For example, compare two firms with equal indirect cost and revenue producing the same product portfolio. Firm A elects to produce everything internally and Firm B chooses whether to make or buy its intermediate products or services based on its comparative advantage. If indirect costs are allocated over each firm's direct labor, Firm A will have a lower overhead rate since Firm B has lower direct labor and higher purchased material cost. This analysis provides little value in comparing the two companies when the customer should only care about the total price it pays and the quality of the product or service.

Even this simple example can be used to further illustrate how undesirable consequences can arise out of simple incentive schemes. Assume the government seeks to encourage Firm B to reduce overhead by, for example, limiting the amount of allowable overhead cost. To reduce overhead, the firm eliminates design staff by outsourcing content to full-service suppliers capable of sub-system design. This is a common practice in many industrial sectors. Conversely, without the luxury of a deep commercial market for advanced weapon systems, the government may desire prime contractors with deep design capability.

Ultimately, the fundamental agency conflict discussed in Chapter 1 is at play here. Contractors, particularly in sole source procurements, have less incentive to reveal their potential to save costs than they would in a competitive market. In a competitive market, firms have incentives to reduce unnecessary costs when they are price takers, but it is still a particularly difficult task with overhead activities.

The weighted guidelines appear to address this problem with their efficiency factor, although the effectiveness of this incentive tool is unknown. The efficiency factor is a fee paid on a new contract that is based on a contractor's prior efforts. For example, a contractor could receive between 0 and 4 percent of cost for instituting cost-reduction efforts—presumably efforts with sustained benefits to the government. Unfortunately, the factor is not quantitatively linked to contractor behavior; thus, it is probably impossible to test its effectiveness.

However, the efficiency factor does break the mold of penalizing contractors for reducing cost, which appears to be inherent in a cost reimbursable sole source contracting environment. It rewards the contractor's future business for reducing costs now. A related incentive scheme that is reported to be employed by General Motors with its suppliers is to allow a contractor to keep some fraction of the cost it saves as profit as long as the item is procured. This practice is also allowed in Value Engineering Change Proposals (VECPs).[24] However, as will be discussed later, these incentives are not restricted to overhead reductions but, rather, apply to the total procurement cost. In the next section we will present approaches to reducing total cost.

C. Total Cost-Reduction Approaches

It would be very challenging for the government to seek significant sustained savings by targeting specific contractor overhead costs. Instead, the government should consider developing incentives and structures that motivate the contractor to find efficiency savings wherever they exist. We approach this problem in two steps. First we present a unique application of the efficiency factor; then we propose a complementary approach to cost management based on automotive industry practice.

1. Application of the Efficiency Factor across a Portfolio of Contracts

The efficiency factor was included in the DFARS weighted profit guidelines in 2002 to encourage contractor cost savings. The profit regulations include a wide variety of cost-saving efforts that can be used in determining the efficiency factor. However, we are most interested in cost performance on prior contracts. Although this is called out in the DFARS as a potential criterion for determining the efficiency factor, there is no formula

[24] Department of Defense Contractor's Guide to Value Engineering, Version 2.4, August 2011.

or range of parameters provided to relate past cost savings to objective values of the efficiency factor. In this subsection we will explore the formulation of an efficiency factor that more explicitly ties profit rates to past contract cost savings.

This was done using the investment model introduced in the PIP analyses in Chapter 2 and presented in more detail in Appendix A. Here the relevant contract costs include all programs/contracts across the business unit, albeit using the simplified assumption of only two programs/contract series with a mix of FFP and CPFF. C_t is the actual total cost across the two contracts, including direct and indirect cost, with the exception of an allowable depreciation expense, D_t.[25] $\hat{C}_t$ and $\widehat{D}_t$ are negotiated costs corresponding to C_t and D_t. The negotiated costs are based on information from an earlier period denoted by *t-ℓ* where *ℓ* is the number years required for cost information to become available.[26]

We define an incremental fee percentage, π_t^E, as the efficiency factor for the contracts in period *t*:

$$\pi_t^E = -\theta\left(\frac{C_{t-\ell}+D_{t-\ell}}{\hat{C}_{t-\ell}+\widehat{D}_{t-\ell}} - 1\right).$$

The *t-ℓ* time index indicates that confirmation of past cost savings is subject to the same lag experienced in collecting cost data used in negotiation. $\frac{C_{t-\ell}+D_{t-\ell}}{\hat{C}_{t-\ell}+\widehat{D}_{t-\ell}} - 1$ is the percentage change in realized costs relative to negotiated costs for the latest period for which actual costs are available. θ is a scalar that relates past cost savings to current values for the efficiency factor. We added the efficiency factor incremental fee to the revenue equations for the baseline model. Sensitivity analyses were performed, in which contract-type composition and θ was varied. The model was optimized for each scenario with output values noted.

Sensitivities to contract-type composition for the baseline case (no efficiency factor) are analogous to the results for the simplified model shown in Table 2. For the efficiency factor scenarios, θ was set to 1. Figure 7 shows sensitivities for investment in indirect-cost reductions and the ratio of direct to indirect costs.

[25] The depreciation values are included to be consistent with the accounting costs collected for DoD contracts and are roughly equivalent to the investment recapture included in the simple model in Chapter 2.

[26] We assumed ℓ =2 which is equivalent to the one year reporting lag included in the model in Chapter 2.

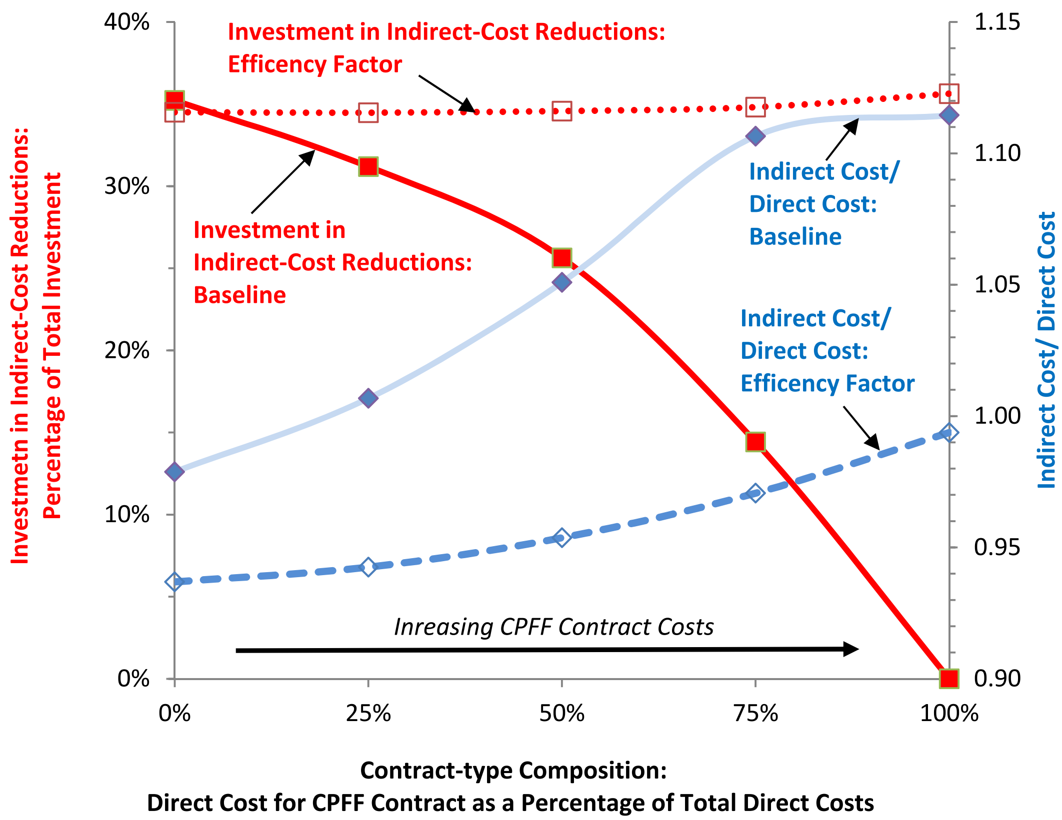


Figure 7. Sensitivity of Indirect Cost Metrics to Contract Composition: Baseline and Efficiency Factor Scenarios

For the baseline case, the results were similar to those for the simplified model (Table 2) with investments to reduce indirect costs (solid red line) decreasing with increasing CPFF content. The results show that when the efficiency factor is included, investments to reduce indirect costs (dotted red line) and the resulting levels of indirect cost were close to those for the pure FFP case, even as the CPFF portion of the business base increases.

Ultimately, we are interested in the effect of the π_t^E efficiency factor on the government's total contract expenditures. The cost and resulting price savings from additional investment must overwhelm increases in contractor margin for this to be a worthwhile policy initiative. Figure 8 presents comparisons of total contract expenditures averaged over total production quantities for the business unit. Cases with and without the efficiency factor are shown, and sensitivities across variations in both contract composition and θ are provided.

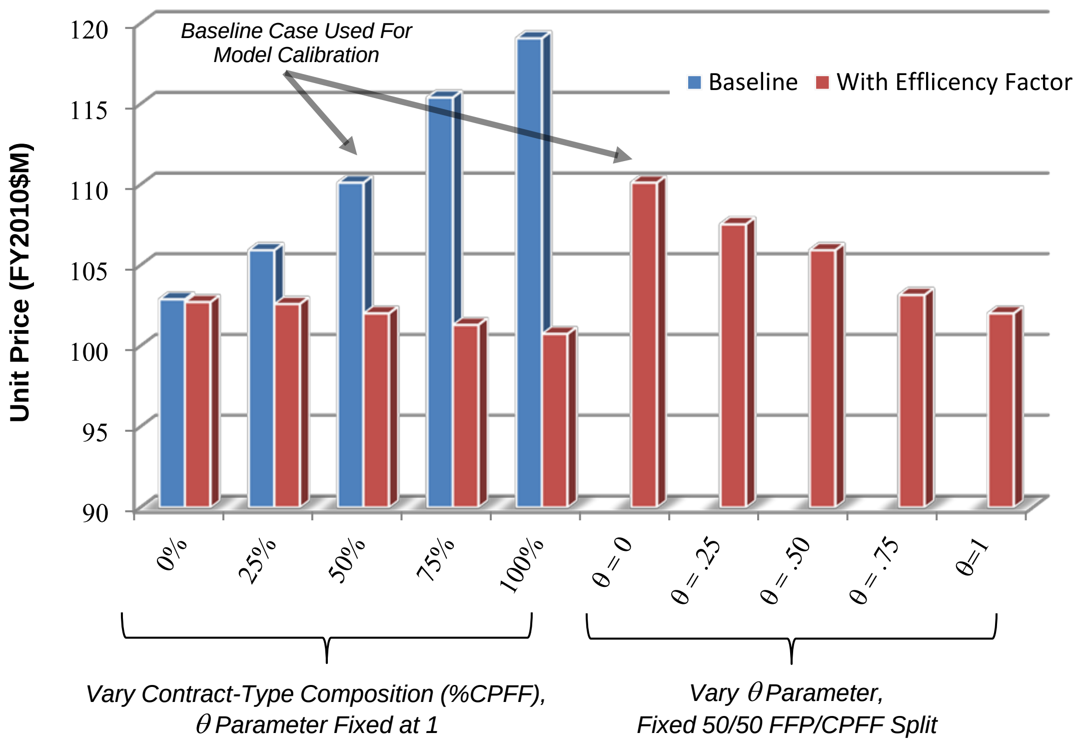


Figure 8. Sensitivity of Unit Price to Contract Composition and θ Parameter: Baseline and Efficiency Factor Scenarios

Prices with the efficiency factor cases and $\theta = 1$ are close to those for the pure FFP case (CPFF = 0 percent) even when the contract composition becomes dominated by CPFF contracts. For the baseline contract mix, increasing θ causes unit price to decrease, albeit at a decreasing rate. The policy simulations indicate that tying the efficiency factor directly to past cost savings across the business unit can be effective at decreasing both indirect costs and prices to the government.

The simplified case of a business unit with a two-contract portfolio shows the potential of an efficiency factor fee scheme to reduce indirect and total cost. However, in practice, a contractor or business unit may have hundreds of contracts in their portfolio. This would present a substantial government management challenge in applying the efficiency factor across a contractor's business base as envisioned above. In the next section, we describe lessons learned from the automotive industry that may be applicable to DoD in managing the costs across a contractor's portfolio.

2. Top-Down Total Cost Management

This subsection describes a process large US auto makers developed for managing purchased materials costs that could be adapted by DoD for managing contractor costs. Large firms' cost structures are very complex. Corporate buyers such as the government or an automaker are at an informational disadvantage in negotiated sole source procurements relative to their contractors and suppliers, respectively.[27] Like the government, automakers' informational asymmetry is reduced by collecting cost data on purchased materials; unlike the government, they also tie efficiency targets to supplier total cost. For example, the Ford Motor Company negotiates annual contracts with its suppliers at the "end-item" level (purchase orders) as well as agreements at the supplier firm level that act as an umbrella over the individual purchase orders. The supplier level agreement may even apply over the long term, e.g., four contract years, and act as terms and conditions that apply to end item contracts. Together, these agreements reflect Ford's desire for the supplier to improve its processes and lower costs. It also acknowledges that the supplier has the best visibility into its own cost structure, enabling it to find the best opportunities to achieve sustainable cost reductions. This is shown in the copy of a Ford-Visteon supply agreement reproduced in Appendix B.

The total cost approach to reducing purchased material at Ford and other US autormakers evolved out of conditions in the 1990s that are similar to those DoD faces today: the prospect of little top line budget growth and the need to rebuild or improve existing military capabilities throughout all of the Services.

The process Ford used is a two-pronged effort to reduce costs. Pressure flows simultaneously from the highest levels of the purchasing organization to high levels of the supplier management. Within Ford, purchasing and product engineering management set efficiency objectives for the program teams that design and release new parts and processes into the production system. A brief primer on the (automotive) original equipment manufacturer (OEM) supply chain will help illustrate how the process can be mapped to the DoD acquisition system.

a. The Automotive Supply Chain

About 40–50 percent of the OEM's cost of a vehicle is composed of purchased components that range from fasteners to seats or even entire powertrains (Vyas et al. 2000). Many of these systems are designed by the suppliers who must also agree to furnish service parts for the effective service life of the vehicle. OEMs prefer to limit their procurement to a few "tier one" suppliers that can take a significant amount of responsibility for their content, such as design. These suppliers often have multiple billions of dollars in annual revenue from a single OEM over many different product lines. For example, automotive climate control systems come from a few main suppliers, such as Visteon, who might supply products on a sole source basis for several Ford

[27] Commercial firms often have access to more competitive supply targets, that is, until product development requires complex partnerships with full-service suppliers for such commodities as seats, interiors, powertrain subsystems, climate control, and entertainment systems.

vehicles. There is a parallel between Ford's relationship with Visteon and the relationship between a military Service, such as the Army, and its contractor who makes tanks.

Continuing with the automotive climate control example, a specific purchase order may last for one year, while the Ford-Visteon purchase and supply agreement may last for four or more years. The supplier and OEM negotiate annual efficiency targets based on the total volume of business between the two companies, not necessarily on the individual product contracts. Climate control systems with significant changes for new models might be excluded from the basis on which the targeted efficiency is aimed since new parts usually come late in the calendar year. Targets are also adjusted for actual volumes purchased and possible other economic factors. The supplier-OEM business relationship contains many similarities between DoD and its sole source prime contractors.

The OEM has various levers for enforcing the targeted savings. There is always the threat of switching the climate control system orders to a competitor; however, this can be very expensive in both capital and development cost and disruptive to operations, sales, service, and quality assurance. Another alternative is to seek restitution through "set-off." This entails offsetting payments due to the supplier with the amounts not achieved in efficiency cost reductions. While these contract provisions are common (Ben-Shahar and White 2006), IDA researchers have not been able to assess how frequently they are exercised. The effectiveness of this overall process was reported by Maurer et al. (2004) to have led to a decline in tier one supplier revenues by 2.3 percent compounded annually from 1997 to 2003, while at the same time industry volumes expanded 1.3 percent annually. Again, the automotive industry and the defense business have in common both business practices and the limited flexibility of sole source relationships. DoD often requires longer lead time than commercial firms to change contractors and usually does not have as many capable competitive suppliers from which to choose. However, the carrot is huge; a compounded annual real efficiency of 1 percent on an acquisition base of $100 billion saves over $50 billion over 10 years.

b. Process and Organization Overview

The process for DoD could resemble the automotive process because both organizations concentrate their purchases with large tier one-type suppliers. The process starts at the top level of the buying organization (DoD or the automaker) with a cost reduction goal that is mapped to each major contractor at a level where all of the purchases of the Services and Agencies are consolidated into a single DoD-wide procurement.[28] At this level, the year-over-year procurement cost reduction targets are developed for each contractor. Priorities should go to contractors with large production programs or ongoing support operations in which efficiencies can be sustained.

An Office of the Secretary of Defense (OSD)-level acquisition official would likely be the best candidate to negotiate cost-reduction targets at the contractor corporate level, e.g., with Lockheed or Northrop. The firms, and to some extent the Service- or Agency-level contracting and program organizations, are charged with implementing the actual reductions. Negotiated targets become budgeted in the years of execution and, as in the automotive industry, progress towards the cost-reduction budget must be carefully tracked. The contractor should be held accountable towards meeting its cost-reduction budget, just as DoD procurement management performance appraisals should be linked to the progress made towards meeting the cost-reduction goals.

Even though the overall target for the contractors is negotiated at the top level, the target is developed from a consolidation of plans and ideas at the individual procurement level. That is, the overall plan is linked to an achievable prospective plan worked out throughout the acquisition community that will be charged with execution. Developing targets at the top level improves visibility and accountability, but ultimately the actions that deliver the savings are generated at lower levels across both the program management offices of the government and at the contractors.

DoD will need to develop organization and information technology to track the cost reductions. Tracking cost reductions is a key part of the process. It is essential if targets are to become meaningful that they are incorporated into budgets to which both contractors and DoD procurement management are held accountable. The tracking process is ultimately linked to supplier payments and performance metrics. The Services and Agency-level contracting activities would be tasked with ensuring that reductions ultimately be reflected at the contract level.

There are three important elements of the top-down total cost process required for success:

1. An accurate baseline budget level identified by contractor;
2. The capability to track cost changes at the product, Service, and contractor levels; and
3. Top-level DoD support.

[28] While the services are charged with most system-level acquisitions, the Office of the Secretary of Defense (OSD) may be the best point of contact for target negotiations to leverage as much buying volume as possible.

The main function of these elements is to raise the overall awareness of the importance of improving cost efficiency and to assign accountability for achieving savings to both responsible individuals in DoD and the contractor.

Developing the baseline and tracking cost reductions, while conceptually simple, represent a major information technology hurdle, since the cost and budget reporting systems are a vast array of legacy systems that are dispersed organizationally and geographically and designed for purposes other than reporting cost reductions. The automotive suppliers have made substantial investments towards the capability to track cost reductions at the parts level (White 2001). This has included staff at the product division level who looked across products as well as staff in each plant who looked across all of the materials acquired for production at a single location. A successful top-down material cost-reduction process within DoD will need similar cost aggregation capabilities as well. For the automakers, this capability emerged over two decades; for DoD, it can evolve gradually. One approach would be to create a dedicated material cost tracking and reduction organization. This is what some automotive OEMs and suppliers have done. It is possible for this organization to evolve out of existing engineering and cost-estimating activities.

c. Incentives and Enforcement

What happens when suppliers are short of their objective? Ideally the Department should offset unachieved reductions with lower current or future fees. This might occur through an aggregate transfer from the contractor to the government. Over-achievements on the cost reduction targets should be rewarded, such as by providing some or all of the excess reduction back to the firm’s present and future fee. Losing long-term fee as a result of short-term cost reductions is a disincentive to lower costs, as shown in Chapter 2.

Another mechanism would be to offer contractors greater profits as they achieve the desired level of savings. For example, a permanent cost share (vice a single contract share in an FPIF contract) on items procured through a series of negotiated contracts would reverse the incentive to avoid short-term savings because of their potential reduction of long-term fees. DoD already allows some permanent savings to be shared on VECPs.[29] As contractors achieve cost reductions and the cost basis declines, a portion of the savings is added back to the price of the item in the form of higher fee. Linking cost reductions to future fee can be a powerful incentive to contractor cost reductions as shown in the efficiency factor experiments in the previous section.

[29] FAR Part 52 Section 248-1.

In the past, measures existed, and to some extent were used, to recover cost from contractors. The Armed Services Procurement Regulation contained pricing guidance to reduce contractor fee by up to two percentage points of cost for poor performance on prior contracts. Presently the weighted guidelines contain a more positive incentive in the efficiency factor, which provides fee provision of up to four percentage points of cost for good performance on prior contracts that will lead to sustained savings. A simple application of the efficiency factor to a portfolio of two contracts was shown in the previous section.

4. Contracting for Services

Analyses presented in previous chapters focused on the general case of government contracting and phenomena modeled in the context of the procurement of equipment in a weapon system franchise. In this chapter we examine the characteristics of services contracting, focusing on ways they contrast with those of contracting for goods. The aim was to relate some general findings (from both IDA's current analyses and the broader literature) to the specific case of DoD contracting for services. Our ultimate goal was to draw out implications for contract design and profit policy, particularly with regard to FFP contracts and alternatives. Questions to be answered were: (1) whether the use of contract types and observed negotiated fees is consistent with theory and government policy and regulations, and (2) given these findings, whether the potential exists for changes in government policy or practice to reduce contract prices.

This chapter explores the conditions under which FFP contracts are appropriate for acquiring services. Some of this analysis is based on reviewing the literature associated with the use of different contract types and incentives to acquire services for governments. Further analysis makes use of contract cost data and the financial reports for a number of firms that specialize in government service contracts to determine the types of contracts used, their pricing, and profitability. The task was not intended to be a deep empirical analysis of service contracting; consequently, quality metrics are excluded from the analysis even though contract type could have a significant effect on service quality.

A. Economic Concepts

The essential differences between goods and services were noted at least as far back as Adam Smith: "But the labor of the manufacturer fixes and realizes itself in some particular subject or vendible commodity..." while the value of labor employed in services "generally perish in the very instance of their performance." Thus services can be thought of as a flow, while goods are a stock embodying past efforts. With the growth of the service sector in post-WWII-developed economies and the later rise of international trade in services, the nature of services again became a popular topic in the economic literature. On the micro level, the trend towards contracting-out of services, both by private sector firms and government, has also created interest.

Services contracts appear to allow more flexibility compared to the government performing the same tasks organically. This is due to the contract between the government and service provider, which limits the liability of the government to paying only the amount that has been authorized for the statement of work. When the contract is completed, the government is under no obligation to enter into further contracts with the firm.

1. Incomplete Contracts

The problem with contracting for services is that the benefit of the contract outcome can depend more on how valuable the outcome is to the public than whether the contractor fulfilled its obligation within the contract price. This problem is more pronounced for services than goods because the outcomes of services are often very difficult to quantify in terms of quantity and quality. Economists refer to this as "incomplete contracting"—where no contract can specify all states of the world. Engaging in an FFP service contract in which the quantity and quality of the service are vague leads to an incomplete contract in which the contractor can fulfill the contract requirements in the least cost way and earn extra profits. If the government needs to change the statement of work, a CPFF contract allows this flexibility since ownership of the contract execution has not been transferred to the contractor. Does this mean that services are best acquired through cost reimbursable contracts? The answer is echoed in the FAR Part 16 (although in different terms) and it depends on the *completeness* of the contract specification.

An important hypothesis examined in the economic literature is that service industries are not as amenable to labor and other cost-saving innovation when compared with goods-producing industries. This is known as the Baumol (1967) "cost disease." The standard explanation for this lower measured productivity growth in services was that the intrinsically more labor-intensive nature of services made it more difficult to apply technological innovations (e.g., Baumol's example of the string quartet playing the music of 19th-century composers). Griliches (1992) suggested that at least part of the lower-reported productivity growth could be due to the measurement problems associated with most services. The measurement problems for services stem from both lack of data (thinner data collection on the part of government Agencies) and conceptual challenges associated with services. Griliches notes "The conceptual problem arises because in many service sectors it is not exactly clear what is being transacted, what is the output, and what services correspond to the payments made to their providers." Quality adjustment is also difficult, given the heterogeneity of output and transactions. While price indexes can be developed to account for differences in the quality of goods based on differences in specifications, such data are generally not available or even feasible for many services.

Contracting for services presents the same difficulties as for equipment acquisition—these difficulties are exacerbated by the additional quantity and quality measurement problems noted above. This complicates the problems associated with asymmetric information and incomplete contracts.

2. Contracting for Time vs. Contracting for Performance

There is a substantial literature on government service contracting that provided helpful guidance on the subject. We took as examples two studies, one, a positive analysis relating the propensity to contract out services to characteristics of cities and different services (Levin and Tadelis 2007) and the other, a normative investigation providing guidance to city administrators (Brown and Potoski 2005). Both studies include transactions cost considerations in their framework. In contemporary DoD practice, the make-or-buy decision may be an issue in many service categories—e.g., depot repair, base operating support and acquisition management support. More relevant for our purposes, the drivers of the outsourcing decision should correlate with those determining the type of contract employed.

Levin and Tadelis (2007) propose a model with two ideal types of service contracting. In the first, the government contracts for time—they pay their employees for a set amount of work hours (like a cost reimbursable contract); in the second they contract for performance—a contract is let with an outside organization with only performance requirements specified, with an agreed-to price (e.g., an FFP contract). The transactions cost will be higher for contracting for performance vs. time, as a substantial amount of effort is needed to both define and monitor performance metrics.[30] There is also a tradeoff between cost and quality. The outside contractor will try to fulfill the bare minimum effort and cost requirement, so quality may suffer.[31] Cost is assumed to be lower for the performance contract, based on both lower quality and inefficiencies associated with contracting for time (e.g., moral hazard). However, if the outside contractor can gain a monopoly position, the government will not be able to fully benefit from reduced costs. The asset specificity related to a given service activity is used by Brown and Potoski (2005) as a proxy for market power (this is associated with the holdup problem in the contracting literature). A third driver of the outsourcing decision is the degree of flexibility needed when delivering the service.

[30] This is based on the Coase Theorem's idea of the firm existing, in part, to minimize the "transaction costs" of producing exclusively in a market environment. For example a firm does not have to hire or fire workers according to every change in demand as they might if all of their workers were independent contractors.

[31] This is a consequence of the contract being incomplete, as it cannot anticipate all eventualities. The contractor's incentive is the opportunity to make additional profits in the form of informational rents.

This model of service provision has obvious empirical implications:

- Services whose quantity and quality are difficult to measure will be less likely to be outsourced,
- Services that require large investments in assets specific to the task are less likely to be outsourced,
- Services that call for flexibility in performance are less likely to be outsourced,
- Services where citizens/constituents are most sensitive to quality will be less likely to be outsourced, and
- Cities that are under fiscal pressure will be more likely to outsource.

Levin and Tadelis (2007) collected survey data characterizing different classes of services, whether different cities outsourced those services, and the attributes of the cities. Their statistical analyses generally confirmed the above hypotheses.[32] Brown and Potoski (2005) took similar survey data and created a 2 x 2 matrix based on degrees of asset specificity and measurement difficulty. Where a given service fell within the matrix could then be a guide to city administrators as to whether it is a good fit for outsourcing.

Although the outsourcing decision is not central to our analyses, the transactions cost framework offers insights into the choice of contract type. The two ideal types of contracts put forth by Levin and Tadelis, pure time and pure performance, bound the contract-type choices facing DoD, with time and materials (T&M) contracts fitting within the continuum closer to the pure time contract and fixed-price contracts closer to the pure performance contract.

B. Empirical Analysis of DoD Service Contracting

Our empirical analyses had several strands. We examined the characteristics of DoD contracts for each service category and compared them with goods contracts (coded as supplies and equipment contracts in DoD databases). These analyses were performed using data from the comprehensive federal procurement data system (FPDS). A more limited data sample was used to analyze differences in negotiated fees between service and equipment contracts. Lastly, we calculated financial benchmarks using data from publicly traded firms whose revenues are dominated by federal government service contracts; these benchmarks were compared with those from a broader sample of defense and industrial firms. We first adopted a classification system to facilitate our analyses.

[32] As asset specificity, difficulty in measurement, and flexibility were highly correlated in their sample, they developed a factor capturing all three effects.

1. Classification of Services

Beyond the basic divide between services and goods there are important distinctions between types of services. One way of looking at the classification of services is how they are treated in economic data. It is relatively straightforward to bin North American Industry Classification System (NAICS) categories into goods and services classifications. Although some databases correlate DoD contracts by NAICS code, we found the use of Federal Service Classification (FSC) identifiers to be the best way to classify service contracts. Chao (2007) presented a taxonomy of service contract types based on FSC codes. The categories were:

- Information and communications technology (ICT);
- Professional, administrative, management support (PAMS);
- Research and development (R&D);
- Equipment-related services (ERS);
- Facilities-related services (FRS); and
- Other.

Table 3 shows the assignment of FSC codes to the categories by the FSC A–Z letter prefixes.

Table 3. Categorization of Services by Federal Service Classification (FSC) Codes

Category	FSC Prefix	FSC Description
ICT	D	Automatic data processing (ADP) services and telecommunications
PAMS	B	Non-R&D studies and analyses
	C	Architect and engineering
	H	Quality control, testing, and inspection
	L	Technical representatives
	R	Professional, administrative, and management support
	A[a]	R&D management and support
R&D	A[b]	Basic and applied research, experimental and advanced development, engineering, and operational systems development
ERS	J	Maintenance, repair, and rebuilding of equipment
	K	Modification of equipment
	N	Installation of equipment
	W	Lease or rental of equipment
FRS	E	Purchase of structures and facilities
	M	Lease or rental of facilities
	S	Operation of government-owned facility
	X	Utilities and housekeeping
	Z	Maintenance, repair, or alteration of real property
Other	F	Natural resources management
	G	Social services
	T	Photographic, mapping, printing, and publication services
	U	Education and training services

Source: Chao.

[a] Only includes FSC codes ending in 6.

[b] Excludes FSC codes ending in 6.

Excluded are construction and medical services. The Chao study presents a taxonomy that is superior to the NAICS categories for our purposes. It served as an organizing instrument for conducting our empirical analyses.

2. Characterization of DoD Service Contracts

Information from FPDS allowed us to characterize DoD service contracts in several dimensions of interest. Table 4 compares the value of service contracts (1) across categories at two points in time and (2) with goods contracts.

Table 4. Value of Service and Goods Contracts

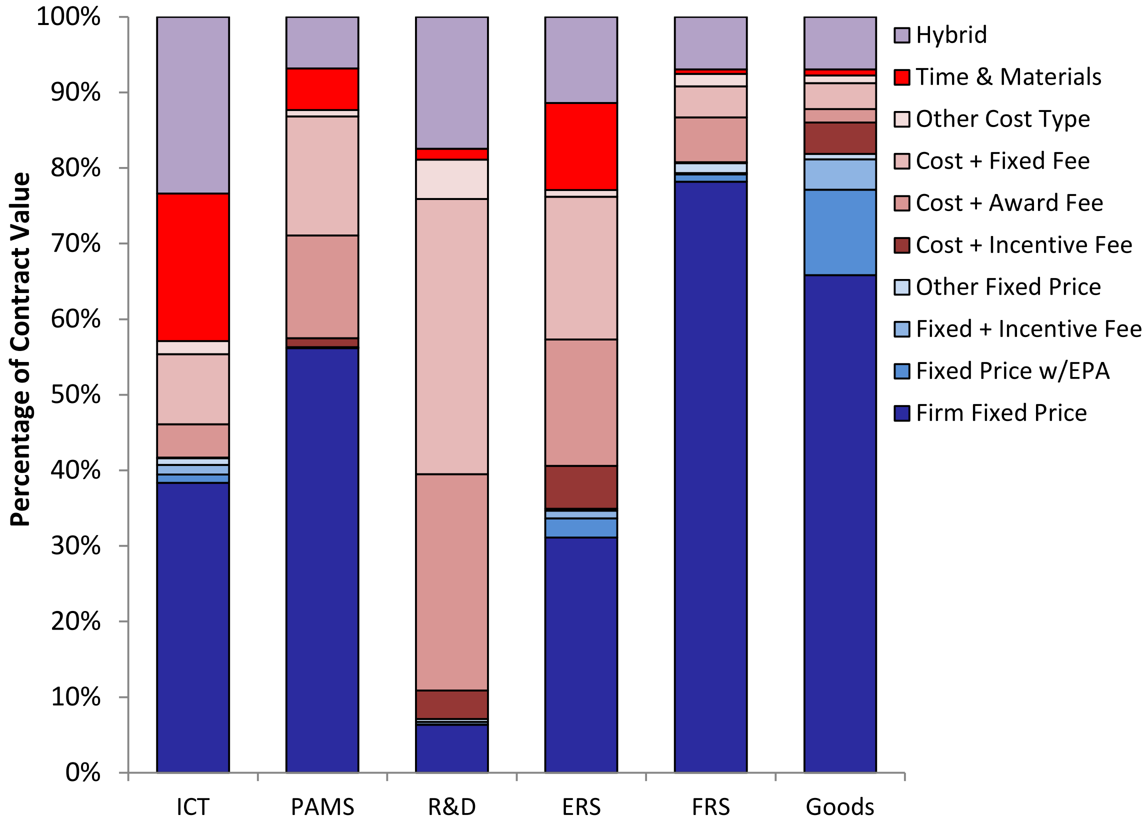
Category	2004 Contract Value Billions of TY Dollars	2008 Contract Value Billions of TY Dollars	2004–2008 Compound Average Growth Rate
ICT	10.3	11.9	3.8%
PAMS	26.0	31.1	4.6%
R&D	33.2	43.7	7.1%
ERS	12.5	20.5	13.1%
FRS	16.6	20.1	5.0%
Goods	110.1	199.5	16.0%

Source: IDA analysis of FPDS data.

This shows the relative importance of different types of services, as well as the relationship between the value of services and goods. Note that Chao's service definitions excluded substantial portions of defense contracting which were not otherwise captured by goods. The categories with double-digit growth rates are most closely related to contracting for combat operations in Iraq and Afghanistan, with ERS being the only service contracting category with large impacts.[33]

Other attributes of interest include contract type, the degree of competition, and the prevalence of performance contracting and commercial items. These all have relevance to contracting issues discussed earlier. A breakdown of contract types for each category expressed as value percentages is included in Figure 9.

[33] Note also that 2008 saw a spike in petroleum and other commodity prices that had a substantial effect on DoD expenditures.

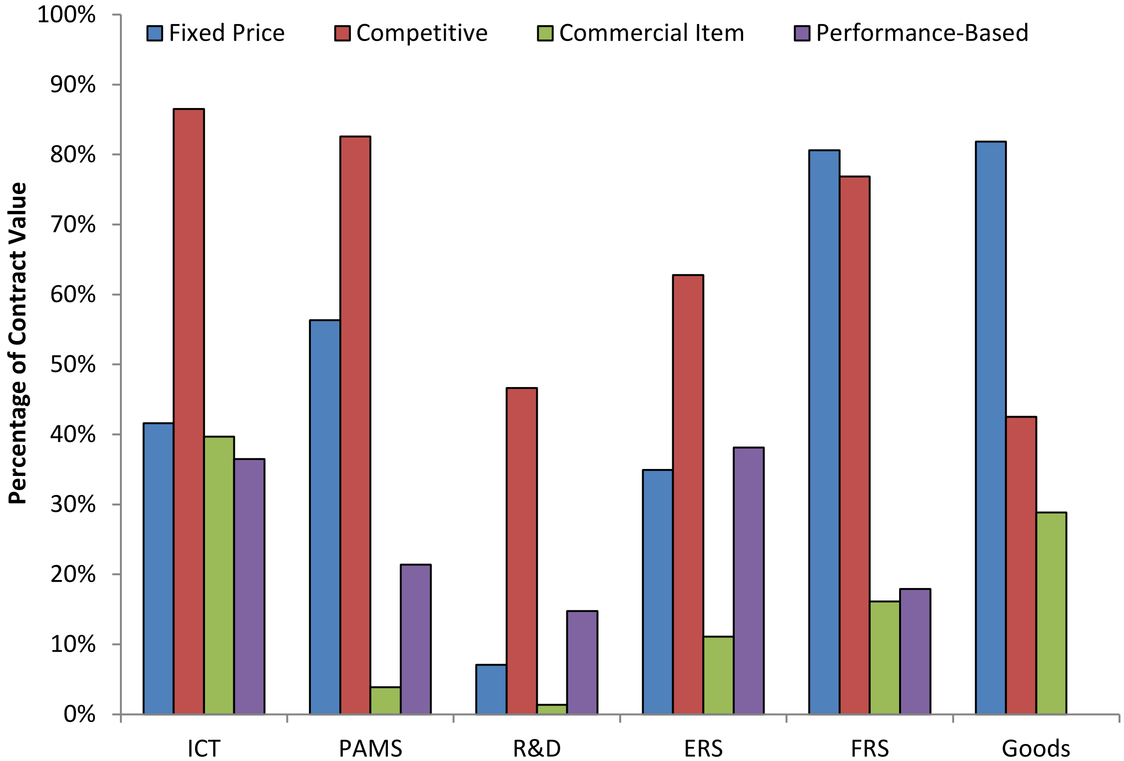


Source: IDA analysis of FPDS data.

Figure 9. Distribution of Contract Types by Category: 2008 Data

These data were generally consistent with expectations, with goods contracting dominated by fixed-price contracts (shades of blue) and services with more hybrid (more than one contract type per contract action), cost-type (shades of brown) and time and materials contracting. The exception is FRS, where the intensity of fixed-price contracting was similar to that for goods. This is consistent with the routine and non-specific nature of facilities services. Also evident is the fairly broad use of award fees for services—this is consistent with difficulties in objectively measuring output and quality. Note the relatively rare use of FPIF contracts in the service categories. We expected, given the problems of asymmetric information and incompleteness in service contracting, and with the advantages of FFP contracts for series production not relevant to most services, that a higher representation of FPIF vs. FFP contracts would be evident.

The other attributes also show variety within and across the different categories. Figure 10 shows the incidence of the attributes expressed as the percentage of total contract value within each category.



Source: IDA analysis of FPDS data.

Figure 10. Distribution of Contract Attributes: 2008 Data

The fixed-price designation refers to all types of fixed-price contracts shown in Figure 9 as shades of blue. A contract is considered competitive if FPDS identifies it with “full and open competition.” “Performance-based” refers to performance-based service acquisition (PBSA) contracts as defined by FAR subpart 37.6 and identified as such in FPDS. PBSA contracts are treated in more detail later. Values for the competitive designation should be treated as an upper bound, as a contracting process in which rules for full and open competition are followed may only have one viable competitor with regard to the parameters of the solicitation.

For goods, the lower incidence of competition and dominance of fixed-price contracts is consistent with the weapon system franchise model assumed in our investment analyses in previous chapters. The substantial representation of commercial items and competition likely reflects commodity purchases. Note that the 60 percent of goods value not subject to competition would represent the upper bound for goods contracting within the franchise model. For services, there is a higher level of competition relative to goods; this comports with lack of *de facto* franchises in the services realm. In terms of total DoD contracting, this indicates the franchise model is relevant to approximately one-third of contract spending.

There were some surprises in the distribution of PBSA contracts across the services categories (PBSA is not relevant for goods procurement). PBSA contracts are designed for situations in which performance metrics can be easily defined and measured; this often correlates with the existence of a commercial market for that service (Ausink et al. 2002). Given this, we did not expect such a low incidence of PBSA contract value in the FRS category. Part of the explanation for this may be that leases and utilities, which are part of FRS, were excluded from the list of FSC codes where PBSA was focused (Office of Federal Procurement Policy 2003).[34] The high incidence of commercial item contracts for ICT may be due to the prevalence of PBSA contracts, which are allowed to be treated as commercial items if they are FFP and meet other criteria.[35] Examples for ICT could include the purchase/utilization of commercial software licenses, the leasing/employment of commercially available hardware and the development of management information systems that have commercial analogs.

Although regulations for PBSA contracts do not specify contract type, there is an order of preference, in which FFP contracts are at the top. According to FAR guidance the achievement of performance in PBSA contracts should be encouraged through incentive and award fees. This is in line with the data (excluding R&D), where, once commercial items are accounted for, the incidence of the residual PBSA contracts is consistent with that of incentive and award fee contracts.

3. Comparison of Negotiated Fees

Also of interest are differences in negotiated fees between the different categories of service contracts and goods contracts. The data sample used was extensive, although more limited than the exhaustive FPDS sample. DD Form 1547 presents a record of inputs used in the negotiation of contract prices. By definition, the data include only those contract actions that used the weighted profit guidelines. As such they exclude contracts for commercial items, award fee, and selected other contract classifications.

We approached the analyses in two ways. We made comparisons of average values for each of the contract categories (as in FPDS, each contract action in the 1547 database was identified by a PSC code). The comparisons were segmented by contract type, where the focus was on FFP and CPFF contracts with limited analyses with T&M/level of effort contracts. Regression analyses were then performed to test the degree to which differences in negotiated fee percentages between the services and goods categories were due to underlying demographic factors.

[34] OSD set PBSA goals in terms of percentages of value contracted for—leases, utilities, and some R&D categories were excluded from the calculation of the benchmarks.

[35] These are spelled out FAR Part 12; they include a contract value of less than $25 million and the availability of an analogous service contracted with similar terms in the private sector.

a. The DD Form 1547 Data Sample

The 1547 data used includes over 22,000 contract actions from 2002 to 2009, representing a total value of $148 billion. We characterized each category and contract type in terms of both contract actions and percentages of total value reported. Including the value calculations allowed the comparison of the 1547 data sample with the 2008 FPDS sample. Table 5 describes the 1547 data, including comparisons with FPDS data.

Table 5. 1547 Database Description

	Contract Actions					Percentages		
Categories	**FFP**	**CPFF**	**T&M**	**Other**	**Total**	**By Act.**	**Value: 1547[a]**	**Value: FPDS[b]**
ICT	103	44	3	2	152	1%	0.4%	2%
PAMS	1,696	3,193	195	105	5,189	23%	12%	12%
R&D	1,117	6,443	354	104	8,018	36%	12%	11%
ERS	667	200	33	17	917	4%	4%	6%
FRS	314	636	4	11	965	4%	2%	7%
Total Services	3,897	10,516	589	239	15,241	68%	30%	38%
Goods	5,160	1,606	167	397	7,330	32%	70%	62%
Grand Total	**9,057**	**12,122**	**756**	**636**	**22,571**	**100%**	**100%**	**100%**
Percentages								
By Action	40%	54%	3%	3%	100%			
Value: 1547[a]	55%	30%	1%	14%	100%			
Value, FPDS[b]	66%	17%	4%	13%	100%			

Source: IDA analysis of DD 1547 and FPDS data.

[a] Data from 2002 to 2010.

[b] Data from 2008; totals exclude commercial, award fee, and hybrid contracts.

Taken as a whole, the 1547 sample appears to be a fair representation of the universe of relevant contracts as described by the FPDS data. Given that the time periods covered by the two samples are different, it is not surprising that there are some disconnects. The ICT and FRS categories and the T&M contract type appear to be underrepresented in the 1547 sample.

b. Comparison of Average Values

Comparisons between the contract categories were made separately for each contract type. The basis of comparison was the buildup of objective fees as derived from the weighted profit guidelines and the actual negotiated fee. The objective fees were expressed as a percentage of the objective cost while the negotiated fee was expressed as a percentage of negotiated cost. We calculated simple averages across contract actions by category and fee type. For negotiated fees, we also calculated weighted averages; as larger contracts tended to have higher fee percentages, the weighted averages were higher than the simple averages. Figure 11 presents fee comparisons for FFP contracts.

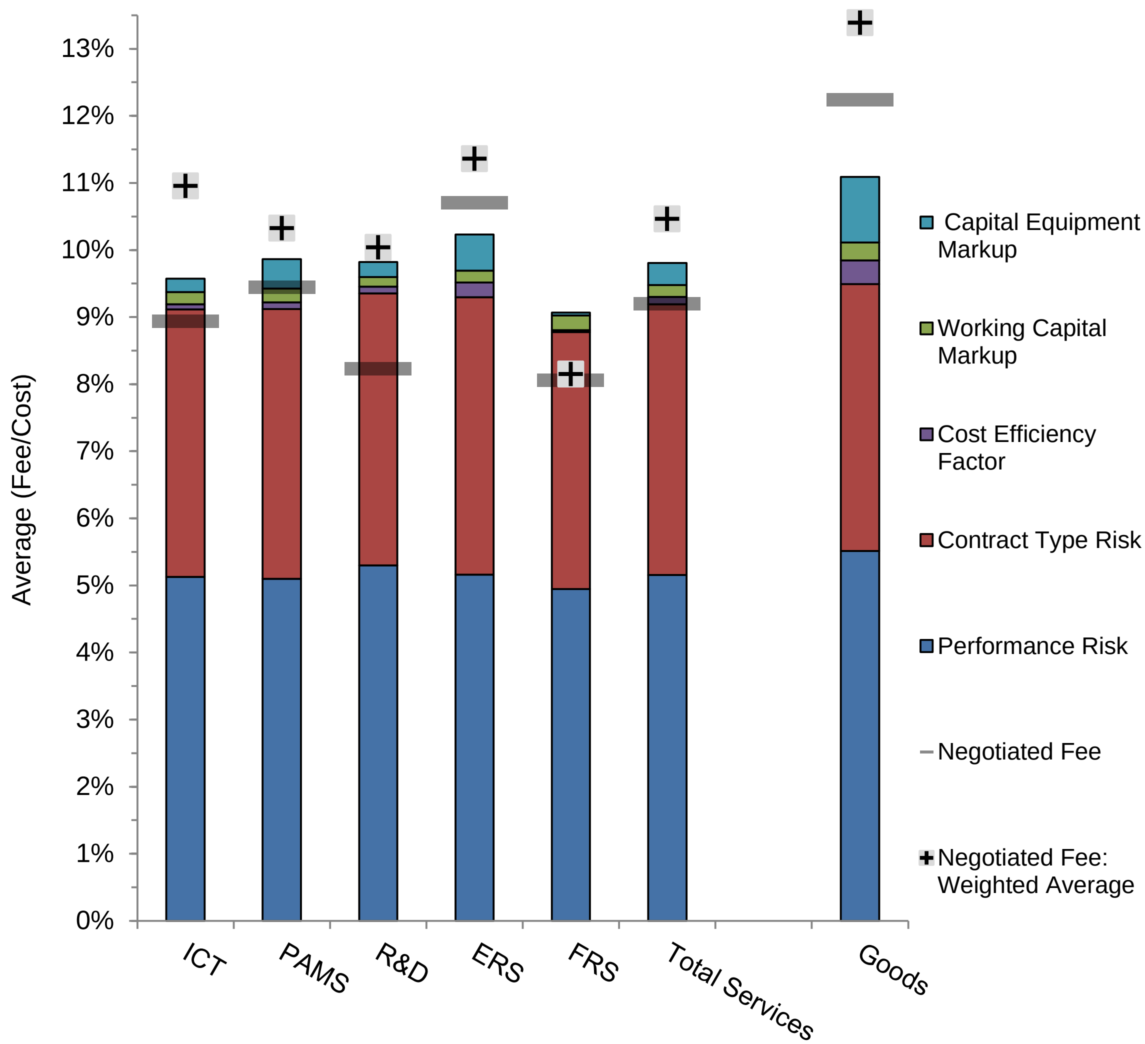


Figure 11. Comparison of Average Fees for FFP Contracts

The results show that average negotiated fees are lower for all service categories relative to goods. Comparing averages between all goods and services we find differences of 3.0 percent (simple average) and 2.9 percent (weighted average).

The buildup of the average weighted-guideline fee percentages for services is generally intuitive. For performance risk (where the weighted guidelines have a normal value of 5 percent), FRS has a lower than normal value (4.9 percent) while R&D and ERS have higher values (5.3 percent and 5.2 percent). Goods have the highest performance risk value at 5.5 percent. Contract-type risk is more difficult to benchmark against normal values from the weighted guidelines, as those values depend on the type of contract finance. The normal values are 3 percent for progress payments, 4 percent for performance payments, and 5 percent where contract finance is left to the contractor. For the progress payment case, there is also a working capital markup that is calculated based on contract length, interest rate, and progress payment percentage. We find that goods contracts are more likely to have progress payments and working capital markup. The data do not provide a way to distinguish between the performance-payment and no-contract-finance cases. On average there is little difference in contract-type risk percentages between the different categories; once the working capital markup is added, all of the categories have average values of 4.2 percent except for ERS (4.3 percent) and FRS (4.0 percent).

Larger differences between goods and services are evident in the efficiency factor and capital equipment markup. For the efficiency factor, the goods contracts have an average of 0.4 percent, while services are at 0.1 percent. The contracting officer has substantial discretion regarding the efficiency factor. Although the criteria listed in the DFARS (Part 215.404-71-5) cover contractor actions that could be relevant to any category, the efficiency factor is more often applied to goods contracts (18 percent of contract actions) than service contracts (6 percent of contract actions).

The capital equipment markup (referred to as the “equipment profit objective” in the 1547 data and described in the DFARS 215.404-71-4 under the topic “facilities capital employed” referred to earlier in this report) has an average of 1 percent for goods and 0.3 percent for services. This markup is a function of the value of the capital equipment used on the contract. A factor with a normal value of 17.5 percent is then applied to the base. Given that there is very little variability in this factor between contracts and categories, the differences in capital equipment markup (when expressed as a percentage of total contract cost) are driven almost entirely by the higher capital intensity associated with the goods contracts.

The largest single driver of the differences between the average negotiated fees of the goods and services categories is the delta between the calculated objective fee and the negotiated fee. With the exception of ERS, the service categories all have average negotiated fee percentages that are lower than the weighted guidelines objective buildup. This delta is positive and substantial for the goods contracts. Comparisons across categories in the average fee percentage differences between services and goods are presented in Figure 12.

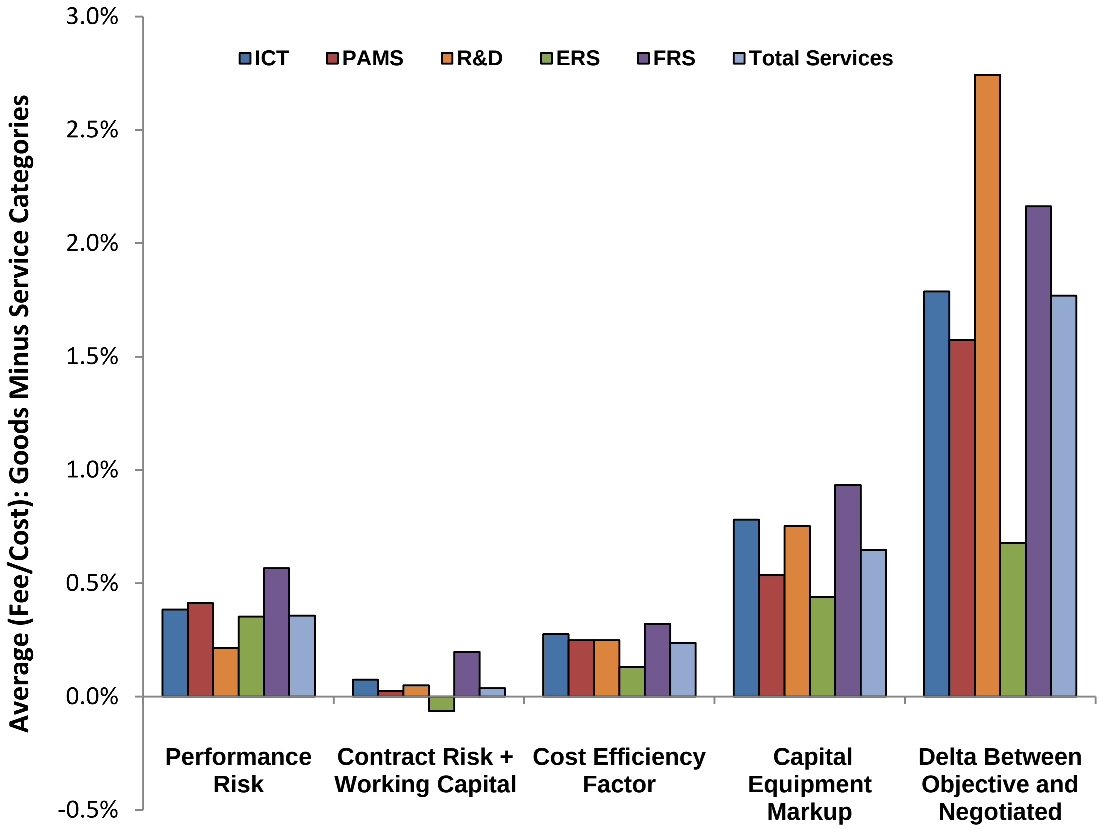


Figure 12. Average Fee Differences for FFP Contracts: Comparisons between Goods and Services Categories

Figure 13 presents analogous fee comparisons for CPFF contracts.

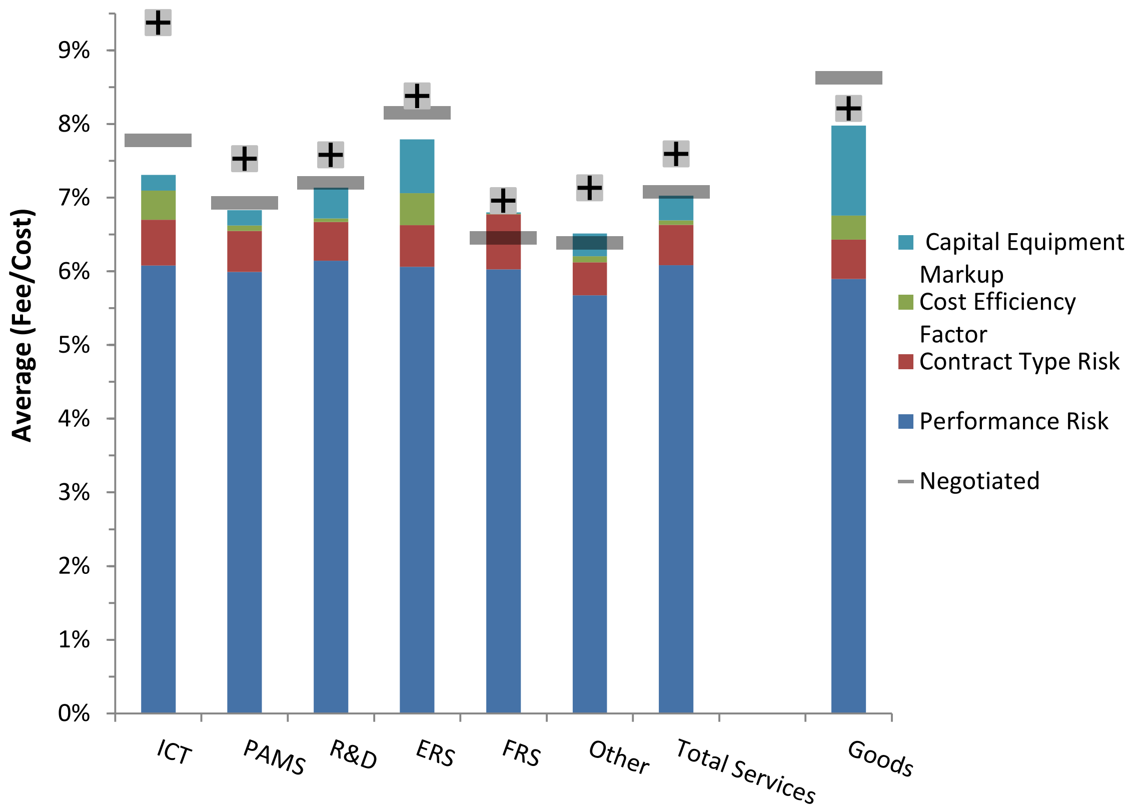


Figure 13. Comparison of Average Fees for CPFF Contracts

There are smaller differences between goods and services for CPFF contracts. The differences are 1.5 percent comparing simple averages and 0.6 percent for weighted averages. Most of the difference between the simple averages is due to the capital equipment markup (0.9 percent), with the delta between objective and negotiated fee at 0.6 percent—the remaining differences cancel each other out. R&D dominates the CPFF service contracts, and there is a substantial divergence within the remaining categories. However, we find that when R&D is excluded from the calculations, there is little change in the comparisons between goods and services. Figure 14 presents comparisons across categories in the average fee percentage differences between service and goods.

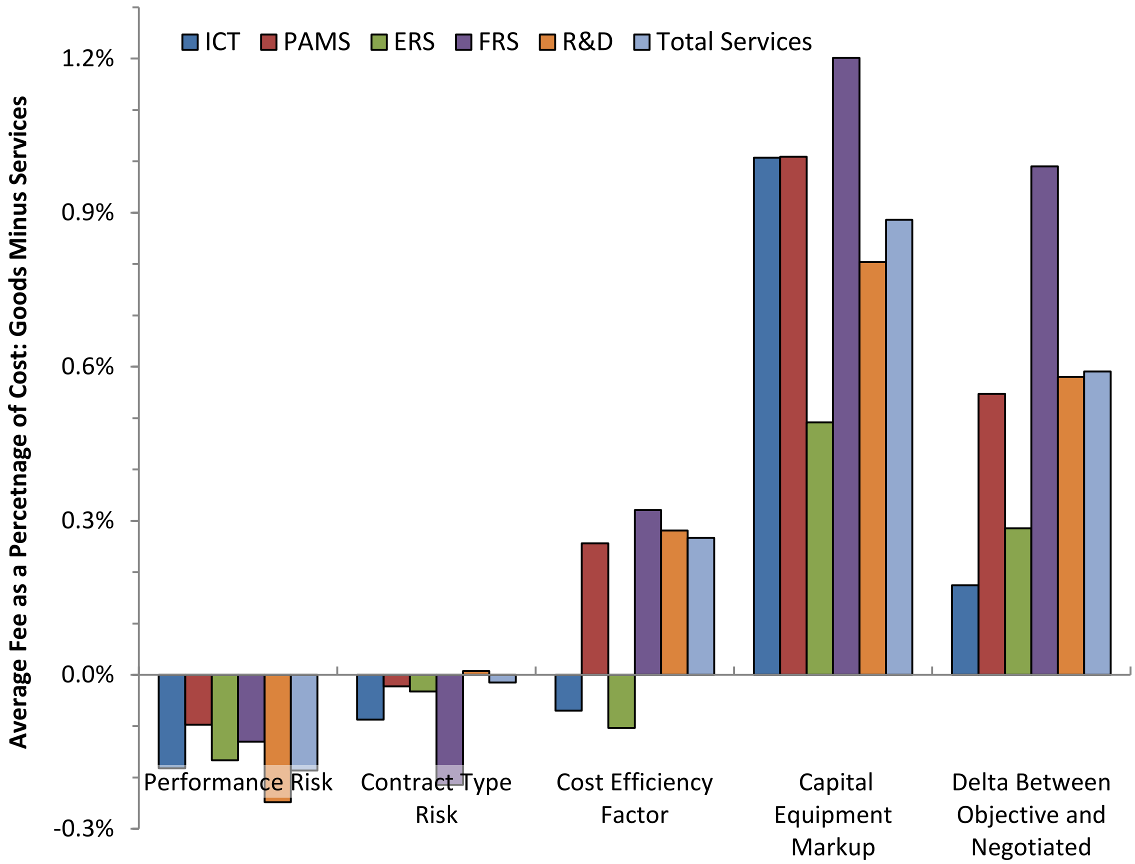


Figure 14. Average Fee Comparisons for CPFF Contracts: Differences between Goods and Services Categories

The differences between goods and services for CPFF contracts are better explained in terms of the weighted guidelines when compared to the FFP case. We also see the same sensitivity of negotiated fee to contract value that is evident for the FFP contracts.

The 1547 data sample for T&M-type contracts was more limited. Other than R&D and PAMS, the individual service categories only had minimal data. Accordingly, we only created comparisons between R&D, all other services less R&D, total services, and goods. Figure 15 presents fee comparisons for T&M contracts.

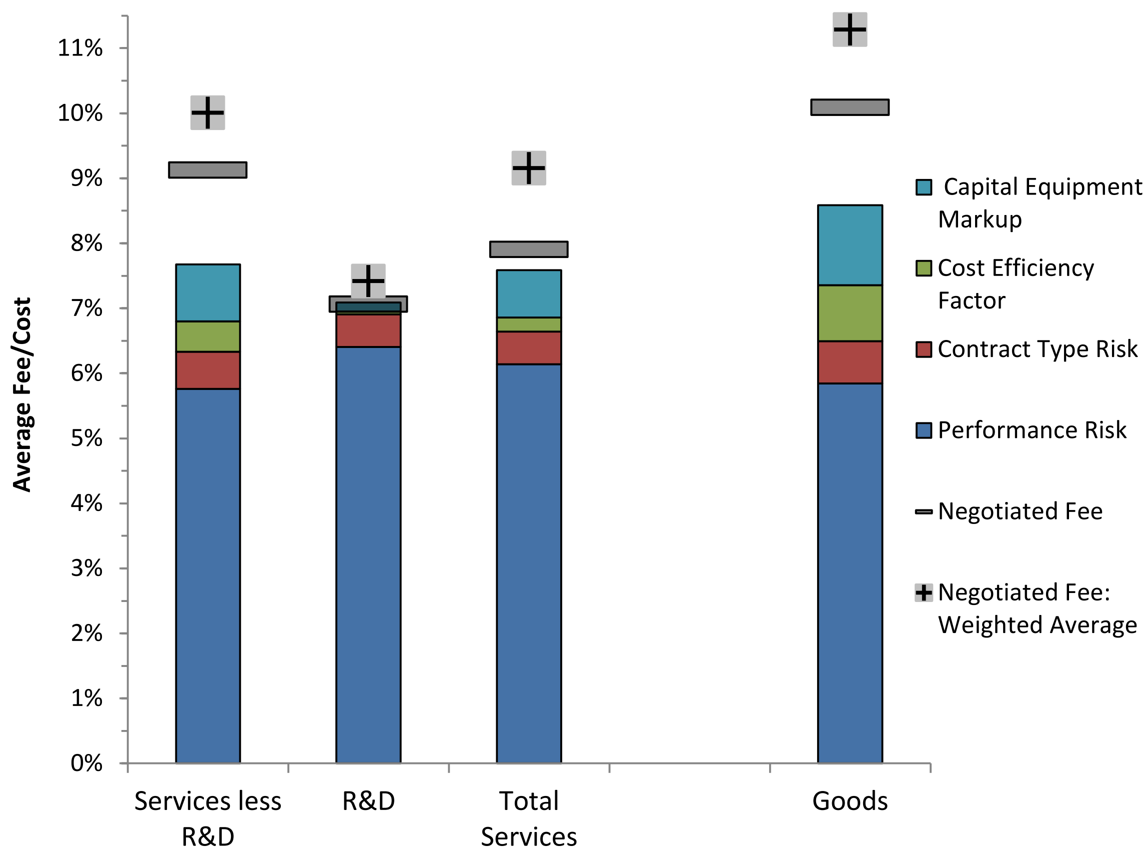


Figure 15. Comparison of Average Fees for T&M Contracts

Most notable are the differences between R&D and other services. While average negotiated fee percentages are 3.0 percent lower (3.9 percent weighted average) for R&D than for goods; for services other than R&D, they are only 1.0 percent lower (1.3 percent weighted average). It is also surprising that, except for R&D, T&M contracts have higher average fees than CPFF contracts.[36] Figure 16 presents a breakout of the differences.

[36] The weighted guidelines specify the same normal values for performance and contract risk for both T&M and CPFF contracts.

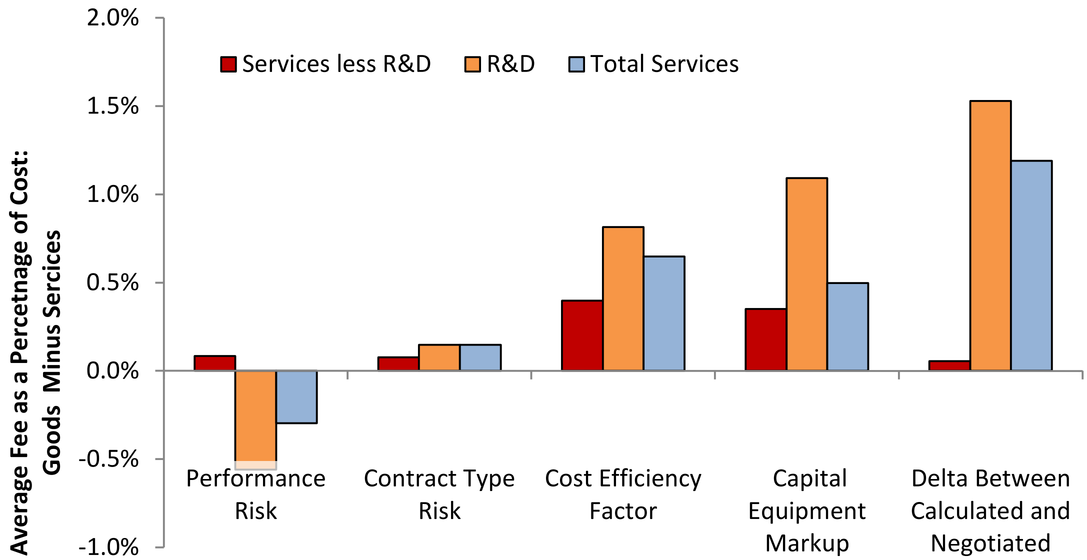


Figure 16. Average Fee Comparisons for T&M Contracts: Differences between Goods and Services Categories

Negative and positive differences in performance risk and the cost efficiency factor nearly cancel one another out for R&D and are small for other services. The capital equipment markup and the delta between the calculated objective and negotiated fee are the large drivers of the lower R&D average fee percentage.

A drawback of comparing averages is that there may be phenomena that can drive fees that may be unevenly distributed across the goods and services categories. We see this in the comparison of the simple and weighted averages, where there is a tendency for higher value contracts to have higher fee percentages. It may be that the differences in the averages across categories are due to these other factors and not the intrinsic differences between goods and services. The best way to explore this question is through linear regression analyses.

c. Regression Analyses

Regression analyses allow us to estimate expected values conditional on the attributes of the data. Thus we can account for observable phenomena that can have an effect on fee percentages while estimating the underlying relationship between the fee percentages across contract categories. The model used was:

$$E\left[\left(\frac{fee}{cost}\right)_i\right] = \left(\alpha^o + \alpha^k D_i^k\right) + \sum_j \beta_j x_{ij},$$

where E is the expectations operator, i indexes each contract action, $a^o$is the intercept value of the reference contract category (in our case goods), α^k is the adjustment on the reference for the kth other contract categories (these are the service categories), and $D_i^k$is a dummy variable taking on the value of 1 or 0 indicating the service category associated with the *i*th contract action. For the summed argument, j indexes the observable variables that have an effect on the negotiated fee percentages. The β_js are the coefficients on the variables and the x_{ij}s are their reported values for each contract action. The x_{ij}s are objective values describing each contract action. The a^o, a^k and b_j coefficients can be estimated using ordinary least squares regression.

The $\left(\alpha^o + \alpha^k D_i^k\right)$ argument can be thought of as portraying purely subjective factors or phenomena that otherwise cannot be observed. As expressions of the weighted guidelines, these could include performance and contract risk and the efficiency factor; also captured would be the unexplained deltas between the objective and negotiated fees. The x_{ij}s are objective metrics that may be related to the weighted guidelines such as capital intensity (capital equipment markup), or may be demographic factors such as the magnitude of contract costs and the prime contractor performing the contract.

Table 6 shows averages of key demographic metrics across categories and contract types.

Table 6. Comparison of Contract Demographics

Category/Contract Type	ICT	PAMS	R&D	ERS	FRS	Goods
Average Negotiated Cost (TY$M)						
FFP	2.2	3.0	1.1	3.6	1.5	12.0
CPFF	5.7	2.6	2.2	9.5	2.6	9.1
T&M		3.7	1.2			3.0
Average (Capital Equipment Value/Cost)						
FFP	1.1%	2.5%	1.3%	3.0%	0.3%	5.3%
CPFF	1.2%	1.2%	2.3%	4.2%	0.1%	6.7%
T&M		4.8%	0.7%			6.9%
Large Primes[a], Percent of Actions						
FFP	19.4%	22.0%	8.7%	41.3%	2.9%	37.3%
CPFF	20.5%	6.3%	12.5%	46.5%	0.3%	52.1%
T&M		22.1%	3.7%			42.5%

[a] Lockheed Martin, Northrup Grumman, Boeing, General Dynamics, Raytheon, BAE Systems.

The metrics are generally consistent with intuition, with the goods contract actions having higher costs, higher capital intensity, and a higher representation of large prime contractors. ERS contracts have characteristics closest to those of goods contracts with relatively high capital intensity and participation of the large prime contractors. With low capital intensity and little prime contractor involvement, FRS contracts are most divergent from goods contracts. Although only capital intensity is explicitly treated in the weighted guidelines, the other two factors could plausibly have an effect on negotiated fee percentages.

Regressions were performed for each of the contract types with the same set of independent variables. Table 7 presents the parameter estimates and measures of model fit along with simple average fee differences for comparison.

Table 7. Regression Analysis Results for Negotiated Fee/Cost

Regression Statistics	**FFP**	**CPFF**	**T&M**
Number of Data Points	9,057	12,122	716
Adjusted R^2	0.33	0.23	0.37
Standard Error of the Estimate	2.6%	1.4%	2.0%
Coefficient Estimates *(Variables)*	**FFP**	**CPFF**	**T&M**
α^{o} *(Goods)*	8.4%	6.4%	5.8%
α^{ICT} *(ICT)*	-2.5%*[-3.3%]*	-0.1%*[-0.8%]*	
α^{PAMS} *(PAMS)*	-2.3%*[-2.8%]*	-0.8%*[-1.7%]*	-0.9%*[-1.0%]*
$\alpha^{R\&D}$ *(R&D)*	-3.1%*[-4.0%]*	-0.7%*[-1.4%]*	-2.2%*[-3.9%]*
α^{ERS} *(ERS)*	-1.2%*[-1.5%]*	-0.3%*[-0.5%]*	
α^{ERS} *(FRS)*	-3.3%*[-4.2%]*	-1.1%*[-2.2%]*	
β_{cost}(*ln* negotiated cost)	0.23%	0.09%	0.25%
$\beta_{K/C}$(*capital equipment value/cost*)	10.3%	6.9%	11.5%
β_{6Prime}(*large prime contractor 1/0 dummy*)	0.5%	0.9%	0.6%

Notes: Values in brackets are simple average fee differences from the previous analyses; all coefficients are statistically significant at the .01 level except for a^{ICT} estimated from the CPFF sample.

For the FFP contracts, the demographic factors explain about one-third of the average differences in fee percentages between goods and services. For CPFF contracts, they explain around two-thirds. Although the R^2 values are low, the standard errors are modest and reflect low variability in the dependent variables, particularly for CPFF contracts.

The magnitude of contract costs has a greater effect on FFP and T&M fees than on CPFF fees; an order of magnitude increase in negotiated cost results in fee percentage increases of 0.5 percent and 0.6 percent versus 0.2 percent for CPFF contracts. It should be noted that direct comparisons of the α^{o}s across contract types is not meaningful, as the values are only relevant to a contract with $1 million in costs (*ln* negotiated cost = 0). Instead, they should be augmented to reflect more likely contract values. For example, given a contract action with $10 million in cost, the values for comparison would be 11.8 percent (FFP), 7.8 percent (CPFF) and 9.8 percent (T&M). The 4 percent difference between the FFP and CPFF contracts is consistent with the differences between the weighted guidelines normal values for FFP and CPFF contracts; the smaller difference for the T&M contracts is less intuitive.

The coefficients on capital intensity (6.9 percent to 11.5 percent) are lower than the 17.5 percent normal value used on most contracts. This indicates that there is some tradeoff between the capital equipment markup and the subjective elements of negotiated fee. We also performed an experiment (not shown in the table) in which we included the efficiency factor fee percentage as an independent variable in the regressions to see if there was a similar tradeoff for it. We found there was no similar tradeoff, as the estimated coefficients were close to 1 (1.14 for FFP, 0.89 for CPFF and 0.99 for T&M).

Differences in fee percentages driven by contract cost magnitudes and the presence of large prime contractors call for some interpretation. One possibility is that these differences reflect the degree of competition or the amount of leverage the contractor can bring to bear during negotiation. Larger contracts and contractors may be associated with assets, both human and physical capital, that are specific to the task being contracted for, and where few if any alternatives are available.

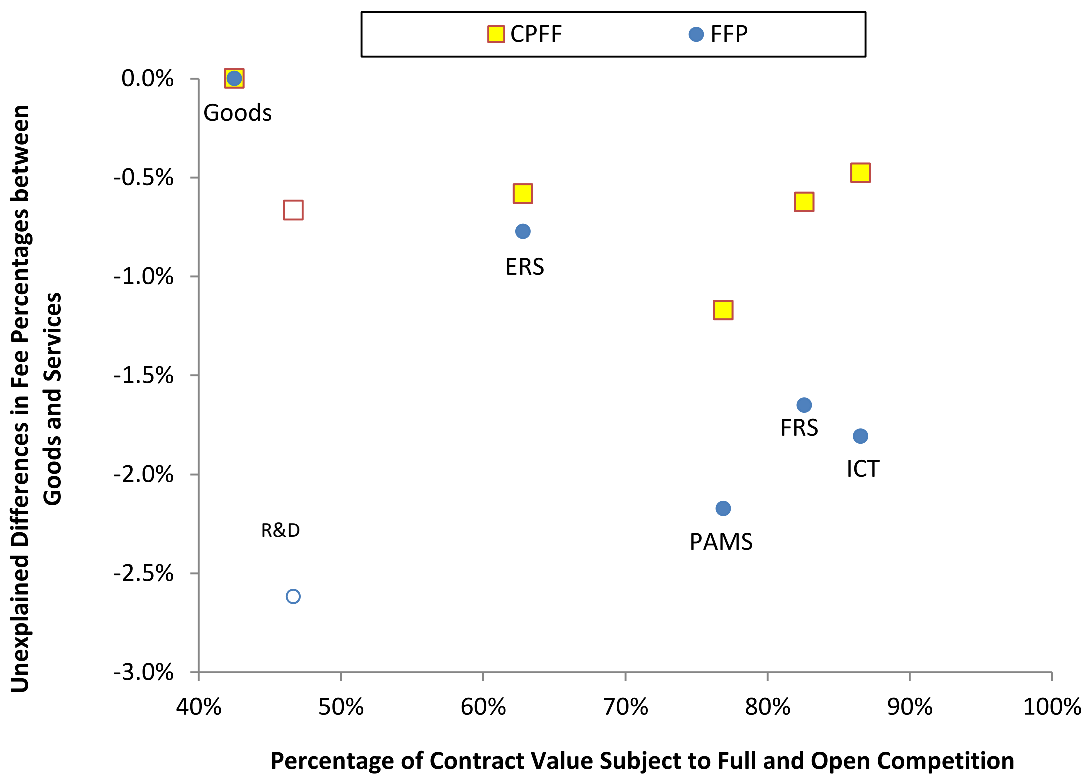
Similar questions arise regarding the fee percentage differences between goods and services. The estimated values of the α^ks adjust the simple average differences for demographic factors. The subjective portions of the weighted guidelines fee percentages can then be subtracted from the α^ks to yield "unexplained" differences. These calculations are shown in Table 8.

Table 8. Breakdown of Differences in Average Fee Percentages between Goods and Services

Contract Type/ Category	Difference in Average Fee Percentage	Minus Demographic Factors (regression)	Adjusted For Demographic Factors (α^ks)	Minus Subjective Factors (weighted guidelines)	Difference Not Explained by Other Factors
FFP					
ICT	-3.3%	-0.8%	-2.5%	-0.7%	-1.8%
PAMS	-2.8%	-0.5%	-2.3%	-0.7%	-1.6%
R&D	-4.0%	-0.9%	-3.1%	-0.5%	-2.6%
ERS	-1.5%	-0.3%	-1.2%	-0.4%	-0.8%
FRS	-4.2%	-0.9%	-3.3%	-1.1%	-2.2%
CPFF					
ICT	-0.8%	-0.7%	-0.1%	0.3%	-0.5%
PAMS	-1.7%	-0.9%	-0.8%	-0.1%	-0.6%
R&D	-1.4%	-0.7%	-0.7%	0.0%	-0.7%
ERS	-0.5%	-0.2%	-0.3%	0.3%	-0.6%
FRS	-2.2%	-1.0%	-1.1%	0.0%	-1.2%
T&M					
PAMS	-1.1%	-0.2%	-0.9%	-0.7%	-0.2%
R&D	-3.0%	-0.8%	-2.2%	-0.4%	-1.8%

Even after adjusting for demographic and subjective factors, there are still substantial unexplained variations. In explaining these differences, the degree of competition may again be relevant.

In general, the equivalent of a weapon system franchise does not exist in services. The one partial exception to this could be ERS, where the original manufacturer of the equipment being serviced would have a natural advantage over others. In fact, differences in fee percentages between goods and the ERS category are relatively small. To further explore the notion of competition influencing fees, we compared the unexplained differences for each of the service categories (where goods are included with a value of zero) with the percentage of contract costs for each category that were subject to fair and open competition. The competition data was from the 2008 FPDS sample as presented earlier. Figure 17 shows this relationship.



Source: IDA analysis of DD 1547 and FPDS data.

Figure 17. Average Fee Differences vs. Degree of Competition

Figure 17 is suggestive of a relationship between average fee differences and the presence of competition, where the unexplained fee deltas appear to be associated with the degree of competition. Note that R&D is an outlier with a degree of competition close to that of goods but with a substantial fee delta.

4. Financial Analysis of DoD Service Firms

The next question is: how do the unique attributes of service contracting affect the financial performance of firms whose primary business is DoD service contracting, particularly in relation to the large DoD prime contractors? Table 9 presents comparisons of key financial metrics.

Table 9. Comparison of Financial Metrics

Income Statement/ Balance Sheet Metrics	Defense			Commercial	
	Primes	Primes & Subs	Services	Capital Goods	Industrial
Operating Margin	10%	11%	10%	14%	16%
Free Cash Flow/Capital	12%	13%	18%	12%	10%

Source: IDA analysis of 2010 results from Capital IQ.

It is surprising that the operating margins between the large primes and service contractors are equal, given the lower negotiated fees for service contracts evident in the 1547 data as well as the higher fees for large primes across all categories indicated by the regression analyses. With similar margins but with a lower level of capital intensity, the end result is a substantially higher return on capital for the service contractors. The disconnect between the lower negotiated fees and the equal margins may be caused by several factors.

The 1547 data reports negotiated fees and not the realized profits that would be reflected as margins in the financial data. As mentioned before, the difficulty in defining and measuring quantity and quality of services could give the contractors substantial opportunity to make profits above negotiated fees for fixed-price contracts. Unfortunately we did not have sufficient data to test this hypothesis. Past IDA analyses (Arnold et al. 2008 and Whitley et al. 2011) examined this question for goods contracting and found that, on average, realized profits and negotiated fees have been similar.

Another contributing factor could be that contracts of types/classifications not included in the 1547 data yield higher margins. Of particular interest are award fee contracts and fixed-price PBSA contracts that were classified commercial items. Award fee contracts tend to have higher fees than CPFF contracts (Arnold et al. 2008) and are most common for service contracts. PBSA contracts that are classified as commercial will not have the same cost visibility as other types of fixed price contracts. If the service has a well-defined commercial analog, there should be no problem, as valid pricing will be available from data on market transactions. However, the rules for declaring a fixed-price PBSA a commercial item only require that like-type services be available commercially. It is not difficult to imagine commercially available services where the variability in initial conditions and outputs, measurement problems, and the unavailability of pricing data would provide contractors the opportunity for higher margins through informational rents.

C. Summary Observations

The first two sections of the chapter presented critical analyses of service contracts, from both a theoretical and empirical perspective. The end goal was to help identify plausible alternatives to FFP contracts in the services context. In this section we recap the previous analyses in the form of "stylized facts" that have a bearing on contract design and profit policy, that also have implications for goods contracting.

We developed the following stylized facts; from the economics literature:

- For service contracts, it is more difficult to specify and measure the quantity and quality of outputs,
  - However, the degree of difficulty varies across types of services.
- Transaction cost theory offers insights into whether the government is better off outsourcing or integrating services (performance vs. time contracting):
  - If asset specificity is high, the contractor may underinvest or behave like a monopoly;
  - If defining and monitoring contractor performance is costly, internalizing may be more efficient despite moral hazard in contracting for time; and
  - These phenomena also have relevance in the choice between cost-type and fixed-price contracts.
- Services are more labor-intensive and may be less susceptible to cost-reducing innovations.
- The challenges associated with government contracting in general described in Chapter 1 are greater for service contracts because of contract incompleteness and measurement problems that exacerbate information asymmetry.

From our empirical analyses, we found that:

- Services are more likely than goods to have cost-type contracts.
- Where there are fixed-cost contracts, very few of them are FPIF.
- There is more competition in service contracting than there is in goods contracting.
- Service contracts have lower negotiated fees than goods contracts.
  - Some of this difference is due to understandable differences in risk and capital intensity reflected in the weighted guidelines.

  - Some of the additional differences can be explained by contract demographics (higher negotiated fees associated with large prime contractors and larger contract value), which in turn can be related to a lack of competition and the contractors' market power.
  - There still remains an unexplained residual that can also be related to a lack of competition and the contractors' market power.
- Despite lower negotiated fees, service contractors have margins that are equivalent to large prime contractors and a higher return on capital. One explanation of this is that there are informational rents accruing to service contractors, particularly on FFP contracts.

5. Summary of Findings

We came away from our analyses with a number of findings that should be of interest to DoD policy makers. We present the summary of findings according to our three major topic areas.

A. Cost Reductions in a Series of Production Contracts

For a series of production contracts in the context of a weapon system franchise in which the system design is mature and stable, the best choice of contract type is FFP. The FFP contract provides the most incentive for the contractor to invest in cost-reducing innovations, as the contractor can keep more of the value of the cost savings in comparison to an FPIF contract. Although the contractor will make higher profits early on, the government will benefit from lower prices later as the cost savings are reflected in future negotiated prices.

Government-funded investments (PIPs) in cost saving appear to have limited value to the government relative to an FFP base case. Given a series of FFP contracts, the contractor will already be willing to commit its own funds to the most promising cost-reduction initiatives. Although the government will gain some visibility into potential cost saving projects, the contractor will still have an information advantage, as it will be the one proposing the projects. PIPs have potential in limited (although potentially important) cases in which the government can pre-commit the contractor to a set increment of savings over an extended number of contracts (e.g., a multi-year procurement case) or when FFP contracts are otherwise indicated.

B. Concepts for Reducing Indirect Costs

Given a portfolio of fixed-price and cost-type contracts, contractor incentives indicate an underinvestment in cost reductions for indirect costs. This is because the contractor only gains profit on the part of the savings allocated to the fixed-price portion of their business base. However, there are problems with targeting overhead costs directly. Even corporations that operate in commercial markets and are not faced with the agency problems of a government manager have challenges in characterizing and managing overhead costs. The government would have difficulty formulating metrics and benchmarks that would have meaning across contractors and time. There also may be reasons for contractors to keep indirect expenses that may appear to be inefficient in the context of current activities, but may be associated with capabilities that are beneficial to both the contractor and the government in the longer run. These could include maintaining production capacity and engineering design teams.

A more promising approach to addressing the underinvestment in indirect cost reductions would be to target total costs for the entire contract portfolio of a contractor or a business unit. We approached this in two steps. In the first, we used a variation of our simulation model to look at a simple two-contract portfolio case. We formulated a variation on the *efficiency factor*, where an incremental profit on future business would be based on cost savings realized in the past period over the contract portfolio. Our simulation experiments showed that such an implementation would address underinvestment in indirect cost reduction projects and result in lower prices to the government.

In reality, a given contractor or business unit may have hundreds of ongoing contracts. To manage and incentivize cost reductions across such an extensive portfolio would require modifications to the current approach to acquisition and contract management. We found a useful exemplar for such changes in the way the automotive OEMs manage their tier-one suppliers. The OEMs use a combination of top-down goals negotiated at the corporate level with complementary actions at the individual end-item level. Such an approach would require a substantial retooling of DoD management and data systems, but if the automotive OEMs' experience with supplier cost reductions could be replicated, the benefits would be large.

C. Issues in Contracting for Services

A review of the literature helped frame the extensive empirical analyses that we performed on data from service contracts. For service contracts, it is more difficult to specify and measure the quantity and quality of outputs; however, the degree of difficulty varies across types of services. Services are more labor-intensive and may be less susceptible to cost-reducing innovations. The challenges associated with government contracting in general described in Chapter 1 are prominent for service contracts because of contract incompleteness and measurement problems that exacerbate information asymmetry.

In our empirical investigation, we found the general pattern of contract types across service categories was consistent with expectations, given the attributes of the different service categories. The more routine and production-like categories (e.g., FRS) have a higher concentration of fixed-price contracts, while those with the most uncertainty regarding inputs and outputs have more cost-type contracts. However, we did find a very low incidence of FPIF contracts relative to FFP contracts.

There were two somewhat surprising empirical findings. The first was the degree to which goods contracts had higher negotiated fees than service contracts, where the higher fees were only partially explained by the differences in objective values from the weighted fee guidelines. Some of the additional difference could be explained by greater dollar values and a higher concentration of large prime contractors in the goods contracts. These metrics could in turn be related to the degree of market power held by the contractor. Even after adjusting for these factors, there was still a residual difference in negotiated fees, with this difference varying across the different service categories; this variation could also be explained by the degree of competition in each service category. These findings are somewhat disturbing, as, on average, negotiated fees should be driven by the objective fee values and not by the market power of the contractors involved in negotiation.

The second surprise was related to the first. Even with the lower negotiated fees associated with services, an examination of financial data for large service contractors found margins similar to those for the large primes that are overrepresented in goods contracting. This, combined with the lower capital intensity associated with service provision, resulted in a substantially higher return on capital for those contractors compared with the large primes. One explanation of this disconnect is that there are informational rents due to contract incompleteness and the measurement problem associated with service contractors; this would particularly be the case for FFP contracts.

D. Implications for Government Policy and Practice

- FFP contracts are most appropriate for series production of weapon systems with a stable design;
- Although PIPs may not be appropriate for FFP contracts, there are specific instances such as MYPs and/or incentive contracts in which they can be of value;
- To rein in overhead costs, the government should look for ways to incentivize cost reductions across portfolios of contracts;
- The disconnect between negotiated fees and objective fee buildups related to the market power of the contractors involved should be addressed;
- For service contracts, the low incidence of FPIF contracts relative to FFP contracts and the apparent existence of informational rents indicate that a shift from FFP to FPIF contracts may be beneficial to the government.[37]

[37] The conditions that make FFP contracts superior to FPIF contracts in series production for the weapon system franchise case would largely be absent in services contracting.

Appendix A.
Modeling Cost Reduction Incentives with Indirect Costs and Two Contract Types

In this appendix, we formulate an extended version of the investment model. The additional assumptions allow us to include a mix of fixed-price and cost-plus contracts as well as indirect costs allocated across those contracts. The ultimate goal is to test the effects of different policy alternatives as they relate to the broader questions addressed by this report. Of particular interest is incentivizing cost reductions across a contractor's entire contract portfolio, including reductions in overhead costs, as well as the effect of government-funded cost reduction investments (Production Improvement Programs (PIPs)).

Model Development

The basic economic phenomena modeled are the same as before (i.e., cost-decreasing investment decisions on the given regulatory lag), but the inclusion of a cost-type contract with shared indirect costs adds the capability to examine additional policy effects. The model was calibrated using data from the F-22 program and sensitivity analyses were performed.

Model Specification

The setup included two programs, each with a series of annual contracts. The programs were performed in the same business unit and share indirect costs. One program consisted of FFP contracts (indexed by the *f* superscript) and one CPFF contracts (indexed by the *c* superscript). Total contract cost for the period t is:

$$C_t = {}^{f}C_{\mathrm{t}} + {}^{c}C_{\mathrm{t}} + V_t,$$

where ${}^{f}C_t$ and ${}^{c}C_t$ are direct costs for each contract and V_t is the indirect costs shared across both contracts. The direct costs follow the learning curve where:

$${}^{f}C_{\mathrm{t}} = {}^{f}q_{\mathrm{t}}\,{}^{f}a_{\mathrm{t}}\,{}^{f}Q_t^b \text{ and } {}^{c}C_{\mathrm{t}} = {}^{c}q_{\mathrm{t}}\,{}^{c}a_{\mathrm{t}}\,{}^{c}Q_t^b,$$

and q_t, a_t, and Q_t are lot quantity, T_1 cost, and cumulative quantity for lot *t*; *b* is the exogenous learning parameter. The definition of V_t follows from Rogerson, where it is decomposed into two elements:

$$V_t = Z_t + J_t.$$

Z_t can be looked at in two ways. Rogerson (1992) describes Z_t as the portion of indirect cost that could, in principle, be assigned to each contract but are not, because of the high costs of doing so. Another interpretation, consistent with but not equivalent to the first, is that Z_t is the portion of indirect costs that will vary with the direct costs of each contract. We express these costs as:

$$Z_t = \zeta_t({}^{f}C_t + {}^{c}C_t).$$

J_t represents costs that are impossible to assign to any one contract; we added the additional restriction that they are fixed in relation to ${}^{f}C_t + {}^{c}C_t$. Note that we excluded the portion of indirect costs that reimbursed capital depreciation expenses. In our modeling of the contractor's perspective on cost and value maximization, depreciation was captured elsewhere. However, when depreciation was accounted for as an indirect cost it played a role in determining contract price, and we treated it in that context later. Otherwise, the expression for Z_t is close to the specification used in IDA's indirect cost forecasting models where the fixed and variable portions of indirect costs were estimated statistically.

While the specification of costs was parallel between the FFP and CPFF contracts, price determination was divergent. For the FFP case, price (negotiated cost plus some fee percentage) was determined solely on the basis of information available to the government prior to the negotiation of the contract—how far prior depended on the regulatory lag length (ℓ) in force. For the CPFF contract, the price—excepting the fixed fee—was determined by the costs for the current contract. The fixed fee was determined using information available outside of the regulatory lag period, parallel to total price determination in the FFP case.

Investments made by the contractor within the regulatory lag period tend to result in cost levels below those negotiated as part of price determination. The contractor had four areas to direct cost-reducing investments: FFP direct costs (${}^{f}C_t$), CPFF direct costs (${}^{c}C_t$), variable indirect cost (Z_t), and fixed indirect costs (J_t).

Estimated direct costs used to negotiate the lot t price for the FFP contract were:

$${}^{f}\hat{C}_t = {}^{f}q_t\, {}^{f}a_{t-\ell}\, {}^{f}Q_t^{b},$$

where ${}^{f}a_{t-\ell}$ and ${}^{f}\hat{C}_t$ were based on information available prior to the regulatory lag period (t-ℓ); cost decreases due to investments were modeled as decreases in T_1 cost, where ${}^{f}a_t \leq {}^{f}a_{t-\ell}$ given positive net investment.

A parallel expression was used for ${}^{c}\hat{C}_{t}$. Indirect costs were treated in a similar way:

$$\hat{V}_t = \hat{Z}_t + \hat{J}_t, \text{ where } \hat{Z}_t = \zeta_{t-\ell}({}^{f}\hat{C}_{t} + {}^{c}\hat{C}_{t}) \text{ and } \hat{J}_t = J_{t-\ell}.$$

To this we added the depreciation expense treated as an indirect cost that can be recaptured in price:

$$D_t = \delta k_t \text{ and } \hat{D}_t = \delta k_{t-1} .$$

When the contracts were priced, indirect costs were allocated based on the ratio of direct costs for each contract to total direct costs. Given the negotiated profit rate for the FFP contract, π_t^{FFP}, the relation for the unit price of the FFP contract was:

$${}^{f}p_{t} = \frac{1}{{}^{f}q_{t}}(1 + \pi_t^{FFP}) \left[{}^{f}\hat{C}_{t} + \left(\hat{V}_t + \hat{D}_t\right) \frac{{}^{f}\hat{C}_{t}}{{}^{f}\hat{C}_{t} + {}^{c}\hat{C}_{t}} \right].$$

For the CPFF contract the price was:

$${}^{c}p_{t} = \frac{1}{{}^{c}q_{t}}\left({}^{c}C_{t} + (V_{t} + D_{t}) \frac{{}^{c}C_{t}}{{}^{f}C_{t} + {}^{c}C_{t}} + \pi_t^{CPFF} \left[{}^{c}\hat{C}_{t} + \left(\hat{V}_t + \hat{D}_t\right) \frac{{}^{c}\hat{C}_{t}}{{}^{f}\hat{C}_{t} + {}^{c}\hat{C}_{t}} \right] \right),$$

where the cost basis for the fee was determined with information outside of the regulatory lag period while the cost portion of price was the observed cost for the contract. Total revenue for period t was $R_t = {}^{f}q_t {}^{f}p_t + {}^{c}q_t {}^{c}p_t$.

The contractor's objective for a given program pair was:

$$\max_{\{i_t\}} \sum_{t=0}^{T} B^{t}\left[R_t - C_t - i_t + \gamma\, k_T\right],$$

where B was the discount factor, i_t was total investment for lot t, k_T was the capital stock at the end of both programs (each program is assumed to be of the same length), and γ was the proportion of k_T that had value after the conclusion of the two programs. The law of motion for the capital stock (k_t) was:

$$k_{t+1} = k_t(1-\delta) + i_t ,$$

where δ was the depreciation rate per lot. Capital and investment can be broken into the four types mentioned above, where:

$$i_t = {}^{f}i_{t} + {}^{c}i_{t} + {}^{Z}i_{t} + {}^{J}i_{t} \text{ and}$$

$$k_t = {}^{f}k_{t} + {}^{c}k_{t} + {}^{Z}k_{t} + {}^{J}k_{t} .$$

Investments affected the evolution of cost through changes in the capital for the relevant cost elements:

$$ {}^{f}a_t = f({}^{f}k_t), \frac{\delta\, {}^{f}a_t}{\delta\, {}^{f}k_t} < 0, \frac{\delta^2\, {}^{f}a_t}{\delta\, {}^{f}k_t^2} > 0, $$

$$ {}^{c}a_t = f({}^{c}k_t), \frac{\delta\, {}^{c}a_t}{\delta\, {}^{c}k_t} < 0, \frac{\delta^2\, {}^{c}a_t}{\delta\, {}^{c}k_t^2} > 0, $$

$$ \zeta_t = f({}^{Z}k_t), \frac{\delta \zeta_t}{\delta\, {}^{Z}k_t} < 0, \frac{\delta^2 \zeta_t}{\delta \zeta_t^2} > 0, \text{ and} $$

$$ J_t = f({}^{J}k_t), \frac{\delta J_t}{\delta\, {}^{j}k_t} < 0, \frac{\delta^2 J_t}{\delta J_t^2} > 0. $$

One challenge in fully specifying the model was in representing the functional relationship between the level of k_t and cost. As the overall level of activity changes over the course of the production program, while ${}^{f}a_t$, ${}^{c}a_t$ and

As fixed costs (J_t) were by definition fixed relative to activity, the relationship could be simplified to:

$$J_t = {}^J\alpha \; {}^Jk_t^{-\beta}.$$

β was roughly equivalent to the parameter on capital in a Cobb-Douglass production function. Note that it would be almost impossible to segregate the effects of capital between its constituent elements. For example, buying a new machining center would lower ${}^f a_t$, but could also lower ζ_t if it is more energy efficient and the variable portion of facilities overhead is reduced.

The greatest payoffs were for cost savings from investments relevant to direct costs for the fixed price contract. Cost savings for indirect costs would only result in increased profits for the portion allocated to the fixed price contract; there is a second order effect in which cost savings in direct cost cause a larger allocation of indirect costs to the cost-type contract.

F-22 Calibration

To test the implications of the model, we assigned model parameters and employed variables based on an existing program, the F-22A. F-22A production consisted of a series of fixed price contracts; given the model also calls for a series of cost-plus contracts, we created a “mirror” program that provided for this. Once the model was calibrated to the baseline programs, a range of sensitivities were explored.

In calibrating the model to the F-22, we used publicly available budget data for the airframe portion of flyaway costs. By focusing on the airframe only, we were able to more directly apply other airframe-specific analyses and data to model calibration. To convert the F-22 data to constant dollars, we used an airframe-specific weighted escalation index available from the Naval Air Systems Command (NAVAIR) based on data provided them by an economics consultancy, Global Insight. Table A-1 presents the data used.

Table A-1. F-22 Airframe Price Data

Lot	Quantity	Cumulative Quantity	Unit Price, TY$M	Unit Price, FY10$M
EMD+PRTV [a]	17	17		
2001	10	27	123.5	164.2
2002	13	40	108.9	143.0
2003	21	61	98.7	124.6
2004	22	83	91.4	110.5
2005	24	107	82.8	93.3
2006 [a]	24	131	83.1	89.2
2007	20	151	84.3	88.1
2008	20	171	83.7	83.5
2009	20	191	86.1	87.1

Source: President's Budget Submission justification books, P-5 exhibits.

[a] The Engineering and Manufacturing Development (EMD) and Production Representative Test Vehicles (PRTV) lots were included in cumulative quantity; also included was a test aircraft replacement bought with RDT&E funds in 2006.

In setting values for the model parameters, we used information from other studies of airframe costs and industry structure, as well as scaling to fit the F-22 data.

Portraying the effects of a mix of contract types required the creation of a series of cost-type contracts. A hypothetical twin of the F-22 program served this purpose. For the baseline case, ${}^{f}a_0$ and ${}^{c}a_0$ were set to be equal. Given this, the first lot total costs (reflecting the initial conditions) were split 50/50 between the actual F-22 contract and its hypothetical CPFF twin.

The next step was to specify values of model parameters. In general this was an iterative process in which initial values were specified based on other information for relevant studies and data and then modified to better fit the F-22 price data (for the series of FFP contracts) as well as provide sensible values for other model-generated metrics. We started by fitting a conventional learning curve to the F-22 data using least squares regression.[1] This analysis produced a learning curve value of 78.4 percent. This bounds the steepness of the exogenous learning curve. Values used for the baseline case were:

${}^{f}a_0$, ${}^{c}a_0$, = \$165 million (FY 2010), initial T1 direct cost;

b = -.286, 82 percent exogenous learning curve;

ζ_0=.7, initial coefficient on direct costs for variable overhead;

J_0 = \$600 million (FY 2010), initial fixed overhead cost;

1 Because the final lot shows an increase in unit price associated with "tail up" costs it was not included in the data used to fit the learning curve.

π^{FFP}= .13, π^{CPFF}=.09, profit rate/mark-up on accounting cost;

B = .85, 18 percent annual discount rate;

γ = .25, 25 percent of the capital stock has value after the completion of the programs;

δ = .10, 10 percent depreciation rate;

β = .15, coefficient on capital;

ℓ =2, indicating an informational lag period of one lot;

$\frac{{}^{f}k_0}{{}^{f}\bar{C}_t}, \frac{{}^{c}k_0}{{}^{c}\bar{C}_t}$ = .2, initial values for capital intensity for direct costs; and

$\frac{{}^{z}k_0}{{}^{f}\bar{Z}_t}, \frac{{}^{j}k_0}{J_0}$ = .1, initial values for capital intensity for indirect costs.

Note that the αs are not specified directly but are a fallout of the initial values of capital intensity, β, and the cost variables.

The direct cost T1s and exogenous learning curve slope were determined primarily by the fit to the data. The values for ζ_0 and J_0 were calibrated based on earlier IDA indirect cost studies. $\pi^{FFP}$was based on representative F-22 experience with π^{CPFF} adjusted downward based on the weighted profit guidelines. The relatively high discount rate reflects an elevated cost of capital associated with volatile future revenue streams due to uncertainties in future quantities. β was based on a previous IDA study (Harmon 2010) relating the capital/labor ratio of aircraft manufacturers to unit manufacturing labor hours. The remaining parameters relating to capital were calibrated based on model outputs for $\frac{k_t}{\hat{C}_t+\hat{D}_t}$, where an analog value can be calculated from contract negotiation data reported in DoD Form 1547.[2] The average value from the baseline model calibration was 17 percent—this is higher than the 9 percent average we calculated from a sample of 64 large aircraft production contracts from 1547 data, but still within the range of this sample.

Figure A-1 presents the fit of the model outputs for unit price against actual unit prices derived from the budget data. Shown are both the FFP case portraying the F-22 program as executed and the hypothetical CPFF case.

[2] The value of equipment used on a contract has to be estimated in order to calculate the facilities capital markup (equipment employed) portion of profit. If k_t is interpreted as including buildings as well as equipment, there would be a smaller delta between the model generated values and the 1547 sample. Also, the 1547 data only reports the k_t analog for the prime contractor, while our model estimated k_t associated with all contractor effort.

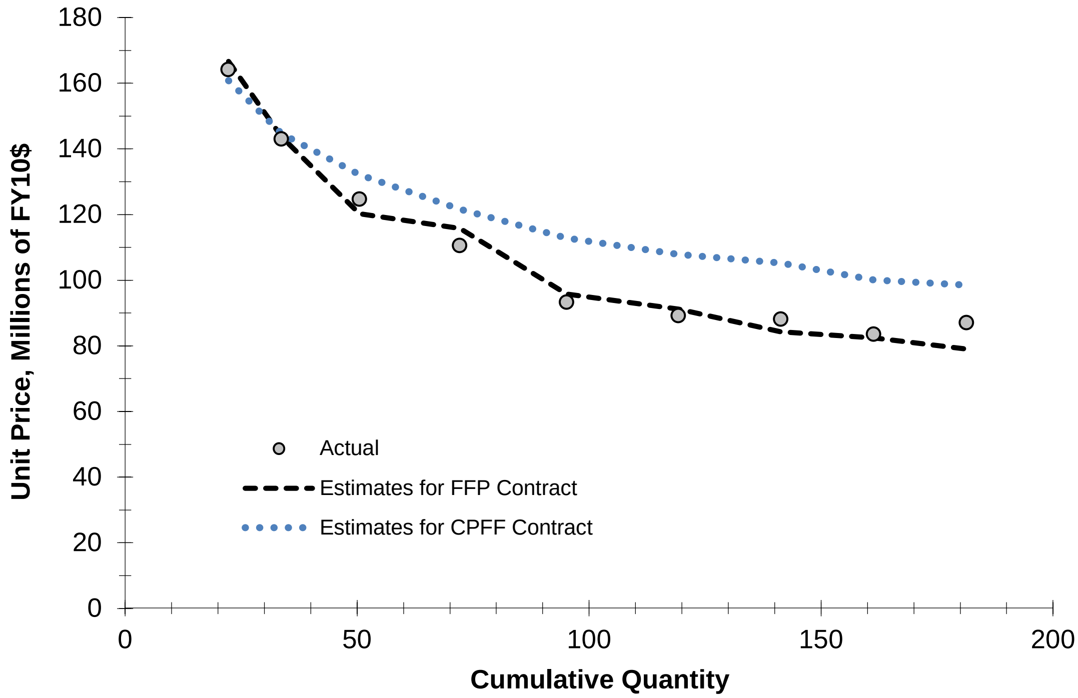


Figure A-1. Model Estimates and Data for F-22 Airframe Unit Costs

The CPFF result corresponded to an 85 percent learning curve. This is shallower than the exogenous learning curve for two reasons. Capital intensity for CPFF direct costs decreases as the contractor has no incentive to replace depreciated equipment, and, as direct costs decrease faster for the FFP contract, more indirect costs are allocated to the CPFF contract. Other model outputs are also of interest. Fixed overhead costs were 17 percent of total costs, indirect costs were 106 percent of direct costs,[3] and for the FFP contract, the realized profit on cost was 17.8 percent vs. 13 percent for the negotiated value. The 17.8 percent value is likely high—it is the result of the assumption that the government always negotiates future lot costs based on the exogenous learning curve, even though the contractor consistently does better through additional investments. However, changing this assumption to something more realistic (and difficult to implement) would not change the contractor's investment incentives. On average, each investment dollar resulted in around 6 dollars of total cost savings.

Sensitivity Analyses

We wanted to see how contractor investment behavior would change with changes in the proportion of contract value assigned to each contract type. We did this by varying the relationship between the values of ${}^{f}a_0$ and ${}^{c}a_0$. The baseline case was for a 50/50

[3] These values for indirect costs were similar to those for earlier IDA studies of overhead in the airframe industry; see, for example, Balut et al. (1991).

split where $\frac{{}^{c}a_0}{{}^{f}a_0 + {}^{c}a_0} = .50$; for the sensitivity analyses, ${}^{f}a_0$ and ${}^{c}a_0$ were varied such that $\frac{{}^{c}a_0}{{}^{f}a_0 + {}^{c}a_0}$ ranged between 0 percent and 100 percent in 25 percent increments. The model was optimized at each of the values, and changes in selected variable were noted. Of particular interest were changes in investment directed towards reductions in indirect costs relative to total investment $\left(\frac{{}^{z}i_t + {}^{J}i_t}{i_t}\right)$. These changes in turn drove the relationship between indirect and direct costs $\left(\frac{V_t}{{}^{f}C_t + {}^{c}C_t}\right)$. The sensitivities of these variables to values of $\frac{{}^{c}a_0}{{}^{f}a_0 + {}^{c}a_0}$ are presented in Figure A-2.

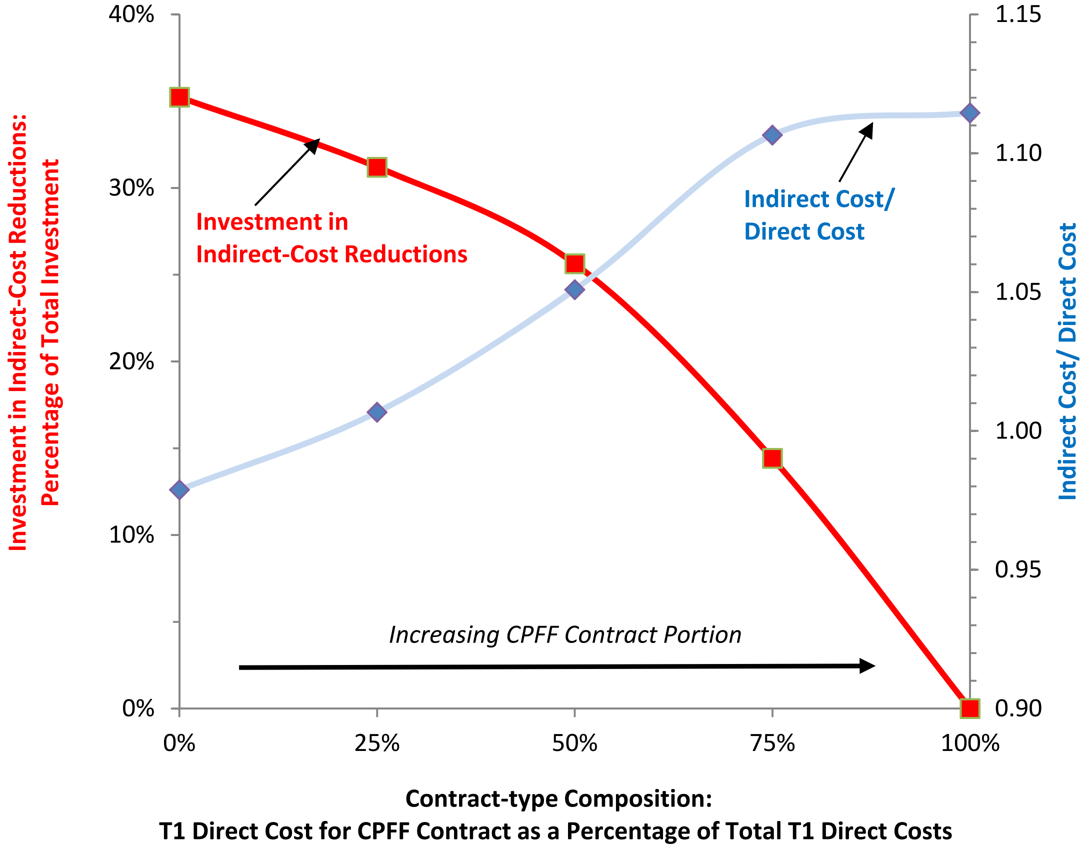


Figure A-2. Sensitivity of Indirect Cost Metrics to Contract Composition

This shows that business units with a larger percentage of contract value attached to cost-type contracts will have less incentive to invest in cost reductions for indirect costs, and in turn will have higher overhead rates. This helps set up a framework for designing policies and related incentives to encourage reductions in indirect costs.

Policy Experiments

Additional profit for cost reductions – the efficiency factor

The efficiency factor was included in the DFARS weighted profit guidelines in 2002 to encourage contractor cost savings. The profit regulations include a wide variety of cost-saving efforts that can be used in determining the efficiency factor. However, we are most interested in cost performance on prior contracts. Although this is called out in the DFARS as a potential criterion for determining the efficiency factor, there is no formula or range of parameters provided to relate past cost savings to objective values of the efficiency factor. In this subsection we will explore the formulation of an efficiency factor that more explicitly ties profit rates to past contract cost performance. This is done using the investment/learning model in which the relevant contract costs include all programs/contracts across the business unit. This is consistent with our suggested approach of setting cost reduction goals across a contractor's entire business base and rewarding them accordingly.

We define an additional element of profit, π_t^E, as the efficiency factor:

$$\pi_t^E = -\theta\left(\frac{C_{t-\ell}+D_{t-\ell}}{\hat{C}_{t-\ell}+\hat{D}_{t-\ell}} - 1\right),$$

where $\hat{C}_t$ is parallel to the already defined C_t; and $\hat{C}_t$ and C_t are the negotiated and actual costs across the entire business base of the contractor for a given time period. The *t-ℓ* time index indicates that confirmation of past cost savings is subject to the same lag experienced in collecting cost data used in negotiation. The depreciation values are included to be consistent with the accounting costs collected for DoD contracts. θ is a parameter that relates past cost savings to current values for the efficiency factor. The pricing equations are then modified as follows:

$${}^{f}p_t = \frac{1}{{}^{f}q_t}(1+\pi_t^{FFP}+\pi_t^E)\left[{}^{f}\hat{C}_t + (\hat{V}_t+\hat{D}_t)\frac{{}^{f}\hat{C}_t}{{}^{f}\hat{C}_t+{}^{c}\hat{C}_t}\right]$$

and

$${}^{c}p_t = \frac{1}{{}^{c}q_t}\left({}^{c}C_t + (V_t+D_t)\frac{{}^{c}C_t}{{}^{f}C_t+{}^{c}C_t} + (\pi_t^{CPFF}+\pi_t^E)\left[{}^{c}\hat{C}_t + (\hat{V}_t+\hat{D}_t)\frac{{}^{c}\hat{C}_t}{{}^{f}\hat{C}_t+{}^{c}\hat{C}_t}\right]\right),$$

where the contractor's objective function is the same as before. In the pure FFP case, the first-order effect of the efficiency factor is to stretch out by an additional year the profit associated with cost-saving investment made prior to year *t-ℓ*.

Sensitivity analyses were performed in which both contract-type composition and θ was varied. The model was optimized for each scenario and output values of interest noted.

Sensitivities to contract-type composition were directly comparable to those performed with the baseline cases without the efficiency factor. For the efficiency factor scenarios, θ was set to 1. Figure A-3 shows sensitivities for investment in indirect-cost reductions and the ratio of direct to indirect costs; the results for the baseline are included for comparison.

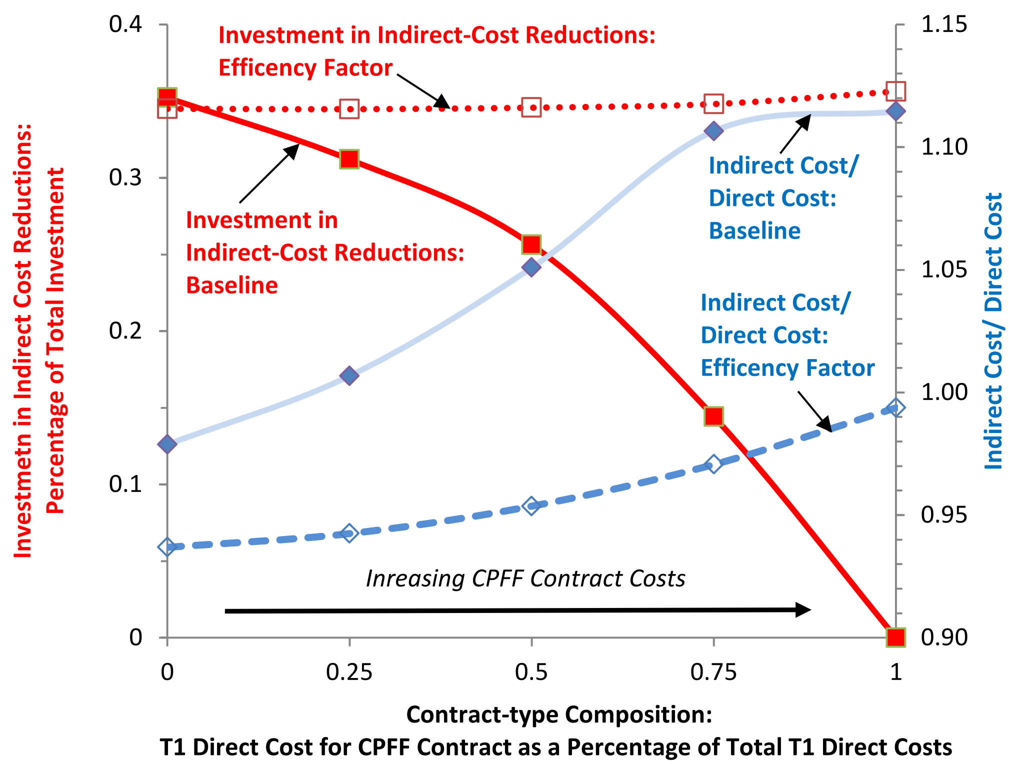


Figure A-3. Sensitivity of Indirect Cost Metrics to Contract Composition: Baseline and Efficiency Factor Scenarios

The results show that when the efficiency factor was included, investments to reduce indirect costs and the resulting levels of indirect cost were close to those for the pure FFP case, even as the CPPF portion of the business base increased.

Ultimately, we are interested in the effect of the π_t^E efficiency factor on the government's total contract expenditures ($\sum_{t=0}^{T} R_t$). The cost and resulting price savings from additional investment must overwhelm increases in contractor margin for this to be a worthwhile policy initiative. Figure A-4 presents comparisons of total contract expenditures averaged over total production quantities, $\frac{\sum_{t=0}^{T} R_t}{\sum_{t=0}^{T} {}^{f}q_t + \sum_{t=0}^{T} {}^{c}q_t}$, for the business unit. Cases with and without the efficiency factors are shown and sensitivities across variations in both contract composition and θ are provided.

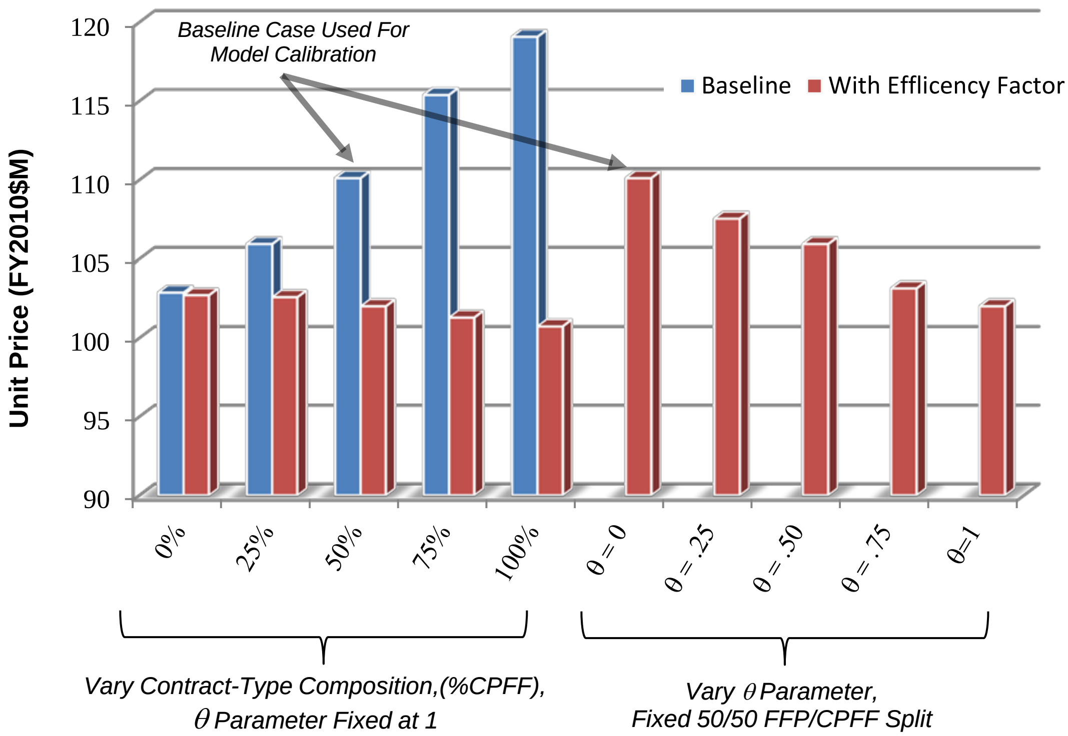


Figure A-4. Sensitivity of Unit Price to Contract Composition and θ Parameter: Baseline and Efficiency Factor Scenarios

Prices with the efficiency factor cases and $\theta = 1$ were close to those for the pure FFP case (CPFF=0 percent), even when the contract composition became dominated by CPFF contracts. For the baseline contract mix, increasing θ caused unit price to decrease, albeit at a decreasing rate. The policy simulations indicated that tying the efficiency factor directly to past cost savings across the business unit could be effective at decreasing both indirect costs and prices to the government.

Government Funded Investments – Production Improvement Programs (PIPs)

Even for fixed-price contracts, the contractor's incentives for making cost-reducing investments are limited because the resulting cost savings will eventually lead to lower negotiated prices. One way to increase total cost-reducing investments is to have the government directly fund investments that the contractor would not otherwise undertake.

Such PIP efforts have been evident in past procurements (sometimes referred to as cost-reduction initiatives or CRIs), but are not a standard part of the acquisition process.

Including PIPs in our modeling framework required specific assumptions regarding contractor and government behavior and associated information asymmetries. We assumed that the contractor initiated PIP investments with the government's input limited to setting spending constraints. We did include an information-gathering/management tax on the government-side PIP expenditures. Following from past PIP implementation, we restricted the investments to those affecting direct costs and assumed the value of those investments went to zero at program end. These assumptions reflected the product-specific nature of PIP investments.

To implement the model we took as a starting point the contractor-funded investments indicated by the solution to the baseline case, ${}^{*}i_t$; to this, we added PIP investments:

$$i_t = \ {}^{*}i_t + {}^{pip}i_t ,$$

where ${}^{pip}i_t$ is restricted to investments that only affect direct costs. The contractor's objective function becomes:

$$max_{\{{}^{pip}i_t\}} \sum_{t=0}^{T} B^t[R_t + {}^{pip}i_t - C_t - i_t],$$

where the PIP investments are a supplement to revenue and can be distributed by the contractor both across time and between contracts (all the PIP exercises used the baseline 50/50 split between FFP and CPFF T1 direct costs). We added to the optimization problem budget constraints. These can take two forms. The first is a simple constraint on the total amount of PIP investment:

$$s.t. \sum_{t=0}^{T} {}^{pip}i_t \leq L.$$

This assumes only a limited amount of knowledge and control on the part of the government—the contractor is free to apply PIPs in any way that maximizes the contractor's value over the series of contracts. We consider this the most realistic case. The second version of the constraint assumes the government has greater knowledge and a higher level of control and enforcement. In this case the government will only fund PIPs such that they result in total expenditures equal to or lower than the baseline without PIPs:

$$s.t.\, \rho \sum_{t=0}^{T} R_t + (1+\tau)\ {}^{pip}i_t \leq \sum_{t=0}^{T} {}^{*}R_t,$$

where ρ is a scalar determining the percentage savings determined by the government, τ is an implementation tax borne by the government for management and information-gathering activities, and $\sum_{t=0}^{T} {}^{*}R_t$ is the total contractor revenue/government expenditure for the baseline case with no PIPs. Here the government has the knowledge to define specific goals and the control to hold the contractor to indicated price reductions.

We think that the above cases, in which the government is dependent on the contractor to propose a PIP investment program, are consistent with the range of plausible situations. However, as a point of comparison we posited a scenario where the government determines the PIP investment program unilaterally based on their own incentives; in this case, the government essentially gains the attributes of an omniscient social planner. The mechanics of the exercise are fairly simple. The government's objective function is:

$$\min_{\{{}^{pip}i_t\}} \sum_{t=0}^{T} B^{t}\left[R_t + (1+\tau)^{pip} i_t\right],$$

where the government specifies ${}^{pip}i_t$ such that the NPV of its total expenditures are minimized.[4]

We ran experiments by varying L in the PIP-constrained case and both ρ and τ for the expenditure-constrained case. The contractor's objective functions were maximized for each excursion. The outputs were compared with results where the government's objective function was optimized.

For the PIP-constrained case, we varied L from \$100 million to \$1300 million. In every scenario, the contractor directed all PIP investment to cost reductions on the FFP contract. Overall government expenditures were changed little with results both above and below the baseline expenditure. For the scenario with the greatest net savings (L = \$750 million), total government expenditures were less than 1 percent below the baseline.

For the expenditure-constrained case (with τ fixed at 10 percent) we varied ρ starting at ρ = 1 (no savings), with reductions at 5 percent increments. The solution at ρ = 1 indicated very large PIP investments; at ρ = .95, investments decreased substantially; at ρ = .90 there was no feasible solution. The highest savings associated with a feasible solution was 8.5 percent (ρ = .915). PIP investments were weighted towards the CPFF contract.

[4] For the government's discount rate, we use 1.3 percent—the real rate currently specified by the OMB for ten-year projects.

Figure A-5 shows the results of these experiments using the mapping of PIP investments against total government expenditures.

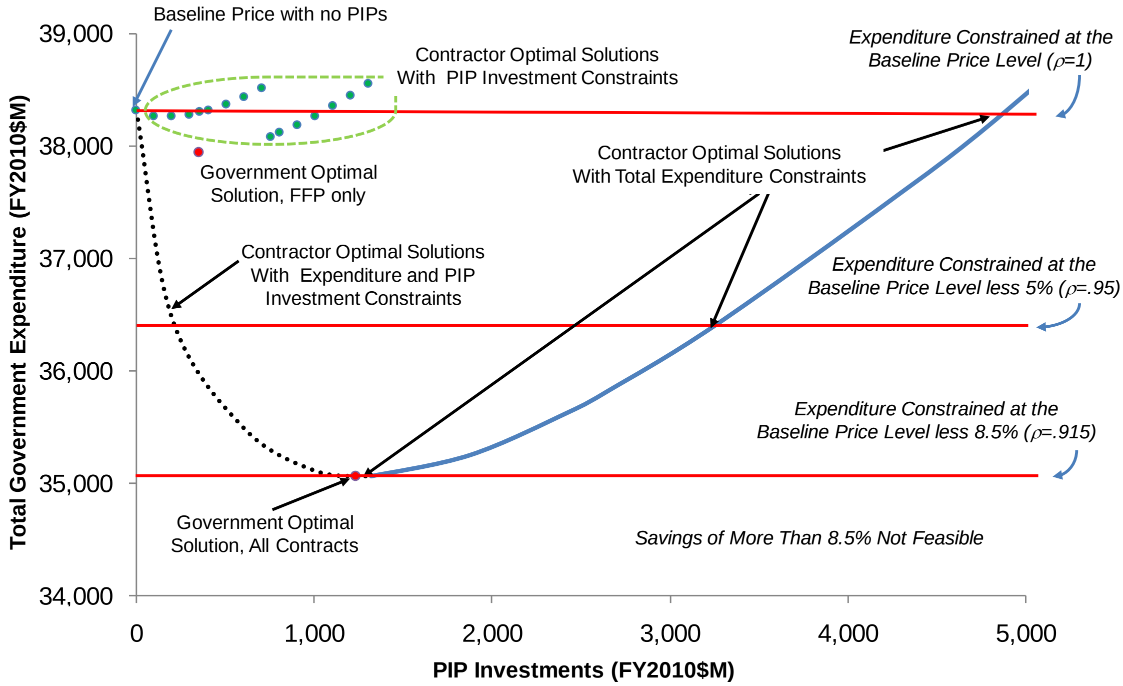


Figure A-5. Optimal Solutions for PIP Investments: Vary *L* and ρ with τ = .10

This shows the substantial gains obtained when the government can specify and enforce an expenditure constraint vice the case where only the level of PIP investments is determined. The minimum point of the mapping for the expenditure-constrained case is where lower prices from PIP cost savings are exactly offset by the additional government expenditure for PIP investments. As the contractor is interested in the lowest costs (and highest profits) possible for a given expenditure constraint, their optimal PIP investment level will be greater than or equal to the value at the minimum point. For mapping to the left of the minimum point to be relevant, a PIP investment constraint must be added to the expenditure constraint. We found that when the government's objective function was minimized, the resulting solution was little different than the minimum for the expenditure-constrained case; total PIP investment was slightly lower with a modest shift from the FFP to CPFF contract. We also ran the government solution with PIP investments limited to the FFP contract—this was to provide a comparison with the PIP-constrained case where the contractor only directs PIP investments to the FFP contract. Although total government expenditures were lower than for any of the contractor solutions, savings were still modest at 1 percent of the non-PIP baseline.

Variations in τ only resulted in minor changes in solution values, with the maximum feasible savings ranging from 8.8 percent (τ=0) to 7.5 percent (τ=0.4). Although the previous analyses included an overall budget constraint, in reality budget constraints will bind on an annual basis.[5] Given this, we performed sensitivity analyses where annual budget constraints were also imposed on the PIP baseline case. In addition to the overall budget constraints, we limited annual government expenditures to be 5 percent or 10 percent above annual expenditures for the baseline case. This resulted in a smoothing out of PIP investments over time, but the overall effect on savings was modest. The maximum feasible savings decreased from 8.5 percent to 7.9 percent and 7.2 percent for the +10 percent and +5 percent annual constraints.

[5] The contractor's optimal behavior indicated a front-loading of PIP investments.

Appendix B.
Copy of Ford-Visteon Supply Agreement

<PAGE>

EXHIBIT 10.2

PURCHASE AND SUPPLY AGREEMENT

BETWEEN

VISTEON CORPORATION

AND

FORD MOTOR COMPANY

December 19, 2003

<PAGE>

PURCHASE AND SUPPLY AGREEMENT

This Purchase and Supply Agreement ("Agreement") dated as of December 19, 2003 (the "Effective Date") is entered into by and between Visteon Corporation, a Delaware corporation ("Visteon"), and Ford Motor Company ("Ford"), a Delaware corporation. Each of Ford and Visteon is herein referred to as a "Party" and collectively, the "Parties."

RECITALS

A. Ford and Visteon entered into a Purchase and Supply Agreement dated as of January 1, 2000 (the "Original Agreement") covering the purchase from Visteon and supply to Ford and its subsidiaries and affiliates worldwide of motor vehicle-related components and systems.

B. The Panics intend to terminate the Original Agreement as to all Components and to substitute this Agreement for the Original Agreement as to such Components.

C. It is the intent of this Agreement that Visteon and Ford achieve the following common goals:

- that Visteon achieves the goal of becoming a profitable and growing business and remains a top quality supplier to Ford;
- that Ford achieve competitive price reductions and competitive prices from Visteon over time, contributing to Ford's profitable growth;
- that Ford and Visteon work collaboratively to meet the commitments made in the Master Agreement; and
- that Ford and Visteon establish a basic framework for working cooperatively on their ongoing commercial relationship.

The Parties acknowledge that Visteon must achieve and maintain competitiveness as described in this Agreement in order for it to become profitable and grow, and in order for Ford and others to be able to source Visteon with products. While no specific targets for maintenance of Existing Business or sourcing of New Business have been established herein, the Parties acknowledge that Visteon needs to grow its business from non-Ford customers and maintain sufficient sourcing from Ford to support the business objectives of both Parties.

D. The Parties are entering into this Agreement in good faith anticipating that the parties will achieve the intentions set forth above. If, during the term of this Agreement, it appears that the intentions of the Parties as described above are not being, or are not likely to be, met in some material respect or that the financial results of either Party resulting from implementation of this Agreement are materially different from the financial results anticipated by the Parties, then the Parties will discuss in good faith the underlying reasons and present an analysis and recommendations for any actions to be taken to the Governance Council; provided, however, that neither Party shall be obligated to take any action as a result thereof.

NOW, THEREFORE, in consideration of the mutual promises contained in this Agreement and intending to be legally bound, Visteon and Ford agree:

1. DEFINED TERMS

1.1 All terms with initial capitalization used herein shall have the following definitions unless specifically stated otherwise.

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"AAI" means AutoAlliance International, Inc.

"AFFILIATE" means any Person directly or indirectly Controlling, Controlled by, or under common Control with, such Person. For purposes of this definition, the terms Control, Controlling, and Controlled mean having the right to elect a majority of the board of directors or other comparable body responsible for management and direction of a Person by contract or by virtue of share ownership.

"ANNUAL VOLUME" has the meaning specified in Section 6.1.

"CAPITAL INVESTMENT" has the meaning specified in Section 8.1.

"COMMODITY GROUP" means the groups of commodities listed on Exhibit IA attached hereto. Ford may modify such list from time to time. The commodities that are included in each Commodity Group will be determined by Ford.

"COMPETITIVE" means a Visteon quote that, excluding the Labor Differential Uplift and any investment sharing pursuant to Article 8, is equal to or better than that of the supplier to which the business would be awarded if Visteon were not awarded the business; provided that comparisons of quotes will be with other full service suppliers where Visteon is being asked to act as a full service supplier and comparisons should be made on a systems or component basis consistent with how Visteon has been asked to quote. Factors to be considered in the determination of Competitiveness include, but are not limited to, Price Competitiveness, quality, warranty costs, service, delivery and design/technology. These requirements are consistent with those to which other comparable suppliers are held when sourcing decisions are being made.

"COMPETITIVE BID MINUTES" has the meaning specified in Section 6.1.

"COMPETITIVE GAP" has the meaning specified in Section 4.1.

"COMPETITIVE GAP CLOSURE PLAN" has the meaning specified in Section 4.1.

"COMPONENTS" means motor-vehicle-related parts, components and systems that are produced by Visteon or its wholly-owned subsidiaries (or its Affiliates to the extent production comes from Master Agreement Plants(1)) in North America that are shipped directly to Ford facilities in North America or to AAI for use in vehicles that are sold under the Ford, Lincoln or Mercury brand. In addition to the above, for purposes of Articles 3 and 6 only, the term "Components" shall include all motor vehicle related parts, components and systems produced by Visteon in North America that are supplied by Visteon to Ford Tier 1 Suppliers where such components are sold to Ford or its wholly-owned subsidiaries for use in Ford, Lincoln and Mercury-branded vehicles.

Notwithstanding anything to the contrary in the foregoing paragraph, parts, components and systems that are (i) produced by Visteon Affiliates (other than its wholly-owned subsidiaries) from facilities that are not Master Agreement Plants or (ii) are covered by the FCSD Agreement, are not considered "Components"; provided that to the extent that the purchase and supply of Service Parts (as that term is defined in the FCSD Agreement) are governed by the Original Agreement pursuant to Section 1 of the FCSD Agreement, then such Service Parts shall be deemed "Components" under this Agreement and the Original Agreement shall no longer govern the purchase and supply such Service Parts.

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(1) For avoidance of doubt, as of the Effective Date, there are no Visteon Affiliates who produce Components from Master Agreement Plants.

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"CONFIDENTIAL INFORMATION" has the meaning specified in Section 17.1.

"DAMAGES" means any and all obligations, liabilities, damages, penalties, deficiencies, losses, judgments, costs and expenses (including, but not limited to, costs and expenses incurred in connection with performing obligations, interest, bonding and appellate costs and reasonable attorneys', accountants', engineers' and investigators' fees and disbursements), in each case, after the application of any and all amounts recovered under insurance contracts or similar arrangements and from third parties by the person claiming indemnity.

"DEFAULTING PARTY" has the meaning specified in Section 15.1.

"DESIGN CHANGE" means any change to the physical Component, its performance, or its interface with other parts or systems that results in a change to the part number.

"EFFECTIVE DATE" means the date of this Agreement as specified in the opening paragraph of this Agreement.

"EFFICIENT DIRECT LABOR HEADS" has the meaning specified in Section 6.1.

"EFFICIENT INDIRECT LABOR HEADS" has the meaning specified in Section 6.1.

"EFFICIENT MANNING" has the meaning specified in Section 6.1.

"EVENT OF DEFAULT" has the meaning specified in Section 15.1.

"EXCUSABLE DELAY" means a delay or failure to perform directly due to an Excusable Event. An "EXCUSABLE EVENT" is a cause or event beyond the reasonable control of a party that is not attributable to its fault or negligence. Excusable Events include fire, flood, earthquake, and other extreme natural events, acts of God, riots, civil disorders, labor problems (including strikes, lockouts, and slowdowns regardless of their lawfulness), and war or acts of terrorism whether or not declared as such by a government. In every case, other than those relating to labor problems, the failure to perform must be beyond the reasonable control, and not attributable to the fault or negligence, of the party claiming the Excusable Event. Excusable Events also include delays or non-performance of a subcontractor, agent or supplier of a party only if and only to the extent that the cause or event would be an Excusable Event as defined herein. Excusable Events do not include the failure to comply with applicable law or to take actions reasonably necessary to schedule performance

in anticipation of any customs, export-import, or other government requirement
of which public notice has been given.

"EXISTING BUSINESS" means all Components that are the subject of an Existing
Agreement.

"EXISTING AGREEMENTS" means all Purchase Orders, Long Term Supply Agreements,
Target Agreements, and Sourcing Agreements with Pricing in existence as of the
Effective Date entered into by Ford and its applicable Affiliates and by Visteon
with respect to Components.

"EXISTING VEHICLE" means a vehicle using Components that is produced by Ford or
one of its Affiliates in North America or, if Ford, Lincoln or Mercury-branded,
by AAI, that is in existence as of the Effective Date.

"FCSD AGREEMENT" means that certain Relationship Agreement dated as of January
1, 2000 between Automotive Consumer Services Group of Ford (now known as Ford
Customer Services Division) and Visteon.

"FORD BUY TURNOVER" has the meaning specified in Section 3.1.

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"FORD CARRYOVER FROZEN TURNOVER" has the meaning specified in Section 3.1.

"FORD MASTER AGREEMENT WORKERS" has the meaning specified in Section 6.2.

"FORD TIER 1 SUPPLIER" means a supplier who directly provides goods and services
to Ford including (a) production and service parts, components, assemblies and
accessories; (b) raw materials; (c) tooling; and (d) design, engineering or
other services that are covered by the Global Terms.

"FORD'S COST OPTIMIZATION MODEL" has the meaning specified in Section 6.1.

"GEN" means Guaranteed Employment Number and refers to the program as agreed in
the Master Agreement.

"GEN ASSISTANCE PROGRAM" has the meaning specified in Section 7.2.

"GLOBAL TERMS" means the terms and conditions set forth in Ford's standard
purchase order (PPGTC January 1, 2004) and any revisions made by Ford to such
standard purchase order terms and conditions that are generally applicable to
Ford's suppliers.

"GOOD CAUSE" means:

(i) A demonstrable decline in quality, service or delivery of Visteon's Components, or a Commodity Group in general, as identified either in accordance with the applicable Purchase Order(s) or then-current Q1 revocation thresholds; or

(ii) The ability of Ford to substitute supplies of significantly advanced design, technology and/or processing (as determined by Ford's Product Development activity); or

(iii) An upward re-pricing on the applicable Component, excluding mutually agreed price increases related to (a) approved design changes as permitted under Section 5.1 or (b) other mutually agreed reasons; or

(iv) default, within the prior twelve months, of a commitment by Visteon to adhere to a Competitive Gap Closure Plan for a given Component or Commodity Group. Such commitments will be in writing. The Existing Business on which the Parties have agreed as of the Effective Date to a Competitive Gap Closure Plan is listed on Exhibit 3.1 hereto; or

(v) Material default by Visteon under the terms of a Purchase Order.

"GOVERNANCE COUNCIL" means the Governance Council established pursuant to the
Relationship Agreement.

"INCREMENTAL NEW BUSINESS" means all New Business that is not defined as
Replacement New Business.

"LABOR DIFFERENTIAL" means the cost differential incurred by paying Ford Master
Agreement Workers, at Efficient Manning levels, at Master Agreement Wage Rates
rather than Supplier UAW Wage Rates.

"LABOR DIFFERENTIAL UPLIFT" means the amount reimbursed by Ford to Visteon to
compensate it for the Labor Differential, which amount is calculated pursuant to
the formula set forth in Section 6.1.

"LONG TERM SUPPLY AGREEMENT" means a multiple-year contract with a supplier committing Ford to procure and the supplier to supply goods or services for a specified time period on specified terms.

"MASTER AGREEMENT" means the collective bargaining agreement and all supplements thereto between Ford and the UAW dated September 15, 2003.

"MASTER AGREEMENT JOB #1 ECONOMICS" has the meaning specified in Section 6.1.

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"MASTER AGREEMENT PLANT" means a Visteon facility, including a Visteon Affiliate's facility, where some or all of its hourly employees are represented by the UAW under the Master Agreement.

"MASTER AGREEMENT WAGE RATE/MASTER AGREEMENT WAGES" has the meaning specified in Section 6.1.

"MASTER TRANSFER AGREEMENT" means that certain Master Transfer Agreement dated as of March 30, 2000 between the Parties.

"MASTER TRANSFER AGREEMENTS" means the following agreements between the Parties: Master Transfer Agreement, the Master Separation Agreement dated June 1, 2000, the Information Technology Services Agreement dated as of June 27, 2000, the Software and Information Technology License Agreement effective September 2, 2003, and the Relationship Agreement dated January 1, 2000 between the Automotive Consumer Services Group (now Ford Customer Services Division) of Ford and Visteon.

"NEW BUSINESS" means all Components put up for award by Ford or a North American Affiliate of Ford to Visteon between the Effective Date and December 31, 2007 that are not covered by an Existing Agreement.

"NEW BUSINESS AGREEMENTS" means all Purchase Orders, Long Term Supply Agreements, Target Agreements, and Sourcing Agreements with Pricing and similar agreements entered into by Ford and its applicable Affiliates and Visteon with respect to New Business between the Effective Date and December 31, 2007.

"NEW VISTEON CBA AND SUPPLEMENT" means the new collective bargaining agreement and supplement presently under negotiation between the UAW and Visteon that is intended to provide wage and benefit levels that meet those of an appropriate, representative group of UAW-represented employers in the U.S. automotive component and truck component industry.

"NON-DEFAULTING PARTY" has the meaning specified in Section 15.1.

"NORTH AMERICA" means Canada, Mexico and the United States.

"NORTH AMERICAN SOURCING COUNCIL" means a process to ensure that Ford honors commitments to Ford Master Agreement Workers at Ford or Visteon facilities in the United States with respect to Sourcing actions; to provide a framework for avoiding labor disturbances and lost production; and to ensure that Ford senior management concurs with sourcing decisions.

"ORIGINAL AGREEMENT" has the meaning specified in Recital A.

"OTHER GOOD BUSINESS REASONS" means all good business reasons, as determined by Ford (for example the strategic need for component commonality or supplier diversification within a commodity); provided that cancellation of a vehicle program, Excusable Delay and Good Cause are not Other Good Business Reasons.

"PARTY" or "PARTIES" has the meaning specified in the opening paragraph of this Agreement.

"PERSON" means an individual, a partnership, a corporation, a limited liability company, an association, a joint stock company, a trust, a joint venture, an unincorporated organization or a governmental entity or any department, agency or political subdivision thereof.

"PRICE COMPETITIVE" means competitive in price elements, including, without limitation, piece price, ongoing productivity pricing commitments, Competitive Gap closure commitments for Commodities that are not

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listed on Exhibit 4.2, and other financial elements (e.g., tooling, price reductions on other commodities or components); provided, however, that the obligation of Ford, if any, to pay a Labor Differential Uplift or to share capital investment costs pursuant to Article 8 with respect to a Component shall not be considered when making a determination of Price Competitiveness.

"PRICE TEXTURING" has the meaning specified in Section 3.2.

"PRODUCTIVITY REQUIREMENTS" has the meaning specified in Section 3.1.

"PURCHASE ORDER" has the meaning specified in Section 10.1.

"PUT UP FOR AWARD" means the issuance of a Request for Quote by Ford.

"RELATIONSHIP AGREEMENT" means that certain 2003 Relationship Agreement dated as of the date hereof between Visteon and Ford.

"REPLACEMENT NEW BUSINESS" means New Business that is put up for award to Visteon between the Effective Date and December 31, 2007 that replaces Existing Business awarded to Visteon before the Effective Date. Replacement New Business may represent a new Component for an Existing Vehicle or a new or carry-over Component for a new vehicle that will replace an Existing Vehicle. Ford Labor Affairs will determine whether New Business is Replacement New Business or Incremental New Business using the same process as has been used by Ford in connection with its UAW collective bargaining agreements since the inception of this concept in 1987, including the attributes and process described on Exhibit IB.

"REQUEST FOR QUOTE" means a request issued by Ford to one or more suppliers to provide a quotation for the supply of Components.

"SOURCE" means the awarding of a Target Agreement or a Sourcing Agreement with Pricing as to a Component for an estimated program volume over a specified number of years. The term "Source" does not include the issuance of a Sourcing Agreement with Preliminary Targets.

"SOURCING AGREEMENT" means an agreement that may be entered into before a Purchase Order is issued to advise the supplier that Ford intends to Source goods or services to such supplier assuming that the requirements of the Sourcing Agreement are met. There are two types of Sourcing Agreements: Sourcing Agreements with Pricing and Sourcing Agreements with Preliminary Targets.

"SUPPLIER AGREEMENT JOB #1 ECONOMICS" has the meaning specified in Section 6.1.

"SUPPLIER UAW WAGE RATE/SUPPLIER UAW WAGES" has the meaning specified in Section 6.1.

"TARGET AGREEMENT" has the meaning specified in the Global Terms.

"TARGET AGREEMENTS TURNOVER" has the meaning specified in Section 3.1.

"TOTAL FROZEN TURNOVER" has the meaning specified in Section 3.1.

"TOTAL HOURLY WORKERS" has the meaning specified in Section 6.1.

"VISTEON WORKERS" has the meaning specified in Section 6.1.

"VISTEON WORKERS TO TOTAL HOURLY WORKERS RATIO" has the meaning specified in Section 6.2.

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"WAGE DIFFERENTIAL" has the meaning specified in Section 6.1.

2. PURCHASE AND SUPPLY COMMITMENTS

2.1 Existing Agreements, (a) Subject only to the provisions of Sections 3 through 18, Visteon and Ford shall continue to honor the terms and conditions of all Existing Agreements regarding the purchase and sale of Components.

(b) The Global Terms are incorporated herein and, except for Purchase Orders that already incorporate an earlier version of the Global Terms, in the Existing Agreements by this reference. Upon renewal of the term of any Purchase Order that already incorporates an earlier version of the Global Terms, the Global Terms shall apply. Except as provided in the two preceding sentences, in the event of a conflict between the terms of an Existing Agreement and this Agreement, then the terms of this Agreement shall control. The Parties agree that in situations where the parties are silent with respect to the applicability of all of the Global Terms, it shall be presumed that such terms and conditions apply.

2.2 New Business. (a) With respect to New Business, except as set forth herein. Ford shall treat Visteon in the same manner as it treats its other Ford Tier 1 Suppliers with respect to Ford's general sourcing policies and practices, including new purchasing and sourcing initiatives.

(b) All New Business that is awarded to Visteon will be governed by the Global Terms, the applicable terms of this Agreement and any other specific terms and conditions agreed to in writing by the applicable parties under which that business is awarded.

(c) With respect to all Replacement New Business and Incremental New Business and except as otherwise mutually agreed, Visteon will be included on Ford's list of suppliers receiving Requests for Quotes, including Requests for Quotations, design competitions and advanced technology development activities unless Good Cause or Other Good Business Reasons exist to exclude Visteon. If Ford elects not to include Visteon for Good Cause or Other Good Business Reasons, then such election will be (i) reviewed with the Sourcing Council, if required, and (ii) reviewed with the Governance Council. Where Ford asserts Good Cause to exclude Visteon from Ford's list of suppliers as above, such assertion of Good Cause must relate to substantially the same commodity. If a Component is produced at more than one facility, then Good Cause cannot be used to preclude Visteon from the bid list where the Good Cause being asserted is not relevant to the facility in which the New Business will be produced.

(d) Where Visteon has been asked to quote, consistent with commitments made to the UAW and Visteon to "look to Visteon first", Replacement New Business and Incremental New Business will be awarded to Visteon if Visteon's quote is Competitive. Ford's reasons for not awarding business to Visteon will be reviewed as part of the ongoing Governance Council process.

(e) If Visteon, due to Other Good Business Reasons, is excluded from the list of suppliers receiving a Request for Quote for (i) Replacement New Business; or (ii) business put up for award between September 1 and the Effective Date which business could have been Replacement New Business if it had been put up for award after the Effective Date, then Ford will compensate Visteon on account of such exclusion in accordance with the formula set forth on Exhibit 10.1; provided that Ford may propose New Business to Visteon to replace such business in which event, if Visteon is Sourced such New Business, then Profit from the New Business will be used to offset compensation otherwise payable under this Subsection 2.2(e).

(f) If Visteon is included in the list of suppliers receiving a Request for Quote, but is not Sourced because it is not Competitive, then Visteon will not be entitled to any compensation under Section 2.2(e).

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3. PRICING

3.1 Productivity Price Reductions. (a) Visteon has provided to Ford certain productivity price reductions that are applicable to Components supplied by Visteon to Ford in 2003. In addition to those reductions, Visteon shall rebate to Ford in North America $150,000,000 in lieu of additional productivity price reductions on Components supplied by Visteon to Ford in 2003. Such amount shall be paid in immediately available funds in three installments of $50 million each. The first installment shall be paid no later than December 31, 2003; the second installment shall be paid on or before February 1, 2004; and the third installment shall be paid on or before March 1, 2004.

(b) Visteon shall reduce the prices for all Components beginning January 1, 2004 and on each January 1 thereafter for a period of four years (through 2007) by the following percentages:

<TABLE>
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Calendar Year 2004   2005   2006   2007

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Percentage Reduction	*	*	*	*

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For a given calendar year, the turnover against which these percentages shall be applied shall be the "Ford Carryover Frozen Turnover", which turnover shall be equal to the Total Frozen Turnover less the Target Agreement Turnover less the Ford Buy Turnover. The Labor Differential Uplift will not be included in the price of any Component, nor will it be included for purposes of calculating the Ford Carryover Frozen Turnover. The following definitions shall apply to this calculation:

"Total Frozen Turnover" shall be equal to the total projected sales of Components by Visteon to Ford using Ford's budgeted volume, mix and rates assumptions for the applicable calendar year; provided that Total Frozen Turnover shall not include any Components described in Subsection 3.1(c).

"Target Agreement Turnover" means that portion of the Total Frozen Turnover for Components that will be launched during the applicable calendar year where Ford and Visteon have entered into signed Target Agreements.

"Ford Buy Turnover" means that portion of the Total Frozen Turnover for which Ford has negotiated the price on behalf of Visteon. All productivity price reductions negotiated by Ford with respect to such Components shall be passed on in total to Ford by Visteon.

*Material has been omitted and confidential treatment has been requested therefore. All such omitted material has been filed separately with the Securities and Exchange Commission pursuant to Rule 24b-2 under the Securities Exchange Act of 1934, as amended.

(c) Where Ford and Visteon agree in writing on different productivity price reductions than those specified above, such separate agreements shall supercede the provisions of Subsection 3.1(b) and all Components covered by such separate agreements shall not be included in Total Frozen Turnover. Exhibit 3.1 is a list of the Components for which separate agreements exist as of the date of this Agreement.

(d) The productivity price reductions described in Section 3.1(b) are referred to herein as the "Productivity Requirements."

3.2 Ford will consider Visteon's reasonable requests for Price Texturing by Commodity Group and limited requests for Price Texturing within a Commodity Group. Requests for Price Texturing by Component will be considered in rare circumstances. Notwithstanding any Price Texturing, the total productivity price reductions shall not be less than those calculated pursuant to Section 3.1 above. "Price Texturing" means the achievement of the Productivity Requirements by applying different productivity price reductions to different Commodity Groups, or to different commodities, or to different Components within a commodity.

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3.3 The Parties will process the productivity price reductions applicable to each Component on or before March 31 of the year in which the productivity price reductions are to be applied; provided that if the productivity price reductions are not so processed by March 31, then (i) all productivity price reductions will nevertheless be retroactive to January 1 of the applicable year; and (ii) if the productivity price reductions are not processed prior to the end of any calendar quarter during the applicable year, Visteon shall pay to Ford a lump sum equal to a reasonable estimate of the effect of the productivity price reductions based on Visteon's shipments of Components to Ford during such calendar quarter. Such amount shall be paid on or before the last day of such calendar quarter. The Parties acknowledge that once the actual productivity price reductions are determined, they will be entered into a system that will result in productivity price reductions retroactive to January 1 of the applicable year; therefore, if Visteon has made a lump sum payment for any calendar quarter and Ford later receives a retroactive price adjustment, Ford will reimburse Visteon any amounts that are charged twice to Visteon.

4. PRICE GAP CLOSURE

4.1 For purposes of defining price gap closure obligations, the following definitions are provided:

"Competitive Gap Closure Plan" means, for purposes of this Agreement, a plan agreed between Ford and Visteon to reduce or eliminate a Competitive Gap on certain Existing Business through sharing the benefits from the application to Existing Business of new designs, design principles, processing advances, new manufacturing equipment or other advantages associated with New Business awarded to Visteon; provided that the intent is not to reduce Visteon margins. From the resulting benefits, Visteon will receive the greater of (i) 10% of the benefits or (ii) the cost of any capital investment made by Visteon to achieve the benefits. As a principle, Competitive Gap Closure Plans will be incremental to productivity price reductions. If Visteon believes there is a valid basis for modifying the application of the principle, on a case-by-case basis, then Ford will consider the request and make a determination, in its reasonable judgment, as to whether the application of the principle should be modified. Ford and Visteon will inform the Governance Council of Ford's determination, as applicable.

"Competitive Gap" means the gap between the price paid by Ford to Visteon for a Component and the price at which Ford could obtain the same or substantially the same Component (i.e., same functions, performance, and same level of specifications) from another supplier under generally consistent circumstances (e.g., volume., engineering support, etc.) and excluding the Labor Differential Uplift and investment sharing pursuant to Article 8. The parties acknowledge that the Competitive Gap can be positive (Visteon's price is better than Competitive) or negative (Visteon's price being non-Competitive) with respect to a given Component or commodity and can change over time. Upon Visteon's request, Ford will provide to a mutually agreed independent third party, documentation supporting the existence and extent of a Competitive Gap (as evidenced by a Ford purchase order, market test, firm verifiable price quotation from another similarly situated supplier, or other relevant information supplied by Ford). The cost of the third party will be shared equally by the Parties.

4.2 (a) As a condition of awarding New Business to Visteon for commodities other than those listed on Schedule 4.2 hereto, Visteon will identify opportunities to reduce the price of Existing Business for the same or similar Component to competitive levels, without reducing Visteon's margins on the Existing Business, by applying the elements of a Competitive Gap Closure Plan as described above. Such Competitive Gap Closure Plans will be provided to Ford as soon as feasible, but in any event, no later than the earlier of (i) 60 days after the submission of a quote by Visteon or (ii) within 15 days prior to the date on which a Sourcing decision will be made (of which date Visteon will be notified). If Visteon is unable to provide a Competitive Gap Closure Plan within the specified time period, Visteon shall provide to Ford such information as Ford may reasonably request to support Visteon's inability to provide such a Plan, and Ford will waive the requirement to provide a Competitive Gap Closure Plan as a condition of being Sourced the applicable New

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Business if Visteon has demonstrated to Ford's satisfaction Visteon's inability to provide such a plan; provided, however, that Visteon and Ford will agree on a time period within which a Competitive Gap Closure Plan will be provided, with a target of providing a plan within six months after such New Business is Sourced to Visteon if Ford reasonably believes that additional time will enable Visteon to provide a plan. The Parties also may agree that Visteon is unable to provide a Competitive Gap Closure Plan with respect to a given Component or Commodity, in which case the condition to award of New Business with respect to such Component will be waived by Ford.

(b) For commodities listed on Exhibit 4.2, Visteon shall not be required to prepare and deliver Competitive Gap Closure Plans on Existing Business.

4.3 To help ensure the Parties that Visteon is advancing toward becoming a profitable and growing supplier and that Ford is achieving competitive prices over time, the provision and implementation of Competitive Gap Closure Plans, and the results thereof, will be reviewed regularly with the Governance Council.

5. DESIGN CHANGES

5.1 Ford and Visteon will negotiate increases and decreases in prices of Components for Design Changes in good faith. When a Ford vehicle program team requests a Design Change, Visteon shall submit to the team a good faith estimate of the change in the price of the Component that would result from such Design Change, which estimate will be used by the program team to seek approval to make the Design Change. Promptly after submitting its estimate, Visteon shall provide documentation reasonably satisfactory to Ford to support the actual change to the price of the Component resulting from the Design Change. The actual change to the price to Ford for the Component resulting from the Design Change will be negotiated after approval is received from the program team, but will not exceed the original estimate of the change in price.

5.2 In support of good faith negotiation of changes to prices of Components for Design Changes, Visteon will provide all documentation reasonably requested by Ford to support quotes for price changes. In any event, Visteon shall provide at least as much supporting documentation as is provided by other similarly situated suppliers in connection with Design Changes.

6. LABOR DIFFERENTIAL

6.1 For all New Business Sourced to Visteon at Master Agreement Plants using Ford Master Agreement Workers, Ford will pay during the period from January 1, 2004 through December 31, 2007 a Labor Differential Uplift that will be calculated as provided in the following formula, subject to the rules specified in Section 6.2 and 6.3:

Labor Differential Uplift = Efficient Manning * Wage Differential at Job #1 Economics

Illustrations

Figures

Tables

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Abbreviations

CPFF	Cost Plus Fixed Fee
CRI	Cost Reduction Initiative
DFARS	Defense Federal Acquisition Regulation Supplement
DoD	Department of Defense
DPAP	Defense Procurement and Acquisition Policy
EMD	Engineering and Manufacturing Development
EPA	Economic Price Adjustment
ERS	Equipment-Related Services
FAR	Federal Acquisition Regulation
FFP	Firm Fixed Price
FP	Fixed Price
FPDS	Federal Procurement Data System
FPIF	Fixed-Price Incentive Fee
FRS	Facilities-Related Services
FSC	Federal Service Classification
ICT	Information and Communications Technology
IDA	Institute for Defense Analyses
LRIP	Low Rate Initial Production
MDAP	Major Defense Acquisition Program
MYP	Multi-Year Procurement
NAICS	North American Industry Classification System
NAVAIR	Naval Air Systems Command
NPV	Net Present Value
OEM	Original Equipment Manufacturer
OSD	Office of the Secretary of Defense

PAMS	Professional, Administrative, Management Support
PBSA	Performance-Based Service Acquisition
PIP	Production Improvement Program
PRTV	Production Representative Test Vehicle
R&D	Research and Development
T&M	Time and Materials
TINA	Truth in Negotiations Act
VECP	Value Engineering Change Proposals

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14. ABSTRACT

The Institute for Defense Analyses (IDA) performed analyses of contract type choice and other policy levers to reduce contract prices to the Department of Defense. The contract -type focus was on alternatives to Firm Fixed Price contracts, particularly Fixed-Price Incentive Firm contracts.
IDA's analyses focused on three distinct but related subject areas:
1. Contract type choice and savings incentives in the serial production of a major defense acquisition program,
2. Incentives and other initiatives for reducing overhead (indirect) expenses, and
3. Issues associated with contracting for services including contract-type mixes and fee levels.
The quantitative models employed assumed that contractors are motivated by value maximization. Given this and the incentives presented in different contracting scenarios, we conducted simulation experiments to gauge the sensitivities of outcomes to different assumptions. Empirical analyses focused on characterizing the choice of contract types and negotiated fees across goods and service categories.

15. SUBJECT TERMS
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