Inflation Adjustments for Defense Acquisition

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Acquisition program managers are required to develop budget projections in terms of then-year dollars. That means they must adjust their future costs for escalating prices. Following a reasonable interpretation of guidance from the Department of Defense Comptroller, program managers have sometimes estimated these costs using a measure of economy-wide inflation, the Gross Domestic Product deflator. But price escalation for a particular kind of defense system may be systematically higher or lower than overall inflation. We used a hedonic cost-estimation approach to develop a price escalation index for fighter aircraft. Applying this index can vastly improve the development of budget requirements compared to using estimates of general inflation.

Because of uncertainty about the validity of existing indexes, we developed a hedonic price index for tactical aircraft that uses data on aircraft characteristics to construct a constant-quality price index.

Uses of Price Indexes in Defense Acquisition

The cost of defense acquisition programs must be adjusted for price increases for two major reasons.

- *Developing budgets*. If the price of a system is expected to rise in the future (escalation), the extent of this rise must be estimated. Using too low an estimate of escalation will lead to budgets that are not adequate to execute the program.
- *Calculating real cost growth for the system*. This requires comparing the actual escalation of system price (relative to the level of general inflation) to the level of escalation that was expected in some base period. Underestimating escalation in the base period will lead to real cost growth. This can subject the program to increased scrutiny and, perhaps, reduction in scope or even termination.

Good estimates of future, program-specific cost escalation require both development of accurate budgets and avoidance of real cost growth.

Comparison of Price Indexes for Aircraft

Several estimating methodologies are in use specifically for aircraft programs. They are as follows:

- The Department of Commerce's Bureau of Economic Analysis (BEA) national defense index for military aircraft tracks the prices the Department of Defense (DoD) pays for military aircraft and major components such as engines and avionics. Costs for systems are obtained from budget exhibits published by the DoD Comptroller supplemented by information from industry literature and general news.

- The Bureau of Labor Statistics (BLS) Producer Price Index, which is published on the BLS website, is calculated for the civilian aircraft production industry from sales price data obtained from commercial producers.
- The Naval Air Systems Command (NAVAIR) index for naval aircraft, which is derived from indexes for airframe, engine, and electronics, is an overall index of flyaway cost for fixed-wing naval aircraft.
- The Gross Domestic Product (GDP) deflator is a chain-weighted price index that BEA calculated as part of the National Income and Product Account (NIPA) from the prices and quantities of the entire U.S. national market basket of goods and services. Published on the BEA website, the GDP deflator is only weakly linked to the growth in prices of military aircraft, since military aircraft are a negligible subset of the entire U.S. market basket.

Historical Growth Rates

Figure 1 portrays the growth of these four quality-constant indexes applied to DoD aircraft systems during the 28-year period 1985–2012, inclusive. The rates were normalized to 1985 = 100 for comparison. The slightly negative growth of the BEA index is especially inconsistent with both growth in the BLS index and the general view of Office of the Secretary of Defense budget analysts that aircraft prices have been rising substantially. Military and civilian aircraft are substantially different, of course, but they are similar enough to raise the question of why their growth rates should be so different. We investigated whether differences in data or methods caused the disparities.

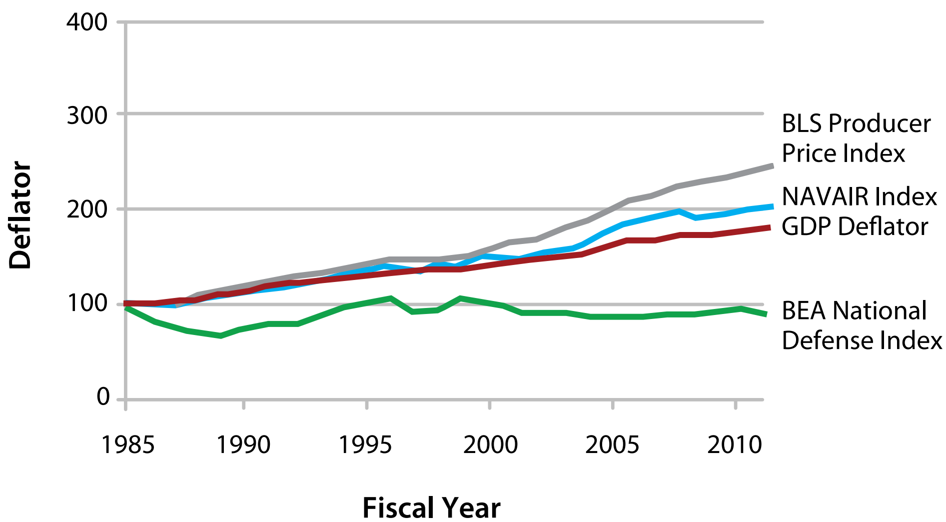


Figure 1. Growth Rate in Price Indexes Often Applied to Aircraft, 1985–2012

Conclusion of Methodological Comparison

The BEA and BLS deflators are generated in mathematically similar ways. The differences in methodologies do not explain the BLS index rising much faster than the BEA index. We suspect that the key difference is the treatment of product improvement.

The price indexes are meant to refer to the price of products of constant quality. In fact, even the same model of aircraft is improved over time. An estimate of the extent to which price increases are due to quality improvements is backed out of raw price data when the index is constructed. We do not have enough information on how these quality adjustments were made to understand their validity or their role in the difference between BEA and BLS price trends for aircraft.

Because of uncertainty about the validity of existing indexes, we developed a hedonic price index for tactical aircraft that uses data on aircraft characteristics to construct a constant-quality price index.

Building a Hedonic Price Index for Tactical Aircraft

Hedonic indexes derive price indexes from regressions that directly relate nominal prices to specific, easily identifiable, quality-related features of the product. In our tactical aircraft case, these features are known with near certainty from legal contracts and from developmental and operational test and evaluation. Table 1 shows the explanatory variables: five quality variables describing the aircraft; two quantity variables describing the number of aircraft produced for use in incorporating the effects of learning and production rate in the procurement process; and a time dummy variable, measured by year of procurement.

Table 1. Explanatory Variables

Quality variables
Empty weight in pounds
Maximum speed in knots
Advanced materials as percentage of structure weight
Dummy variable for 5th-generation aircraft[a]
Dummy variable for short takeoff and vertical landing (STOVL) aircraft[b]
Quantity variables
Cumulative production
Lot size (number of aircraft produced in a year)
Time dummy variable

[a] In our sample, the F–22 and F–35A/B/C fighters are classified as 5th-generation aircraft, which are characterized by stealth, internal weapons carriage, avionics with information fusion, and support of net-centric operations.

[b] In our sample, the AV–8B attack and F–35C fighter are both aircraft with STOVL capability, which is needed for operations from small aircraft carriers and short, unimproved airfields.

Our regression analysis used pooled cross-section and time-series data. The time-series covers the 40 fiscal years from 1973 to 2012, inclusive. Each year other than the base year, 2012, is given a different time dummy in order to calculate a different price index for that year. The cross-sections are the 22 aircraft programs shown in Table 2, consisting of 11 original designs plus 11 derivatives of these original designs from series or block changes.

Table 2. Aircraft Programs

Original Designs	Derivatives (Series or Block Changes)
F–14A	F–14A+, F–14B
F–15A	F–15C, F–15C MSIP, F–15E
F–16A	F–16C Blocks 25/30/50
F/A–18A	F/A–18C Night Attack
A/V–8B	A/V–8B Night Attack, A/V–8B Radar
F/A–18E	–
F–22A	–
F–35C	–
EA–18G	–
F–35A	–
F–35B	–

Result of Hedonic Estimation

Our regression equation from which the hedonic price index was derived had high explanatory power and predictive variables. All had the correct signs and high levels of statistical significance. The R^2 of the equation was 0.97.[1]

Figure 2 compares the trend in the hedonic index with the trends shown in Figure 1. The hedonic index shows a relatively high growth rate that agrees with the perception in the DoD acquisition community that (1) the GDP deflator understates annual quality-constant price increases and (2) the BEA index greatly understates them. This implies that real program growth in the area of tactical aircraft procurement has been less than is generally calculated.

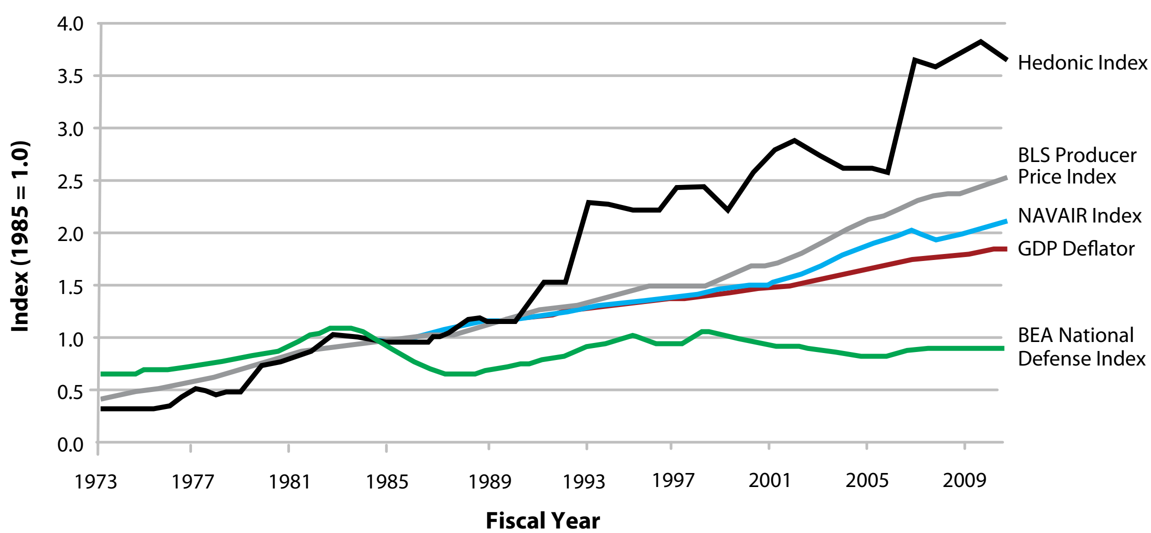
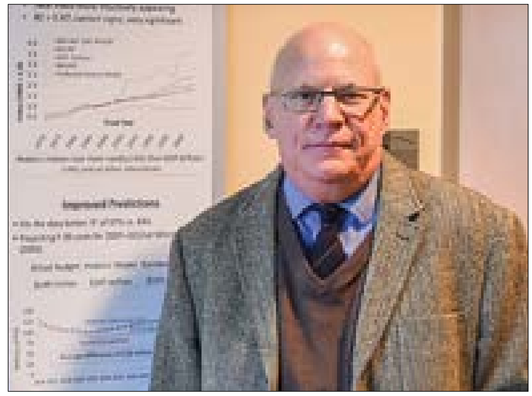


Figure 2. Hedonic and Other Aircraft Price Deflators

1 R^2, or the coefficient of determination, is a statistical measure of how close data are to the fitted regression line.

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