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3 Deflation of Defense Purchases

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3.1 Perspective

This paper discusses the deflation of federal government purchases that are classified as national defense in the national income and product accounts (NIPAs). The paper is divided into five sections. The first section, Perspective, reviews the relationship of national defense purchases in the NIPAs, the history of the deflation effort, the summary results, and their impact on the gross national product. The second section, Concepts, Measurements, and Problems, discusses the general approaches involved in developing price indexes for defense purchases. The third section, Specific Approaches to Defense Purchases, discusses the approaches taken in measuring the prices of four types of purchases: compensation, new aircraft and missiles, new ship construction, and military construction. These types are considered in detail because they are of considerable relative importance in defense purchases and presented significant measurement problems. The fourth section, Comparisons with Private Sector Measures of Price Change, compares price changes for defense purchases with those for similar goods purchased by the private sector. The fifth section, Future Plans, looks ahead at how the work can be extended to other types of government purchases.

3.1.1 Background

National defense purchases include Department of Defense (DOD) military functions, military assistance to other nations, atomic energy defense functions, stockpiling of strategic materials, and certain other small items. DOD military functions and military assistance to other

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nations generally account for over 95% of total national defense purchases. The relationship of national defense purchases to GNP is shown in table 3.1.

Prior to the 1980 GNP benchmark, current-dollar estimates of national defense purchases appeared in the NIPAs, but constant-dollar estimates were not available. The primary reason for this was that price indexes applicable to national defense purchases had been lacking. The deflation of federal government purchases in the NIPAs had been carried out only for the total of defense and nondefense purchases. Of necessity, the Bureau of Economic Analysis (BEA) placed heavy reliance on component price indexes from the Producer Price Index (PPI), which excludes goods specific to the military, and the Consumer Price Index (CPI). While reliance on the use of the PPI and CPI was necessary and might be satisfactory for the total, BEA felt that it certainly would not be satisfactory at a more detailed level of government purchases, particularly for national defense purchases. Indeed, the lack of defense purchases in constant dollars had long been a serious shortcoming of the NIPAs.

Substantive work on developing constant-dollar estimates of defense purchases began in February 1973, when the BEA initiated a study, sponsored by the U.S. Arms Control and Disarmament Agency, to determine the requirements and the feasibility of measuring the prices of defense purchases (Commerce 1975) The study concluded that the application of standard pricing techniques to existing data taken from actual DOD transactions would allow the development of price indexes for purchases of goods and services related to the defense function. The study also concluded that such a measure could be constructed for defense purchases in constant dollars.

Subsequently, with the urging of the Joint Economic Committee of the U.S. Congress, and with the presentation of a proposal prepared by BEA in August 1975, DOD entered into an agreement with BEA to conduct research and develop measures for estimating defense purchases in constant dollars within the framework of the NIPAs, and to publish an official defense deflator. That study has now been completed. (Commerce 1979) These data have not only improved the accuracy of real GNP but they also make it easier for policymakers in government to measure the attainment of real growth objectives. The president, for example, recently established a real growth objective for the defense budget. Without appropriate measures of real defense purchases and of changes in the prices of defense purchases, the meeting of such an objective cannot be adequately assessed.

It should be noted that total DOD purchases as well as the estimates by major type of product shown in this paper differ from estimates of national defense purchases published in the *Survey of Current Business*. These differences arise from the somewhat different coverage of the two series as well as the use of more extensive information not earlier available. The data derived in this study were statistically integrated into the NIPAs at the time of the 1980 benchmark revision.

3.1.2 Summary Results

Table 3.2 provides summary measures of DOD purchases in current and constant dollars as well as implicit price deflators for major product types and for the total from 1972 to 1978. More detailed results, some of which are contained in Section 3.3, are available from BEA. The universe of DOD purchases was stratified into 26 categories and 87 relatively homogeneous subcategories. These subcategories and their relative importances are shown in Appendix B for 1972 and 1977. Table 3.3 shows how incorporation of the new DOD series would change various implicit price deflators (IPD).

3.2 Concepts, Measurements, and Problems

Current-dollar defense purchases consist of compensation of employees and goods and services purchased from the private sector and valued at market prices. Most but not all goods and services purchased for national defense are reasonably constant in quality over time and consequently are susceptible to the statistical methodologies associated with the price indexes published by the Bureau of Labor Statistics (BLS). Even major technological breakthroughs such as jet aircraft can be considered new products and can be introduced into price indexes with these statistical methodologies. Still, matching desired concepts with actual transactions involved the many problems associated with using data that have been created for purposes other than incorporation into the NIPAs.

A few measurement conventions are worth noting before specific pricing procedures are taken up. For many types of defense contracts the value of defense goods produced but not delivered is reflected as an increment in business inventories. When these goods are delivered to DOD there is an offsetting increase to national defense purchases such that GNP is not changed. Thus, to the extent that defense goods had entered private inventories, a current period delivery to DOD should have no current period effect on GNP as a whole because of the offsetting effects of the decrease in business inventories and the increase in national defense purchases. In principle, constant-dollar GNP as well as current-dollar GNP is to remain unchanged when defense goods are shipped from business inventories. The defense goods treated in such fashion are durable goods with long production times, such as aircraft and tanks, but ships and military construction are important exceptions.

Another measurement convention arising from the structure of the NIPAs distinguishes the value of transfer payments such as retirement pay from the current-dollar value of defense purchases. Transfer payments are considered financial flows that are additions to personal income and do not represent an increment to the value of current production.

The measurement of current-dollar defense purchases is also complicated because of numerous intra-DOD transactions that appear in DOD financial reports and would cause double counts in the NIPAs if not removed. Such transactions are consolidated into a single DOD financial statement so that only the value of transactions with the private sector and the compensation of employees enter the NIPAs.

3.2.1 Measurement of Price Change

The NIPAs concept of valuing purchases at market prices has been interpreted to mean transaction prices, that is, the price that was actually paid to a supplier for a specified good or service.

The measurement of price change for defense purchases as defined in the NIPAs is difficult for many reasons. One difficulty arises because many prices are frequently unknown, even after the good is delivered, because of cost-sharing agreements and disputed costs. In addition, at any point in time there exists an array of values to which the term "price" is or can be applied. There are list prices, order prices, shipment prices, fixed prices, escalated prices, and many other types (National Bureau of Economic Research 1961, pp. 32–34; Council on Wage and Price Stability 1977, pp. I-9–20; Department of Defense 1975, pp. 2C1–2C27). BEA has chosen to use those prices, by whatever name, which are closest to the price finally paid. For example, where a good is bought under a firm-fixed-price contract the contract prices could be used. However, if the contract had an escalator clause, then the escalated contract price finally paid by DOD would be used.

Another measurement problem of pricing goods arises from the need to price repetitive purchases, that is, a good with an identical physical specification purchased in different time periods. For many goods this is difficult because many types of available records do not separate recurring and nonrecurring components of a purchase. Nonrecurring components of a purchase might include technical drawings that will appear only in the initial purchase contract. These drawings could be priced as a separately specified item, or, alternatively, their value could be spread over all units made from those technical drawings. If such nonrecurring items are not excluded from contracts where a good with a fixed specification is being priced, they can seriously distort subsequent price change. Consequently, in order to price the identically specified good over time it is necessary to strip out such nonrecurring items from contracts.

Defense purchases are typically for components of a complete good. A round of ammunition, for example, may be purchased with separate contractors supplying the metal casing, fuse, powder, and assembly of the finished round. Virtually every durable good is bought in pieces that are provided to a prime contractor who assembles the components into a ship, tank, missile, or aircraft. In addition, a single contractor may have numerous contracts related to the assembled good, for example, for research and development, technical services, and production components. Each contract is considered by BEA as the basis for a separate transaction that is individually priced.

Many separable goods and services may be bought as part of one contract with one contractor, but not every item within a contract is necessarily priced by BEA. It is not possible or necessary to price every item within a contract, particularly if prices can be expected to move similarly. Therefore, prices were generally obtained for finished items that were separably specified within contracts. The number of pricing specifications that were directly priced is shown in Appendix C for each of the 26 categories into which DOD purchases were stratified.

3.2.2 Specification versus Functional Pricing

Specification pricing and functional pricing are the two major approaches to measuring price change (United Nations 1977, p. 11). Specification pricing, which conforms to other government statistics (e.g., PPI), is the general approach used to measure price change in the NIPAs.

Specification pricing defines a commodity by its physical characteristics; functional pricing, in contrast, defines a commodity by attributes that serve a particular purpose regardless of physical characteristics. What is a quantity change under the specification pricing approach will frequently be a price change under the functional approach.

A specification pricing approach was used to adjust for quality change in DOD purchases. It is similar to the technique used by the Bureau of Labor Statistics for the PPI and CPI (Commerce 1975, pp. 41 ff.). A change in specifications is the key to the determination of quality change; once the existence of quality change has been determined, it must be evaluated. The value of a quality change is defined as the production cost associated with the specification change. For example, if a combat boot is changed at some cost to make it waterproof, a changed specification, then the value of the quality change is defined as the cost of the specification change. In calculating the pure price change in combat boots, it is necessary to adjust for the improved quality. It is important to remember that the valuation of the quality change is based on the cost and not the usefulness of the quality change to the user.

"Costless quality change" is a special problem that was treated in this study with the traditional approach. If the quality of a good has improved but there is no associated change in factor cost, the valuation of the quality change is defined as zero. If the quality of an item has improved and the cost has decreased, the procedure is to treat the good as though no quality change had occurred. The price change is a simple comparison of prices. By making no quality adjustment and using the two unadjusted prices, a price decrease and unchanged quality are reflected.

3.2.3 Other Measurement Problems

Many measurement problems are of concern because the nature of actual purchases makes implementation of the concepts difficult. For example, in some cases quantities could not be associated with certain types of purchases, primarily because they were of a unique nature. The output of research and development purchases could not be specification priced in quantifiable units. Space satellites were another defense purchase that were not directly priced because rapid technological advances of satellites have brought about numerous physical differences that make specification pricing very difficult.

Another measurement problem arises because of what is known as the "warm production base" or purchase of readiness. Briefly, a warm production base reflects a situation where DOD buys a small quantity of a good from a contractor at an extremely high price in order to maintain a production capability in case the good is needed in large quantities in the future. Excess capacity in the aircraft industry has been the subject of a recent study and cited by some as an example of a "hidden" and pervasive warm production base (Department of Defense 1977*b*). This situation occurs principally, however, in the areas of unique defense goods. Identification of a readiness purchase is not always easy. They were not specifically identified and treated in this study.

The base year for price deflators in the accounts is 1972. However, the selection of this or any base period will present problems if all prices are not at equilibrium. Those prices that have not reached their equilibrium position are over- or underweighted relative to the prices that are at equilibrium in the base period. This problem is found in any statistical series but is accentuated in the case of new weapon system purchases. As production of a new system increases, these purchases generally experience sharp decreases in the quantity of labor inputs per unit and in output prices. That is, cost and price per unit display what is known as a learning curve. Any weapon system that is introduced during or slightly before the base period will be overweighted in the series because its base period price will be unusually high.

3.3 Specific Approaches to Defense Purchases

The universe of purchases was stratified into 26 categories and 87 relatively homogeneous subcategories. These subcategories and their relative importances are shown in Appendix B for 1972 and 1977. Various approaches to deflating these categories reflect the nature of the purchases, available information, and limits of measurement techniques. In order to illustrate a range of problems, results are discussed for five major items: aircraft, missiles, compensation of employees, ships, and military construction.

3.3.1 Aircraft

The aircraft subcategories discussed in this section are those relating to the separately purchased components of new aircraft procurements such as the airframe, engine, and electronic equipment.

The approach used to measure price change of new production aircraft was to use specification pricing techniques on components such as airframes and engines. Major components such as engines are usually purchased by DOD from separate contractors and are furnished to the airframe contractor for installation. Such components, plus the airframe and assembly, were separately priced to develop deflators for purchases of aircraft.

The three most important characteristics determining price change for military aircraft appear to be the number of years a particular model has been in production, the quantity produced in a fiscal year (including non-DOD, i.e., foreign military sales), and the specific component group (engines, electronics, etc.).

The age of an aircraft system influences price change because a "learning curve" dominates price behavior early in the life of a particular model or specification. The learning curve reflects the decreasing costs per unit of production associated with a repetitive operation as the operation is continued. These decreasing costs may apply to several inputs, but they are usually expressed in terms of manhours.

Learning curve theory is not new (Wright 1936). Basically, learning curve theory states that over a wide range of output marginal man-hour requirements per unit can be described by a straight line on log-log paper. Learning curves vary from aircraft to aircraft and from specification to specification.

As the number produced continues to rise, the rate of decline in unit costs will gradually diminish and the unit price approaches a constant. Regardless of the particular learning curve, by the time production reaches the one-hundredth unit, man-hour requirements per unit are nearly constant. This point can be reached by high production rates for a short period of time, or low production rates for a longer time. After this point, the price changes of labor and materials will ordinarily increase as inflation more than offsets the effect of increases in the productivity of labor.

The second characteristic affecting price change is the number of units ordered in a contract. Changes in the quantity of aircraft purchased in a contract have significant effects on unit prices, even if the quantity does not accrue to DOD. "There will be a savings on the order of $90 to $100 million to the U.S. Air Force fiscal year 1980 and fiscal year 1981 F-15 procurements if potential Foreign Military Sales to Israel and Saudi Arabia are consummated and current estimates of delivery schedules and buy quantities remain unchanged" (United States Senate 1978*b*, p. 4611). Low production rates are typical of current DOD aircraft procurements. Low production rates keep production lines going, avoid start-up and close-down costs, which can be substantial, and keep procurement costs within annual DOD budgets. On a unit cost basis, however, low production rates are costly and reduce possibilities for automation.

The third characteristic affecting price change is the specific component group, that is, airframe, engines, or electronics. Price changes of these major component groups differ because these components are produced with significantly different mixes of labor and capital equipment and reflect differential price movements in the mix of materials.

Direct consideration of these characteristics in the sample selection procedure could result in more efficient samples. However, it was easier to price more aircraft models than it was to develop an efficient sample.

New aircraft were initially stratified into air force, army, and navy purchases, and a sample (shown below) was systematically selected with probability proportional to the estimated value of deliveries. However, the sample is now judgmental and is virtually the universe of new aircraft purchases. Each new aircraft model entering production is added to the sample with certainty. The specifications selected for pricing within a new aircraft, such as the airframe, engines, and electrical equipment, generally account for most of the value of the system.

Air Force	Navy	Army
A-7D	A-4M	AH-1G/S
A-10A	A-6E	C-12A
C-5A	A-7E	CH-47A
C-12A	AH-1G/J/T	UH-1H
C-130E/H	E-2C	UH-60A
CH-47C	EA-6B	
E-3A	F-14A	
F-4E	P-3C	
F-5E	S-3A	
F-15A/B	UH-1N	
F-16A		
F-111D/F		
UH-1D/H		

The value of delivered aircraft, as required for the NIPAs, is not available from any known source. Therefore, the current-dollar value of new aircraft purchases was estimated for each quarter based upon the value of deliveries of the priced components (Commerce 1979, pp. 57–58).

A current-dollar value of deliveries was developed for each directly priced component from the product of delivered units times the component unit price. Within each system this value of deliveries was blown up to the total value of the system to account for any nonpriced components in that system. For systems not in the sample the value of deliveries was estimated as being proportional to those systems that were priced within the military service. Since most systems are included in the sample, the value of unpriced systems is very small relative to the total value of purchases for aircraft.

Aircraft components are frequently purchased at prices that are not fully known until the rewards, penalties, and engineering changes are determined and negotiated at contract completion. The prices generally used were ones which reflect the ultimate total payment by DOD for a good with a given physical specification. Estimated prices at completion were derived from data routinely found in contract control documentation and used whenever they were available. Although these prices at completion are only estimates at any point in time, they are frequently the best of the available prices because they reflect profit adjustments and contractual cost-sharing agreements.

A combination of reports was vital to ensuring that the values used to develop prices related to goods with the same physical specification. Estimated prices at completion were derived from Cost Performance Reports (CPR) after prorating cost sharings, profit, and overhead across the total contract. Cost Information Papers were then used to identify nonrecurring costs that are not shown in CPRs and which, if not removed, would distort the price change.

The previously described specification pricing approach was the basis for the quality adjustment guidelines applied to military aircraft. These guidelines are shown in Appendix D. The results of quality adjusting aircraft of the same model (e.g., A-10A) were surprisingly slight. While the number of engineering changes was great, especially for new models, most changes did not require quality adjustments and those that did made only a slight difference. It was found that most engineering changes did not involve a physical change to the specific item priced, or were undertaken to remedy a design defect, or were done at no change to the contract price. Contracts frequently had clauses that provide for changes at no additional cost if they were below a certain threshold, that is, $25,000. A great deal of the costs usually announced with engineering changes involved nonrecurring items that were not priced, that is, tooling, training, changes to technical manuals, special tools, and modification kits for aircraft already delivered. Such nonrecurring items were treated as separate purchases.

Although the values involved in quality adjusting an existing aircraft model were generally insignificant, when a new model replaces another the differences in costs are substantial. The process of introducing new aircraft involves a procedure known as linking.

Introducing the price of a new model is an extension of the quality adjustment problem that confronts all compilers of price indexes. The following discussion illustrates the methodology as it was applied to the linking of the F-15A to the F-4E.

The F-15 replaced the F-4. Often it is not clear what the new product is replacing, and this obviously can greatly complicate an attempt to link a new product to specific existing products. However, according to the DOD, "The F-15 is an advanced tactical fighter developed for the air superiority mission. It will replace the F-4 as the primary air superiority aircraft" (Department of Defense 1977*a*, p. 22).

The F-15 had a substantially higher cost, and the question arose as to how much of the higher cost represented quality improvement. The F-15 clearly outperforms the F-4. The F-15, for example, has a lighter basic takeoff weight, shorter takeoff distance, faster sea level rate of climb, quicker time to climb, quicker acceleration time, higher maximum ceiling, higher sustained load factor, slower approach speed. When there is a quality improvement at a higher cost, such as between the F-15 and F-4, then the correct procedure is to value the quality difference and link the two weapon systems, component by component. Linking allows only that part of price change not associated with quality change to be reflected as a price increase. The following is an example of linking in which prices that had been used in the past were quality adjusted so as to be comparable with current period prices. (This is called "back price" linking as distinct from "forward price" linking).

Time Period	Unadjusted Prices	Adjusted	
		Prices	Indexes
1	$5.00	(5.40)	100.0
2	5.00	(5.40)	100.00
3	5.60	5.60	103.7
4	5.88	5.88	108.9
5	5.88	5.88	108.9

Between periods 2 and 3 the unadjusted price increased 60 cents, with 20 cents judged to be a price increase and 40 cents attributed to quality change. Under the back price method of linking, the period 2 price is made $5.40 and the current price is left unchanged, so that between periods 2 and 3 only a 20-cent price increase is shown in the index.

The value of the quality difference between the F-15 and F-4 is defined as the difference in overlap prices in a particular time period. By valuing the difference in models, it is possible to relate the two specifications in terms of each other. These prices should reflect not only the same general price level but also the same relative position on the respective learning curves if serious problems are to be avoided. F-4Es had been delivered by the hundreds before the contract for the first F-15A was signed in 1972. The same point on the learning curve of the F-15A is the proper basis for overlap price measurement of the quality difference. However, in the absence of such an overlap, the one-hundredth unit of the new model was compared to one of the last units of the old model. Both models are represented by points where the learning curve has flattened and additional production is judged to have relatively little effect on the unit price change.

The overlap time period used for valuing the quality difference was taken to be the time at which the first production contract for an F-15 was signed. The F-4E price in the overlap period had the virtue of being an actual transaction price. The F-15A price, however, had to be derived from estimates of future production costs. This calculation was carried out with the DOD estimates of future program costs that are used for their own cost analyses and budgeting for the Congress. This was done for each component; in addition, the inflation factors built into the DOD estimates were removed. What remained is an estimated F-15A component specification price that represents a similar state of learning for the time period of the last F-4E.

The table below shows the airframe deflator for the F-4E and F-15A without adjustment for quality differences and with the adjustment. The Total columns are weighted averages of the F-4E and F-15A series using the quantity of airframes delivered in each year as weights. The index for the F-15A without quality adjustment is based on the functional pricing approach, that is, one F-15A is the same quantity of airframe as one F-4E. Because the initial F-15As that were delivered in 1974 were approximately 3½ times as expensive as the F-4Es, they enter with an index level of 433.3. Adjusting for quality by the procedures described above reduces the F-15A index to 296.8 in 1974. Approximately 40% of the difference in cost between F-4Es and F-15As in 1974 was considered a quality improvement, the remainder a price difference. It should be noted that the percentage decline in price for the F-15As from 1974 to 1977 is the same in both series and mostly represents movement along the learning curve.

Airframe Deflator (1972 = 100)

	Without Quality Adjustment			With Quality Adjustment		
Year	F-4E	F-15A	Total	F-4E	F-15A	Total
1972	100.0		100.0	100.0		100.0
1973	127.2		127.2	127.2		127.2
1974	126.1	433.3	330.9	126.1	296.8	253.3
1975	130.1	418.7	260.6	130.1	286.8	215.7
1976	134.7	329.3	285.4	134.7	225.5	210.4
1977		326.6	326.6		223.7	223.7
1978		334.9	334.9		229.4	229.4

The results of pricing new aircraft are shown in table 3.4. The pronounced contrasts between the IPD movements of navy and air force aircraft especially from 1972 to 1975 are the result of the introduction of new weapon systems. The navy IPDs declined because the first deliveries of the F-14A, S-3A, and E-2C happened to occur during the base year. This caused the base year prices for navy aircraft to be exceptionally high on average, because actual deliveries were those of aircraft produced early in their respective learning curves. This overstates the constant-dollar value of subsequent deliveries of F-14As, S-3As, and E-2Cs to the navy. The air force series, in contrast, had relatively low base year prices because only the older systems were still being delivered in 1972. Therefore, the air force aircraft index moved upward after 1972 when the first deliveries began of the F-15A and A-10A, which were high on their learning curves. The sharp changes in the IPDs for the air force in the fourth quarter of 1973 and navy in the second quarter of 1976 were caused by a change in the mix of deliveries of aircraft components with quite different price indexes.

3.3.2 Missiles

Missile series were developed using the same concepts and measurement conventions as aircraft. The sample selection shown below and the derivation of current-dollar estimates and prices were also similar. The missiles subcategories included in this section are for components of new missiles. The unit of purchase appropriate to measure the price change of missiles was determined by the contractual procedures used by DOD to purchase different missiles. Although some missiles are purchased as complete units, for example, army's Dragon and air force's Maverick, most missiles are purchased as components. These components, such as the missile body, guidance and control unit, and rocket motor are assembled into a final product by the main contractor or by a facility owned and operated by the federal government. In all cases, the particular items priced represented actual purchases from non-DOD sources.

Army and Marine Corps Missiles	ICBM and SLBM	Other Air Force Missiles	Other Navy Missiles
Chapparal	Minuteman	Maverick	Harpoon
Dragon	Poseidon	Shrike	Phoenix
Hawk	Trident	Sidewinder	Shrike
Lance		Sparrow	Sidewinder
Pershing		SRAM	Sparrow
Tow			Standard ER
			Standard MR

The implicit price deflators for missiles shown in table 5 were quite surprising. The army and marine corps missile series showed sharp declines, because early contracts of the Dragon and Tow systems had high base year prices similar to those of navy aircraft. However, the decline was further accentuated because of price competition for relatively large numbers of assembly-line production units. Normally the DOD buys from a single contractor, but DOD is sometimes able to seek a second source for missile production because the number of units involved is so much greater than for aircraft. The army realized large price saving on the Dragon as did the air force and navy on Sparrow missiles, because two contractors were competing for the production contracts. Thus, missile prices moved sharply downward because of both the effect of learning and competition.

3.3.3 Compensation

Compensation of civilian and military employees is the largest category of DOD purchases. It consists of wages, salaries, supplements, benefits, and payments in kind to DOD employees.

Purchases of compensation, like other goods and services, are specification priced. The units of compensation being purchased by the government are hours worked with specified characteristics. The characteristics of education and experience of the employee have been determined to be the major price-determining characteristics of employees in the U.S. economy. It should be noted that Denison (1974) also used sex of the employee as a price-determining characteristic, but this was not deemed necessary for federal government compensation because of the antidiscrimination policies in effect during the period under consideration. Any violations of these policies would represent misclassifications that were not identifiable in the data used. The correct base price measure then is the base period average compensation for each hour worked by individuals who are stratified by education and experience. Since current data on the education and experience of DOD employees are not available, proxy measures for these characteristics were developed through the use of Civil Service grade and step classifications.

The Civil Service classification system (and to a considerable extent the wage grade system for blue-collar workers) provides a built-in measure of these strata because requirements for each grade are based on the education or experience of the employee. In addition, promotions to steps within a grade reflect additional employee experience. "Grade creep," a gradual increase in the average grade of employees that is not commensurate with their education and experience represents an overstatement of employee "quality." However, no data were available on the extent of this or other misclassifications. This study adhered to the NIPA convention of making no adjustments for changes in employee productivity.

Employment data on civilian employees were available by grade and step for each time period. Data on hours worked were not available, so data on "weekly hours paid for" were substituted. These were applied to the employment data to generate the number of hours paid for in each quarter. Data were developed on the average hourly compensation by grade and step for the base period and were multiplied by the number of hours in each grade and step to develop the quarterly estimate of hours paid for valued at base period prices.

A similar but somewhat modified procedure was used for military personnel. Employment was stratified by rank and by years of service as a measure of education and experience. Adjustments were not made for average hours worked, since military personnel are considered to be on duty 24 hours a day, except during actual periods of leave.

Certain allowances (e.g., basic allowance for quarters, uniform and clothing allowance, family separation allowance) were treated as part of basic pay; changes in rates for these allowances appear as price changes. It was assumed that increases in these allowances do not relate to experience and education and, thus, do not reflect increased employee quality. Using this same assumption, the value of food and clothing furnished to employees were also treated as part of basic pay. However, certain types of pay (e.g., flight pay, jump pay) represent additional training or experience of the employee. These types of pay are deflated separately and added to real compensation to reflect the additional quality to DOD.

The military and civilian compensation IPDs are quite different (table 3.6). Although the military and general schedule (GS) civilians have been given the same basic salary increases, the total civilian IPDs increased more rapidly because of the impact of higher pay raises to "wage-board" or blue-collar workers. Wage-board workers are given increases on the basis of local wage surveys; this has resulted in substantially greater increases than those given to military personnel and GS civilians.

3.3.4 New Ship Construction

New ships, like other major weapon systems, are generally purchased as components. Major components, such as propulsion systems and electrical equipment, are often separately contracted for by the navy and delivered to a private shipyard for integration with the hull. The private shipyard constructs the hull, procures some equipment, and installs the government furnished equipment (GFE) to complete the ship for delivery to the navy.

Although purchases of GFE components were separately priced and deflated with standard techniques, ship construction at private shipyards was deflated with a method of pricing different from that used for the other weapon systems. Ship construction is included in the NIPAs on a work put-in-place rather than on a delivery basis, that is, work on ships is recorded on the books of contractors as sales as the work progresses. With other weapon systems involving lengthy production periods, the work done is charged to inventory, which is liquidated only when the completed item has been delivered.

Most attempts to develop prices for ship construction in the past have relied on an input approach. The input method has two drawbacks. First, since the output is not being measured, it is virtually impossible to measure the quality change in the product being produced. Second, any changes in productivity are difficult to measure and incorporate into the estimate of price change. In order to circumvent these problems the BEA decided to select the physical design of several ship models that were kept constant, that is, "frozen." The "frozen" physical design became the pricing specification that was repriced over time at shipyards. In this way the many engineering and design changes that occur during ship construction were assumed to experience the same price change as the basic design. The "frozen" ship approach overcame the drawbacks of a technique based on a fixed set and quantity of inputs. The problems of productivity change and capital/labor substitutions were overcome because the constant specifically defined output permitted variations in inputs.

The exact specification for a frozen ship was developed by BEA in conjunction with selected private shipyards to ensure that the data on labor hours, labor rates, materials, and overhead costs related to an appropriate design that could be reconstructed over time. The ship models whose designs were frozen were an attack submarine (SSN 688 class), surface combatants (FFG-7 class and DD-963 class), and support ship (auxiliary oiler). Once the basic hours, labor rates, materials, and overhead costs were developed for the frozen ship, these data were then reestimated in each succeeding time period to calculate price change for a fixed output.

Total labor hours changed as a result of skill levels at shipyards and the impact of regulations imposed by the Environmental Protection Administration (EPA), Occupational Safety and Health Administration (OSHA), and the navy. The overhead rates used were those prevailing in particular time periods at private shipyards for work on navy ships.

IPDs for materials actually purchased by shipyards for navy ships were not developed because similar materials were bought infrequently and to different specifications. Most material costs were associated with major equipment items such as propulsion turbines, reduction gears, and general classes of goods such as pumps. The contract prices that shipyards actually negotiated with producers of major pieces of equipment and the navy are frequently escalated by the movement of PPIs. Consequently, until a contract is renegotiated, the price change to DOD for many important pieces of equipment will be equal to the movement of particular PPIs. In these instances, weighting of PPIs provided the correct measurement of price change for these items to the shipyard.

A total frozen ship price should include not only the cost of labor, material, and overhead but also profits. Profit, however, relates to the completed ship, and the ship's actual price remains uncertain until delivery is made and the rewards, penalties, engineering changes, and any claims are settled. Moreover, the frozen ship methodology assumes that shipyards are compensated for their costs. If shipyards are not fully compensated because of disputes over cost-sharing or claims made at time of settlement, a frozen ship index will probably overstate the actual price change to the navy. The overstatement, however, relates only to the difference between reported shipyard ship construction costs and the amount paid under the navy contract including any claim settlement. If claims are not reflected in the frozen ship data, then the price change to the navy will be understated to the extent that final claims will be greater than anticipated. As a result of these considerations, no explicit incorporation of profit in frozen ship prices was made, and the direction of any measurement error is unclear at this time.

The price change for the ship category was the net result of significantly different deflators for new ship construction at shipyards and GFE as shown in table 3.7. The relatively low deflator for ship GFE is attributed to the high relative importance of electronic equipment. The prices of many pieces of electronic equipment have declined as a result of new technology and lower labor inputs. The upward price movement of new ship construction reflected declining productivity at several shipyards.

3.3.4 Military Construction

This category includes all construction purchased by the military services on contract from the military construction appropriation. Construction activities included in other categories are those performed in-house by DOD employees, government purchases of construction materials, family housing, and the construction portion of the Minuteman Force Modernization Program.

Purchases of construction in the NIPAs are recorded on a work put-in-place basis. Thus DOD is assumed to purchase the construction as it is performed, even though they do not take title until the contract is completed. During the period of construction, payments are made to the contractor on the basis of an estimate of work completed. While at any given time these payments will not exactly correspond to the total amount of work that has been completed, they are a good approximation.

The definition and measurement of an appropriate price for construction purchases poses many difficult problems. As was indicated in the pricing of ships, input pricing is generally considered to be unsatisfactory in that it does not allow for changes in the productivity of labor, capital/labor substitution, or output quality change.

An attempt was made to bypass these problems and directly price the unit of construction that was being purchased by DOD. The price per unit (i.e., square foot, linear foot, cubic yard, etc.) of a specified type of construction (e.g., barracks) was defined to be the appropriate market price of construction purchased by DOD. Generally, physical changes that were made during the construction period did not affect either the quality or function of the structure. This is because the approach of DOD to construction is to specify functional requirements rather than to enumerate detailed material or structural specifications. For example, the specifications for troop housing center around the number of bathrooms for each intended occupant and requirements such as soundproofing. Deviations from the basic physical specification which affected utilization, for example, a bathroom for every two occupants in place of one for every four, would require quality adjustment. The average unit price, therefore, accurately measures the purchase price of a particular construction type to DOD. The measure of price change derived from these data reflects any changes in productivity, capital/labor substitution, material substitution, etc., that occur during the construction period as well as changing profit margins.

It should be noted that the regional differences in factor costs for the same specification are considered price change to DOD. However, differences in construction performance requirements based on climate (e.g., a storage facility for JP-4 in Alaska vs. Southern California) were considered quality differences.

Generally construction was purchased on fixed-price contracts; therefore, the price was constant for each project through the duration of the construction period. Only changes to the work being performed or legal claims altered the price for a given project. Wherever feasible, the final price paid for a project was used. This price, calculated on a per unit basis, included all changes or modifications during the life of the project.

Military construction purchases were stratified into nine classes (see table 3.17). Reports on selected projects were not always available within these classes, and it was assumed that within each class the project prices moved similarly.

The number of units of construction (square feet or cubic yards) put-in-place per quarter was determined by dividing total units by the number of quarters between contract award and contract completion. In many cases, construction started or ended during a quarter rather than at the beginning or end. Therefore, the nearest one-third of a quarter was determined from the starting month, and quarter units were allocated for one-third or two-thirds of the total.

Expenditures by project were estimated by multiplying the total units put-in-place per quarter on the project by the unit price of the project. Total units per quarter and total current-dollar expenditures for that quarter were aggregated by class and divided to arrive at a weighted average price per quarter stated in dollars per unit put-in-place during that quarter. These average prices by class were used to develop price indexes and then to deflate the current-dollar estimates of the value of construction put-in-place.

Unit price differences relating to geographic area or to project size were assumed to be price differences and not unit quality differences. The concept of quality change used in construction may be illustrated by some specific examples. If the requirements for troop housing were changed from open dormitory sleeping facilities on each floor to private rooms for each occupant, a quality change occurred. If, however, brick exterior walls were used in one facility and concrete block with stucco walls were used in another, there would be no quality difference if both met construction standards with respect to load-bearing, sound-deadening, etc.

Table 3.8 shows implicit price deflators for military construction, which has just been discussed, as well as the somewhat more comprehensive category "structures."

3.4 Comparisons with Measures of Price Change in the Private Sector

In the short run, price changes of goods purchased by the DOD need not be the same as those for similar goods priced in the PPI. These potential differences provided one basis for BEA concern that use of PPIs might provide unreliable estimates of national defense purchases in constant dollars.

The DOD and government in general are considered by the private sector as a distinct market, with its own set of paperwork and special specifications, together with political and social overtones. Products may be similar, but they may be subject to different demands purchased in different lot sizes under different terms of sale and with different specifications as compared to those purchased in civilian markets. Therefore price change in this market may be quite different from the price change experience of the private marketplace. Although the price-determining forces in civilian and military markets are different in a number of respects, they are similar in other respects. For example, materials and labor are drawn from the same sources of supply, the composition of products is roughly the same, and manufacturers may use the same or similar capital equipment in the production of these products.

There has been little information available to test whether price indexes representing goods in civilian markets can be relied upon to represent price trends of articles purchased for military programs. There have been fewer doubts concerning goods like missiles and tanks, which have no civilian counterparts. The use of civilian market price trends for materials (steel, engines, chemicals, etc.) and labor rates as inputs were discussed earlier in the paper. So long as price trends of defense purchases had to be estimated through proxy indexes such as the PPI, which, by definition, excludes sales of unique military purchases, the questions remained largely unresolved. However, when the BEA began to construct price indexes for military purchases, the question could be answered at least in part.

The comparisons made herein are limited but indicate the nature of the problem. Comparisons are made between PPIs and DOD price indexes for petroleum products, citrus fruits, clothing, and hot rolled carbon steel; broader indexes are used for construction. The PPI has been the subject of numerous reviews (Stigler and Kindahl 1970; Council on Wage and Price Stability 1977). One conclusion of the COWPS report that the data reaffirm is that "the scope and coverage of the body of wholesale price data are not adequate for the uses made of the data."

The BEA IPDs are constructed by means of the Paasche formula—that is, weights for each current quarter are used in the calculation of the index change from the base period (1972) to the current period. The PPIs, on the other hand, utilize the Laspeyres formula whereby weights are fixed for relatively long periods of time (five or more years). In order to remove the effect of different price index formulas, the BEA indexes were recalculated at the lowest feasible level as Laspeyres indexes using fixed weights.

All of the price indexes in this section are fixed weighted by base period quantities, as is usual for the Laspeyres price index formulation used by the PPI. Other differences in the methods used by the PPI could not be adjusted for in the DOD data available for this paper. The PPI, for example, frequently uses price as of a single day of each month. The DOD data are generally an average of the transation prices for specification for an entire quarter. The PPI generally represents sellers' prices; the DOD data usually refer to buyers' prices. Further, the PPI makes the seller or buyer part of the pricing specification, that is, if company *X* provides a price for specification *Y*, the price of company *X* for *Y* is only compared to itself. In calculating transaction prices for DOD, the seller was not part of the pricing specification because the objective was to measure what DOD had to pay for the same specification in different time periods. The BEA indexes are developed quarterly. Since the PPIs are monthly, quarterly indexes for each commodity were computed as simple averages of the three monthly indexes and then put on the reference base of the corresponding BEA series. Despite these differences, a comparison with the PPI is made because they are the government statistics used to represent price change in the private sector, and historically they have been used implicitly to estimate national defense purchases, which are part of federal purchases in constant dollars in the published national income and product accounts.

3.4.1 Petroleum Products

Petroleum products are a major nondurable purchase of the DOD and an especially good series in the PPI, since petroleum prices were overhauled to reflect (recent upgrading that introduced direct pricing of) major market transactions of refiners. Regular gasoline, kerosene base jet fuel, and diesel fuel are purchased by the DOD and are also priced in the PPI. Each of these goods is rather homogeneous so that a comparison of the PPI and prices of defense purchases is greatly facilitated.

Price indexes and specifications are shown in tables 3.9 and 3.10, respectively. Figure 3.1 shows the price change for regular gasoline. The

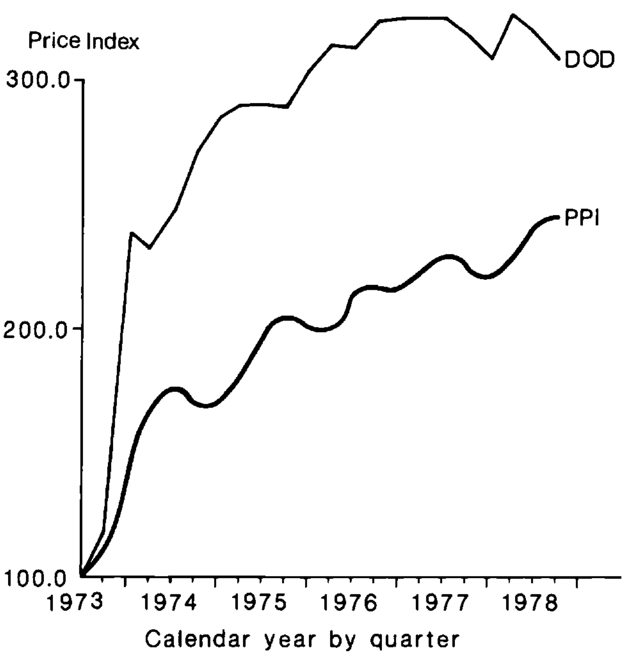

Fig. 3.1 Comparison of price indexes for regular gasoline (July–September 1973 = 100.0)

indexes were put on a third quarter of 1973 (73-III) base because comparable data at this level of detail were not available for earlier periods.

The PPI data are collected as monthly sales (revenue and volume) for each of the Census Bureau regions for specified products from refiners and deep water terminal operators. The use of monthly sales data results in a one-month reporting lag to the BLS. This lag was removed in the comparisons. The PPI fixes the weight of these petroleum products below the product specification level, that is, each seller of these petroleum products has its weight fixed at a regional level regardless of actual sales in current time periods.

The DOD average specification price, in contrast, is a delivered price (the quotient of disbursements divided by delivered quantities) for the national stock number specification in each quarter. Available DOD data did not allow fixing weights at a regional and company level as is done in the PPI so that the effect of such weighting differences is unknown.

The price indexes for these petroleum products indicate that the price change to the DOD was much greater than it was to industrial and commercial consumers in the PPI.

The DOD began having problems obtaining bids for petroleum products as early as September 1972, a full year before the Arab embargo of October 1973. Growth of refinery capacity slowed in the United States during the late 1960s, in part from declines in domestic crude oil production capacity and environmental legislation. By late 1972, many domestic refiners no longer had surplus refining capacity. Quantities offered by domestic refiners to DOD for delivery in the first half of 1973 fell far below historic experience. Foreign offers did not exhibit a similar trend until the second half of 1973. As nonmilitary demand rose and surplus refining capacity diminished, price freeze regulations enacted in May 1973 froze price levels for petroleum products to the military at levels far below those in commercial markets (United States House 1974). Many contracts that had been negotiated at much higher prices for delivery beginning in July 1973 were faced with a government edict to roll prices back to the level in earlier contracts. Consequently, many suppliers exercised their legal right to refuse delivery, and DOD was forced to draw down their inventories. The embargo imposed by the Arab states in October 1973 further reduced supply, and DOD inventories dropped sharply. The inventory reductions halted in December 1973 as a result of temporary restrictions on consumption and increasing supply resulting from legislative allocations. DOD was then able to start rebuilding inventories, but at considerably higher prices than earlier.

Measures of price change say nothing about average prices. This fact is often forgotten and is especially revealing for these petroleum products. Average prices of regular gasoline sold to the DOD and commercial consumers appear below for 1973-III and 1978-IV in cents-per-gallon.

	73-III	78-IV	73-III/78-IV Difference
PPI	18.0	43.9	25.9
DOD	12.2	37.3	25.5

Both sets of prices exclude taxes and include transportation charges to the consumer which can change over time. The absolute difference in the price change of regular gasoline seems insignificant given the measurement differences of the two series. The DOD price index increased more than the PPI because its base period price was lower. The same absolute change, therefore, yields a greater percentage change to DOD.

Jet fuel purchased by DOD had a smaller price change than that reflected in the PPI. Both the airlines and the DOD are large consumers eagerly sought by refiners. JP-4 is a kerosene base jet fuel that is virtually the same as reflected in the PPI. JP-5 is a naptha base jet fuel which is made about equally from gasoline and kerosene components of crude petroleum and accounts for most of DOD jet fuel. JP-5 experienced price change less than that of the kerosene base jet fuel and greater than that for regular gasoline, which is what one would expect.

Average prices for jet fuel are shown below for 73-III and 78-IV in cents-per-gallon. Both series include some transportation charges and

	73-III	78-IV	Difference
PPI (kerosene base)	12.5	39.2	26.7
JP-4 (kerosene base)	13.2	38.7	25.5
JP-5 (naptha base)	14.2	39.5	25.3

exclude taxes. Despite the effect of different methodologies, a one-cent per gallon difference in price change for jet fuel is substantial. The impact of the price increase to DOD was reflected earlier because of the decline of surplus refining capacity and the frequency and method by which DOD solicits competitive bids. Some airlines were fortunate to have bought under multiyear contracts that resulted in lower average prices, even though surplus refining capacity was disappearing and petroleum exporting countries were setting higher crude oil prices.

Diesel fuel prices as shown in table 3.9 increased dramatically more to DOD than shown in the PPI. Prices in cents-per-gallon are shown below.

	73-III	78-IV	Difference
PPI	13.8	38.7	24.9
DOD	10.6	39.2	28.6

The absolute difference in price changes between PPI and DOD is significant and represents the loss of surplus refining capacity. The price-per-gallon differential in 78-IV is probably not significant. The DOD is no longer sought as a market to sell off production needed to keep refineries at full capacity.

3.4.2 Citrus Fruits

Citrus fruits have volatile price changes that are greatly influenced by the weather, season, and competitive markets.

The PPI prices reflect only the spot market prices in Chicago and New York. Prices are taken from trade publications on the Tuesday of the week containing the thirteenth of the month. The DOD price in contrast reflects both the spot and contract market throughout the United States. The DOD average price each quarter is a self-weighted average of prices paid in all geographical regions and types of transactions (spot, contract). The DOD price indexes are quarterly averages of the three months weighted by purchases in each month. The PPI quarterly average, in contrast, is an equally weighted average of spot market prices, for geographical points, on a single day. These differences in methods are significant because of the substantial swings in the price of these products over a three-month period. Price indexes and detailed specifications for citrus fruits are shown in tables 3.11 and 3.12, respectively.

Figure 3.2 shows the movement of the two composite price indexes over time. The long-term trend is clearly evident, and the short-run differences in the magnitudes of price change are significant. The use of PPIs would generally have understated constant-dollar citrus purchases because the price index is generally greater than that shown for DOD purchase prices.

3.4.3 Clothing

Comparisons for groups of clothing and footwear were made with similar PPI groupings. The composite indexes for men's apparel and footwear are shown on a fixed-weighted basis in table 3.13. The detailed specifications making up the two composite indexes are shown in table 3.14. Figure 3.3 shows the price change of men's footwear in the PPI and DOD.

An unpublished study by Allan Searle (1977) made an item-by-item comparison of DOD and PPI price indexes for similar clothing, textiles, and footwear. Searle found greater price dispersion of DOD apparel and footwear prices than was reflected in the PPI. He also found that substitution of DOD for PPI weights had no effect on PPIs. However, the substitution of PPI for DOD weights had an appreciable downward effect on the DOD indexes because of the impact of greater price dispersion of DOD items.

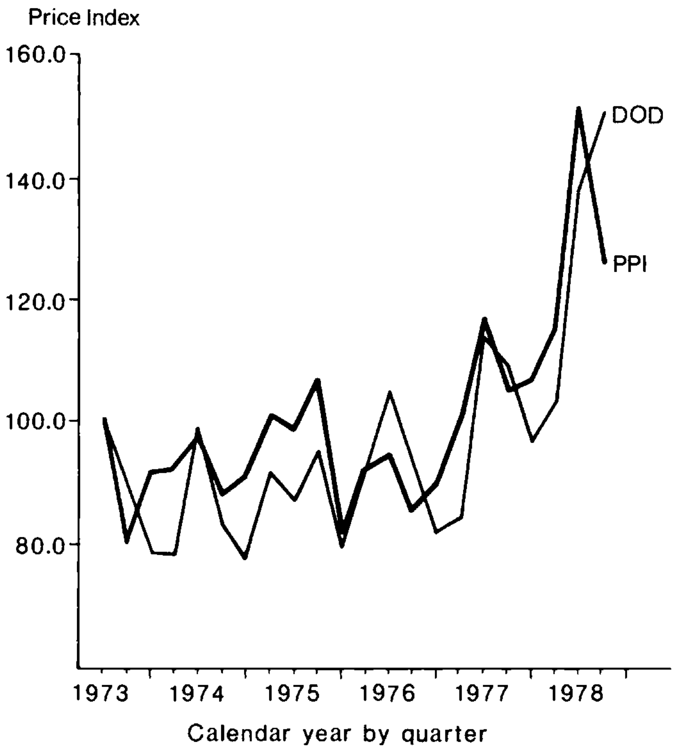

Fig. 3.2 Comparison of price indexes for citrus fruit (July–September 1973 = 100.0)

Both the DOD and PPI indexes were put on a base of first quarter 1972 = 100 to make them comparable. No attempt was made to weight similar specifications equally within the composites. Although the more rapid rise of DOD clothing prices cannot be attributed to any one factor, several influences were isolated. The DOD items frequently represented the purchase of a service, for example, the materials were supplied by DOD to the contractor who manufactured the shirt. The DOD series would then have a higher labor component than the PPI price, which includes the producers' cost of materials.

Another factor is that DOD is required to purchase combat boots produced at certain federal prisons. In many cases, these prices were higher than bid prices from private producers, which accelerated the change in the price of footwear to DOD.

If composite PPI indexes were used to deflate defense purchases, they would have overstated constant-dollar purchases of men's apparel in almost every time period. Using proxy indexes for DOD clothing and

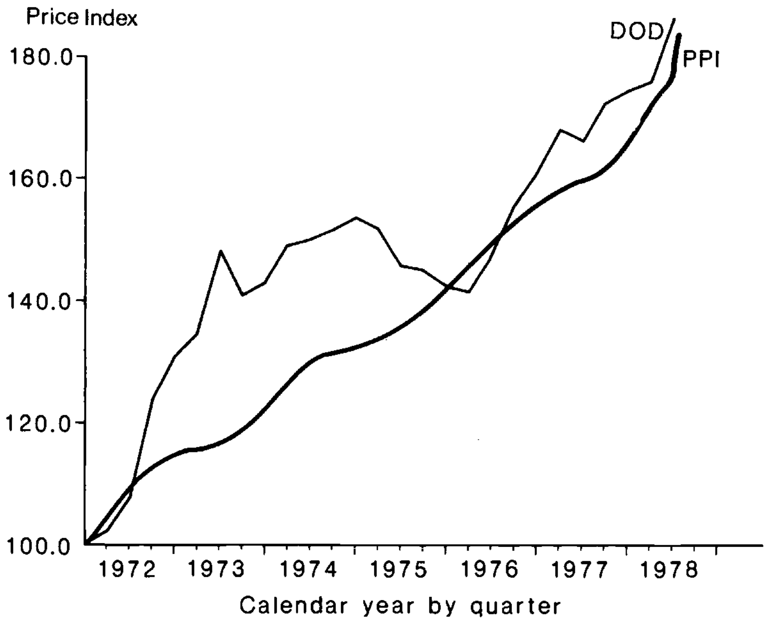

Fig. 3.3 Comparison of price indexes for men's footwear (January–March 1972 = 100.0)

footwear seems unlikely to provide a correct estimate of constant-dollar purchases or price change.

3.4.4 Hot Rolled Carbon Plate

Hot rolled carbon plate is purchased by the DOD under a variety of detailed specifications. These specifications are shown in table 3.15. The prices for these various specifications were converted to a price per ton, and then a weighted average price for delivered hot rolled carbon plate to DOD was calculated. The PPI is a list price less usual discounts. The price change to DOD is greater for most periods for which data were available, as shown by the indexes in table 3.16 and figure 3.4. The Cost of Living Council also found that average realized prices for hot rolled carbon sheets increased more than those shown by the PPI (Council on Wage and Price Stability 1977, p. IV–19).

Although the price change reflected in the DOD data is greater, the average price for 100 pounds was very similar in the base period (72-IV).

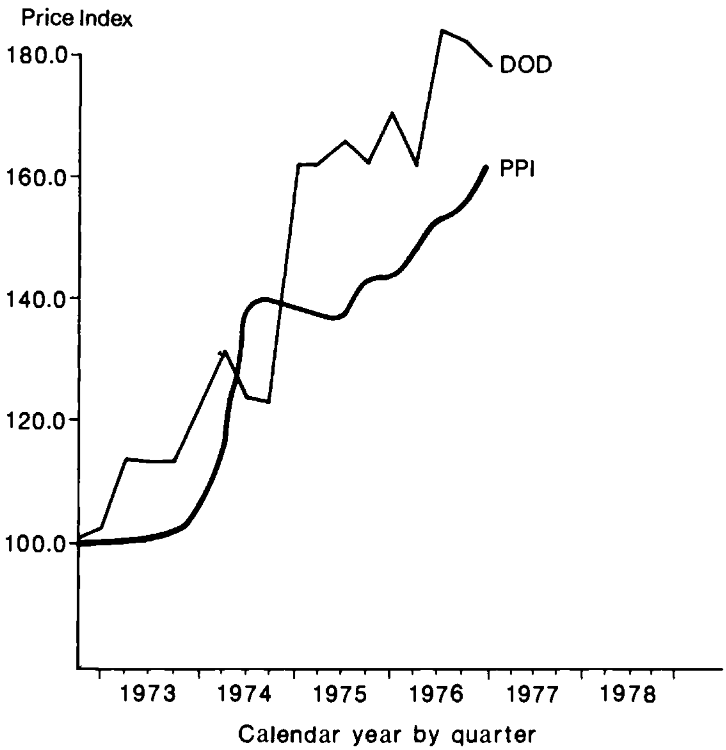

Fig. 3.4 Comparison of price indexes for hot rolled carbon plate (October–December 1972 = 100.0)

This is in sharp contrast to the petroleum products where base period average prices were significantly different. These average prices in dollars per 100 pounds are shown below for 1972-IV and 1977-I.

	PPI ($)	DOD ($)	Difference ($)
72-IV	8.657	8.578	.079
77-I	13.364	15.212	1.848

The increase in DOD average prices does not seem due to a change in mix, that is, to the use of several national stock numbers (NSN) or the method used to combine them. This is supported in that the only product to be delivered in both 72-IV and 77-I was NSN 9515–00–153–3310 and was close to the average. The differences appear more likely due to changes in discounts and extra charges which accompany changes in market conditions.

3.4.5 Construction

There is no reasonable comparison between the PPI and the DOD construction series. The PPI contains only price indexes of construction materials, while the DOD series includes the total construction cost (labor, materials, and overhead) and profit. There exist many other measures of price change for construction, most of which are based on input costs of materials and labor. The Engineering News Record Building Cost Index (ENR) is used by DOD as a guide in evaluating cost changes of military construction. The ENR index includes labor costs as well as materials costs (see table 3.17) but contains no adjustments for changes in labor productivity, competitive conditions, or other intangibles.

The ENR was rebased to 1972, and the DOD construction series was recalculated on a fixed-weight Laspeyres basis for comparison purposes (see fig. 3.5 and table 3.18). The two series show a remarkably similar trend over the entire period. There are, however, large differences in short-term changes, especially during 1973 and from mid-1977 to mid-1978.

3.4.6 Summary of Detailed Comparisons

Detailed comparisons of PPIs and DOD indexes have been made showing differences and similarities that are striking. The differences are short term, while the similarities are long term. The nature of the DOD market makes it likely that it will experience price changes that will be significantly different from these prevailing in the private sector. It seems obvious that the precision of short-term estimates of price change of defense purchases cannot be reliable unless actual DOD transactions are measured.

3.5. Future Plans

The direct pricing of DOD purchases for the purpose of deflating national defense in the NIPAs has just begun. A set of historical statistics has been prepared and is updated on an ongoing basis. These data were fully incorporated into the December 1980 benchmark revision of the NIPAs and are updated each quarter in the *Survey of Current Business*.

The program is unique in many respects. One aspect is the effort to extract information from massive amounts of data on actual transactions contained on computer tapes. Such an approach is quite different from the usual manner in which price indexes are compiled, and the price data base rapidly becomes too large to be individually handled and under-

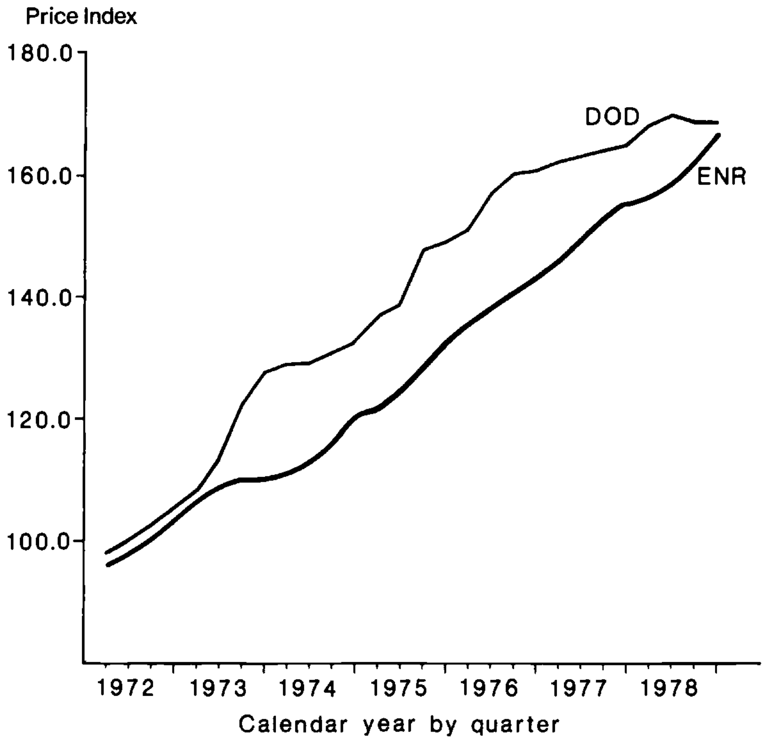

Fig. 3.5 Comparison of price indexes for construction (calendar year 1972 = 100.0)

stood. More reliance is placed on conventions and edit steps, which are established to process data and reveal problems with the basic inputs.

Deflation of DOD purchases has been of primary interest in this project. However, there is no reason why the rest of government (i.e., federal, state, and local) cannot be directly priced and deflated. There is evidence that records or prices paid exist at all levels of government. Only the lack of resources prevents the assembly of an appropriate data base.

Deflation at this time has been done primarily for the purpose of deflating the NIPAs. Other users of statistics have interests that might be better served by price indexes based on approaches other than specification pricing and aggregations other than the NIPAs. Aggregations by appropriations or military force structures seem to have special appeal to the DOD. The future may well inaugurate a time when the price index techniques and principles will be known widely enough that individuals and organizations will create their own measures in order to facilitate their analysis. The Office of Management and Budget, for example, could examine budgets with much greater sophistication if programs were deflated by actual and not proxy measures of price change. The life cycle costs of various programs (i.e., the research and development, production, and maintenance) could all be integrated and deflated to reveal the true price change and cost of existing and planned programs.

Individuals and organizations have relied too long on existing price indexes. Indexes based upon government documents are attractive because they impose no direct paperwork or reporting burden on the private sector. The knowledge and resources are already in place to create comprehensive price indexes relating to government activity.

Table 3.1 Relationship of National Defense Purchases to the GNP

	1972	1973	1974	1975	1976	1977	1978
				$Billions			
GNP	1185.9	1326.4	1434.2	1549.2	1718.0	1918.0	2156.1
Govt. purchases goods and services	253.1	270.4	304.1	339.9	362.1	394.5	432.6
Federal	101.7	102.0	111.0	122.7	129.2	143.9	153.4
National defense	73.1	72.8	77.0	83.0	86.0	93.3	100.0
				% GNP			
GNP	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Govt. purchases goods and services	21.4	20.4	21.2	21.9	21.2	20.6	20.1
Federal	8.6	7.7	7.7	7.9	7.5	7.5	7.1
National defense	6.2	5.5	5.5	5.4	5.0	4.9	4.6

Table 3.2 Department of Defense Purchases, NIPA Basis by Major Type of Product ($Millions)

Calendar Year	Total Purchases	Durable Goods	Non-durable Goods	Services	Struc-tures	Compen-sation
			Current-Dollars			
1972	72,053	14,921	5,006	15,223	1,671	35,232
1973	72,743	14,350	4,663	16,005	1,987	35,738
1974	78,072	15,723	5,886	17,649	2,081	37,033
1975	81,288	17,360	5,454	17,266	2,166	39,042
1976	83,601	18,064	4,931	18,479	2,044	40,083
1977	90,700	20,873	5,643	20,107	2,088	42,009
1978[a]	98,126	22,873	6,160	21,826	2,098	45,169
			Constant 1972 Dollars			
1972	72,053	14,921	5,006	15,223	1,671	35,232
1973	68,268	13,938	4,107	15,115	1,773	33,335
1974	67,845	14,737	3,595	15,172	1,693	32,648
1975	65,259	15,113	2,941	13,214	1,655	32,336
1976	63,160	14,588	2,531	13,026	1,443	31,572
1977	63,925	15,443	2,646	13,051	1,396	31,389
1978[a]	64,593	15,665	2,649	13,331	1,302	31,646
			Implicit Price Deflators			
1972	100.00	100.0	100.0	100.0	100.0	100.0
1973	106.56	103.0	113.5	105.9	112.1	107.2
1974	115.07	104.7	163.7	116.3	122.9	113.4
1975	124.56	114.9	185.4	130.7	130.9	120.7
1976	132.36	123.8	194.8	141.9	141.7	127.0
1977	141.92	135.2	213.2	154.1	149.6	133.8
1978[a]	151.9	146.0	232.5	163.7	161.1	142.7

[a]Preliminary.

Table 3.3 Comparison of Published Implicit Price Deflators and New Estimates Incorporating DOD Data

	Previously Published Estimate	1973 New Estimate	Difference	Previously Published Estimate	1974 New Estimate	Difference	Previously Published Estimate	1975 New Estimate	Difference
					Index Numbers, 1972 = 100.0				
GNP	105.80	105.86	.06	116.02	115.95	−.07	127.15	127.02	−.13
Govt. purchases goods and services	106.7	107.0	.3	117.5	117.1	−.4	128.9	128.3	−.6
Federal	105.8	106.6	.8	115.9	115.1	−.8	127.5	125.9	−1.6
Less compensation	104.0	105.4	1.4	119.0	117.1	−1.9	133.5	130.1	−3.4
					% Change from the Preceding Year				
GNP	5.8	5.9	.1	9.7	9.5	−.2	9.6	9.5	−.1
Govt. purchases goods and services	6.7	7.0	.3	10.1	9.4	−.7	9.7	9.6	−.1
Federal	5.8	6.6	.8	9.6	8.0	−1.6	10.0	9.4	−.6
Less compensation	4.0	5.4	1.4	14.4	11.1	−3.3	12.2	11.1	−1.1

	1976			1977			1978[a]		
	Previously Published Estimate	New Estimate	Difference	Previously Published Estimate	New Estimate	Difference	Previously Published Estimate	New Estimate	Difference
	Index Numbers, 1972 = 100.0								
GNP	133.76	133.70	−.06	141.61	141.64	.03	152.09	152.07	−.02
Govt. purchases goods and services	136.8	136.5	−.3	146.3	146.5	.2	157.8	157.7	−.1
Federal	134.4	133.6	−.8	142.7	143.2	.5	153.3	153.0	−.3
Less compensation	140.3	138.7	−1.6	148.7	149.6	.9	160.8	160.2	−.6
	% Change from the Preceding Year								
GNP	5.2	5.3	.1	5.9	5.9	0	7.4	7.3	−.1
Govt. purchases goods and services	6.1	6.4	.3	7.0	7.3	.3	7.9	7.6	−.3
Federal	5.4	6.1	.7	6.2	7.2	1.0	7.4	6.8	−.6
Less compensation	5.1	6.6	1.5	6.0	7.9	1.9	8.1	7.1	−1.0

Source: Bureau of Economic Analysis.
Note: All estimates are based on data prior to the 1980 GNP benchmark revision.
[a]Preliminary.

Table 3.4 **Implicit Price Deflators for DOD Purchases of Aircraft (CY 1972 = 100)**

Calendar Year/ Quarter	Total	New Army Aircraft	New Air Force Aircraft	New Navy and Marine Corps Aircraft
1972	100.0	100.0	100.0	100.0
1973	101.8	104.4	107.4	97.8
1974	97.6	116.0	113.4	87.9
1975	107.9	127.8	132.2	92.4
1976	117.5	144.4	135.2	102.7
1977	132.3	142.4	153.9	121.8
1978[a]	146.2	147.2	155.7	142.2
1972-I	96.2	98.7	91.1	99.4
II	101.9	99.9	104.6	100.1
III	100.7	99.9	101.9	100.1
IV	101.0	101.5	102.4	100.2
1973-I	102.5	101.8	105.3	101.0
II	103.2	104.7	110.0	102.0
III	104.1	107.5	113.6	99.7
IV	97.9	110.4	103.0	92.2
1974-I	99.6	113.2	115.6	93.2
II	97.9	116.1	109.7	89.7
III	98.7	118.8	110.8	90.5
IV	94.5	121.8	117.8	79.7
1975-I	104.5	124.6	132.2	89.4
II	105.9	127.4	138.5	89.3
III	111.3	127.5	134.4	95.2
IV	109.4	128.8	127.4	95.7
1976-I	117.3	136.7	127.5	99.7
II	119.6	144.8	139.3	102.9
III	116.3	154.1	139.3	103.2
IV	116.9	146.4	136.1	104.8
1977-I	123.9	142.3	145.6	113.5
II	132.3	141.9	155.0	122.4
III	133.6	142.2	151.2	123.5
IV	139.8	143.2	163.5	127.5
1978[a]-I	141.0	142.6	153.8	133.1
II	146.7	141.3	154.3	147.1
III	147.1	141.0	155.0	146.1
IV	149.4	157.4	158.6	142.1

Source: Bureau of Economic Analysis.
Note: The total for the aircraft category includes subcategories not shown separately for aircraft modifications, spare and repair parts, support equipment and facilities. Engineering services, other contractual services, and government-furnished materials are excluded from the aircraft category.
[a]Preliminary.

Table 3.5 **Implicit Price Deflators for DOD Purchases of New Missiles Systems Components, by Major Subcategory (CY 1972 = 100)**

Calendar Year/ Quarter	Total	Army and Marine Corps Missiles	Air Force Other Missiles	Navy Other Missiles	Intercontinental and Submarine launched Ballistic Missiles
1972	100.0	100.0	100.0	100.0	100.0
1973	98.6	98.9	84.3	106.8	95.6
1974	96.0	90.1	69.8	106.5	98.3
1975	104.2	92.0	70.2	102.8	111.7
1976	115.3	74.9	80.9	128.0	141.0
1977	122.0	75.1	128.7	107.7	162.4
1978[a]	128.1	85.2	118.2	131.4	173.6
1972-I	100.5	105.1	102.6	104.6	100.5
II	100.3	98.2	102.7	105.0	100.2
III	100.4	98.8	100.9	105.3	100.1
IV	99.2	98.7	92.7	92.3	99.6
1973-I	99.6	98.6	93.3	95.4	99.3
II	98.9	100.8	93.3	104.0	95.1
III	99.4	99.7	87.0	107.7	92.3
IV	96.5	97.3	76.5	116.8	93.6
1974-I	92.9	89.5	71.1	92.5	97.4
II	93.3	90.2	71.1	94.5	97.3
III	97.1	88.7	69.9	110.4	97.5
IV	101.0	91.8	65.6	120.1	101.2
1975-I	102.5	94.1	64.7	89.4	109.8
II	101.0	92.4	67.9	97.8	110.0
III	106.9	100.4	74.4	109.1	112.6
IV	107.6	80.0	75.1	125.4	116.7
1976-I	114.4	71.0	83.0	148.6	135.7
II	115.3	66.3	81.4	163.0	140.2
III	117.4	85.4	79.4	118.3	142.2
IV	114.2	79.5	80.5	103.8	146.2
1977-I	116.4	72.0	127.7	104.7	152.6
II	123.1	77.2	126.9	104.7	160.0
III	120.5	74.1	127.2	107.0	165.1
IV	129.2	78.5	135.2	113.3	172.1
1978[a]-I	121.1	82.6	129.2	132.7	179.5
II	123.0	86.8	121.1	125.6	171.5
III	133.5	85.6	113.7	130.0	177.1
IV	134.2	85.3	115.1	137.8	167.1

Source: Bureau of Economic Analysis.
Note: The total for the missile category includes missile modifications, spare and repair parts, support equipment and facilities which are not shown separately. Engineering and other contractual services, components produced in industrially funded activities, and the construction portion of the Minuteman force modernization program are excluded from the missiles category.
[a]Preliminary.

Table 3.6 Implicit Price Deflators for Compensation of DOD Military and Civilian Personnel (CY 1972 = 100)

Calendar Year/ Quarter	Total	Military	Civilian
1972	100.0	100.0	100.0
1973	107.2	107.0	107.5
1974	113.4	113.1	114.1
1975	120.7	118.7	124.0
1976	127.0	123.7	132.2
1977	133.8	129.5	140.7
1978	142.6	137.3	151.0
1972-I	98.4	99.0	97.3
II	98.6	98.9	98.0
III	99.1	98.4	100.2
IV	104.1	103.7	104.6
1973-I	105.3	104.8	106.3
II	105.5	105.7	105.1
III	107.0	106.6	107.7
IV	111.1	111.1	111.0
1974-I	111.1	111.2	110.9
II	111.4	111.2	111.8
III	113.1	112.4	114.3
IV	118.2	117.5	119.3
1975-I	118.8	117.5	120.9
II	119.2	117.5	122.0
III	120.2	117.5	124.5
IV	124.8	122.3	128.7
1976-I	125.3	122.3	130.1
II	125.6	122.3	130.8
III	125.9	122.6	131.2
IV	131.0	127.5	136.7
1977-I	131.4	127.5	137.6
II	131.7	127.5	138.4
III	132.2	127.5	139.6
IV	140.0	135.4	147.4
1978[a]-I	140.5	135.4	148.6
II	140.8	135.7	148.8
III	141.0	135.6	149.5
IV	148.3	142.5	157.2

Source: Bureau of Economic Analysis.
[a]Preliminary.

Table 3.7 Implicit Price Deflators for DOD Purchases of Ships (CY 1972 = 100)

Calendar Year/ Quarter	Ships	New Ship Construction at Private Shipyards	Government furnished Equipment for New Ship Construction
1972	100.0	100.0	100.0
1973	109.2	113.4	103.5
1974	125.5	133.2	113.4
1975	139.7	155.0	117.8
1976	146.1	165.7	118.9
1977	157.8	186.1	124.8
1978[a]	171.5	199.5	137.7
1972-I	99.7	99.7	99.8
II	100.1	100.0	100.1
III	100.1	100.1	100.0
IV	100.1	100.2	100.1
1973-I	106.5	111.7	99.5
II	107.9	113.0	101.3
III	111.1	114.0	106.5
IV	112.5	115.2	108.3
1974-I	117.7	123.1	109.8
II	122.0	127.8	112.5
III	128.7	138.8	113.2
IV	132.4	142.1	117.4
1975-I	134.9	150.2	113.2
II	137.9	152.4	116.9
III	143.2	157.7	121.9
IV	144.0	160.7	120.1
1976-I	143.3	160.8	118.0
II	145.7	161.8	121.5
III	146.8	166.1	118.0
IV	148.8	174.7	118.4
1977-I	155.3	184.4	122.1
II	160.9	185.5	130.7
III	156.1	186.3	121.7
IV	158.9	188.3	124.9
1978[a]-I	168.4	195.4	135.6
II	171.0	200.0	136.6
III	172.5	200.6	138.6
IV	173.9	201.7	140.0

Source: Bureau of Economic Analysis.
Note: The ship category also includes conversions at private shipyards and government-furnished equipment for conversions.
[a]Preliminary.

Table 3.8 Implicit Price Deflators for DOD Purchases of Structures and Military Construction (CY 1972 = 100)

Calendar Year/ Quarter	Structures	Military Construction
1972	100.0	100.0
1973	112.1	112.8
1974	123.0	124.0
1975	131.0	132.0
1976	143.8	144.1
1977	151.8	152.5
1978[a]	161.1	162.1
1972-I	98.0	97.2
II	98.7	98.3
III	101.6	102.3
IV	101.9	102.2
1973-I	104.6	104.7
II	108.4	108.6
III	115.4	116.0
IV	119.6	120.7
1974-I	124.1	126.0
II	124.9	126.4
III	126.7	127.5
IV	116.7	116.4
1975-I	120.9	121.5
II	129.4	129.7
III	137.3	137.7
IV	136.3	137.7
1976-I	139.4	139.7
II	145.8	146.3
III	146.1	146.5
IV	144.8	145.1
1977-I	136.9	136.8
II	158.8	160.4
III	155.5	156.2
IV	158.2	158.9
1978[a]-I	158.9	159.6
II	162.1	163.9
III	161.3	162.6
IV	162.1	162.2

Source: Bureau of Economic Analysis.
Note: Structures include, in addition to military construction, family housing, missile silos, and net purchases of existing structures.
[a]Preliminary.

Table 3.9 Petroleum Products Comparisons (CY 1973-III = 100)

Calendar Year/ Quarter	Regular Gasoline		Jet Fuel			Diesel Fuel	
	PPI	DOD	PPI	DOD (JP–4)	DOD (JP–5)	PPI	DOD
1973-III	100.0	100.0	100.0	100.0	100.0	100.0	100.0
IV	105.6	119.5	107.8	115.8	106.9	110.1	139.3
1974-I	133.7	237.3	132.6	198.8	183.4	156.0	248.3
II	160.6	230.4	165.2	207.1	204.2	189.4	250.9
III	176.4	248.2	190.0	245.4	227.0	210.2	272.0
IV	168.3	272.7	197.8	249.9	233.8	206.6	288.8
1975-I	169.6	286.3	205.5	237.2	227.5	203.8	290.0
II	179.0	289.1	218.2	234.8	226.7	206.1	289.4
III	201.6	289.5	230.0	240.9	220.1	219.5	307.1
IV	207.5	289.7	237.2	236.6	228.5	230.0	288.7
1976-I	201.0	304.2	245.6	239.2	230.8	234.1	300.3
II	198.3	313.3	240.7	237.3	221.0	230.5	306.2
III	215.5	308.6	240.9	241.5	227.2	234.4	298.1
IV	215.7	309.6	250.1	246.3	234.2	240.5	292.7
1977-I	213.2	319.8	262.8	250.6	243.3	254.3	299.9
II	223.6	321.7	276.7	263.5	252.3	266.3	321.5
III	228.5	321.4	283.3	270.3	256.7	268.3	337.7
IV	224.6	317.6	298.0	277.4	270.4	269.8	334.9
1978-I	222.0	309.6	305.2	283.9	268.1	272.8	345.3
II	225.1	330.2	308.6	282.6	267.7	270.8	338.6
III	238.8	327.9	312.9	286.1	273.0	271.0	341.8
IV	245.4	309.7	315.0	293.8	227.8	279.4	369.5

Source: Bureau of Economic Analysis.

Table 3.10 Petroleum Product Specifications

Regular gasoline
- PPI
  - PPI 05–71–02–03, gasoline, regular grade, monthly sales to commercial consumers
- DOD
  - NSN 9130–00–160–1818, gasoline, automotive, combat type I, MIL–G–3056, NATO code no. F–46, MG1

Jet fuel
- PPI
  - PPI 05–72–03–01, jet fuel, kerosene base, commercial type, monthly sales to airline industry, bonded fuel excluded
- DOD (JP–4)
  - NSN 9130–00–256–8613, turbine fuel, aviation, grade JP–4, (naptha base), MIL–T–5624
- DOD (JP–5)
  - NSN 9130–00–273–2379, turbine fuel, aviation, grade JP–5 (kerosene base), MIL–T–5624

Diesel fuel
- PPI
  - PPI 05–73–03–01, diesel fuel, no. 2 or standard diesel, monthly sales to large consumers
- DOD
  - NSN 9140–00–273–2377, diesel fuel, MIL–F–16884 (NATO symbol F–76)

Source: Bureau of Economic Analysis.

Table 3.11 **Citrus Fruits**

Calendar Year/ Quarter	Citrus Fruits		Grapefruit		Lemons		Oranges	
	DOD	PPI	DOD	PPI	DOD	PPI	DOD	PPI
1973-III	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
IV	86.7	80.0	66.8	74.4	95.0	77.6	93.1	91.2
1974-I	78.3	91.3	60.9	57.1	91.4	103.4	72.6	106.6
II	77.8	91.9	61.0	64.2	90.3	94.8	72.3	117.5
III	98.2	97.6	82.4	73.7	108.3	102.6	96.2	114.8
IV	82.7	87.6	63.8	62.3	89.8	91.1	90.1	109.3
1975-I	77.3	90.9	62.1	67.5	82.7	100.5	83.9	98.6
II	91.4	100.8	82.3	75.4	94.8	115.2	95.0	101.6
III	86.4	98.7	82.2	91.8	86.2	106.8	91.7	90.5
IV	94.3	106.8	112.5	61.9	93.2	135.0	75.8	102.6
1976-I	79.2	81.7	60.5	63.7	87.8	86.8	83.6	92.2
II	90.2	91.7	74.3	70.1	103.7	105.1	81.8	90.0
III	104.7	94.7	104.2	97.7	105.0	90.9	104.7	98.7
IV	94.2	84.4	86.5	76.3	90.8	85.2	109.7	91.9
1977-I	81.7	89.2	74.7	64.4	70.0	99.7	112.3	96.8
II	83.9	100.5	82.7	71.3	66.0	106.4	120.1	122.1
III	113.5	116.4	128.2	110.5	100.0	117.3	123.2	124.6
IV	108.8	104.3	88.6	79.7	104.0	83.0	140.9	173.7
1978-I	96.1	106.1	74.7	81.2	89.9	97.4	132.4	151.4
II	103.7	115.8	74.3	82.8	106.5	136.1	131.3	113.4
III	137.6	151.5	82.9	106.6	166.1	180.4	144.0	172.8
IV	150.5	125.5	126.4	122.2	144.2	95.9	190.0	187.7

Source: Bureau of Economic Analysis.

Table 3.12 **Citrus Fruit Specifications**

DOD
- NSN 8915–00–126–8804, oranges, fresh any variety except temple
- NSN 8915–00–582–4071, lemons, fresh
- NSN 8915–00–616–0198, grapefruit, fresh

PPI
- 01–11–01–01, grapefruit, Florida, white, seedless, sizes 32, 36, 40, N.Y. Auction, 4/5 bushel
- 01–11–01–04, lemons, California, sizes 115, 140, 165, half box, Chicago Auction marted
- 01–11–01–11, oranges, California, Naval or Valencia, sizes 88 and 113, half box, Chicago Auction market

Source: Bureau of Economic Analysis.

Table 3.13 Men's Clothing and Footwear

Calendar Year/ Quarter	Men's Apparel		Men's Footwear	
	DOD	PPI	DOD	PPI
1972-I	100.0	100.0	100.0	100.0
II	102.2	100.3	101.8	104.7
III	103.5	100.9	106.7	107.7
IV	104.7	102.1	122.3	110.8
1973-I	105.7	103.1	128.7	114.1
II	105.6	104.6	133.5	115.6
III	108.8	105.7	146.5	115.6
IV	121.2	108.6	139.4	118.3
1974-I	136.3	112.6	141.8	120.9
II	138.0	117.7	147.6	125.7
III	153.1	121.8	148.1	128.2
IV	164.8	124.5	150.8	130.8
1975-I	161.5	124.5	152.2	131.6
II	147.2	123.5	150.2	132.8
III	143.9	123.8	144.8	134.2
IV	145.3	126.5	144.5	136.9
1976-I	144.9	129.4	140.4	140.8
II	148.3	131.1	140.0	145.9
III	147.8	135.2	145.7	148.9
IV	154.9	138.6	154.5	150.8
1977-I	156.7	142.4	159.7	153.7
II	159.6	143.8	167.7	157.1
III	160.2	146.0	164.5	159.4
IV	167.3	147.2	171.8	161.7
1987-I	164.8	148.4	173.2	166.6
II	162.5	149.3	175.2	172.1
III	163.1	151.1	184.3	175.5
IV	163.8	154.0	185.1	183.2

Source: Bureau of Economic Analysis.

Table 3.14 Men's Clothing and Footwear Specifications

Men's Apparel
DOD
NSN 8405–00–082–6609, trousers utility cotton sateen, OG–107
MIL–T–833 k (class 1) dtd 11 Feb 71 and am. #2 dated 16 Feb 72
NSN 8405–00–614–9938, shirt, utility, durable press, army shade 507
NSN 8405–00–935–2714, trouser, mens, poly/wool, tropical blue shade 3346, type 1, class 5
NSN 8415–00–163–7701, trouser, food handlers, cotton drill white
NSN 8415–00–177–4834, cap, hot weather, OG–106
NSN 8415–00–268–7871, gloves, leather, work, cream heavy M–1950
NSN 8415–00–394–3598, trousers, flying men's, cotton warp and nylon filling oxford USAF shade 1509, sage green (modified F–18)
NSN 8415–00–491–2679, coveralls, flying men's cotton
NSN 8415–00–634–4794, gloves, shell, leather, black M–1949
NSN 8415–00–753–6483, coveralls, cold weather mechanics
NSN 8415–00–782–2916, cap, cold weather (A–2) navy
NSN 8415–00–904–5134, undershirt, men's winter lightweight
NSN 8420–00–166–5850, drawers, men's ctn thigh length white type 1, class 1
NSN 8420–00–543–6643, undershirt, man's ctn, quarter sleeve
NSN 8440–00–872–2171, socks, men's, ctn/nyl/wl, OG–408, stretch type, cush. sole 20%/30%/50%
PPI
PPI 03–81–02 men's apparel[a]
Men's Footwear
DOD
NSN 8430–00–554–4228, shoe, dress, men's, black, oxford
NSN 8430–00–620–0520, shoe, service, chukka
NSN 8430–00–782–3077, boot, combat, men's leather, DMS
PPI
PPI 04–31 men's and boys' footwear[a]

Source: Bureau of Economic Analysis.

[a]These PPIs are based upon numerous eight-digit codes, roughly 18 for men's apparel and five for men's footwear in 1978. Prior to December 1977 there were about 27 eight-digit codes for men's apparel. The codes and their short descriptions can be seen in the appropriate monthly Bureau of Labor Statistics report for *Producers Prices and Price Indexes*.

Table 3.15 Hot Rolled Carbon Plate Product Specifications

DOD

- NSN 9515–00–153–3183, steel plate, carbon, hot rolled, 10.2 lb/sq ft, 60 inches wide × 240 inches long, 1,020 lb/pm
- NSN 9515–00–153–3185, same as 3184 except 348-inch width, 60 inch long and 10.2 lb/sq ft, 1,479 lb/pm
- NSN 9515–00–153–3214, same as 3184 except 0.25 inch thick, 96 inches wide × 348 inches long, 2,368.6 lb/pm
- NSN 9515–00–153–3223, same as 3184 except 15.30 lb/sq ft, 60 inches × 240 inches long, 1,530 lb/pm
- NSN 9515–00–153–3224, same as 3184 except 15.3 lb/sq ft, 60 inches × 348 inches long, 0.375 inch thick, 2,218.5 lb/pm
- NSN 9515–00–153–3236, same as 3184 except 0.500 inch thick, 60 inches wide × 240 inches long, 2,042 lb/pm
- NSN 9515–00–153–3255, same as 3184 except 0.75 inch thick, 60 inches wide × 240 inches long, 3,060 lb/pm
- NSN 9515–00–153–3262, same as 3184 except 35.7 lb/sq ft, 72 inches wide × 348 inches long, 6,212 lb/pm
- NSN 9515–00–153–3264, same as 3184 except 1.0 inch thick, 60 inches wide × 240 inches long, 4,083 lb/pm
- NSN 9515–00–153–3280, same as 3184 except 2.0 inches thick, 60 inches wide × 240 inches long, 8,167.6 lb/pm
- NSN 9515–00–153–3310, same as 3184 except 0.375 inch thick, 72 inches wide × 240 inches long, 1,837 lb/pm
- NSN 9515–00–153–3341, same as 3184, 30.6 lb/sq ft, 96 inches wide × 240 inches long, 4,896 lb/pm

PPI

10–13–02–61, hot rolled carbon steel sheets, commercial quality, cut lengths, .1271 inch minimum (TMW) × 48 inches wide × 120 inches long, cut edge, not pickled, base chemistry, base quantity (40,000 or over of an item) mill to user, f.o.b. mill.

Table 3.16 Hot Rolled Carbon Plate

Calendar Year/ Quarter	PPI	DOD
1972-IV	100.0	100.0
1973-I	100.0	101.3
II	100.0	112.5
III	100.0	112.5
IV	100.0	112.5
1974-I	105.3	120.3
II	115.5	131.9
III	139.3	123.4
IV	139.3	122.1
1975-I	138.9	161.1
II	136.6	161.7
III	135.8	164.4
IV	143.6	161.6
1976-I	143.6	168.7
II	146.4	161.5
III	152.1	182.3
IV	155.2	180.8
1977-I	161.3	177.3

Source: Bureau of Economic Analysis.

Table 3.17 Construction Specifications

DOD. The nine classes of construction which comprise military construction are:

1. Airfield pavements
2. Training facilities
3. Maintenance facilities
4. Covered storage facilities
5. Administrative buildings
6. Troop housing
7. Facilities for personnel support and services
8. Research, development, and test buildings
9. Roads and streets

ENR. The ENR is based on four specifications:

1. Structural steel shapes base mill price
2. Bulk portland cement, 20-city average
3. 2 × 2 lumber, 20-city average
4. Skilled labor, 20-city average

Source: Bureau of Economic Analysis.

Table 3.18 **Construction Comparisons (CY 1972 = 100)**

Calendar Year/ Quarter	DOD	ENR
1972	100.0	100.0
1973	116.8	108.5
1974	129.6	114.9
1975	142.2	124.5
1976	154.9	135.9
1977	162.2	147.3
1978	166.6	159.7
1972-I	96.9	96.9
II	97.8	99.0
III	102.1	101.0
IV	103.2	103.1
1973-I	106.5	106.2
II	112.9	108.5
III	121.0	109.1
IV	126.6	110.3
1974-I	128.4	110.1
II	128.3	113.0
III	129.6	118.0
IV	132.2	118.4
1975-I	137.3	119.9
II	138.2	122.8
III	145.7	126.5
IV	147.4	128.9
1976-I	149.0	130.7
II	154.1	133.7
III	158.3	138.2
IV	158.0	141.1
1977-I	160.7	142.8
II	162.4	144.1
III	162.6	148.8
IV	163.0	153.6
1978-I	169.3	154.1
II	165.6	157.1
III	165.5	162.8
IV	166.0	164.9

Source: Bureau of Economic Analysis.

Appendix A

Relation of Unified Budget Outlays to NIPA Purchases for DOD and MAP

The relationship between outlays in the unified budget and NIPA purchases is determined by the definition and magnitude of the adjustments made for coverage and timing. This reconciliation is shown in table 3.A.1 for fiscal year 1974.

Outlays require coverage adjustments for DOD outlays that are outside the scope of national defense purchases in the national accounts. These include net lending, payments to U.S. territories (geographical exclusions), foreign currency conversion, capital gains, land and netting

Table 3.A.1 Relationship of DOD Outlays in Unified Budget and NIPA National Defense

	Fiscal Year 1974
Unified Budget DOD and outlays of Military Assistance Programs (MAP)	78,445
Less:	
Net lending	251
Geographic exclusions	18
Foreign currency conversion	1
Capital gains	(4)
Land	20
Plus:	
Netting and grossing	29
Timing: Progress payments	291
Foreign military sales	534
Accounting adjustments	300
Equals NIPA DOD and MAP expenditures	78,813
Less:	
Grants-in-aid to state and local governments	180
Military retirement transfer payments	5,061
Transfers to foreigners	54
Net interest paid	40
Subsidies less surplus PXs and commissary	(142)
Equals NIPA DOD and MAP purchases	73,620
Plus:	
Social Security	60
Atomic Energy Activities	1,417
General Service Administration sales	(1,289)
Civil Service Commission	419
Special programs	(198)
Other agencies	32
Equals NIPA national defense purchases	74,061

Source: Bureau of Economic Analysis.

and grossing. Timing adjustments to outlays to reflect current purchases are largely for the increase in advances net of payables (i.e., progress payments), foreign military sales, accounting adjustments, and Military Assistance Programs (MAP).

DOD and MAP expenditures are further adjusted for transfer payments, which are not included in defense purchases in the NIPAs, by removing grants-in-aid to state and local governments, military retirement transfer payments, transfers to foreigners, net interest paid, and subsidies less current surplus of government enterprises (i.e., PXs and commissaries).

NIPA DOD and MAP purchases are also adjusted for activities of other federal agencies that are included in the definition of national defense purchases. These include atomic energy activities by the Department of Energy and sales by the General Service Administration. Small adjustments are also made for Social Security, Civil Service Commission, special programs, and other agencies.

Appendix B

Defense Price Index: Relative Importance of Purchases in Current Dollars

	1972	1977
Total defense purchases	1.000	1.000
Compensation	.490	.465
Civilian	.180	.189
Military	.310	.276
Structures	.023	.023
Construction	.019	.025
Family housing construction	.002	.002
Family housing improvements and minor construction	.001	.001
Family housing maintenance	.002	.003
Military construction	.014	.018
Missile silos (force modernization program)	[a]	.001
Net purchases of existing structures	.004	−.002
Services	.211	.221
Communication services	.008	.007
Base communications	.002	.002
Communications services industrial fund	.004	.003
Postage	.002	.002
Depot maintenance	.015	.019
Air Force	.006	.004
Army	.002	.005
Navy	.007	.010
Installation support services	.002	.026
Contract operation installations	.002	.003

Appendix B (continued)

	1972	1977
Equipment maintenance	.005	.006
Housepeeking services	.007	.006
Maintenance, repairs and minor construction of real property	.005	.006
Rents	.002	.003
Training and education	.001	.002
Medical services	.005	.006
Other services	.029	.030
Automatic data processing contractual service	.003	.003
Automatic data processing leased equipment	.004	.003
Consulting, engineering, and technical services	.005	.004
Indirect hire	.011	.014
Miscellaneous services	.005	.004
Printing and reproduction	.001	.002
Research and development	.079	.081
Transportation of things	.024	.022
Air	.003	.001
Rail	.003	.003
Sea	.009	.006
Terminal services	.001	[a]
Truck	.008	.012
Travel and transportation of persons	.012	.015
Air	.006	.006
Bus	[a]	[a]
Rail	[a]	[a]
Reimbursable expenses	.006	.009
Utilities	.005	.010
Electricity	.004	.007
Gas	.001	.001
Sewage services	[a]	.001
Steam and hot water	[a]	[a]
Water	[a]	.001
Weapons services	.012	.005
Aircraft	.002	.003
Missiles	.009	.001
Ships	.001	.001
Durable goods	.203	.234
Aircraft	.081	.083
Air Force new aircraft	.031	.027
Army new aircraft	.002	[a]
Modification equipment, spares, and support equipment	.029	.029
Navy and Marine Corps new aircraft	.019	.027
Ammunition plant modernization	.002	.003
Communication and electronics equipment	.013	.015
Air Force	.003	.004
Army	.003	.004
Marine Corps	.001	[a]
Navy	.006	.007
Defense stock funds (durable goods)	.009	.013

Appendix B (continued)

	1972	1977
Industrial funds purchases (durable goods)	.007	.007
Military services stock funds (durable goods)	.015	.026
Air Force	.006	.008
Army	.005	.013
Navy	.004	.005
Missiles	.023	.024
Air Force other missiles, new missiles	.002	.002
Army and Marine Corps missiles, new missiles	.003	.004
ICBM/SLBM new missiles	.001	.004
Modification equipment, spares, and support equipment	.004	.004
Navy other missiles, new missiles	.010	.003
Satellites	.002	.002
Special activities	.001	.005
Other equipment	.018	.022
Air Force	.010	.012
Army	.002	.003
Marine Corps	.001	[a]
Navy	.005	.007
Ship construction	.025	.029
New ship construction	.014	.019
New ship GFE	.007	.009
Ship conversion	.003	.001
Ship conversion GFE	.001	[a]
Vehicles	.009	.012
Combat	.003	.007
Noncombat	.006	.005
Weapons	.001	[a]
Nondurable goods	.073	.057
Ammunition	.028	.011
Air Force	.009	.005
Marine Corps	.001	[a]
Navy	.005	.004
Defense stock funds (nondurable goods)	.004	.043
Bulk petroleum	.026	.029
Clothing and textiles	.004	.005
Other nondurables	.002	.003
Subsistence	.012	.006
Military services stock fund (nondurable goods)	.001	.001

[a] = less than .0005.

Appendix C

Number of Price Specifications by Category

Category	Number of Price Specifications
Aircraft	73
Ammunition	171
Communications	542
Compensation	4,332
Construction	201
Depot maintenance	450
Electronic equipment	890
Installation support services	50
Medical services	32
Missiles	104
Other equipment	377
Other services	72
Research and development	90
Ship construction	105
Stock funds: defense stock fund	1,200
Stock funds: military services	4,500
Transportation of things	99
Travel and transportation of persons	218
Utilities	124
Vehicles	20
Weapons	9
Total	13,659

Appendix D

Guidelines for Quality Adjusting Aircraft

Quality changes for which price adjustments were made include all physical changes that have cost and performance consequences.

Improved performance is recognized as an enhancement of the aircraft's mission, for example, close air support, electronic warfare, antisubmarine warfare. It assumes that expected or specified performance characteristics are associated with the physical configuration of aircraft in production. The remedy of unexpected physical defects is considered price increases and not quality improvements because production aircraft are expected to fit together properly and to work. Aircraft enter production after considerable research and development that includes full-scale development models and prototypes.

A. Quality adjustments are made for:
   1. Changes in design or materials which change the aircraft's
      a) Length of service
      b) Need for repairs
      c) Ease of repair
      d) Weight
      e) Quality of materials in relation to their function
   2. Changes in mechanical features that affect the aircraft's
      a) Overall operation
      b) Efficiency
      c) Ability of a component to perform
   3. Engineering changes that affect the aircraft's probability of mechanical failure with respect to particular systems
   4. Safety features, for example, better seat ejection systems
   5. Antipollution, noise abatement equipment, etc., installed for nonmilitary objectives
B. No quality adjustments are made for physical changes associated with
   1. Style
   2. Appearance
   3. Design solely to make the aircraft seem new or different
   4. Comfort
   5. Convenience
   6. Remedy of production compatability deficiencies
C. New technology may make it possible to achieve recognizably better quality at lower cost. No satisfactory technique has been developed for adjusting for quality change in such situations. Therefore, rather than reflect erroneous quality deterioration no adjustments were made. Prices before and after the change are directly compared in order to give at least partial credit for quality improvement.

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Comment Marilyn E. Manser

In their paper, Ziemer and Galbraith discuss the deflation of defense purchases. The recent publication of implicit price deflators (IPD) for Department of Defense (DOD) purchases of goods and services is the culmination of an effort which began in 1973. (Commerce 1979). A forthcoming article in the *Survey of Current Business* will present the IPD for all defense purchases based on these new price data, and they will be

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fully incorporated into the national income and product accounts (NIPA) at the time of the next benchmark revision.

The importance to budget planning and to public policy debate of satisfactory constant-dollar measures of total government expenditures for various types of defense purchases needs no comment. A project similar to this one for nondefense purchases would clearly be desirable, and, as the authors note, it could be done in a manner similar to this one. But before doing so, attention should be paid to evaluating the results of this project.

By far the major portion of the Ziemer-Galbraith paper, specifically Sections 3.2 and 3.3, is devoted to summarizing the results of the project to develop deflators for defense purchases and to describing in detail the construction of the deflators for certain categories of defense expenditures. Much of this material is presented elsewhere (Commerce 1979) and will, it is hoped, be readily available from government sources to users of these deflators. It is useful that such extensive discussion of methodology and data has been provided by the Bureau of Economic Analysis (BEA) on these indexes; however, this conference paper would, in my opinion, have been more usefully devoted to comprehensive analysis of the importance of the various issues and problems noted below for the resulting measures.

The first thing to think about in assessing these new IPDs is what questions we want to ask about price increases for defense and how useful this new index is for answering them. Ideally, we might want to have a deflator for the output of national defense. Appropriately, constructing such an index was ruled out for the present because of the problems of measuring "national defense." Clearly, measuring the output of nondefense government goods would also be highly complex, and the approach taken here is consistent with the usual treatment of government in the NIPA.

The authors say that the results of this project are instead measures of the real volume of inputs used to provide national defense. That does seem to be an appropriate construct to measure for defense. The components of DOD purchases are labor compensation and material goods in various states of production (However, the theoretical construct that an implicit price deflator is generally taken to correspond to is *not* an input price index [Fisher and Shell 1972, pp. 49–59].)

Previous work on price measurement has identified a number of methodological and statistical problems. One methodological problem given a great deal of attention in previous work on price measurement is the choice of the form of the index. (Presumably, as has been done recently in the *Survey of Current Business* for the major category IPDs, alternative index formulations will eventually be presented for defense purchases.) Other major problems and issues concern choice of transaction versus list prices, sample selections, timing problems, quality change and introduction of new goods.[1] Choices that were employed in this project are described, but more discussion of their rationale and alternatives considered would have been useful. Choices made regarding use of specification pricing and treatment of quality change and introduction of new goods are akin to those used for the PPI. This effort to construct a deflator for DOD purchases attempts to obtain exclusively transaction prices. No consistent criteria for sample size were applied. Section 3.2 of this paper considered in detail the measurement of prices for five categories. For aircraft, missiles, and ship construction, the sample coverage of prices was extremely high. Thus, while there may be a problem of inefficiency, there is unlikely to be a problem of their being misrepresentative. For compensation, collection of wage data was comprehensive and straightforward. However, for construction, the price coverage was erratic.

The problems that arise with respect to aircraft and missiles, both of which are included in the NIPAs on a delivery basis, are similar to one another. The major conceptual problem arising here is the method of linking into the index a new aircraft or missile which is intended to replace an older type. The conceptually appropriate measure of the price of the old type to use for the link is the marginal cost of the last unit produced; the choice made here, to use "one of the last old aircraft model units," is therefore reasonable. In order for the state of technology to be comparable, the choice was made to price the new unit at the point at which the new learning curve reaches the flattening out stage; a reference or discussion in the paper to explain and justify the method used to establish the learning curve estimate used for new models would have been helpful.

It is well known that in price index construction the choice of the base year will generally affect the values. Here, for aircraft and missiles, the base year is especially important. This is because high base year prices that occur for items produced early in their respective learning curves can, as noted by the authors on page 152, cause the base year prices to be exceptionally high on average and thus to overstate the constant dollar value of subsequent deliveries of the item. It would have been useful if the authors could have included, in addition to their verbal discussion, some calculations of how different these price indexes would have been if (1) a different base year has been chosen, or (2) a different method of handling the problem had been adopted.

For the ship construction category, the approach taken is to pick a particular physical design of a ship and use it as the specification to reprice over time at shipyards. The nature of the item does seem to warrant a somewhat different treatment than that employed for aircraft and missiles, which are produced in larger quantities of identical products. Nonetheless, more frequent change of ship design than that mentioned—10 years—would seem to be clearly desirable.

On the surface, the development of a price index for defense might be thought to entail special measurement problems and methodological issues only for those defense goods which have no counterpart in the civilian marketplace. Consequently, the authors' comparison in Section 3.4 of the IPD for selected DOD goods for which markets may be the same as for nondefense goods with what appears to be a corresponding PPI is very useful. (In fact, these comparisons are the major contribution of this paper, since the description of this new IPD series has been released elsewhere.)

For this purpose, the DOD price data are used to construct a Laspeyres index which is then compared to the PPI. Thus, the discrepancy caused by use of different index formulations is removed. It would also be interesting to see a comparison of the DOD Laspeyres index with the IPD, but the IPDs for the categories on which the DOD-PPI comparisons are made are not published separately in the BEA reports. (This raises the question of whether the DOD coverage for these categories is sufficient to make the comparisons undertaken in Section 3.4 statistically meaningful.)

Assuming that the indexes for these selected defense categories are statistically reliable, I would state their conclusion somewhat more strongly than they did—the DOD and PPI price series are quite different. Although they find one similar pair, namely, the DOD index for military construction and the PPI for construction, as they note, the DOD index is much more comprehensive, since the latter measures only the price of construction materials. Thus, these data provide no evidence that the DOD and PPI prices are the same for comparable categories.

Other categories of market goods they consider are three types of fuel, four types of citrus fruits, men's apparel and men's footwear, and hot rolled carbon plate. Only for one of these categories—that for men's footwear—do the two indexes show a nearly identical change over the 28 quarters for which the data are given (1972-I to 1978-IV), and even for that category one cannot say the indexes are similar, since some of the movements within that period are considerably different.

Prior to discussing sources of differences in the DOD and PPI indexes for specific categories, the authors note that the DOD measurement of prices as the average of many transactions over a quarter, and the measurement of prices for many categories of the PPI on the basis of prices on a single day of each month, provide a general source of discrepancies. Similarly, sources of discrepancies they note with respect to specific categories—for example, the exclusive use of spot prices in particular markets versus an average of types of transactions (spot and contract) in many geographic areas for the period of interest—are general issues in price measurement. Presumably, they have concluded that these sources of differences are important only for those categories where they are specifically noted, but a more unified framework for discussing sources of differences would help the assessment.

Other types of discrepancies noted by the authors arise from special aspects of DOD purchasing; an example of this is the requirement that DOD make certain purchases from noncompetitive suppliers, for example, the purchase of combat boots produced at federal prisons. An attempt to assess the quantitative importance of this factor would be useful.[2]

The final source of discrepancies they discuss from use of different weights for the two indexes. The authors cite an unpublished study by Allan Searle which found that substitution of PPI for DOD weights had an appreciable downward effect on the DOD indexes for clothing. Such a comparison would be useful here for other categories.

Notes

1. For a detailed discussion of problems in price measurement see, e.g., Triplett (1975).
2. If a large portion of expenditures on combat boots is in fact a subsidy to federal prisons, then that component might more appropriately be included elsewhere in the accounts. In any case, it is not clear that this should result in consistently higher price increases than faced for privately produced boots, even though the price level may be higher.

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