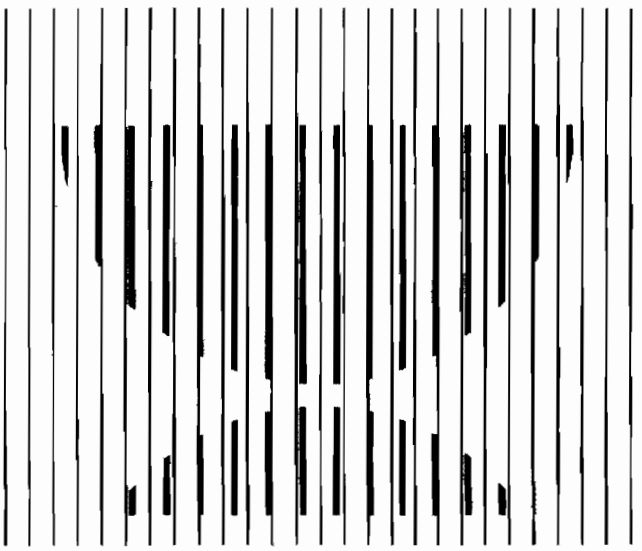
CBO STAFF MEMORANDUM

OPTIONS FOR FIGHTER AND
ATTACK AIRCRAFT:
COSTS AND CAPABILITIES

May 1993



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This year the Congress is debating the fate of fighter and attack aircraft in the Air Force and the Navy. Decisions about these planes will significantly affect both the cost and the capability of U.S. military forces. This Congressional Budget Office (CBO) Staff Memorandum addresses the affordability of fighter and attack aircraft under a base case that, where possible, is based on service statements made earlier this year about their plans for these planes. The memorandum also discusses the effects of alternative approaches to equipping the fighter and attack fleets.

The memorandum was prepared for submission as testimony requested by the Defense Subcommittee of the Senate Committee on Appropriations. Robert Hale is scheduled to deliver the testimony on May 12, 1993.

Lane Pierrot prepared the memorandum under the supervision of Robert Hale. Bill Myers performed the cost analyses. Geoff Cohen provided substantial assistance on various parts of the analysis. Michael O'Hanlon and Karen Ann Watkins also provided assistance. Paul L. Houts edited the memorandum, with editorial assistance from Christian Spoor, and Cindy Cleveland prepared it for distribution.

SUMMARY

The United States maintains a substantial fleet of fighter and attack aircraft in both the Air Force and the Navy. These planes are designed to engage enemy planes in the air and to attack targets on the ground.

The Clinton Administration will not submit its long-term plan for fighter and attack aircraft, or for other defense forces, until later this year or early next year. Nevertheless, the Administration's 1994 budget request earmarks $4 billion for developing the four aircraft--the Air Force's F-22, the Navy's F/A-18E/F, the Navy's A/FX, and the Air Force's Multirole Fighter--that are the focus of much of this memorandum.

Will funds be available when these planes are ready to be procured in the late 1990s and beyond? What alternative approaches to purchasing these aircraft might the Congress consider? This memorandum addresses those questions.

The Outlook for Affordability

Last year, the Congressional Budget Office (CBO) concluded that, given the plans of the Bush Administration, the four aircraft programs would be affordable only under optimistic assumptions about unit costs and the size of future budgets. Press reports suggest, however, that the services--and particularly the Navy--are considering sharp reductions in forces and modernization programs. These changes would make the four aircraft programs affordable under more plausible assumptions.

It would be highly premature, however, to say that the issue of cost is a worry of the past. Difficulties may remain depending on final decisions about aircraft programs and other forces, particularly those of the Navy. Reductions in the defense budget beyond those proposed by the Clinton Administration, even if made later this decade, would also darken the outlook for affordability.

Options that Reduce Costs

The Department of Defense (DoD) is currently debating alternatives that could significantly affect both the cost and the capability of fighter and attack planes. This memorandum analyzes a base case that represents apparent service plans from several months ago and three alternatives designed to illustrate approaches that DoD might pursue. (See Summary Table for costs and capabilities of the base case and alternatives.)

Option 1 would focus on buying the F-22 and F/A-18 aircraft. As the services have proposed, this alternative would also develop a new aircraft--the Joint Attack Fighter (JAF)--that would eventually be bought instead of the A/FX and the Multirole Fighter (MRF). This alternative seems most consistent with service preferences, which have accorded highest priority to purchase of the F-22 and the F/A-18E/F.

Option 1 would reduce costs over the next few years, but not long-term costs. Moreover, under Option 1, the Navy would not have a medium-attack aircraft with advanced stealth characteristics. (Stealth characteristics permit

SUMMARY TABLE

Alternative	Types of Planes Purchased: Air Force	Types of Planes Purchased: Navy	Average Annual Costs or Savings Under Options (Billions of 1994 Dollars): 1994-1999	Average Annual Costs or Savings Under Options (Billions of 1994 Dollars): 2000-2015	Average Fleet Age in 2015 (Years): Air Force	Average Fleet Age in 2015 (Years): Navy
Base Case	F-22, MRF, A/FX	F/A-18E/F, A/FX	7.6[a]	10.1[a]	19	14
Option 1: Focus on Near-Term	F-22 JAF	F/A-18E/F JAF	-1.0	0.1	19	14
Option 2: Cancel F-22 Program	MRF A/FX	F/A-18E/F A/FX	-2.3	-3.0	26	14
Option 3: Employ Silver Bullet Approach	F-22 (fewer) MRF A/FX	F/A-18C/D A/FX (sooner)	-1.3	-2.6	25	13

SOURCE: Congressional Budget Office.

NOTE: Minus signs indicate savings.

a. For the base case, figures represent total costs rather than savings

aircraft to avoid detection by enemy radars and other sensors.) The United States would therefore depend heavily on land-based aircraft for this capability, which would limit the flexibility of U.S. forces.

To achieve large savings, especially in the near term, a major program, such as the Air Force's F-22, would have to be canceled, which is what Option 2 assumes. The result would be a substantially older fleet of Air Force fighter and attack planes that would leave the service without a fighter with advanced stealth characteristics. The absence of this capability may, however, be judged acceptable given reduced security threats, and the greater emphasis on attack rather than fighter missions, associated with the end of the Cold War.

A third approach, the "silver bullet" strategy, buys both of the most capable aircraft -- the F-22 and the A/FX -- but only in small numbers. The majority of the fleet would be equipped with less capable and cheaper aircraft, including the C/D version of the F/A-18 in the Navy and the Multirole Fighter in the Air Force.

The silver bullet approach garners budgetary savings over the next few years that fall in between those of the other two options. The approach would produce substantial savings over the long term. Substantial portions of the fleet would be equipped with relatively less capable planes under Option 3. But the option would provide the Navy with a small number of medium-attack aircraft that have advanced stealth characteristics, thereby preserving more flexibility in U.S. forces.

KEY MISSIONS AND TYPES OF AIRCRAFT

Over the next two decades, the Air Force and the Navy may buy four new or modified aircraft to modernize the U.S. fleet--the F-22, the F/A-18E/F, the A/FX, and the MRF. (A fifth possible plane, the JAF, has recently been proposed and is discussed below in the section on alternatives.) Those planes would perform two key missions:

- o Fighter missions--engaging enemy planes in the air; and
- o Attack missions--attacking targets on the ground. The mission of attacking ground targets at relatively long distances is termed medium attack.

F-22 Fighter Aircraft

The first of the four planes the Department of Defense may buy is the Air Force's new F-22 fighter. The F-22 would replace the Air Force's current top-of-the-line fighter, the F-15 (see Table 1). F-22s are designed to have

TABLE 1. NEW AND MODIFIED AIRCRAFT

New Aircraft	Mission	Older Aircraft That the New Plane Will Replace	When New Plane Enters Production Under the Base Case
F-22	Fighter	F-15	1997
F/A-18E/F	Multirole	Earlier models of the F/A-18, interim replacement for the A-6 and some F-14s	1997
A/FX	Medium Attack	A-6, F-15E, F-111	2007
MRF	Multirole	F-16	2010

SOURCE: Congressional Budget Office.

"stealthy" characteristics--that is, to be much less visible than current aircraft to radar and other detectors. They would also fly at high speed without using an afterburner and would offer other improvements. According to current Air Force estimates, each will cost more than $80 million in today's dollars, making them a high-price item, particularly in a time of shrinking budgets.

F/A-18E/F Multirole Aircraft

The F/A-18E/F is a significantly modified version of the Navy's F/A-18 aircraft, a plane that can carry out both the fighter and attack missions. Compared with the current model of the F/A-18, the E/F will be able to fly farther, have higher thrust engines, and be better able to survive in combat.

The new version of the F/A-18 is likely to become a mainstay of the Navy's fleet, providing a replacement for the A-6 aircraft until the A/FX comes on line. It may also supersede some older F/A-18 models, as well as some portion of the F-14 fleet. According to Navy procurement estimates, the E/F version could cost almost $60 million apiece, an increase of about 40 percent compared with the cost of the current F/A-18.

A/FX Medium-Attack Aircraft

The A/FX is an attack aircraft that is expected to have stealthy characteristics and to be capable of carrying large numbers of a variety of weapons over relatively long distances. Although primarily a medium-attack aircraft, the A/FX may also have some capability as a fighter. Last year, the Navy estimated that each A/FX would cost about $115 million. The Navy has revised these numbers and now estimates that the A/FX will cost about $90 million each.

Multirole Fighter

Two years ago, the Air Force announced plans to develop a new multirole fighter. According to the Air Force, no definite plans are available for this plane, which might not be deployed until 2012. At that time, the MRF will replace today's F-16 aircraft and will provide both attack and fighter capability. According to statements last year, the Air Force hoped to hold down the cost of the MRF to no more than $35 million apiece, which argued for altering an existing plane, though the timing of this program would have made that difficult.

BASE-CASE ASSUMPTIONS ABOUT MODERNIZATION AND FORCE SIZE

The Clinton Administration's detailed plans for tactical aircraft and other defense forces will not be available until later this year or early next year. In the meantime, the Congress must begin to act on the 1994 defense budget request. That request includes about $4 billion in funding to develop the four new or modified aircraft described above, two of which may not enter production for more than 10 years. To assess the long-term affordability of these planes, CBO made base-case assumptions about the size of future forces and plans for modernization. Where possible, the assumptions represent statements by the services about their possible plans as of early this year.

At the beginning of 1993, neither DoD nor the services had indicated that they would terminate any of the four programs. Indeed, the 1994 budget provides funding for developing all four, though funding for the most speculative of the programs--the MRF--is quite modest. In its base case, therefore, CBO assumes that the services will eventually buy them all.

The base case also assumes that the planes are purchased at rates similar to those planned last year. For example, procurement rates reach as high as 48 aircraft per year for the F-22, 72 for the F/A-18E/F, and 18 for the A/FX (see Table A-1 in Appendix A for details).

In contrast to last year's plan, the base case does assume significant delays in some programs. For example, the A/FX aircraft would enter production later (2007 compared with 2001 in last year's plan) as would the MRF aircraft (2010 compared with 2002). Table 1 and Table A-1 show CBO's assumptions about timing.

This analysis focuses on procurement costs, but numbers of units are relevant in assessing both capability and the ability of procurement plans in the base case to meet numerical requirements for aircraft. Although no specifics have been proposed, the new Administration has stated that it will reduce the overall size of the U.S. military below the level proposed by the Bush Administration.

Under the base case, therefore, CBO assumes that the Air Force maintains only 21 wings of tactical aircraft compared with the 26 wings envisioned by the Bush Administration. A reduction below the Bush Administration's plan is consistent with service proposals in the 1994 budget request, which reduced the number of wings below the Bush level. Air wings in the Department of the Navy, which were not reduced in the 1994 request, are assumed to remain at 13, the same level planned by the Bush Administra-

tion. To be consistent with possible Navy plans, however, CBO does assume that the number of aircraft in each Navy wing will be reduced. (Tables A-2 and A-3 in Appendix A provide more detailed assumptions about the numbers and composition of forces.)

MEETING NUMERICAL REQUIREMENTS

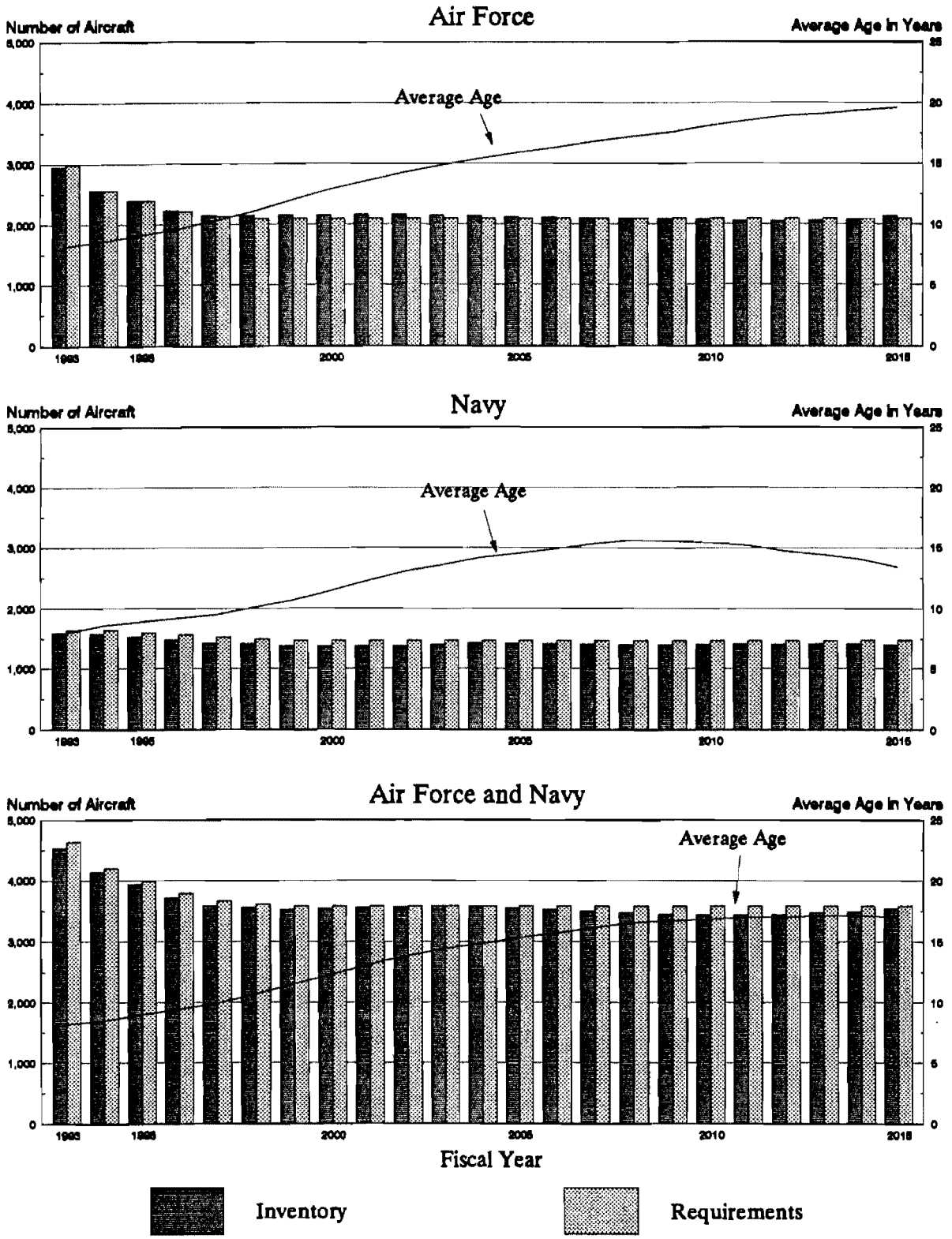
Under these base-case assumptions, the Air Force and Navy can meet or exceed their numerical needs for aircraft if they are willing to keep aircraft in their fleets for many more years than in the past. CBO bases this conclusion on projections of requirements and inventories through 2015, a period long enough to reflect the effects of the planned purchases of the four aircraft (see Figure 1).

These projections are based on several assumptions about when planes are retired (see Appendix B for a discussion of assumptions about planned service lives and rates of use; Table B-1 contains the assumptions). If the number of aircraft of a particular mission area exceeds requirements, then planes are assumed to be retired before their engineering service lives expire. But if retiring aircraft at the end of their service lives would leave a particular mission area short of its required aircraft, then planes are assumed to be kept in service longer. Shortfalls occur only when no planes are being bought for a particular mission area and peacetime accidents reduce inventories below requirements.

The Air Force fleet of fighter and attack aircraft would get much older in terms of chronological age based on these assumptions. The modest deliveries of new aircraft result in an average age that more than doubles, from about 9 years in 1994 to almost 20 in 2015, despite scheduling early retirement for large numbers of surplus aircraft.

Although chronological age may be useful as a measure of technological obsolescence, flight hours are a better gauge of wear and tear. By that measure, the Air Force is in pretty good shape through the end of the 1990s. During the first half of the decade, however, the Air Force would need to retain about 5 percent of its aircraft beyond their planned service lives measured in terms of flight hours. Percentages retained would rise rapidly toward the end of the period of analysis; by 2015, about 23 percent of Air Force planes would exceed their service lives (see Figure A-1 in Appendix A).

Figure 1. Inventory, Requirements, and Average Age Under Base Case



SOURCE: Congressional Budget Office projections based on Department of Defense, Air Force, and Navy data.

The Navy would experience major problems sooner under the plan in the base case. Navy inventories just meet or fall slightly below requirements. In terms of chronological age, the Navy's fleet would actually age more modestly than that of the Air Force, reaching an average of more than 15 years in 2010, compared with about 9 years today. The age of the Navy's fleet would then decline; by 2015, it would average only about 14 years. However, by the start of the next decade, about 12 percent of the Navy's aircraft would exceed their planned service lives when measured by flight hours. That figure rises to almost 50 percent by 2010, though it declines to almost a third by 2015 as A/FXs and F/A-18s enter the fleet simultaneously.

Older Fleets Pose Problems

Are aging fleets a problem? Under the base case, aircraft would be retained in the inventories well into their twenties and thirties. In the past, both the Air Force and Navy have expressed concerns about holding aircraft that long. They argue that accumulated stresses on wings and other parts might limit the utility of the aircraft, maintenance costs might rise, and older planes might not be sufficiently capable in the face of enemy threats.

These ages are also outside the range of historical experience. Indeed, average ages under the base case are higher than the services have experienced during the entire history of tactical aviation using jet aircraft.

Older Fleets May Be Acceptable

However, older fleets may now be more acceptable for a number of reasons. After the breakup of the Soviet Union, other countries are unlikely to develop aircraft that have capability significantly better than today's U.S. planes.

Maintenance problems, which are more closely linked to the number of hours flown than to chronological age, might be avoided if reduced threats to U.S. security permit the services to fly their aircraft for fewer hours each year. For example, reducing annual flying hours for the Navy's fleet by one-third would reduce the number of aircraft that would need to be retained beyond normal retirement age to only about 13 percent of the fleet in 2015, compared with 30 percent at standard operating levels.

Unfortunately, reducing operating levels would shorten the time pilots have to practice, despite the advantages for aircraft inventories. Moreover, reducing pilots' training would also reduce their skills and might lower morale. Yet such reductions might be tolerable if the United States has sufficient

warning time before a major war, and thus time to train, or if simulators can be used to reduce training needs.

The Air Force, which has many more planes than it needs in the near term, might also be able to store some of the excess planes and bring them out later when inventories are tight. Of course, storage expenses could add to operating costs. The changes might, however, make an older fleet acceptable and thus reduce procurement costs.

Finally, if the services attempt to hold down the age of their fleets, they will fall short of their requirements. For example, the Air Force could fall short of its aircraft requirements by almost 400 planes--about 20 percent--in 2015 if it retires aircraft when they reach their planned service lives (see Figure A-2 in Appendix A). The Navy would have an even bigger problem. It might meet only two-thirds of its requirements in 2015 if it retired aircraft at the end of their planned service lives. Plus the Navy would begin experiencing large shortages around the middle of the next decade.

CAPABILITY OF TACTICAL AIRCRAFT

Even as forces get older and smaller, the capability of U.S. tactical aircraft is likely to be overwhelmingly superior to that of some selected regional powers for some time. For example, by the year 2000, U.S. forces would have been reduced to the levels assumed in the base-case plan. Even so, U.S. tactical aircraft would still have about 4 times the capability of the current Chinese forces, more than 15 times the capability of the forces of North Korea and post-war Iraq, and more than 40 times Cuban forces (see Figure A-3 in Appendix A).

U.S. tactical aircraft are also superior, though by much smaller margins, to Russian forces. U.S. forces exceed Russia's capability by about 30 percent. These estimates assume that Russia has all the forces it is allowed under the limits of the Conventional Forces in Europe (CFE) Treaty now in effect. The estimates do not lower the capability of Russian forces to account for any damage done to them now, despite press reports indicating that Russia may not be paying to maintain many of its weapons stocks. Thus, from the U.S. perspective, these estimates represent a worst-case assessment.

The comparisons are based on a scoring method (called the TASCFORM method) that was developed for the Department of Defense by The Analytic Sciences Corporation. The method takes into account both the quantity and quality of weapons. U.S. scores reflect contributions of both Air Force and Navy aircraft but do not assume any contributions from allies. The version

of the TASCFORM method used in this analysis does not address important factors that could affect the outcome of a war, including training and logistics support. All such scoring methods ignore specific wartime scenarios, tactics, terrain, and luck. Some of these factors, particularly training, could add to the U.S. advantage.

The overwhelming superiority U.S. forces enjoy does not necessarily mean that the forces in the base-case plan would be too large or too modern. The United States may want overwhelming superiority in order to minimize casualties in a future war. It may also want the capability to fight in one major regional contingency, such as an Operation Desert Storm, while maintaining a reserve of forces to deter war or to fight in other regions.

Moreover, the comparisons in this memorandum are based on the current capability of selected regional powers. If those nations modernize their tactical air forces by buying foreign-made planes, this country may need to respond with a modernization plan of its own to maintain its dominance.

The comparisons do suggest, however, that the United States possesses a substantial margin of superiority in tactical air capability. If it chooses, the country can take time to assess carefully its plan for modernizing tactical air forces.

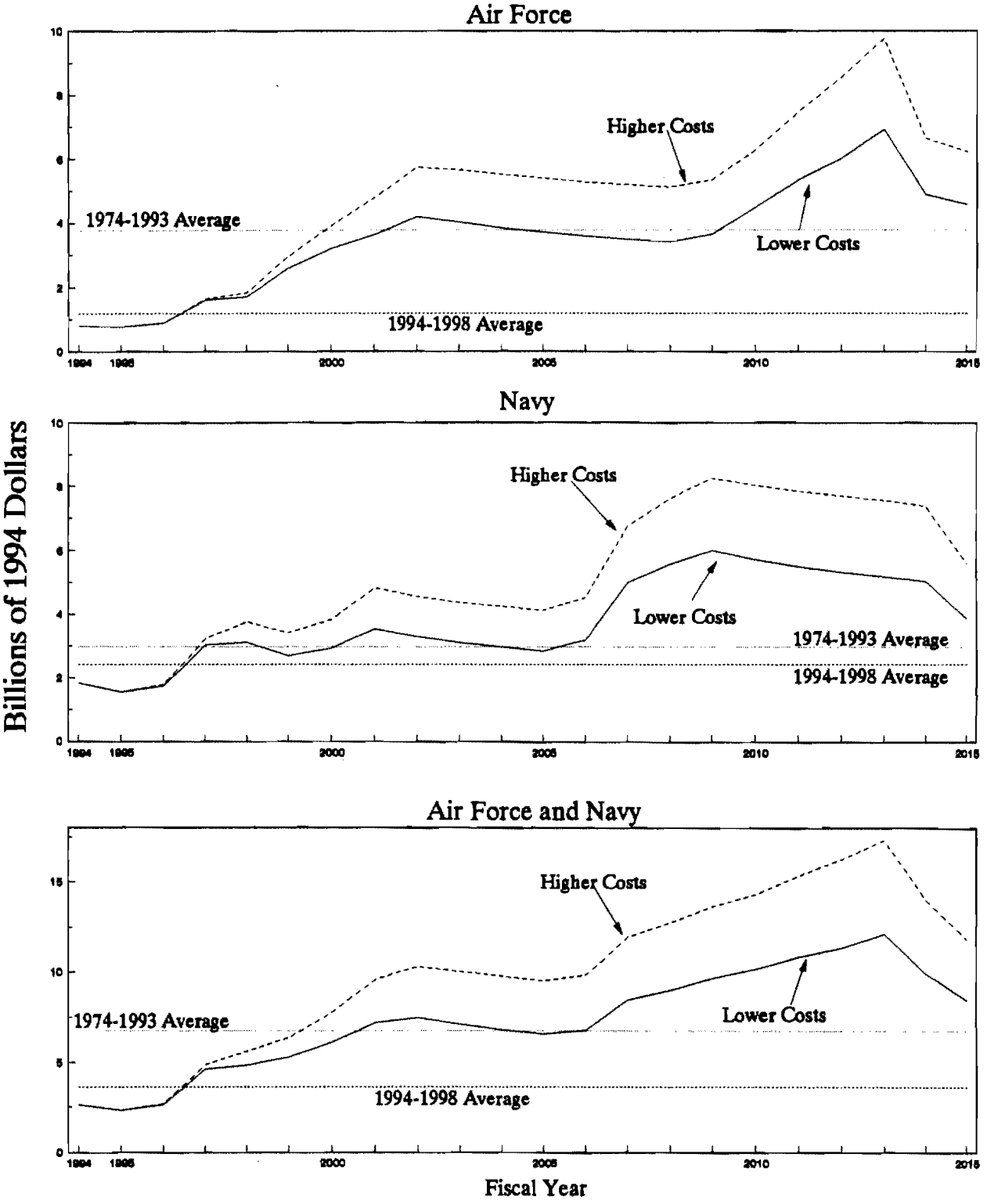
HOW AFFORDABLE IS THE BASE-CASE PLAN?

The affordability of the procurement costs associated with the illustrative plan is one factor that must enter that assessment.

Sharp Increases in Procurement Funding

To assess affordability, CBO made two estimates of the procurement funding required to purchase the aircraft in the base-case plan. The lower estimate generally relies on the services' projections of the unit cost of new aircraft (see Table A-5 in Appendix A). Under this lower estimate, the Air Force and Navy together would require procurement budgets for tactical aircraft averaging $8.6 billion a year during the 2000-2015 period, the years of CBO's projections (see Figure 2). Average required funding would be about four times the approved funding for 1993. (All costs in this memorandum are in constant 1994 dollars and include only the cost of purchasing major aircraft.)

Figure 2. Projected Procurement Funding for Fighter and Attack Aircraft Compared with Historical Levels



SOURCE: Congressional Budget Office projections based on Department of Defense, Air Force, and Navy data.

At the end of the next decade, procurement funding could balloon to as much as about $12 billion a year under the lower estimate. This bulge in funding reflects plans to buy all four of these expensive aircraft (F/A-18E/F, F-22, A/FX, and MRF) at the same time.

Moreover, procurement funding could be substantially higher than that under the lower estimate. In the past, unit costs of aircraft have risen from one generation to the next. For example, the first model of the F-15, the A/B model, cost three times more than its predecessor, the F-4. Applying this ratio to the cost of the F-15 suggests that the F-22 could grow in cost to $115 million, about 40 percent higher than the Air Force estimate. The higher estimate of costs in this memorandum anticipates growth in costs at roughly this rate (see Table A-4 in Appendix A). Growth of this magnitude is also roughly consistent with estimates of historical cost growth from design to production.

Under the higher estimate, procurement funding between 2000 and 2015 would average $12.1 billion a year, almost six times the 1993 level. Funding in this estimate could rise to more than $17 billion a year toward the end of the period.

Required Funds Exceed Historical Shares

Would enough money be available to procure these aircraft? The answer is no, if the total defense budget remains at planned levels and aircraft procurement receives its long-term share of that budget.

This analysis assumes that, through 2015, the total defense budget remains constant in real terms at the level now planned by the new Administration for 1998. It also assumes that procurement of tactical aircraft receives the same average share of the total budget as it received between 1974 and 1993. Available funds would then equal $6.7 billion a year between 2000 and 2015. That amount would be $1.9 billion a year short of the funding required under the lower estimate, and $5.4 billion less than required funding under the higher estimate. Shortfalls would be larger in the Navy and smaller in the Air Force (see Figure 2).

Using budgetary shares may be a reasonable first step in assessing affordability. Under the base case, tactical aircraft would require high levels of funding for a sustained period. Budgetary shares calculated over a long period should suggest the feasibility of such funding. Indeed, it may have been this type of analysis that led the Chairman of the Joint Chiefs of Staff to conclude, in his February 1993 report on roles and missions, that the

"acquisition plan for major aviation programs would require more resources than might be available."[1]

New Plans May Improve the Outlook for Affordability

The four aircraft programs would be affordable, however, if the share of funds devoted to the programs rose substantially above its average in the 1974-1993 period. For example, doubling that share would make enough funds available to finance all the base-case plans even under the higher estimate of costs in this analysis. Changes in defense plans now being considered may make such increases realistic, a departure from the situation just a year or so ago.

In December 1991, when CBO projected funding requirements for all the services, the share for tactical aircraft seemed unlikely to rise significantly.[2] At that time, each of the services had long-term plans that, by the early part of the next decade, would have required increases in funding. Plans in 1991 also called for deploying an extensive system of missile defenses beginning early in the next decade, a program funded outside the budgets of the services.

Defense plans may now be changing in significant ways. The Clinton Administration has indicated that it will scale back its deployment of missile defenses. Funding for that program was cut sharply in 1994 compared with the level proposed by the Bush Administration. Although CBO has not projected Army and Air Force funding requirements under likely plans, those services have also curtailed programs in ways that will reduce their budgetary needs.

Perhaps most important, press reports and service statements indicate that the Navy--which in 1991 had the largest requirement for funding increases among all the services--is considering substantial changes in its force and modernization plans. The Navy is contemplating a cut in its ship fleet of 27 percent, from 450 ships under the Bush Administration's plan of 1991 to about 330 ships. This cutback would delay the need to buy large numbers of expensive ships such as attack submarines and surface combatants until around 2010. In addition, the Navy has apparently canceled plans to modernize most of the other aircraft it operates, including P-3, S-3, E-2C, and EA-6B aircraft.

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1. Chairman of the Joint Chiefs of Staff, "Report on Roles, Missions, and Functions of the Armed Forces of the United States" (February 1993).

2. Congressional Budget Office, "Fiscal Implications of Administration's Proposed Base Force," CBO Staff Memorandum (December 1991).

CBO's analysis of this possible Navy plan suggests that, if the Navy retains its planned share of the Clinton Administration's budget, substantial funds could be transferred from procurement of Navy ships and supporting aircraft to fighter and attack planes.[3] In terms of funding, the year 2000 would mark the beginning of the "decade of tacair."

With these transfers, the Navy could finance the base-case plans for procuring its fighter and attack aircraft without a budget increase beyond the level expected in 1998. This finding holds through the middle of the next decade, even under the higher-cost case that assumes increases in the unit costs of ships and aircraft above planned levels. Since most of the growth in funding required to pay for the four planes in this memorandum is for Navy aircraft, this result would make the whole package more affordable.

Problems of cost would also be eased if the overall defense budget grows in real terms above the Administration's planned level in 1998. It may be reasonable to assume some growth given the relatively long period of this assessment. CBO's long-term projections assume that U.S. gross domestic product (GDP) will grow by an average of 2 percent or so a year over long periods. If the defense budget maintains the share of GDP planned for 1998, rather than experiencing the decline that would be associated with constant defense budgets, many problems of affordability would vanish or be eased.

Less Optimistic Assumptions Suggest Potential Problems

Unfortunately, it is too soon to conclude that affordability is a problem of the past.

Plans Remain Uncertain. The new defense plans that could ease concerns about affordability are still under discussion. Indeed, the Department of Defense is just beginning its "Bottom-Up Review" of military forces and weapon programs. The outcome of that review could be influenced by changes in security threats as well as a reluctance on the part of services to countenance large cuts in forces. If, for example, the Defense Department were to recommend maintaining naval forces near their current level, rather than sharply reducing the size of the fleet, concerns about affordability would remain. The Congress could also alter plans in ways that add to costs.

Changes in plans for weapon systems other than fighter and attack aircraft could also cause problems. For example, the Navy apparently plans not to replace many types of its supporting aircraft, at least not until after

3. Congressional Budget Office. "The Long-Term Costs of Naval Forces." CBO Staff Memorandum (May 1993).

2010. Some of those aircraft--for example, some P-3 and S-3 antisubmarine warfare aircraft--could approach 40 or more years in age toward the end of the next decade. If the Navy decided that those venerable ages were not acceptable, and instituted expensive programs to replace or modernize the aircraft, funding problems would be more severe.

The Funding Bulge. Even without changes in plans that add to costs, CBO's analysis suggests that a bulge in defense funding needs might develop under the base case beyond 2005. By that time, all four aircraft in this analysis would be in procurement. Even if it reduces the size of its ship fleet, by then the Navy would need to begin buying substantial numbers of submarines and surface combatants, and needs for funds for the Army and Air Force could increase as well. The real levels of defense spending now planned for the late 1990s might not be adequate to fund all of these programs.

The year 2005 is, of course, a long way off. Between now and then, growth in GDP may allow more money to be devoted to defense. Further reductions in security threats may also permit the United States to maintain smaller forces than those now planned.

However, this funding bulge, though far in the future, is largely a result of the four aircraft programs that will be debated in 1994--programs that will consume $4 billion in 1994 development funds. It may therefore be reasonable to keep this bulge in mind, even though it would not occur for many years.

An Earlier Funding Bulge. Moreover, this funding bulge could arrive sooner if, for example, procurement of the A/FX started earlier. Under base-case plans, the A/FX aircraft would enter procurement in 2007. Measured from the beginning of development of the A-12 aircraft (the A/FX's canceled predecessor), the A/FX development period would span about 20 years, an unprecedented length for a fighter. A/FX procurement might be accelerated if the requirement for a stealthy, medium-attack aircraft were deemed critical. If so, earlier procurement could move up the funding bulge. For example, if the A/FX entered production in 2003 and production reached 18 aircraft per year by 2005, funding would increase by $3 billion in 2005 under the higher-cost case.

The funding bulge would be larger still if the Navy decided to increase the planned purchases of F/A-18E/F aircraft in order to offset aging in its forces. Expensive modification programs could also increase costs during the early part of the next decade. The Navy currently plans to modify and extend the life of the Marine Corps' short-range bomber, the AV-8B, at a potential unit cost of about $35 million. (This figure represents the funding requested

in 1994, the first year of procurement for the modification program. As a result of increasing efficiencies related to learning during the production process, average costs of later models may be lower.) Funds for this modification program are not included in the costs of major aircraft procurement, but they might add to that funding.

Additional Budget Cuts. Problems of affordability could reappear quickly if the defense budget undergoes cuts beyond those already announced by the Clinton Administration. The fiscal program recommended by the new Administration would make a substantial contribution toward reducing the U.S. deficit, but it is not sufficient to solve the long-run deficit problem.[4] An additional package of policy changes aimed at reducing the deficit would be necessary to eliminate the problem. Such a package might include a substantial additional cut in defense spending. Unless such a cut was fully accommodated by additional reductions in forces, the problems of affordability for tactical aircraft and other defense procurement programs could again become severe.

ALTERNATIVE APPROACHES TO MODERNIZING TACTICAL AIRCRAFT

If the issue of cost remains, the Congress could examine other strategies to reduce costs. Moreover, even if all four aircraft programs are affordable, the Administration and the Congress must be sure that each one is needed to meet U.S. security requirements. Three alternatives are consistent with differing assumptions about what aircraft are needed and how much funding is likely to be available.

Option 1: Focus on Near-Term Programs

The first option would not change plans for the F-22 fighter and the F/A-18 E/F, the two aircraft expected to enter procurement in the 1990s. (See Table 2 for a list of the planes bought under the base case and alternatives.) Plans for the other two aircraft, the A/FX and Multirole Fighter, would be restructured to reduce costs.

Specifically, Option 1 assumes that plans for developing and procuring the F/A-18E/F and the fighter version of the F-22 are identical to those in the base case. But a new plane--the Joint Attack Fighter--is assumed to be

4. Congressional Budget Office, "An Analysis of the President's February Budgetary Proposals," CBO Paper (March 1993).

developed, as the services have proposed, to replace the Navy's carrier-based A/FX and the Air Force's Multirole Fighter. CBO assumes that the Navy and the Air Force would buy the JAF in numbers that match their purchases of the A/FX and the Multirole Fighter (see Table A-5 for more details).

The services have indicated that the JAF is expected to have a unit "flyaway" cost of between $40 million and $45 million. Its unit cost for procurement, including some support costs not in the flyaway figure, is assumed to be about $60 million.

Option 1 also assumes that the Air Force will develop a variation of the F-22 to meet the medium-attack requirements that, under the base case, were met by Air Force purchases of the A/FX. F-22s for the medium-attack mission are assumed to be purchased on the same schedule as Air Force purchases of the A/FX.

TABLE 2. TYPES OF PLANES PURCHASED UNDER BASE CASE AND OPTIONS

		Options		
	Base Case	Focus on Near Term	Cancel F-22 Program	Employ Silver Bullet Approach
Navy				
Medium attack	A/FX	JAF	A/FX	A/FX (sooner)
Multirole	F/A-18E/F	F/A-18E/F	F/A-18E/F	F/A-18C/D
Air Force				
Fighter	F-22	F-22	MRF	F-22 (a few)
Multirole	MRF	JAF	MRF	MRF
Medium attack	A/FX	F-22 (variation)	A/FX	A/FX

SOURCE: Congressional Budget Office.

NOTES: A/FX is a medium-attack aircraft with advanced stealth characteristics. F/A-18E/F is a multirole plane, an improved version of the F/A-18. F/A-18C/D is the existing version of the F/A-18. F-22 is a fighter aircraft with advanced stealth characteristics. MRF is the Multirole Fighter. JAF is the Joint Attack Fighter.

Option 1, with its focus on procuring the F-22 and F/A-18E/F, may reflect the preferences of the two military services. Senior service officials have stated that these two programs enjoy the highest priorities among all programs to modernize aircraft.

Costs. How would Option 1 affect costs? For simplicity, the analysis of the cost of options in this memorandum focuses only on the lower estimate, which relies on service estimates of the unit cost to procure new planes. In contrast to analysis in previous sections, both development and procurement costs are estimated, since each would be altered under the options. Average annual costs are estimated for the 1994-1999 and 2000-2015 periods.

During the 1994-1999 period, savings under Option 1 could be substantial, principally because of reductions in development costs. Total savings during the period might average about $1.0 billion a year, slightly less than one seventh of the approximately $7.6 billion that would be required under the base case to develop and procure all four planes (see Table 3).

TABLE 3. AVERAGE ANNUAL SAVINGS AND COSTS UNDER OPTIONS ASSUMING LOWER ESTIMATES (In billions of dollars)

	1994-1999			2000-2015		
	Development	Procurement	Total	Development	Procurement	Total
Base Case	3.9[a]	3.7[a]	7.6[a]	1.5[a]	8.6[a]	10.1[a]
Savings Under						
Option 1 -- Focus on Near Term	-1.0	0	-1.0	-0.2	0.3	0.1
Option 2 -- Cancel F-22 Program	-1.7	-0.6	-2.3	b	-3.0	-3.0
Option 3 -- Employ Silver Bullet Approach	-0.4	-1.0	-1.3	-0.1	-2.5	-2.6

SOURCE: Congressional Budget Office.

NOTE: Minus signs indicate savings.

a. For base case, figures represent total costs rather than savings.

b. Less than $50 million.

These savings stem primarily from CBO's assumption that development costs for the JAF would be only about two-thirds as much as the combined cost to develop the A/FX and MRF.

In the longer term, however, this option would add slightly to costs. Compared with the base case, additional funding for development and procurement during the 2000-2015 period would average $0.1 billion a year. The JAF is expected to be cheaper than the A/FX, which produces some savings. But 70 percent of the JAFs would substitute for Multirole Fighters, and the JAF is expected to cost substantially more than they do. Moreover, CBO assumed that the medium-attack variation of the F-22 would cost 30 percent more than the basic fighter version. This assumption is consistent with the added costs to procure an attack version of the Air Force's existing F-15. CBO also assumed that the Air Force would incur additional costs to develop the medium-attack version of the F-22, as has been the case with earlier programs.

Option 1 could eventually lead to even higher long-term costs than these estimates. The JAF would not enter procurement for many years. That long delay offers many chances for the JAF program to be split again, perhaps back into programs similar to the A/FX and the Multirole Fighter. Thus, the taxpayer could eventually end up paying for two programs rather than one.

Capability. By one measure of capability, the age of aircraft, there is no change from the base case under this option. Although the kinds of aircraft change under this option, the number and timing of planned buys remain the same as in the base case. The age of the Air Force and Navy fleets would therefore be the same under this option and the base case (see Table A-6 in Appendix A for details).

Option 1, however, would leave the Navy without a stealthy, medium-attack aircraft--that is, a plane that could fly relatively long-range bombing missions over hostile territory with a high chance of surviving enemy defenses. The F/A-18E/F could not perform this mission, in part because it lacks the most advanced stealth technology. The JAF, which would replace both the A/FX and Multirole Fighter, would probably have to be relatively small and agile in order to carry out the fighter mission. Yet aircraft that fly long distances and carry substantial payloads are typically large. So the JAF might have ranges that are substantially shorter than the A/FX, and perhaps shorter than the F/A-18E/F.

The absence of a capable medium-attack plane may be consistent with the Navy's current decision about its roles and missions. The Navy has

recently placed increased emphasis on assisting the Marine Corps in amphibious operations, which generally take place close to shore.

Moreover, by 1999, the Navy intends to retire all of its A-6 aircraft, the plane that currently carries out the medium-attack mission. Under the base case, procurement of the A/FX, which would replace the A-6, does not begin until 2007. Hence, the Navy would be without a capable medium-range bomber for most of the next decade. The Air Force would presumably pick up this mission using aircraft such as the F-111, F-15E, and F-117, and eventually the medium-attack variation of the F-22. The service could also use bombers such as the B-1, B-2, or B-52. If the United States can rely on the Air Force to carry out the medium-attack mission for a decade, it may be able to rely on that service permanently.

Nonetheless, replacing the A/FX with a JAF involves important disadvantages. Carriers may need to stay well out to sea in order to remain beyond the range of shore-based missiles. Without a capable medium-attack plane, carriers could only influence events relatively close to shore, which calls into question the wisdom of maintaining a large carrier fleet. Indeed, the Chairman of the House Armed Services Committee recently warned that, if the Navy terminates the A/FX program, support for carriers would be diminished.

Perhaps more important, if the JAF is substituted for the A/FX, the United States would not be developing any new carrier-capable aircraft that is dedicated primarily to the medium-attack mission and has advanced stealth characteristics. Yet surface-to-air missiles (SAMs), which are relatively inexpensive, can be bought by regional powers in large numbers and may become even more lethal in the years to come. Advanced stealth capability may be required to survive attacks by these SAMs. This option may therefore represent a decision to rely primarily on land-based aircraft to carry out relatively long-range bombing raids over enemy territory that is well defended. Such a decision would somewhat limit the flexibility of U.S. forces since land-based aircraft must have bases from which to operate.

Option 2: Cancel the F-22 Program

Whatever its advantages and disadvantages, Option 1 would not reduce long-term costs. If large reductions are to be achieved, one or more aircraft programs must be canceled. Some analysts might favor canceling the F-22. The F-22 aircraft was developed to counter the highly capable air forces of the former Soviet Union. According to its critics, the added capabilities it provides are both unnecessary and too expensive for the sorts of regional

conflicts the United States is now likely to confront. Indeed, the analysis of capabilities presented earlier suggests that the capability of U.S. fighter forces substantially exceeds that of most regional powers. The speed with which U.S. fighter forces prevailed over Iraq in the Persian Gulf War supports that analysis.

Critics of the F-22 fighter also argue that attack aircraft, such as the A/FX, would be more useful in future conflicts than fighters. Also, even if F-22s end up costing only $80 million each, which may be optimistic, the plane is likely to lead to "sticker shock" among many taxpayers.

Because it is expensive and enters production relatively soon, canceling the F-22 would produce the largest savings of any of the alternatives. Cancelation would save an average of $2.3 billion a year during the 1994-1999 period, reflecting reductions in both development and procurement costs. Savings during that period are more than twice those under Option 1. Long-term savings are also substantial. During the 2000-2015 period, canceling the F-22 would reduce annual funding by an average of about $3 billion, or 30 percent.

Canceling the F-22 program, however, would mean that only one new fighter or attack aircraft--the F/A-18--would be produced in the United States throughout the 1990s and well into the next decade. Moreover, this plane would not have the most advanced stealth technology. U.S. capability to respond to increases in security threats by producing more aircraft, particularly stealthy aircraft, might therefore be limited.

The Air Force fleet of fighter and attack planes would also age sharply if no F-22 aircraft are purchased. By 2015, the fleet would have an average age of about 26 years, compared with about 20 years under the base case. Another measure, the portion of the fleet retained beyond its planned service life, also suggests rapid aging. If the Air Force keeps enough aircraft to equip 21 tactical fighter wings, then under this option about 47 percent of the Air Force fleet would be retained beyond its planned service life by 2015. Under the base case, that figure is only 22 percent.

This older fleet would lack many advantages the Air Force views as crucial. The Air Force argues that advanced fighters are needed to secure the skies above enemy territory, making attack missions feasible. The current generation of U.S. fighters, which does not have the stealthy characteristics that would be a key part of the F-22 design, are vulnerable to attack by surface-to-air missiles. Since fighters must fly over enemy territory to engage enemy aircraft, more numerous and lethal SAMs place fighters at risk unless they are stealthy.

The Air Force also believes that a number of other countries may procure aircraft that are as capable as those in today's U.S. fleet. Although these enemy planes would be deployed in small quantities, the United States may need a more capable fighter to maintain superiority in one-on-one encounters.

Option 3: Employ a Silver Bullet Strategy

Rather than choosing either of the first two options, the Congress could steer a more middle-of-the-road course and elect a silver bullet strategy. This strategy involves buying only a few of the more costly and sophisticated aircraft. In wartime, these planes would be used to attack the most important and heavily defended targets. The majority of the force would be equipped with less sophisticated, cheaper planes.

To illustrate the silver bullet approach, this option assumes that the Air Force develops and buys only 150 of the F-22 aircraft, compared with approximately 650 aircraft that might otherwise be purchased (see Table A-5 in Appendix A). The planes would be bought at the low rate of 12 a year. (The Air Force itself is reportedly considering a reduction in the number of F-22s bought annually, and perhaps in total procurement as well.) The remainder of the Air Force's fleet of fighter and attack aircraft would be equipped with a relatively inexpensive plane. To keep the plane inexpensive, the Air Force would have to exercise more control over costs than it has historically.

Under this option, CBO assumes that the Navy would develop and buy the A/FX aircraft at a rate of 18 planes per year. Because of the importance of deploying a stealthy attack aircraft, this option also assumes that, compared with funding under the base case, $2 billion is added to development funding for the A/FX. As a result, procurement of the A/FX aircraft would begin during the early part of the next decade and 222 A/FXs would be purchased during the 2000-2015 period, compared with 144 planes under the base case.

Consistent with the silver bullet approach, most of the Navy's fleet of fighter and attack aircraft would be equipped with the less capable C/D version of the F/A-18. The E/F development program would therefore be terminated, but C/D versions of the F/A-18 would be bought at the rate planned for the E/F version.

Costs. Compared with the base case, this combination of changes would produce savings that average about $1.3 billion a year in the 1994-1999 period. The savings reflect the net effects of terminating the E/F program, while also

accelerating development of the A/FX. Savings are less than those under Option 2, but somewhat larger than the savings under Option 1.

During the 2000-2015 period, savings would average about $2.6 billion a year, a reduction of about one-fourth compared with costs under the base case. Savings reflect the smaller purchases of the F-22 and the purchase of the less expensive F/A-18C/D, offset partially by added costs associated with beginning A/FX procurement sooner. Long-term cost reductions are almost as great as those of Option 2, which canceled the F-22 program.

The estimated savings for Option 3 take into account the inherent inefficiency of the silver bullet approach. Small purchases of sophisticated aircraft usually result in low rates of annual procurement. As a result, overhead is spread over fewer aircraft and the benefits from learning are dampened, raising unit costs.

Cost disadvantages might be minimized if the silver bullet strategy is selected during the planning phase. Rather than responding to unanticipated cuts in annual purchases, companies could tailor their production to the smaller quantities, minimizing (one hopes) the inefficiencies associated with low-rate production.

Capability. Under this option, the fleets in each service would be equipped with a small number of the most capable aircraft--the F-22 and A/FX. As a result, the Navy would retain planes with advanced stealth characteristics that can attack targets at relatively long ranges. The Air Force would retain a fighter that is highly stealthy. This option would therefore maintain the flexibility of U.S. forces. The small number of highly capable aircraft may be sufficient in light of the reduced threats to U.S. security.

The silver bullet approach would also continue production of at least two aircraft during most of the next decade. A number of companies would therefore remain in the business of designing and producing sophisticated weapons, including aircraft with the most advanced stealth technology. If threats to U.S. security ever increase substantially, open production lines would somewhat reduce the time required to expand the size of U.S. aircraft fleets.

Compared with the base case, this option would result in earlier purchases of the A/FX aircraft. The extra purchases would not be sufficient to reduce substantially the average age of the Navy's fleet of fighter and attack aircraft (see Table A-6). But earlier deployment would reduce the period when carrier air wings would have to operate without a capable medium-range bomber. This period would decline from 10 years under the

base case to about six years under this option. A shorter period might make it more feasible to continue to equip the carriers with some older A-6 medium-attack aircraft until the A/FX is available.

The silver bullet approach, however, is not without its disadvantages. Compared with the base case, the majority of the Navy's fleet of fighter and attack planes would be equipped with the C/D version of the F/A-18 rather than the more capable E/F version. The E/F version, for example, is designed to fly 40 percent farther than the current C/D version, in part because of better aerodynamic performance from its modified wing. Design changes should also allow the E/F to land on aircraft carriers without jettisoning unused ordinance, an important improvement given the expense of today's munitions. And the E/F is planned to have some design changes that would lead to modest improvements in the survivability of the planes. Estimates of E/F improvements, however, are still based on simulations rather than flight tests, and the degree of improvement remains contentious among some analysts.

Compared with the base case, the Air Force fleet would be significantly older under this silver bullet approach. By 2015, if it is to meet its numerical needs, the Air Force would have to retain about 40 percent of all its fighter and attack aircraft beyond their planned service lives. This percentage is smaller than under Option 2, which cancels the F-22 outright (47 percent), but substantially larger than under the base case (22 percent).

APPENDIX A. ADDITIONAL TABLES AND FIGURES

TABLE A-1. AIRCRAFT PURCHASED UNDER BASE-CASE ASSUMPTIONS

Procurement Assumed for Future Years Defense Program (FYDP)

Aircraft	1993	1994	1995	1996	1997	1998	1994-1998 Total	1994-1998 Average
Air Force								
F-22	0	0	0	0	4	4	8	2
Multirole Fighter	0	0	0	0	0	0	0	0
F-16	24	24	24	24	24	24	120	24
A/FX	0	0	0	0	0	0	0	0
Subtotal	24	24	24	24	28	28	128	26
Navy								
F/A-18C/D	36	36	36	36	24	0	132	26
F/A-18E/F	0	0	0	0	12	24	36	7
A/FX	0	0	0	0	0	0	0	0
Subtotal	36	36	36	36	36	24	168	34
Total	60	60	60	60	64	52	296	59

Procurement Assumed Beyond FYDP Period, 1999-2008

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Air Force										
F-22	12	24	36	48	48	48	48	48	48	48
Multirole Fighter	0	0	0	0	0	0	0	0	0	0
F-16	24	12	0	0	0	0	0	0	0	0
A/FX	0	0	0	0	0	0	0	0	0	0
Subtotal	36	36	36	48	48	48	48	48	48	48
Navy										
F/A-18C/D	0	0	0	0	0	0	0	0	0	0
F/A-18E/F	24	30	48	48	48	48	48	48	72	72
A/FX	0	0	0	0	0	0	0	0	6	12
Subtotal	24	30	48	48	48	48	48	48	78	84
Total	60	66	84	96	96	96	96	96	126	132

Procurement Assumed Beyond FYDP Period, 2009-2015

	2009	2010	2011	2012	2013	2014	2015	1999-2015 Total	1999-2015 Average
Air Force									
F-22	48	48	48	48	40	0	0	640	38
Multirole Fighter	0	12	24	36	48	48	48	216	13
F-16	0	0	0	0	0	0	0	36	2
A/FX	0	0	0	6	18	24	24	72	4
Subtotal	48	60	72	90	106	72	72	964	57
Navy									
F/A-18C/D	0	0	0	0	0	0	0	0	0
F/A-18E/F	72	72	72	72	72	72	46	964	57
A/FX	18	18	18	18	18	18	18	144	8
Subtotal	90	90	90	90	90	90	64	1,108	65
Total	138	150	162	180	196	162	136	2,072	122

SOURCE: Congressional Budget Office.
NOTE: Numbers may not add to totals because of rounding.

TABLE A-2. WINGS AND AIRCRAFT REQUIREMENTS (ACTIVE AND RESERVE) UNDER BASE CASE

	Clinton Plan (1994)	Bush Plan (1997)	Base-Case Assumptions (Late 1990s and Beyond)	Other Assumptions in the Base Case
Air Force				
Wings	24 1/3	26	21	No fighter interceptor squadrons
Required aircraft	n.a.	2,800	2,100	100 aircraft per wing
Navy				
Wings	13	13	13	
Required aircraft	n.a.	1,700	1,500	Does not include 3 U.S. Marine Corps F/A-18 squadrons assigned to the Navy for support of carrier air wings

SOURCE: Congressional Budget Office.

NOTE: n.a. = not available.

TABLE A-3. COMPOSITION OF CARRIER WINGS

Type of Plane	Current	Near Term	Long Term
F-14	20	14	0
F/A-18	20	36	36
A-6 or A/FX	16	0	16
Total Fighter or Attack	56	50	52

SOURCE: Congressional Budget Office.

NOTE: Excludes a number of other aircraft that are part of the Navy's carrier air wings.

TABLE A-4. ASSUMPTIONS ABOUT THE PRICES OF AIRCRAFT
(In 1994 budget authority)

Service	Procurement per Plane (Millions of dollars) Lower Cost	Procurement per Plane (Millions of dollars) Higher Cost	Total RDT&E for Program (Billions of dollars)
Air Force			
F-22	80	115	18
MRF	35	50	8
Navy			
A/FX	90	130	23
F/A-18E/F	60	80	6

SOURCE: Congressional Budget Office.

NOTES: RDT&E = research, development, test, and evaluation.

Lower cost is based on Air Force and Navy estimates. Higher cost assumes prices grow, as they have historically.

TABLE A-5. NUMBER OF AIRCRAFT PURCHASED UNDER BASE CASE AND ALTERNATIVES

	Base Case		Option 1: Focus on Near Term		Option 2: Cancel F-22 Program		Option 3: Employ Silver Bullet Approach	
	1994-1999	2000-2015	1994-1999	2000-2015	1994-1999	2000-2015	1994-1999	2000-2015
Air Force								
F-16	144	12	144	12	144	12	144	12
F-22	20	628	20	700	0	0	20	130
A/FX	0	72	0	0	0	72	0	72
MRF	0	216	0	0	0	216	0	216
JAF	0	0	0	216	0	0	0	0
Total	164	928	164	928	144	300	164	430
Navy								
F/A-18C/D	132	0	132	0	132	0	192	940
F/A-18E/F	60	940	60	940	60	940	0	0
A/FX	0	144	0	0	0	144	0	222
JAF	0	0	0	144	0	0	0	0
Total	192	1,084	192	1,084	192	1,084	192	1,162
Air Force and Navy	356	2,012	356	2,012	336	1,384	356	1,592

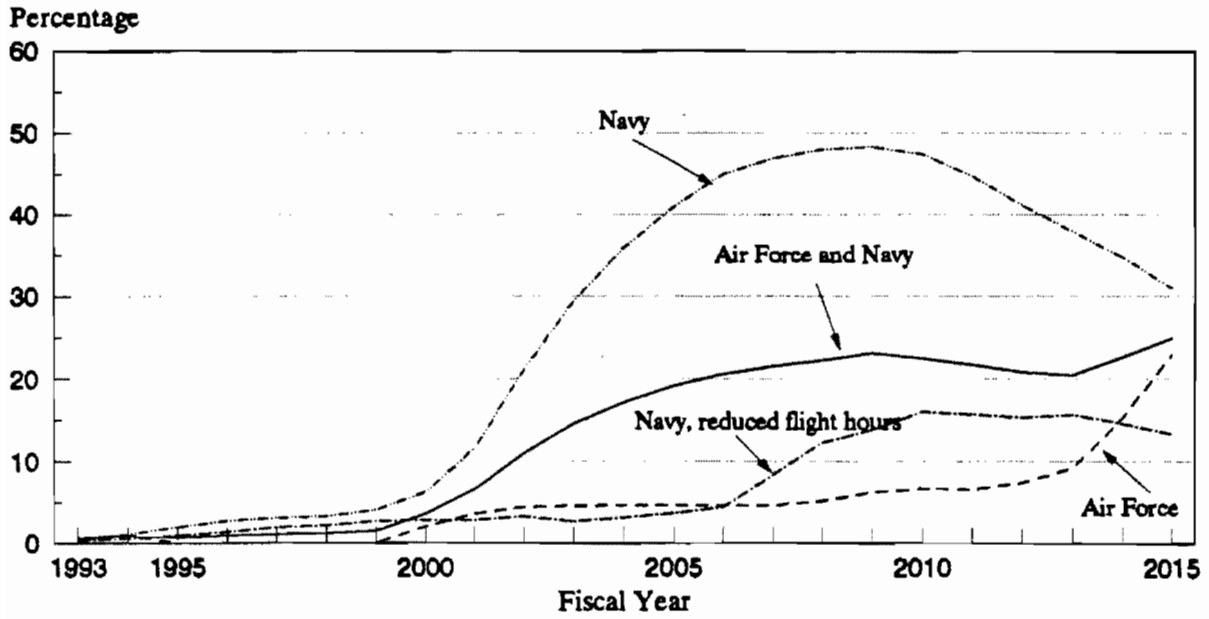
SOURCE: Congressional Budget Office.

TABLE A-6. AGE AND PERCENTAGES RETAINED BEYOND RETIREMENT AGE FOR AIR FORCE AND NAVY FIGHTER AND ATTACK FLEETS, UNDER BASE CASE AND ALTERNATIVES

Service	Average Age of Fleet (Years)			Percentage of Fleet Retained Beyond Retirement Age	
	Current	2010	2015	2010	2015
Base Case					
Navy	9	15	14	46	31
Air Force	9	18	19	7	22
Option 1: Focus on Near Term					
Navy	9	15	14	46	31
Air Force	9	18	19	7	22
Option 2: Cancel F-22 Program					
Navy	9	15	14	46	31
Air Force	9	23	26	25	47
Option 3: Employ Silver Bullet Approach					
Navy	9	15	13	43	26
Air Force	9	21	25	20	40

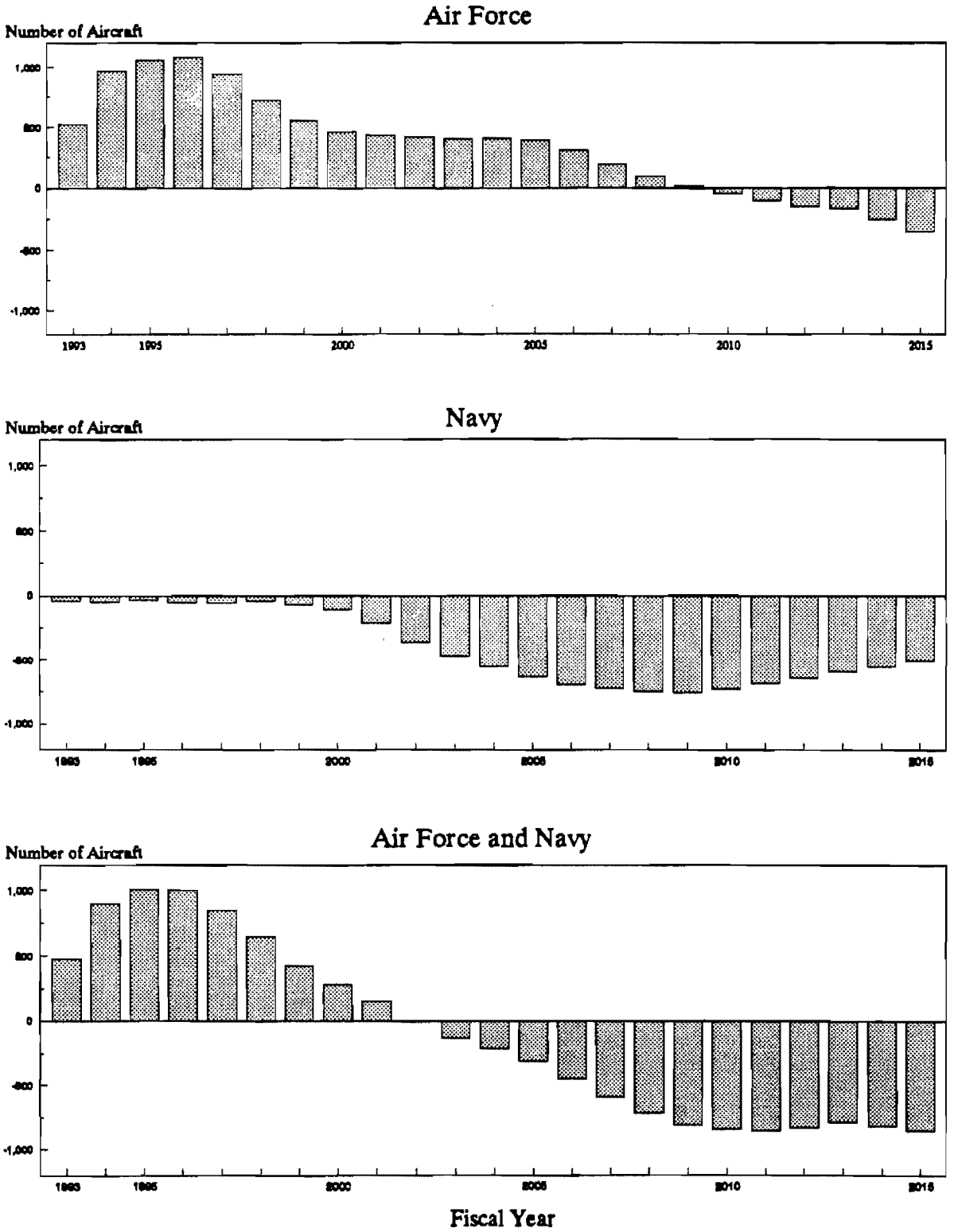
SOURCE: Congressional Budget Office.

Figure A-1. Percentage of Fleet Retained Beyond Retirement Age to Meet Requirements



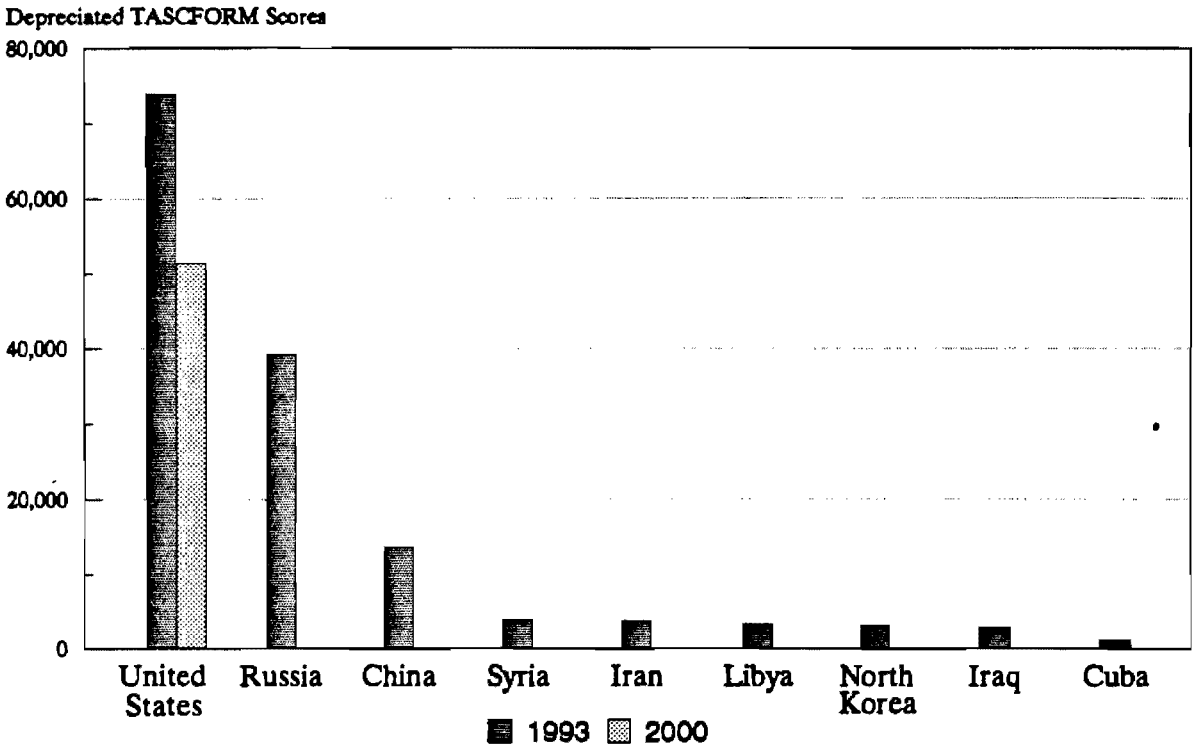
SOURCE: Congressional Budget Office projections based on Department of Defense, Air Force, and Navy data.

Figure A-2. Projected Overages and Shortfalls for the Air Force and the Navy



SOURCE: Congressional Budget Office projections based on Department of Defense, Air Force, and Navy data.

Figure A-3. U.S. Scores Compared with Selected Regional Powers



SOURCES: Congressional Budget Office estimates based on data from *The Military Balance* (London: International Institute for Strategic Studies, 1992-1993); The Analytic Sciences Corporation; U.S. Air Force; and U.S. Department of Defense.

NOTES: TASCFORM = Technique for Assessing Comparative Force Modernization.

CBO provided scores for these countries in testimony before Subcommittees of the Committee on Armed Services of the House of Representatives on April 28, 1993. The U.S. scores shown above, which are about 25 percent less than the scores in preceeding testimony, are better comparisons with the measures used for other countries.

APPENDIX B. SERVICE LIVES AND RATES OF USE

The Congressional Budget Office calculated the shortfalls and overages of aircraft based on assumptions about service lives and rates of use measured in terms of flight hours. For the most part, the data were taken from estimates in the Department of Defense's "Report to the Congress on Fixed Wing Tactical Aviation Modernization" or were provided by the services.

Applying the service-life estimates from this publication to CBO's projections of aircraft inventories suggests that Air Force fighter and attack aircraft would be able to fly an average of about 8,000 hours before retiring, modestly longer than today's average of 7,100 hours (see Table B-1). Navy planes would be expected to have shorter service lives, about 6,700 hours in the future compared with 6,800 hours on average today. The Air Force and Navy also provided estimates of service life. Those estimates are predicated on completion of aircraft modification programs that are not yet complete or even fully funded. Therefore, CBO used the smaller numbers for the case that retires planes when they reach the end of their service lives.

Annual rates of use are roughly the number of hours that an aircraft flies each year. Planned rates of use are somewhat higher in the Navy (a fleetwide average of 350 hours per year per aircraft) than in the Air Force (an average of 320 hours per year per aircraft). Rates of use vary somewhat based on the type of aircraft, and the Air Force's average rate of use would increase modestly to 325 in the future based on a change in the composition of the fleet. The Navy's rates of use are assumed to increase to about 350 hours through 2015.

These planned service lives and rates of use can be translated into chronological retirement ages. The figures suggest that Air Force aircraft would be retired when they are about 25 years old, on average. Navy planes would be retired at about 19 years of age, on average.

TABLE B-1. ASSUMPTIONS ABOUT AIRCRAFT SERVICE LIVES AND RATES OF USE (Expressed in flight hours)

Service	Service Life		Rate of Use	
	Current	2015	Current	2015
Air Force	7,100	8,000	300	325
Navy	6,800	6,700	330	350

SOURCE: Congressional Budget Office.

NOTES: Numbers reflect specific assumptions provided by the Air Force and Navy for each plane in the fleet, weighted by the number of aircraft. Assumptions about service life may, especially for the Navy, assume the existence of modifications that have not yet occurred.