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The Use of Inflation Indexes in the Department of Defense

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Executive Summary

The 2009 Weapon Systems Acquisition Reform Act (WSARA) requires Department of Defense (DoD), Office of Cost Assessment and Program Evaluation (CAPE) to “...periodically assess and update the cost (or inflation) indexes used by the Department to ensure that such indexes have a sound basis and meet the Department’s needs for realistic cost estimation.” The objective of this paper is to provide CAPE with a factual and analytical basis for responding to this provision of WSARA. Since WSARA is concerned with the cost of major systems, much of our attention will be given to the treatment of inflation by Major Defense Acquisition Programs (MDAPs).

Inflation indexes and other price indexes are developed based on changes, or expected changes, in the prices of the mix of goods being examined. The paper is careful to differentiate between the inflation indexes that cover the entire economy as a whole, and price, or escalation, indexes that cover specific classes of goods and services such as DoD procurements.

There are two major uses of DoD inflation indexes:

- Estimation of future budget requirements in then-year dollars.
- Calculation of increases in the cost of systems being acquired in constant (inflation-corrected) dollars, also termed real cost growth. Such calculations are used to identify systems whose real cost growth has breached Nunn-McCurdy thresholds and therefore need extra management attention, a focus of WSARA.

Regarding budgeting, the Office of Management and Budget (OMB) requires every agency to prepare, each year, a “policy” budget that expresses the administration’s most recent policy assumptions, including those concerning inflation. The DoD Financial Management Regulation (FMR) issued by the Office of the Under Secretary of Defense (Comptroller) (OUSD(C)) provides DoD Components with instructions on how to prepare budget estimates within OMB guidelines. The FMR’s guidance is unclear. It states that a DoD budget submission must “reflect most likely or expected full costs.”¹ The next paragraph, however, mandates the use of the OUSD(C)-provided rates—the appropriation-level deflators for all accounts—including determining the amount of price escalation for procurement line items.

¹ DoD Financial Management Regulation 7000 14-R, Volume 2A, Chapter 1, Section 010303, § B.1, 1–70.

The OUSD deflators are calculated from OMB price indexes for five categories of spending: military pay, civilian pay, fuel, medical expenditures, and all “other purchases.” The deflator for each appropriation is calculated by summing the five indexes weighted by the percentage of the appropriation’s spending in each category. The price index for procurement is based entirely on the index for “other purchases,” which is based on projections of the BEA (Bureau of Economic Analysis) deflator for the Gross Domestic Product (GDP). In other words, Comptroller guidance assumes that prices for DoD procurement items will move in accord with prices in the economy as a whole, a questionable assumption.

Some DoD organizations, such as the Naval Sea Systems Command (NAVSEA), the Naval Air Systems Command (NAVAIR), and most Air Force program offices, develop specialized inflation projections for their programs. These projections are usually higher than those provided by OUSD(C), and the program offices use them to ensure that their budget estimates reflect “most likely or expected full costs.” Other organizations, such as the Army, appear to use Comptroller rates. In all cases, Comptroller rates are used to convert then-year dollar costs to constant dollars.

Returning to the two main uses of inflation indexes in DoD noted above, as long as procurement programs follow the guidance to “reflect most likely or expected full costs,” budgets will be prepared as accurately as budgeters are able to estimate future price growth. However, if Comptroller rates are used to estimate future costs and those costs are expected to grow faster than the Comptroller rates, programs will be systematically underfunded, leading to unnecessarily high real program cost growth.

If the GDP deflator were a good overall proxy for DoD procurement costs, calculating real DoD expenditures using Comptroller rates would give a reasonably accurate indication of the real resources available to the Department; otherwise, it would not. Examination of indexes for different types of items that DoD buys shows considerable variation. Some prices, like those for electronics, have risen more slowly than the GDP deflator. Some, including vehicles and ships, moved similarly to the GDP deflator. Some, perhaps including aircraft, have risen more rapidly. Alternative aircraft deflators behave very differently: one showing a high rate of price increase and the other hardly any increase. This may reflect differences in the treatment of quality improvements.

Inflation predictions are valuable aids in budget preparation only to the extent that they are accurate. OMB provides annual inflation predictions for up to five years in the future. Looking over the 19 years from 1991 to 2009, OMB’s initial forecast (five years before the year in question) overestimated the change in the GDP deflator 10 times and underestimated it nine times. The absolute value of the average error was 0.8 percent. Overestimates tended to have slightly larger errors than underestimates.

Our most important observations and suggestions include the following:

- The current practice of some program managers to use “most likely or expected full costs” in estimating then-year costs for budgeting is appropriate, even when these costs differ from those implied by Comptroller guidance regarding price increases. Use of program-specific information, subject to oversight by CAPE and other organizations, reduces the risk of systematically under-funding programs.
- Using the GDP deflator to calculate costs in constant-year dollars for purposes of estimating program cost growth is justifiable. It conforms to OMB’s preference that constant dollars reflect general purchasing power. Expected input price increases greater than the GDP deflator will not lead to measured cost growth if they are included in the baseline estimate. Input price increases that exceed those used in developing the baseline will yield measured cost growth.
- The use of the GDP deflator to measure price increases for all elements of DoD procurement, including all Major Defense Acquisition Programs (MDAPs), is inappropriate. The GDP deflator may empirically be a reasonable proxy for procurement inflation overall, but it does not allow the Department to capture differences between, for example, ships, aircraft, and vehicles. However, the initial examination provided here does not clearly indicate what alternative indexes would provide better estimates of inflation for procuring the various types of systems.
- The GDP deflator and the price indexes for particular sectors developed by BEA and the Bureau of Labor Statistics (BLS) are based on output prices. While DoD’s purchases, including MDAPs, are outputs from the private sector, the cost-based nature of contract development supports the use of input-price-based indexes for MDAPs.
- Guidance by OUSD(C) on the use of its indexes to determine budgetary requirements and develop program cost estimates currently calls for budgets that (a) reflect most likely or full costs, and (b) use OUSD(C) indexes to determine price escalation. The guidance further states that the Comptroller’s price indexes should be used to “determine the amount of price escalation for a procurement line item, major RDT&E system, or construction item over a given time period.”² This guidance is being revised to make it clear that most likely or expected full costs in then-year dollars should be used in budget preparation—even if this implies price increases different from those implied by

² Ibid.

Comptroller's indexes—and that Comptroller indexes must be used to convert then-year dollar values to constant-dollar values.

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A. Introduction

The 2009 Weapon Systems Acquisition Reform Act (WSARA) requires Department of Defense (DoD), Office of Cost Assessment and Program Evaluation (CAPE) to “...periodically assess and update the cost (or inflation) indexes used by the Department to ensure that such indexes have a sound basis and meet the Department’s needs for realistic cost estimation.” The objective of this paper is to provide CAPE with a factual and analytical basis for responding to this provision of WSARA. Since WSARA is concerned with the cost of major systems, much of our attention will be given to the treatment of inflation by Major Defense Acquisition Programs (MDAPs).

Section B of the paper presents a discussion of the general rationale for inflation and price indexes, whether applied to the economy as a whole, the government, or the Department of Defense. Section C describes how DoD price indexes are developed. It addresses: (a) the regulatory and statutory provisions that govern the issuance of inflation guidance by the Under Secretary of Defense (Comptroller) (USD(C)), and (b) how these provisions are applied, by describing the key features of the processes used in the Office of the Secretary of Defense (OSD) and the Services to produce inflation guidance.

The next two sections turn to how DoD uses the deflators and other considerations in budgeting and in cost analyses related to procurement. Section D discusses current practices by the Department in general and by the Services. Section E compares the Comptroller’s price index for procurement with alternatives, principally the national defense indexes published by the Bureau of Economic Analysis (BEA) and defense-related relevant producer price indexes published by the Bureau of Labor Statistics (BLS). The purpose of these comparisons is to explore the possibility that modifications to current practices might better meet the Department’s needs for realistic cost estimation.

Section F assesses current DoD practices for accounting for inflation, and Section G presents concluding observations and recommendations.

The paper will be careful, in discussing price indexes, to differentiate between those that cover the entire economy and those that cover specific classes of goods and services. The former will generally be referred to as inflation indexes and the latter as price indexes or escalation indexes.

B. The General Rationale for Inflation Indexes

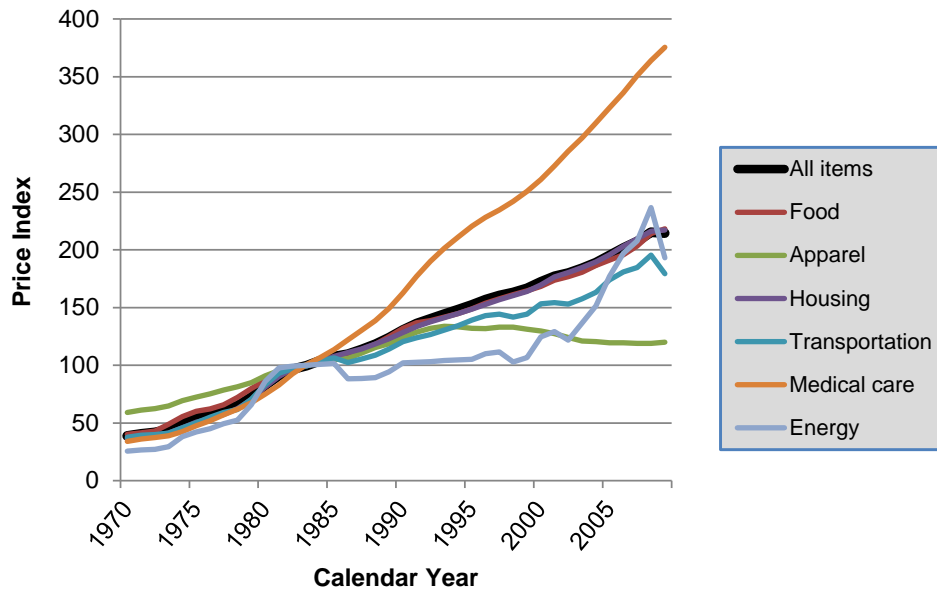
The purpose of inflation and other price indexes is to relate changes in the quantity of resources bought or sold to the amount of money spent on them.¹ Price indexes identify and isolate the effect of price changes. Removing the effect of price changes leaves information on quantity, or real, changes. Indexes permit us to answer questions like the following:

- What has been the change in the real size of the economy over time?
- What effect have changes in the DoD budget had on the resources taken from the economy and the resources available to the Department of Defense?
- How much real cost growth has there been in particular DoD procurement programs?

Price indexes are meant to capture changes in the price of a particular level of capability. They should not capture price changes that are due to changes in the quality of products. As an example, the availability of much better computers at only slightly higher prices means society has gotten richer in real terms. Allowing price indexes to rise with price increases associated with quality improvements would make this appear not to be the case, so price indexes should *not* reflect the price of quality improvements. In other words, that portion of price changes that reflect quality improvements should be subtracted from price indexes. (We will later see that BEA and BLS indexes follow this procedure.)

Price indexes can be developed for different classes of goods and services: the economy as a whole, all DoD spending, DoD procurement, specific types of DoD goods such as aircraft, ships, and computers, and the input prices facing firms that produce things for DoD. Price indexes for different kinds of goods and services can vary substantially over time. Figure 1 shows how indexes for commercial goods and services have varied with the type of good and over time during the last 40 years. Some types of goods and services have moved along with the overall Consumer Price Index (CPI), the price of apparel has risen far more slowly, and the price of medical care has climbed at nearly double the overall rate since 1970.

¹ Conceptually, a price index measures the ratio of expenditures under two alternative price systems that provide quantities of goods and services of the same value. R. G. D. Allen, "Some Observations on the Theory and Practice of Price Index Numbers," *The Review of Economics and Statistics* (October 1935), 58.



Source: "Economic Report of the President 2010," Administration of Barack H. Obama (Washington, DC: Government Printing Office), Table B-60.

Figure 1. Consumer Prices for Selected Classes of Major Expenditures

The fact that one index has not fit all cases of commercial goods suggests that budgeting defense goods for the future should also distinguish between types of goods. A 1983 International Monetary Fund paper put it succinctly: "Every budget is formulated, either explicitly or implicitly, on a price basis. As prices rise and become relatively unpredictable, the problems of budgeting are felt more keenly."² Using different price indexes for different goods can help to ameliorate these problems. The BEA, which produces the U.S. National Income and Product Accounts, notes that the use of a price index is appropriate if its definition and coverage closely match the category of product to which it is applied.³

Different organizations take different approaches in accounting for inflation in budgeting. Organizations such as the Treasury and the Office of Management and Budget (OMB) that are involved in financing aggregate government expenditure focus on broad issues such as the balance between the public and private sectors, and particularly on the value to the private sector of resources taken for public purposes. These offices commonly analyze these issues using the GDP deflator, an index based on the price of the market basket of all goods and services provided to final users by the entire U.S.

² A. Premchand, *Government Budgeting and Expenditure Controls* (Washington, DC: International Monetary Fund, 1983), 242.

³ The Bureau of Economic Analysis, *Concepts and Methods of the U.S. National Income and Product Accounts, Chapters 1–5* (Washington, DC: U.S. Department of Commerce, October 2009).

economy.⁴ By comparison, organizations such as the DoD Comptroller’s office that are responsible for the budgets of particular government agencies frequently use indexes that reflect the prices of the specific resources their agencies buy to support their activities.⁵ A possible compromise would use specific indexes to develop budgetary requirements and a broad index to reflect the constant-dollar burden implied for the economy as a whole.

C. The Derivation of Inflation Indexes for Use by the Department of Defense

This section has three objectives:

- To identify the regulatory and statutory provisions that authorize and prescribe the issuance and use of guidance related to inflation in the Department of Defense;
- To describe the flow of information for developing the economic assumptions, including those for inflation, used in generating the President’s Budget; and
- To describe the five price indexes constructed by OMB and how they are used to develop the Comptroller’s appropriation-specific deflators.

1. Regulatory and Statutory Basis

The statutory requirement for all government budgeting is contained in Title 31 of the United States Code (U.S.C.), entitled “Money and Finance.” This Title directs the President to create an annual budget, delegating administrative authority to OMB.⁶ OMB requires every agency to prepare an annual budget for its spending that expresses the administration’s most recent policy objectives.⁷ OMB forms these inputs into a total annual “policy” budget called the President’s Budget.

The President’s Budget consists of spending for two types of programs:

- Discretionary programs such as DoD procurement line items, which are funded at a level decided by Congress every year.

⁴ GDP is the sum of consumption, investment, government spending, and exports minus imports.

⁵ *Ibid.*, 246–247.

⁶ 31 U.S.C. §1104 resulted from the Budget and Accounting Act of 1921. Administrative responsibility initially existed within the Bureau of the Budget, with OMB tasked through Executive Order in 1970.

⁷ 31 U.S.C. §1109. OMB also prepares a “baseline,” or “current services” budget that assumes that current-year programs will extend into the budget year and out-years, and updates their costs using the most recent economic assumptions.

- Mandatory programs such as Social Security and Medicare, which are passed as permanent law by congressional authorization, written into the U.S.C, and funded by annual appropriation as directed by the permanent law.

This paper concerns inflation for only the discretionary programs. The following paragraphs describe the general guidance contained in OMB Circulars A-11 and A-94 and the specific guidance to DoD Components in the Financial Management Regulation (FMR), issued by the OUSD(C), for meeting the OMB guidance.

OMB Circular No. A-11 (*Preparation, Submission and Execution of the Budget*), sets policy for how agencies are to treat inflation in their budget requests submitted for executive review. The relevant excerpt from Section 31 of the circular provided below states that agencies must ensure that their inputs to the discretionary part of their budgets must be consistent with OMB’s economic assumptions, including those relating to inflation.

(c) What economic assumptions should I use when I develop estimates?

All budget materials, including those for the outyear policy and baseline estimates, must be consistent with the economic assumptions provided by OMB. The specific guidance below applies to outyear policy estimates.

OMB policy permits **consideration** of price changes for goods and services as a factor in developing estimates. However, this does not mean that you should automatically include an allowance for the full rate of anticipated inflation in your request.

...For **discretionary programs**, you may include an allowance for the full rate of anticipated inflation, an allowance for less than the full rate, or even no allowance for inflation. In many cases, you must make trade-offs between budgeting increases for inflation versus other increases for programmatic purposes.⁸

OMB Circular No. A-94 (*Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*), provides agencies with guidance for cost-benefit analyses. It recommends using the Gross Domestic Product (GDP) deflator for the overall inflation rate—the general increase in prices of goods and services—but permits using sector-specific indexes that differ from the general inflation rate “where there is a reasonable basis for estimating such changes.”⁹ Projects with a budget horizon longer than six years (the Future Years Defense Program (FYDP) years in the case of DoD) are advised to use the final year’s rate in perpetuity.

⁸ OMB Circular No. A-11 (2010), (Section 31, paragraph 31.1(c)). This section is titled “Compliance with Administration Policies and other General Requirements” and is the only inflation guidance that appears in the 1,000-page document.

⁹ OMB Circular No. A-94 (1992), (Sections 7.a. and 7.b.), “Recommended Inflation Assumption.”

The FMR provides guidance concerning price indexes in the two paragraphs cited in the footnote below.¹⁰ Paragraph B.1 states that DoD budget estimates should “reflect the most likely or expected full costs.” Paragraph B.2, however, mandates that “price level changes will be based on data provided by OUSD (Comptroller),” and that the Comptroller’s appropriation-specific price indexes should be used to “determine the amount of price escalation for a procurement line item, major RDT&E system, or construction item over a given time period.” This guidance is being revised to make it clear that most likely or expected full costs in then-year dollars should be used in budget preparation—even if this implies price increases different from those implied by Comptroller’s indexes—and that Comptroller indexes must be used to convert then-year dollar values to constant-dollar values.

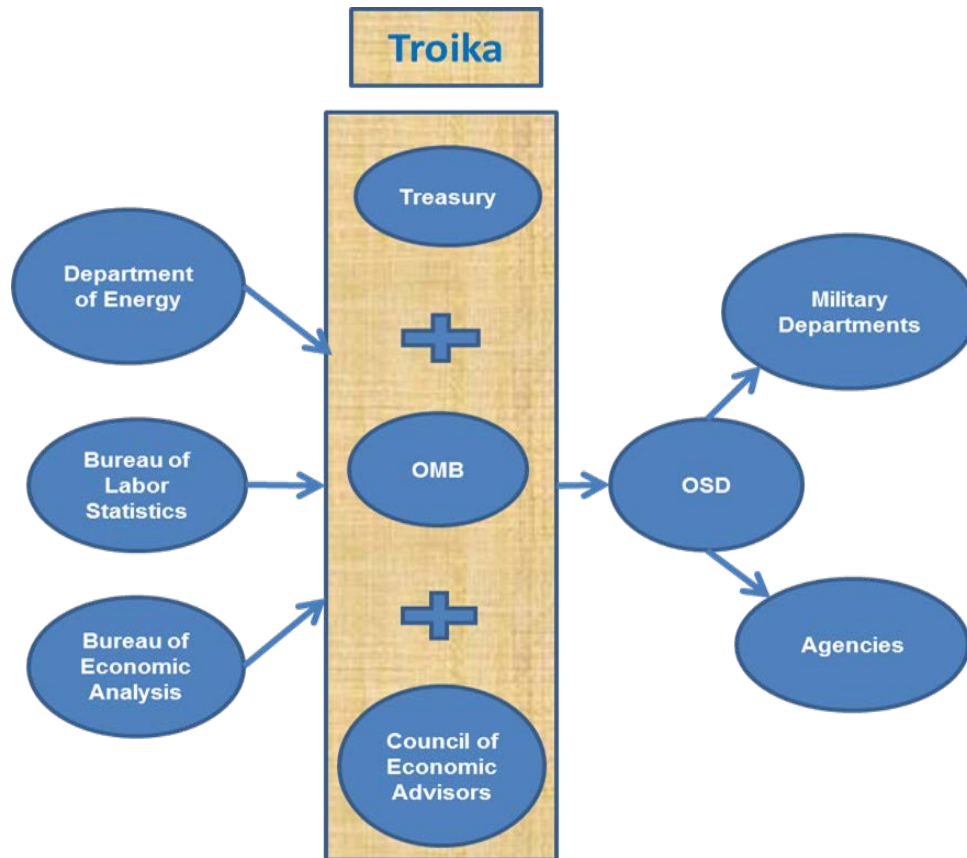
Paragraph B.2 seems to direct the use of the Comptroller’s indexes as the only acceptable value for calculating price escalation for specific programs, while the “most likely or expected full costs” of paragraph B.1 are presumably those for the specific items being purchased. This appears inconsistent because the Comptroller’s indexes are not at all specific to the particular goods being purchased.

2. Development of Economic Assumptions

Each fall, senior officials and staff from OMB, the Council of Economic Advisors, and the Department of the Treasury (collectively known as the “Troika”) draw on Administration policies and use various forecasting models to produce a 10-year forecast of key economic indicators, including inflation. These economic assumptions update previous assumptions to reflect recent data. They are used in forming budget outlay and revenue estimates and developing the annual President’s Budget.

The process for deriving and promulgating DoD inflation rates for use in preparing budgets and cost estimates is summarized in Figure 2.

¹⁰ DoD Financial Management Regulation 7000 14-R, issued by the OUSD(C), offers inconsistent guidance on budget pricing. Volume 2A, Chapter 1, Section 010303, § B.1 and B.2, 1–70.



Source: Gregory A. Wise and Charles B. Cochran, *DoD Inflation Handbook* (McLean, VA: MCR Federal LLC, February 2006), 18.

Figure 2. The Inflation Guidance Development Process

OMB provides the economic assumptions regarding inflation¹¹ to the federal agencies each November as guidance. That guidance, and how the DoD Comptroller uses it to develop more detailed guidance for DoD Components, is discussed next.

3. Derivation of Appropriation-Specific Price Indexes

OMB guidance sent to the OUSD(C) covers the two prior years, the budget year, and four out-years for five categories of funding:

- Military pay, using the projected Employment Cost Index (ECI) for wages and salaries published by the BLS, of the Department of Labor, adjusted for administration policy recommendations as prescribed in Title 37 U.S.C. Section 1009.

¹¹ The Administration's economic assumptions include projections of consumer inflation measured by the urban Consumer Price Index, GDP (Current, Real, and the Price Index between them), Unemployment rate, 91-day Treasury Bill interest rate, and 10-year Treasury Bill interest rate. They are available in OMB's Supplemental Materials at <http://www.whitehouse.gov/omb/budget/Supplemental>.

- Civilian pay, using the projected ECI less 0.5 percentage points, adjusted for administration policy recommendations, as prescribed in Title 5 U.S.C. Section 5303.
- Fuel, using the projected Energy Information Administration Refiner Acquisition Cost. This is the oil refiners’ average price for crude oil.
- Medical, using the projected BLS Consumer Price Index for All Urban Consumers (CPI-U) Medical price index.
- Other purchases—all purchases other than the four categories just listed—using the projected values of BEA’s GDP price index as determined by the Troika and provided to the Comptroller by OMB.

The OUSD(C) uses weighted averages of these five OMB indexes to construct the annual price indexes (often called deflators) for the DoD appropriation-level accounts shown in Table 1. The weights are based on how the spending for each account is distributed across the resources represented by the OMB indexes (military pay, civilian pay, etc.).

Table 1. Composition of Appropriation-Level Inflation Deflators

Appropriation (FY 2010 Outlays)	MilPay	CivPay	Fuel	Medical	Other Purchases
Military Personnel (\$155.0B)	61%			8%	31%
O&M (\$279.7B)		30%	5%	12%	53%
Procurement (\$147.2B)					100%
RDT&E (\$79.3B)		11%	<1%		89%
Military Construction (\$23.8B)		5%			95%
Family Housing (\$3.3B)		4%	1%		95%

Source: Office of the Under Secretary of Defense (Comptroller).

OMB directs that, in deflating program spending for years beyond those for which indexes have been made available, program managers should extend the final year’s inflation rate into the later years.¹²

¹² OMB Circular Number A-94 Revised, October 1992, Section 7.b.

The table illustrates the process for the FY 2010 budget. For example, 30 percent of total DoD spending on Operations and Maintenance (O&M) was for civilian pay. The O&M index was therefore calculated as follows:

$$\begin{aligned} \text{O\&M index} &= (\text{CivPay index}) \times 0.30 + (\text{Fuel index}) \times 0.05 \\ &+ (\text{Medical index}) \times 0.12 + (\text{Other Purchases index}) \times 0.53 \end{aligned}$$

It is significant that while the first four OMB indexes characterize specific types of resources (Civilian Pay, etc.), the last one, “Other Purchases,” does not. In fact, the OMB index for all other purchases is the GDP deflator, the single price index for all spending on U.S. goods and services. The GDP deflator is the main determinant of the amount of inflation allowed for in the DoD budget. It is the sole determinant for procurement spending, and is applied to fully 64 percent of total spending. (Weighting the “Other Purchases” percentages in the last column of Table 1 by the proportion of total outlays implied in the first column yields a weighted average of 64 percent.)

The OUSD(C) deflators are issued to the DoD Components by guidance memo. The Assistant Secretary (Financial Management and Comptroller) of each Military Department issues implementing guidance to its commands and Components that is tailored to its Department’s administrative procedures. The Components use the deflators and instructions contained in the DoD FMR to re-price the President’s Budget through a Resource Management Decision for submission to OMB, and also to prepare detailed budget justification material for submission to the Congress.

D. Current Practice for Incorporating Inflation into Program Budgets and Cost Estimates for Major Defense Acquisition Programs

DoD buys millions of different products: food for Service mess halls, spare parts, construction material, medical supplies, medical equipment, construction equipment, and many others. In these instances, DoD buys at prices generally available in the market to large buyers. Price indexes for these kinds of commodities are properly based on their output prices. Such indexes might often approximate a broad-based index like the GDP deflator.

In this paper we do not focus on these kinds of purchases. We are interested specifically in MDAPs because they are the focus of WSARA. Contracting procedures require that the prices of major defense systems be based on the costs of the inputs to the systems—labor and materials. This is even true of fixed-price types of contracts. Firm-fixed-price contracts are based on the expected cost of inputs, while fixed-price with economic price adjustment contracts incorporate fluctuations in labor or material costs during the period of contract performance. It appears that use of price indexes based on the relevant input prices is best for MDAPs.

This section provides an overview of the treatment of inflation by MDAPs, and then turns to the practices of the individual Services.

1. General Considerations in Use of Inflation Indexes by Program Managers

Program budgeters have to think about inflation for two reasons:

- In budgeting, they must estimate the future costs of their procurement programs in then-year dollars that are based on expected increases in prices.
- They must calculate real cost increases of systems being acquired in constant (inflation-corrected) dollars, also termed real cost growth. Such calculations are used to identify systems that are suffering from high levels of real cost growth, a focus of WSARA.

In addition, all parts of DoD must use price indexes to translate budget submissions developed in then-year dollars to constant-dollar terms.

Regarding budgeting, for a program to be fully funded, money must be appropriated up front to cover all projected future then-year costs of the portion of the program authorized in a given year, such as a specified annual production lot. If planners underestimate the extent to which the cost of the authorized program will rise over time, due to either unanticipated general inflation or increases in the prices of inputs specific to the program, appropriations will fall short and an overrun will occur—an undesirable outcome. We noted earlier that guidance regarding the treatment of inflation in budgeting appears inconsistent, calling for the use of OUSD(C) deflators and also mandating use of “most likely or expected full costs.” As we shall see, some DoD organizations rely on the Comptroller’s projections of inflation for developing then-year budget estimates, while others do not.

Real cost growth is measured by the percentage increase in unit cost relative to a past baseline evaluated in baseline-year constant dollars. The baseline cost can be either the original program cost or a later estimate, depending on the program’s history. For procurement programs, the Nunn-McCurdy Amendment to the 1982 National Defense Authorization Act requires DoD to identify for special attention those programs whose average unit cost growth has breached stated thresholds.

Selected Acquisition Reports (SARs) are used as the source of information concerning cost. The GDP deflator is always used to convert current-dollar costs to constant base-year dollars both for establishing the real cost baseline and for calculating real cost growth.

We now turn to the specifics of how various DoD organizations incorporate inflation into their program budget estimates.

2. Practices of Individual Organizations

This section briefly describes the procedures various DoD organizations use in incorporating inflation into program procurement budgets. Information in this section is based on discussions with staff in the organizations cited. Since not all relevant organizations have been contacted, this is not a complete survey.

a. Army

The Army follows OSD budget guidance without exception in adjusting program costs and budgets for inflation.¹³ The indexes used by the Army are stored together with the standard Navy and Marine Corps indexes on the Navy Center for Cost Analysis's website tool for calculating inflation factors.¹⁴

b. Navy and Marine Corps

1) NAVSEA Projections of Shipbuilding Cost

The Naval Sea Systems Command (NAVSEA) follows a systematic methodology to develop its own estimates of inflation for budgeting its ship programs. NAVSEA developed this methodology in response to 2004 direction from the Under Secretary of the Navy for Acquisition.

NAVSEA has developed a complex and detailed model for making these estimates based on current and historical data on labor and material inputs. Labor prices reflect shipyard-specific labor and overhead rates based on shipbuilder Forward Pricing Rate Agreements (FPRAs).¹⁵ Material prices include class-specific material inflation and vendor base adjustments unique to each ship type's market sector (nuclear, non-nuclear, commercial, etc.). Estimates of future prices are based on forecasts by Global Insight, a private firm that has been involved in economic and financial analysis and forecasting for many years. Historical indexes for labor cost increases are based on actual shipyard data, aggregated to the national level based on the workload at each shipyard. Historical material indexes are based on BLS producer price indexes.

NAVSEA's projections of shipbuilding cost increases are higher than the procurement cost forecasts issued by OUSD(C). NAVSEA estimated annual shipbuilding inflation at 3.3 percent during 2010–2015, while the OUSD(C) procurement index (the GDP deflator) increased at an average annual rate of only 1.5 percent.

¹³ Discussion with personnel in the Army Cost Analysis Agency.

¹⁴ See <http://www.ncca.navy.mil/services/inflation.cfm>.

¹⁵ An FPR is a written agreement negotiated between a contractor and the government to use certain rates during a specified period for pricing future contracts or modifications.

2) NAVAIR Pricing Models

The Naval Air Systems Command (NAVAIR) develops its own projections for pricing naval aircraft (fixed- and rotary-wing). In a similar fashion to the NAVSEA model, NAVAIR develops estimates for labor and material cost increases and uses these to develop estimates for airframe, engine, and electronics—which are then combined into an overall estimate for fixed-wing aircraft flyway cost. Table 2 shows NAVAIR projections for fixed-wing aircraft inflation for 2010-2019 that were developed in calendar year 2009.

The variance in these year-to-year projections is surprising. Note, for example, that aircraft inflation is forecast to be halved from 2015 to 2016.

NAVAIR also makes detailed projections for helicopters and missiles. Future labor rates are based on projections for the labor contracts of the major aircraft and missile manufacturers, and materials prices are derived from estimates by Global Insight.

Table 2. NAVAIR Forecasts of Annual Price Increases for Fixed-Wing Aircraft

Fiscal Year	Fixed-Wing Flyaway (%)	Airframe Composite (%)	Engine Composite (%)	Electronics Composite (%)	Other/GFE^a (%)
2010	1.1	1.1	2.5	0.1	0.9
2011	2.9	2.6	5.7	1.9	1.7
2012	3.3	3.1	5.2	2.5	3.0
2013	3.4	3.3	4.5	3.0	3.1
2014	3.5	3.4	4.7	2.9	3.2
2015	2.6	2.8	1.7	2.4	2.6
2016	1.3	1.7	1.1	2.0	1.4
2017	2.1	2.2	1.9	2.0	2.0
2018	2.5	2.6	2.6	2.2	2.3
2019	2.5	2.7	2.4	2.2	2.4

Source: Naval Air Systems Command, based on Global Insight forecasts.

^a Government-Furnished Equipment.

3) U.S. Marine Corps

U.S. Marine Corps policy is to use the prescribed OUSD(C) inflation factors for program budget and cost estimates. No exceptions have been identified.

c. Air Force

Air Force policy for inflation adjustments is decentralized, unlike that of the Army and Navy. Program offices may develop their own inflation projections using industry-

specific prices. These estimates, however, are subject to review by program executive officers, Service acquisition executives, the Air Force Cost Analysis Agency (AFCAA), and the pertinent OSD offices. The description below is based on personal communication from the staff of AFCAA and other organizations.

1) Air Force Aircraft

Most Air Force aircraft program offices estimate future program costs using specific inflation rates obtained by combining labor and material price rates, commercial forecasting model estimates, and contract information on FPRAs. The methods they use appear similar to those adopted by NAVAIR.

2) Space Systems

Most programs use specific rates developed from historical data on inflation in space systems and comparisons with general inflation.

3) Information Technology

Most programs appear to use OUSD(C)-promulgated rates.

d. National Reconnaissance Office (NRO)

The National Reconnaissance Office (NRO) purchases optical- and radar-imaging satellites for reconnaissance and surveillance missions. NRO in 2004 compared its contractors' labor and material prices with the standard inflation guidance for 1995–2001. Labor prices increased by 4.2 percent, per year on average, but material prices showed no upward trend. Combining the labor and material prices with the appropriate weights yielded an average annual inflation rate of 3.0 percent. The OUSD(C) procurement deflator increased by 1.4 percent annually during the same period.¹⁶ NRO bases its budget and cost estimates in large part on Global Insight direct labor and material price indexes.¹⁷

3. Summary

We have seen that some DoD organizations develop specialized inflation indexes for their programs and use them to ensure that their budget submissions “reflect most likely or expected full costs.” These indexes are used both for development of cost

¹⁶ Kenneth D. Odom, “The Development of the National Reconnaissance Office Inflation Index” (Chantilly, VA: Northrop Grumman Information Technology, TASC, February 2004).

¹⁷ We have not comprehensively surveyed the defense agencies or other organizations to establish their policies with respect to projecting inflation. Most such organizations do not have substantial procurement budgets. Those that do have substantial procurement budgets include the Special Operations Command, the Defense Communications Agency, and the National Security Agency, but we do not have information for them.

estimates for programs in then-year dollars and for budgeting. These rates can be substantially higher than those provided by OMB.

Real program cost and cost growth for MDAPs are then calculated using the GDP deflator to convert current dollars to constant dollars.

We now turn to a comparison of the OUSD(C) price index—the GDP deflator—with other alternatives developed by BEA and BLS. Our interest, here, is in seeing whether using price indexes tailored to different defense goods such as aircraft and ships might offer DoD better tools for accounting for inflation.

E. Analysis of Alternative Deflators for MDAPs

1. Introduction

Note by way of background that all DoD procurement outlays, including MDAPs, account for less than one percent of GDP. There is no particular reason to believe that DoD procurement prices move in tandem with the other 99 percent of the economy. Moreover, using a single price index for all MDAPs ignores the differences among the various military goods that are procured and the markets from which they are bought.

We will proceed by first comparing the distribution of DoD purchases with those in the economy as a whole and then comparing DoD inflation for various procurement categories with other inflation indexes of possible interest and with the GDP deflator. After that we will consider the issue of accurately forecasting inflation.

2. The Distribution of Spending Across Economic Sectors

Table 3 uses figures from Inforum to show that the top 10 sectors that DoD buys from are, with the exception of wholesale trade, all different from the top 10 sectors for the economy as a whole.¹⁸ The 10 sectors in Table 3 account for roughly half of all purchases in both categories, excluding direct purchases of labor.

Since DoD and the overall economy purchase very different mixes of items, using the GDP deflator to represent price changes for defense purchases is questionable. Alternative price indexes might provide a better representation.

¹⁸ The figures are from 360-sector databases developed by Inforum (The Interindustry Forecasting Project at the University of Maryland). The DoD figures are from the “Federal Defense” table and the Economy-Wide figures are from the “National” table. (“National” combines spending for federal defense, federal non-defense, non-federal government, and the private sector.) See <http://inforumweb.umd.edu/services/models.html>.

Table 3. Sectoral Spending in DoD and Economy-Wide (2007)

Defense			Economy-Wide		
Sector Title	Spending (\$M)	Percent of All Sectors	Sector Title	Spending (\$M)	Percent of All Sectors
Scientific research and development services	32,516	9.8%	Owner-occupied dwellings	1,213,969	9.5%
Architectural, engineering, and related services	25,797	7.8%	Retail trade	1,056,938	8.3%
Aircraft	24,174	7.3%	Wholesale trade	669,278	5.2%
Noncomparable imports	22,678	6.8%	Hospitals	644,784	5.1%
Search, detection, and navigation instruments	22,674	6.8%	New residential construction	584,233	4.6%
Wholesale trade	11,168	3.4%	Offices of physicians, dentists, and other health practitioners	515,694	4.0%
Ship building and repairing	9,982	3.0%	Food services and drinking places	504,748	4.0%
Guided missiles and space vehicles	9,081	2.7%	Real estate	461,404	3.6%
Data processing, hosting and internet service providers	8,503	2.6%	Highway, street, bridge, tunnel, water, sewer, pipeline and other construction	405,711	3.2%
Computer systems design services	7,866	2.4%	Telecommunications	282,355	2.2%
Total of Top Ten Sectors	174,441	52.7%	Total of Top Ten Sectors	6,339,114	49.7%

3. Retrospective Comparison of GDP with Alternative Price Indexes

a. BEA National Defense Deflators

In addition to the GDP price deflator, the BEA publishes deflators for procurement of five major types of military systems: aircraft, missiles, ships, vehicles, and electronics. Figure 3 and Table 4 compare these Defense deflators to the GDP deflator during the 1985–2009 time period.¹⁹

The defense deflators are “quality adjusted” to measure price changes, holding the physical specifications of the systems, or their “quality,” constant. Examples of quality adjustment for aircraft are features such as engine improvements. BEA measures the value of quality changes by their cost of production and excludes them from the price index by subtracting the average quality production cost from the average total production cost.²⁰ The BEA deflator thus is influenced by changes in average cost due to factors other than improved specifications, such as changes in input prices. According to BEA, it may be difficult to estimate the quality change when an entirely new kind of aircraft, such as UAVs, is introduced, leading them to consider the entire price as quality change.

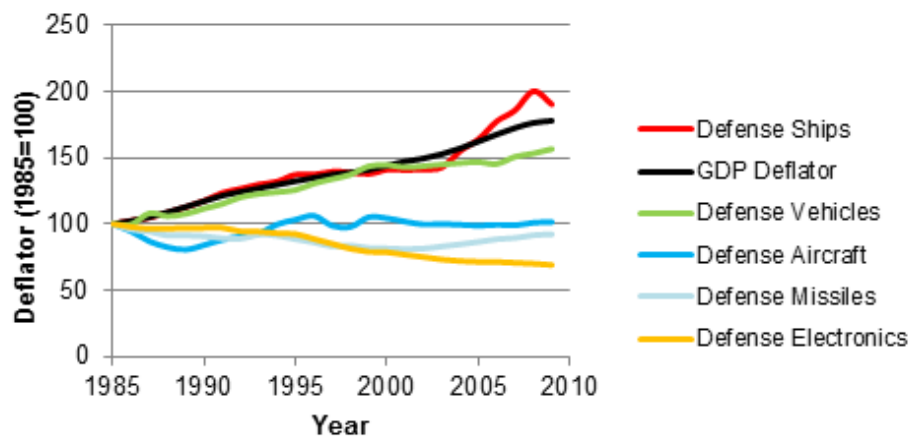


Figure 3. GDP vs. BEA National Defense Deflators

¹⁹ These BEA deflators are expenditure-weighted averages of separate deflators for durables (largely spares, modifications, overhauls, and support equipment) and gross investment (new equipment). The data are from BEA National Income and Product Accounts Table 3.11.4, Price Indexes for National Defense Consumption and Gross Investment, <http://www.bea.gov>.

²⁰ Richard C. Ziemer and Pamela E. Kelly, *The Deflation of Military Aircraft* (Cambridge, MA: National Bureau of Economic Research, 1993); and Murray E. Foss, Marilyn E. Manser, and Allan H. Young, *Price Measurements and Their Uses* (Cambridge, MA: National Bureau of Economic Research, 1993), Chapter 10.

Table 4. Comparison of BEA National Defense Deflators

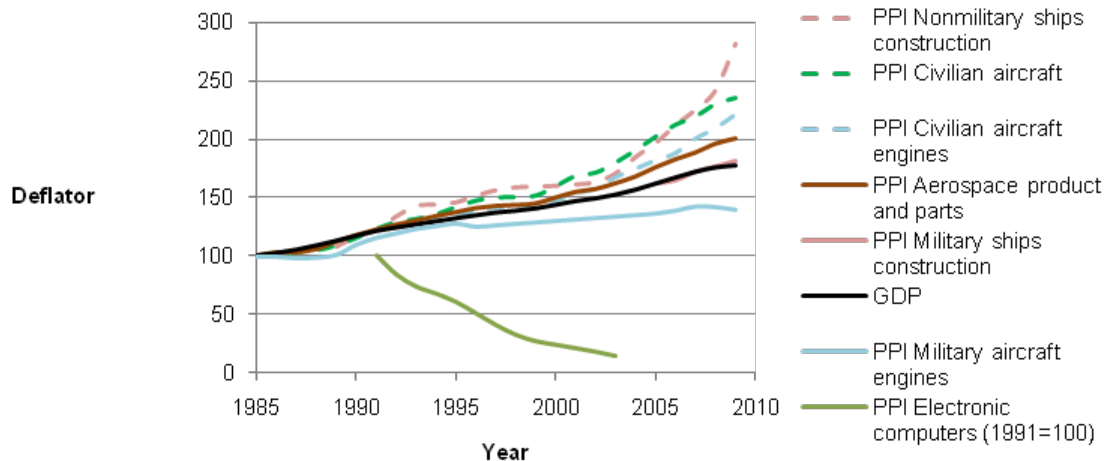
Deflator	Average Annual Growth Rate 1985–2009	Total Growth 1985–2009
Defense Ships	2.7%	90%
GDP	2.4%	78%
Defense Vehicles	1.9%	56%
Defense Aircraft	0.1%	1%
Defense Missiles	-0.3%	-8%
Defense Electronics	-1.5%	-31%

The BEA deflators in Figure 3 show wide variation: (a) substantial deflation over the period for electronics (which includes software), (b) virtually no change in the indexes for aircraft and missiles, and (c) substantial inflation for ships and vehicles. The large decline for electronics is due to the fact that computer speed, memory, and storage capacity have been rising faster than price for many years. The table and figure show that all of the BEA national defense deflators except for ships have had measurably to substantially less growth than the GDP deflator over the period. The wide variations, however, may be due to how BEA identifies and measures quality adjustments.

b. BLS Producer Price Indexes

Figure 4 and Table 5 compare the GDP price deflator with the Producer Price Indexes (PPIs) that the BLS publishes for military and analogous commercial systems. Like the BEA deflators, BLS price indexes are quality-adjusted. The algorithms are described differently but are mathematically equivalent, and they employ the same general criteria (holding specification constant). However, there is no communication between the two organizations on how DoD procurement data are handled.

The bottom four PPIs in Figure 4 (solid lines other than for the GDP deflator) are relevant to defense, and the top three (dashed lines) are for analogous civilian goods included for comparison. The PPIs show substantially smaller growth rates for military aircraft engines and ships than for the analogous civilian goods. The disparity between the GDP and military growth rates is less for the PPIs than for the BEA national defense deflators shown earlier. Aircraft engines have grown less, ships have grown about the same, and aerospace goods have grown more. (We are regarding the aerospace PPI as reflecting defense goods because BLS includes military communication and reconnaissance satellites as well as civilian-funded NASA space shuttles.) A now-discontinued PPI deflator for electronic computers during the 1991–2003 time period, normalized to 1991=100, indicates that computers experienced a huge average annual (quality adjusted) price decrease of 14.8 percent during this period (Table 5).



Source: Bureau of Labor Statistics, Databases, Tables & Calculators by Subject; "Inflation and Prices\Prices - Producer\Industry Data," <http://www.bls.gov/data/#prices>.

Figure 4. PPI Defense and Analogous Civilian Deflators

Table 5. Comparison of BLS Defense-Related Deflators

Deflator	Average Annual Growth Rate	Total Growth
PPI Non-military ship construction	4.4%	182%
PPI Civilian aircraft	3.6%	135%
PPI Civilian aircraft engines	3.4%	121%
PPI Aerospace product and parts	2.9%	101%
PPI Military ship construction	2.5%	82%
GDP	2.4%	78%
PPI Military aircraft engines	1.4%	40%
PPI Electronic computers (1991–2003)	-14.8%	-85%

As with the BEA deflators, some of the differences in growth rates might be due to the criteria and numerical methods for making quality adjustments.

c. BEA and BLS Price Indexes That Are Most Relevant for Defense

Figure 5 brings together the BEA and BLS PPI series that are most relevant to defense final products. There are major differences. The BEA indexes for defense aircraft, missiles and electronics have grown much less than the GDP index. The aircraft index is extremely far below the PPI index for civilian aircraft. The deflators for aerospace and military and ships are quite close to the GDP index.²¹

²¹ The BLS does not publish indexes for military aircraft because there are not enough domestic producers to meet BLS's standards for survey respondent confidentiality and statistical accuracy of the index.

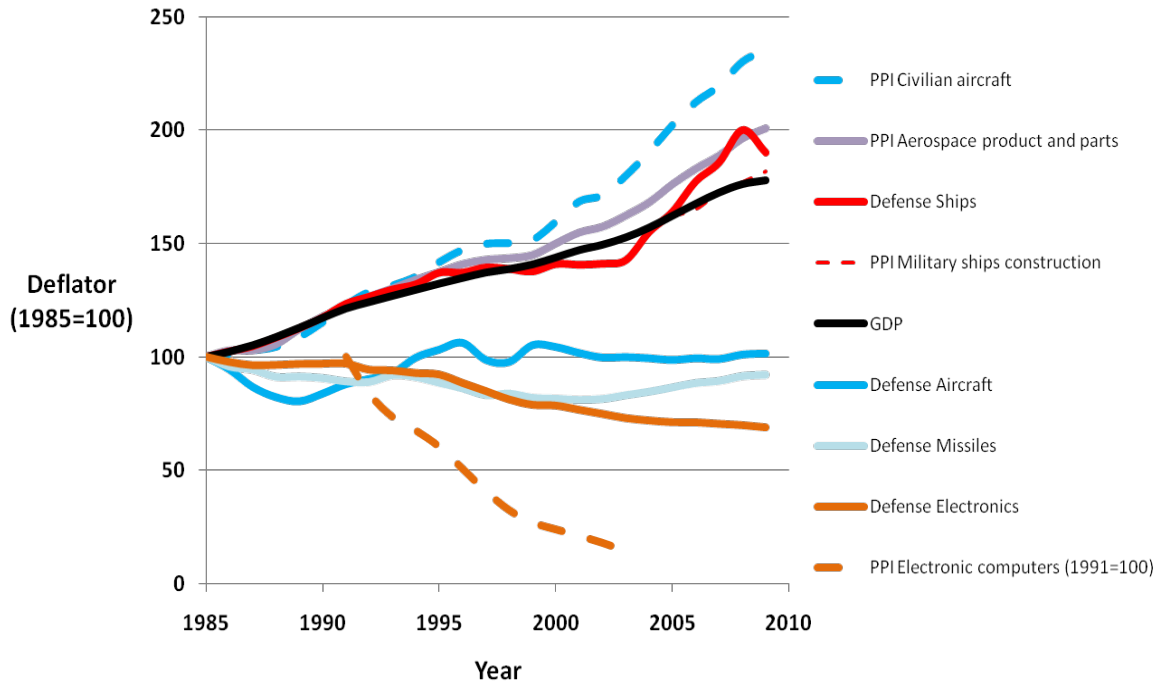


Figure 5. Defense and PPI Deflators Related to Defense

4. Conclusions from Retrospective Comparison of Alternative Deflators

The BEA national defense deflators seem most relevant to MDAPs because of the deflators’ focus on defense-related products, but they are not entirely credible. The indexes for aircraft and missiles show much lower rates of increase than the GDP deflator and even much lower rates of increase than is measured for the commercial aircraft sector. As mentioned earlier, this might depend in part on how costs associated with improvements in capability are measured for purposes of making quality adjustments. Other indexes—the national defense deflators for ships and vehicles and the PPI for military ships, for example—have moved similarly to the GDP deflator.

The policy implication of these comparisons is that the difference in growth rates among the defense and defense-related indexes suggests that DoD might obtain better measures of the real value of the overall MDAP budget by using sector-specific alternative price indexes instead of the GDP deflator. However, given the wide variability we have observed, our analysis fails to provide a clear picture. A better understanding of how the quality adjustments are made is needed.

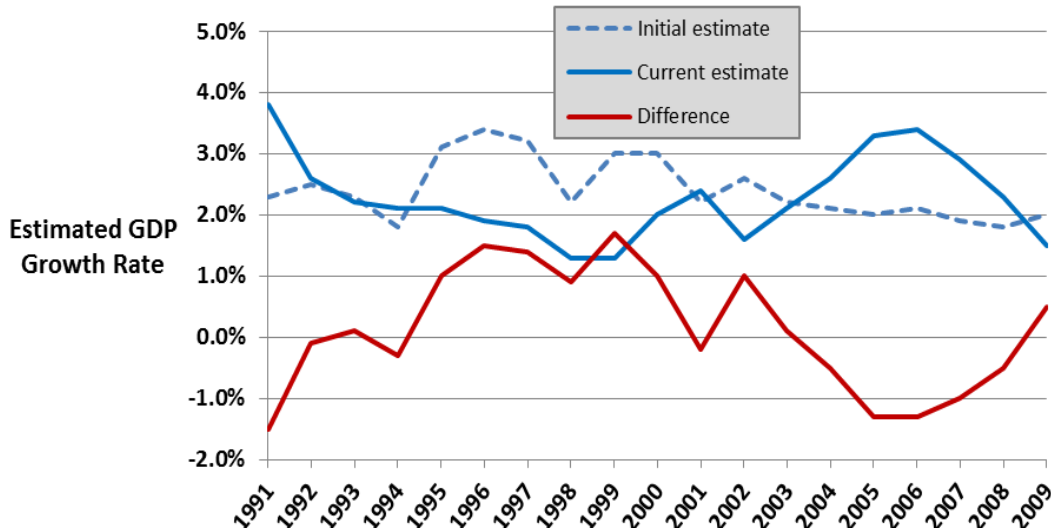
Perhaps most important, neither BEA nor BLS provides price indexes that are derived from the prices of inputs used in the production of various types of MDAPs. The

development and use of such indexes by organizations like NAVAIR reflects the indexes' superiority.

5. Prospective Analysis: Success in Forecasting Inflation

Inflation predictions are useful in budget preparation only to the extent that they are accurate. OMB forecasts the growth rates of the GDP deflator five years into the future, and Figure 6 shows the accuracy of these forecasts during the past 19 years. The initial forecast for 1991 in 1986, for example, was 2.3 percent, 1.5 percent lower than the most recent estimate of 3.8 percent in 2010.

Overall, the five-year forecasts seem fairly accurate. The number of overestimates and underestimates was about the same (10 vs. 9), and the absolute value of the yearly errors averaged only 0.8 percent. The overestimates were a bit larger than the underestimates, with maxima of 1.7 percent and 1.5 percent, respectively.



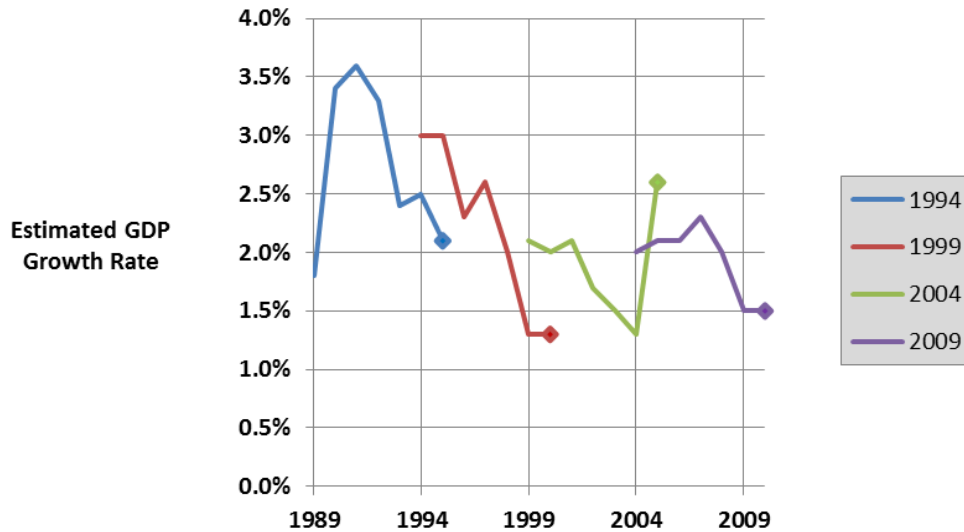
Source: Office of the Under Secretary of Defense (Comptroller), *National Defense Budget Estimates for FY 2011*, March 2010, 52.

Figure 6. Accuracy of Predictions of the GDP Inflation Rate Five Years in the Future

The estimates usually became more accurate as the year of execution approached, but they varied a good deal from year to year.

Figure 7 illustrates this for predictions of the GDP inflation rate for four years: 1994, 1999, 2004, and 2009. The forecast for 1994, for example, jumped from 1.8 percent to 3.4 percent but then settled down to 2.5 percent by 1994. The estimates for the other years showed similar estimates approaching the one made during the year of execution.

Figure 7 also shows, in diamond markers, the estimates made in FY 2010 (the current estimates from Figure 6). In three of the cases, the estimate made in the year of execution was equal or fairly close to the long-term value. Subsequent revision made the estimate for 2004 take a sharp upward turn, from 1.3 percent to 2.6 percent in recent years.



Source: Office of the Under Secretary of Defense (Comptroller), *National Defense Budget Estimates for FY 2011*, March 2010, 52.

Figure 7. Annual Updates of Inflation Forecasts for Selected Years

Since organizations like NAVAIR use inflation estimates developed by Global Insight (shown earlier in Table 2), it would be useful to examine how accurate those estimates have been. Unfortunately, we do not have enough information at present to conduct such an analysis.

F. Assessment of Current Practices for Accounting for Inflation in the Department of Defense

We earlier mentioned that price indexes are used for two separate purposes in DoD:

- Budgeting for future spending.
- Measuring real cost growth in acquisition programs and identifying those programs whose real cost has grown enough to justify special management attention.

A key goal of budget development for particular programs is to allocate sufficient but not excessive funds for specific purposes. Budgeting for personnel, fuel, and health-related expenses draws on specific price indexes tailored for them and should meet the goal.

In the case of MDAPs, as long as programs follow the guidance to “reflect most likely or expected full costs,” the goal should be met. However, if Comptroller rates are used to estimate future price increases, in cases where those increases are expected to be greater or smaller than the Comptroller rates, programs will be underfunded or overfunded.

Program offices may have a tendency to over-estimate future price increases in order to build contingency reserves. The rationale for using specific price indexes should be clearly presented in budget submissions and should be subject to systematic review and approval at both the Service and OSD levels.

Our review of current practices in Section D indicates that program- or sector-specific price indexes based on input prices are used in shipbuilding, aviation, and space—areas in which Comptroller rates are often deemed to rise too slowly. Section E indicates that price increases for ground vehicles may have not differed greatly from the GDP deflator. In other words, current practices for procurement budgeting may reflect most likely or expected full costs fairly well overall.

Concerning the use of inflation escalation indexes for calculating real program cost growth, we’ll discuss two possibilities:

- Adjusting for changes in the prices of inputs used for the particular program. This would absolve programs of responsibility for a category of cost increases that are largely beyond their control.
- Adjusting for price changes in the economy as a whole. This implies calculating real cost growth using the GDP deflator.

Use of program-specific indexes would be most consistent with the goal of identifying programs whose costs have risen for reasons other than higher input prices. However, program-specific input price indexes are not always available and there is some virtue in the simplicity of using a single index to calculate real cost growth.

Using the GDP deflator to calculate real cost growth relative to the baseline can be justified. Real cost growth is consistently measured in terms of the cost of programs to the economy as a whole, not in terms of the physical resources used by the program. Current practice of using the best available information to prepare then-year dollar estimates means that program-specific input price increases that are expected to exceed general inflation are built into the baseline and do not count as cost growth. Unanticipated increases in input prices do contribute to measured cost growth and can contribute to Nunn-McCurdy breaches.

G. Concluding Observations and Suggestions

1. Observations

- There is no single price or inflation index that should be used for all purposes. The appropriate index depends on the mix of goods and services under consideration. If the context is measuring cost to the economy, a broad-index, like the GDP deflator is appropriate. If the context is narrower, like predicting the cost of specific kinds of purchases, a more focused index is appropriate.
- The GDP deflator and the price indexes for particular sectors developed by BEA and BLS are based on output prices. While DoD's purchases, including MDAPs, are outputs from the private sector, the cost-based nature of contract development supports the use of input-price-based indexes for MDAPs.
- Current DoD practices regarding the treatment of inflation support the Department's needs for accurate budgeting and for calculating real program cost growth.
- While the use of program-specific estimates of future input-price changes is the best way to ensure accurate budgeting for MDAPs, the estimates require systematic review at both the Service and OSD levels to resist a possible tendency to accumulate budget reserves in the guise of preparing for inflation.
- Guidance by OUSD(C) on the use of its indexes to determine budgetary requirements and develop program cost estimates currently calls for budgets that (a) reflect most likely or full costs, and (b) use OUSD(C) indexes to determine price escalation. The guidance further states that the Comptroller's price indexes should be used to "determine the amount of price escalation for a procurement line item, major RDT&E system, or construction item over a given time period."²² This guidance is being revised to make it clear that most likely or expected full costs in then-year dollars should be used in budget preparation—even if this implies price increases different from those implied by Comptroller's indexes—and that Comptroller indexes must be used to convert then-year dollar values to constant-dollar values.
- The use of the GDP deflator to measure price increases for all DoD procurement programs is conceptually inappropriate. Health care, fuel and personnel have price indexes specific to them. This is not true for procurement. Empirically the GDP deflator may be a reasonable proxy for procurement inflation overall, though this cannot be demonstrated. But it does not allow the Department to

²² DoD Financial Management Regulation 7000 14-R, Volume 2A, Chapter 1, Section 010303, § B.1, 1-70.

capture differences between, for example, ships, aircraft, and vehicles. Individual organizations often develop their own approaches.

- This initial study does not indicate what alternative system- or category-specific indexes would provide better estimates of inflation for procuring the various types of systems. Government statistical organizations do not publish price indexes based on the prices of inputs to the production of systems, but presumably could.
- Current practice does not appear consistent with either of the notions of constant prices noted at the start of the paper. By using tailored indexes for civilian personnel, military personnel, fuel, and medical care, it does not consistently calculate constant dollar costs in terms of resources foregone by the economy as a whole. By using the GDP deflator for procurement, it does not consistently calculate constant dollar costs in terms of the value of the resources acquired to DoD.
- Some procurement price indexes, particularly the BEA national defense indexes for aviation and missiles, appear surprisingly low, with negligible growth since 1985. This may be due, at least in part, to the way that quality adjustments are identified and estimated.
- There has been little systematic tendency to either overestimate or underestimate inflation. Prediction of inflation five years in the future has been wrong by only about 0.8 percent on average.

2. Suggestions

- Complete the planned revision of OUSD(C) guidance.
- Investigate the feasibility of developing procurement price indexes tailored to different kinds of equipment. This would involve deeper analysis of BEA and BLS for military systems, especially the use of indexes based on the prices of inputs to military systems.
- Compare the accuracy of inflation predictions promulgated by OMB and those developed by Global Insight.

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Abbreviations

AFCAA	Air Force Cost Analysis Agency
BEA	Bureau of Economic Analysis
BLS	Bureau of Labor Statistics
CAPE	Cost Assessment and Program Evaluation
CPI	Consumer Price Index
DoD	Department of Defense
ECI	Employment Cost Index
FMR	Financial Management Regulation
FPRA	Forward Pricing Rate Agreement
FY	Fiscal Year
FYDP	Future Years Defense Program
GDP	Gross Domestic Product
GFE	Government-Furnished Equipment
NAVAIR	Naval Air Systems Command
NAVSEA	Naval Sea Systems Command
NRO	National Reconnaissance Office
O&M	Operations and Maintenance
OMB	Office of Management and Budget
OSD	Office of the Secretary of Defense
OUSD(C)	Office of the Under Secretary of Defense (Comptroller)
PPI	Producer Price Index
RDT&E	Research, Development, Test & Evaluation
SAR	Selected Acquisition Report
U.S.	United States
U.S.C.	United States Code
WSARA	Weapon Systems Acquisition Reform Act

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14. ABSTRACT

The 2009 Weapon Systems Acquisition Reform Act (WSARA) requires DoD's Office of Cost Assessment and Program Evaluation (CAPE) to "... periodically assess and update the cost (or inflation) indexes used by the Department to ensure that such indexes have a sound basis and meet the Department's needs for realistic cost estimation." The objective of this paper is to provide CAPE with a factual and analytical basis for responding to this provision of WSARA.

The paper starts by discussing the rationale for using inflation indexes: in general, in the government as a whole, and in the Department of Defense. It then identifies the regulatory and statutory provisions that support the issuance of inflation guidance by the Office of the Under Secretary of Defense (Comptroller) (OUSD(C)). Next, it describes how this guidance is applied, by describing the key features of the processes used in the Office of the Secretary of Defense (OSD) and the Services to adjust for inflation in estimating the costs of and budgeting for major systems. It evaluates the appropriateness of using the inflation indexes provided by OUSD(C). Finally it compares the Comptroller's rates with some alternatives and considers whether modifications to current practices might better meet the Department's needs for realistic cost estimation.

15. SUBJECT TERMS
Inflation, Budgeting, Cost Growth, WSARA, Price Indexes, Inflation Guidance, Economic Assumptions

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