SYSTEMIC FISCAL OPTIMISM IN DEFENSE PLANNING

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Defense planning and budgeting increase national security costs by significantly overestimating available future resources. An analysis of Department of Defense out-year resource estimates over a period of 20 years and six administrations—the first econometric analysis of budgeted and realized resources in defense—demonstrates that an optimistic bias has spanned administrations and appears to be a systemic characteristic rather than a political one. The result has significant implications for reduction of defense costs without loss of capability.

Some analysts have suggested that fiscal optimism in defense planning and budgeting results in less defense than could have been achieved given the resources available. That is, fiscal optimism results in less bang for the buck, rather than the more bang for the buck traditionally sought by the Department of Defense (DoD). Programs established under a projected fiscal regime with more resources than later are realized may become unaffordable under the tighter resource constraint. Unaffordable means that the budget is not sufficient to carry out the program at the rate, at the unit cost, and in the quantities originally programmed and planned.

The traditional issue of weapons systems cost growth and the issue of DoD's consistent forecast that it will receive significantly more budgetary resources than it does receive are not separate. The gap between planned and realized budgetary resources is the predominant cause of weapons systems cost growth.

Franklin Spinney addressed the problem of cost growth and fiscal optimism in the early 1980s. His analysis was not well received within DoD, although it achieved sufficient notoriety outside DoD: He was pictured on the cover of *Time* magazine (Isaacson, 1983). He addressed the force structure and unit cost problems that result from optimistic assumptions about the cost progress curves[1] and the reluctance to terminate systems that, although well along in development or production, appear unaf-fordable given the resources actually appropriated (Spinney, 1980). Spinney did not address how

DoD consistently gets into the position of not having enough resources to complete what it has started.

Gansler approaches the issue through the effects on weapons system costs and on strategy and the ability to support strategy (Gansler, 1989, chap. 5). Focusing primarily on management within DoD and on the interface with industry, Gansler addresses "optimistic planning," but does not directly address the source of fiscal over optimism. The Packard Commission identified the problem of optimistic planning and recommended some improvements, but did not present an analysis demonstrating the persistence of the phenomenon across time and administrations (Packard, 1986). Efforts to assess the dollar effect of optimistic planning have been rare and have not been published in the academic press. For example, Rolf Clark's papers, prepared under the auspices of the DoD's Defense Systems Management College and circulated within the DoD, were not published in peer-reviewed journals (Clark, 1990a, 1990b).

This article provides an assessment of the quality of the defense out-year resource forecasts from a system perspective, identifies the source of forecast errors, and draws implications about their costs and the potential for improving the forecasts. Its broader purpose is to identify the nation's out-year budgeting practices as an important area of research in which analysts can contribute significantly to the national welfare. Budgeting, whether for next year or longer periods, is an accountancy function directly affecting management; it should be addressed with the same rigor as is applied to stock price movements, earnings forecasts, and the effects of revised standards.

This analysis is based on the following axioms. If one plans to have significantly more resources than become available then it should not be surprising if the plans are unaffordable. The planner should learn from such experience and begin to estimate better the future resources. We should not expect a perfect forecast, but should expect the quality of the forecasts to improve over time.

Forecast accuracy is especially important for national defense when erroneous forecasts contribute to a lesser capability than could have been obtained at the realized resource level.

The analysis presented here concludes that the defense planning and budgeting system is optimistically biased and that the bias has spanned several administrations. Nonetheless, out-year forecasts have been significantly better under some administrations than under others. Those administrations having demonstrated the greatest bias in their real growth projections also have experienced the greatest shortfalls in resources, implying the greatest impact on management. A proportion of the forecast error can be reduced and improvements (discussed below) can be instituted.

Neither this analysis nor those cited suggest that optimistic planning results from malicious intent. Rather, it is the result of a highly complex system that does not function as intended.

Optimism is defined as a form of the bias discussed in the conceptual statements of the Financial Accounting Standards Board (FASB). Were we able to place a probability distribution on the fiscal projections of the defense budget, we would find that those projections consistently are greater than the expected value.

No attempt is made to assign the causes of the bias to the elements of measurer bias or measurement bias. Measurer bias results when the measurer misapplies the measurement methodology. Such misapplicaion may derive from lack of skill or lack of integrity, or both. Measurement bias results from inadequacy, or lack of validity, of the measurement instrument or method. However much the resultant bias may originate in each of those two causes, it remains a systemic characteristic of the national security planning and budgeting system (FASB, 1985).

The Impact on Military Effectiveness

Planning for more resources than become available results in programming a larger force and more investments than can be supported. The defense literature has noted the effects of that discrepancy. Kevin Lewis, in "The Discipline Gap and Other Reasons for Humility and Realism in Defense Planning," concludes that the likelihood of the DoD's planned program achieving its planned effectiveness is small (Lewis, 1994). It is important to recognize that Lewis has in mind the military effectiveness of the forces that result from the plans. Jacques S. Gansler deals with the effects on weapons system costs and on strategy and the ability to support strategy (Gansler, 1989). Spinney also has addressed these effects (Spinney, 1996).

In defense planning, the mix and deployment of forces is optimized within the expected resource constraints.[2] The mix of forces varies as a function of the total financial resources available. For example, a specialized aircraft or other weapons system may be effective and affordable only if it exists in the force in some minimum quantity. Fielding of the system requires development of doctrine and tactics and also the training of the forces and the commanders. In the highly integrated modern battlefield, development and management of compatibility with the associated forces also is required. Clearly, it could be ineffective and cost prohibitive to do all those things for a single aircraft, especially if some backup weapons system were required in the event that single aircraft were lost. At some point, the cost-effectiveness of a specialized system, available in a minimum quantity, is less than the cost effectiveness of the alternative multipurpose weapons system.

> "Planning for more resources than become available results in programming a larger force and more investments than can be supported."

Decisions to produce a special-purpose weapons system or the alternative multipurpose system are made on the basis of projected resources. Even once it becomes clear that resource projections were optimistic, reversing such decisions is difficult. The difficulties arise from the added costs incurred by a termination, both economic and psychological, and from the time-lag that would be incurred in developing the multipurpose system. In fact, that time-lag may preclude fielding of the alternative capability soon enough to counter the threat. Thus, the ability to repair a bad decision in response to near-term information about resource availability is limited.

Given the earlier decisions, made on the basis of optimistic resource projections,

the best possible defense program may be significantly less effective than would have been possible had the earlier decisions been made in the context of realistic resource constraints. That situation is modeled below:

Let E (year, resources, period) represent the maximum effectiveness of the defense program resulting from decisions made in year i, given multi-year projected resource constraint j, and serving in the future period k. The period may be a specified Future Years Defense Program (FYDP)[3] period or some longer time span (such as a decade). Then, the maximum effectiveness of a defense program, given resource constraint $j_{1,}$ is

$$E(i, j_1, k) \qquad (1)$$

and the maximum effectiveness of the next year's defense program, covering the same period k, but with a revised resource constraint $j_2 < j_{1,}$ is

$$E(i + 1,j_2,k) < E(i, j_1, k). \qquad (2)$$

Some observers have identified the revised planning that results from correction of $E(i, j_1, k)$ to achieve $E(i + 1,j2,k)$ as the source of the acquisition turbulence so roundly condemned by the Packard Commission (1986). Clearly, if the effectiveness decline applies to the next year's program, it also applies to the $i + n$ program where n is an integer greater than one and less than some integer representing the time to develop and field an improved mix of forces.

Because the time to develop and field a weapons system is at least 10 years, the effectiveness decline persists for about that same period.

Other Analyses of Planning Bias

The idea that a bias in planning may exist is not new. Henri Thiel (1971) discusses the measurement of such bias and offers several examples of systemic bias. His discussion, because it uses Dutch national forecasts as an illustrative case, establishes the relevance of that technique to the analysis presented here. J. Chapman (1981) applied Thiel's technique to assessment of the accuracy of revenue forecasts by California cities before and after the passage of Proposition 13. He found a tendency toward underestimation of revenues both before and after passage of Proposition 13. Chapman's findings are not directly relevant to this analysis, but his application of Thiel's technique is.

Allusions to bias in national forecasts in the United States are not unusual. For example, J. Sessel (1995) quotes comments by two well-known observers on the White House and Congressional Budget Office (CBO) forecasts. Former CBO Director June O'Neill said, "The history over the past 20 years is that both of us are too optimistic." Alan Auerback, an economist at the University of California, Berkeley, commented, "I've become convinced that there's a pervasive tendency towards overoptimism in both agencies" (Sessel, 1995). In *Affording Defense*, Gansler (1989, chap. 5) refers to "optimistic planning." One of the threads of his analysis is the effect of planning for a greater financial resource than becomes available. Gansler is unusual in his recognition of the adverse effects of such optimism.

The existence of such a systemic bias is relevant to other organizations, both public and private, and knowledge about

the detection and correction of such biases would be an important contribution to the knowledge about managing complex public and private organizations. The magnitude of the effect on other organizations probably is related positively to their planning horizon.

Bias in Defense Planning

Data

For this study we examined data for a period of 20 years: fiscal year 1975 through fiscal year 1995.[4] Planned resource levels were compared to the actually available resource levels for the administrations of Presidents Gerald Ford, Jimmy Carter, Ronald Reagan, George Bush, and for President Bill Clinton through fiscal year 1995.

The projected fiscal resources against which plans were constructed consistently exceeded the fiscal resources that actually became available. The situation is portrayed graphically in Figure 1. That figure presents the actual and planned data for President Reagan's second administration, 1985 through 1988.

The bars in the chart show the resource levels for each year of the DoD's planning period. Because a new planning period begins yearly, the bars for each year represent plans from several prior years. The line represents the funding appropriated by the Congress, the fiscal

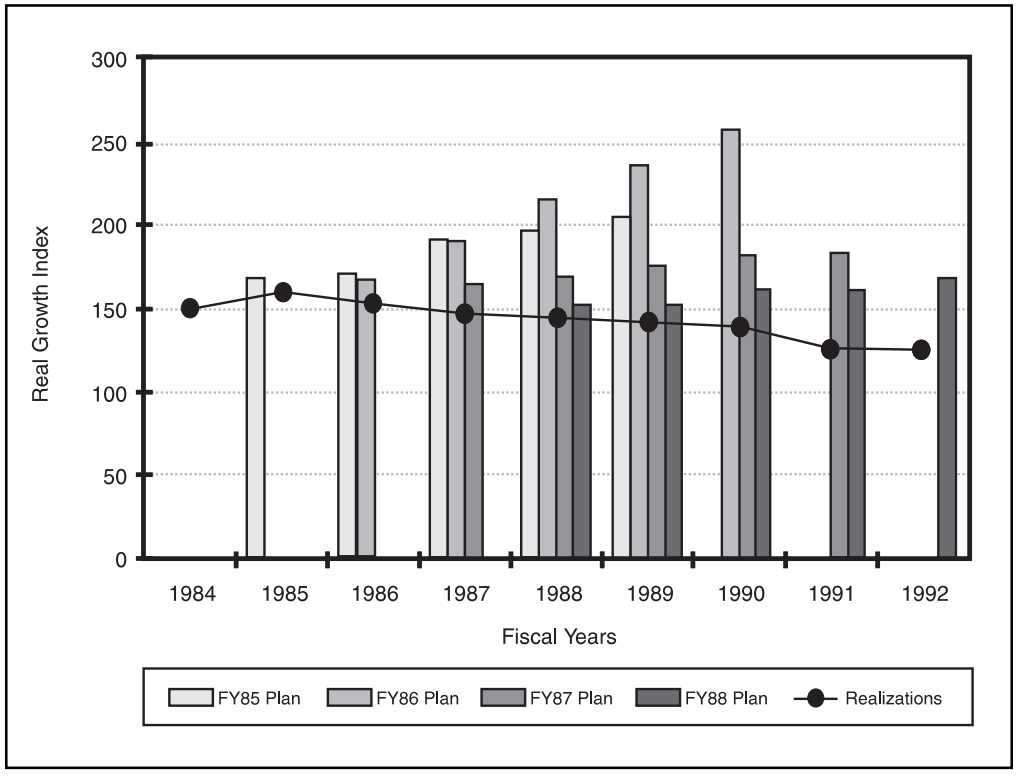

Figure 1. Planned Versus Realized Real Growth, Fiscal Years 1985–88

resource that was realized. Clearly, the plans of each administration extend into the subsequent administrations and, just as clearly, are revised by those subsequent administrations.

In order to remove the effects of inflation, real dollar levels indexed on fiscal year 1974 are plotted. The DoD deflators were applied to the actual appropriations. Those projected at the time of each plan were used to deflate the resource projections, and then were linked to the same deflators that were applied to the series of actual appropriations. Thus, each year's resource levels, projected and actual, were restated in the same dollars and then indexed on fiscal year 1974.

METHODOLOGY

Spinney (1992) used a primarily graphical analysis in his presentations, accompanied by discussion. Figure 1 similarly portrays the data. Gra-phical portrayals provide an intuitive feel for the situation, but they do not support conclusions about the un-derlying causes of the forecasting errors.

In *Applied Economic Forecasting*, Thiel (1971, p. 32) develops a method for analyzing the adequacy of economic forecasts. Thiel decomposes the squared error of the forecast into coefficients related to the sources of the forecasting error.

Our analysis is based on real growth rates, projected and actual, to remove the effects of inflation and also because the projection methodology used in the DoD is based largely on assumptions of future real growth. The analysis uses the natural logarithms of the real growth rates. Their use ensures that the levels in years t_1 and t_2 are the same if the log changes in those years are equal but of opposite sign (Thiel, pp. 47–50).

SOURCES OF THE PROJECTION ERRORS

Thiel's coefficients are derived from the sum of the squared errors as shown below in Figure 2. The coefficients represent bias, variance, and covariance, respectively.

$$\frac{1}{n}\sum (P_i - A_i)^2 = (\bar{P} - \bar{A})^2 + (S_p - S_a)^2 + 2(1 - r) S_p S_a \qquad (3)$$

$$1 = \frac{(\bar{P} - \bar{A})^2}{\frac{1}{n}\sum (P_i - A_i)^2} + \frac{(S_p - S_a)^2}{\frac{1}{n}\sum (P_i - A_i)^2} + \frac{2(1 - r) S_p S_a}{\frac{1}{n}\sum (P_i - A_i)^2} \qquad (4)$$

Figure 2. The Sum of the Squared Errors

ANALYSIS OF THE DATA

Table 1 presents data about the frequency of the forecasting errors. Table 2 presents the coefficients and is followed by a discussion of their meaning.

As Table 1 shows, the real growth rate used in DoD's resource projections exceeded the real growth rate realized in the amounts appropriated in 66 of 94 fiscal years (70 percent of the projections). The effects of inflation have been removed from both the resource projections and the appropriated amounts. The optimistic tendency (70 percent of the projections exceeded the actual appropriations, in real dollars, vice the approximately 50 percent in an unbiased system), therefore, is not a result of the difficulty of forecasting inflation rates.

BIAS

The bias proportion represents deviations in central tendency. It shows the proportion of the root mean square error that results from the difference between the mean of the predictions and the mean of the realizations. Positive values for the difference in the means of the predicted and realized values indicate that, on the average, higher real growth rates are projected than are realized.

In five of the six administrations the mean prediction exceeded the mean realization. The importance of that bias is indicated by the bias proportions in Table 2. In each of President Reagan's administrations, about 75 percent of the error in projections derived from optimism about how much Congress would appropriate. In President Bush's

Table 1. Frequency of Forecasting Errors

Number of periods forecast	94
Forecast real growth rate exceeded actual rate	66
Actual rate exceeded forecast	28

Table 2. Inequality Proportions

Administration	Bias	Variance	Covariance
Ford	.00322	.23899	.75779
Carter	.33380	.32189	.34431
Reagan I	.75237	.03787	.20976
Reagan II	.75249	.00044	.24707
Bush	.48722	.05170	.46109
Clinton	.26872	43326	.29802

administration, about 49 percent of the projection error resulted from an upward bias. About 27 percent of the projection error in President Clinton's first two years resulted from overly optimistic projections. President Ford's administration exhibited very little bias. About .3 percent of his projection error resulted from general overoptimism.

In contrast, President Carter's administration exhibited a bias below what the Congress appropriated, accounting for about one-third of the projection error.

VARIANCE

The variance proportion is zero only if the standard deviations of the projected and realized real growth rates are the same. As Table 3 indicates, for the administrations of Presidents Ford, Carter, and Bush and for President Reagan's first administration, the variance of the realizations exceeded the variance of the projections. For each of those administrations, the projected real growth rate fluctuated less from year to year than did the achieved real growth resulting from Congressional appropriations. For Presidents Reagan and Bush, this difference in consistency contributed only about 3.8 percent and 5.2 percent, respectively, of their projection error, making that source relatively unimportant compared to the effect of the upward bias in central tendency. During the Carter and Ford administrations, the difference in consistency was relatively more important, contributing 32 percent and 24 percent, respectively, of the projection error.

Conversely, in President Reagan's second administration and in the first two years of President Clinton's administration the projections have been less tightly distributed than have the congressional appropriations.

One might hypothesize that the pattern of the variance relationship indicates that Presidents Ford, Carter, Bush, and Reagan (in his first term) had a better-defined vision, or at least a firmer vision, for the national security than did the Congress. Such a hypothesis would accept year-to-year consistency in appropriations as a proxy for a consistent vision. A full

Table 3. Means, Standard Deviations, and Correlations

Administration	$P - A$	$S_p - S_a$	r
Ford	.0028	–.0238	–.0736
Carter	–.0294	–.0289	.0820
Reagan I	.0522	–.0117	.7325
Reagan II	.4934	.0019	.0937
Bush	.0436	–.0141	.1458
Clinton	.0123	.0156	.8524

examination of that hypothesis, however, is beyond the scope of this paper; for the present, we leave it for others to address. As one reviewer noted, however, it might be addressed through an analysis of the concurrent resolutions on the budget.[5]

COVARIANCE

The covariance proportion is zero only if the coefficient of correlation is 1. As indicated in Table 3, the directional agreement, the correlation, between the administration's real growth projections and the congressional appropriations have been highest in President Reagan's first term and in President Clinton's first two years. President Ford and the Congress moved in opposite directions. The correlations in President Carter's administration, President Reagan's second administration, and President Bush's administration each are positive, but quite low. The difference in correlation contributed relatively significantly to the projection error in the Ford administration, less so in the Bush administration, and progressively less so in the Carter, Clinton, and Reagan administrations.

The preceding analysis addressed the sources of the projection error on a relative basis. If the projection error is small, then the importance of a relatively large proportional contribution also is small. Thus, it is important to address the size of the projection errors. Did the administrations have similar projection errors, or did some administrations experience notably large projection errors? What was the source of any larger-than-typical errors?

SIZES OF THE PROJECTION ERRORS

Table 4 presents the average sizes of the projection errors as a percentage of the planned resource level; that is, as a percentage of the projection. Importantly, for Table 4, the calculation is based on the planned resource level (in constant dollars), not on the year-to-year real growth rates, and is not represented

Table 4. Size of Resource Shortfalls[a]

Administration	Mean Shortfall as Percent of Planned Resource Level
Ford	–5.3
Carter	+10.9
Reagan I	–13.4
Reagan II	–19.5
Bush	–11.1
Clinton	–2.5

[a] A minus sign indicates available resources were less than planned. The comparison is across the periods projected during each Presidential term.

logarithmically. The resource-level base portrays the effect on program management better than do the calculations based on year-to-year rates.

It is the error in projecting year-to-year real growth rates that causes the resource shortfalls and that error is an accurate portrayal of the overoptimism. The overly optimistic projection of future resources derives from the overly optimistic projections of real growth. Nonetheless, once resources are realized, it is the resource quantity that constrains management of operations and investment. Hence, the importance of those shortfalls is better measured as a function of the resource levels. Note that measurement using the resource levels makes each year's error dependent on the cumulative effect of the prior years' errors, as it in fact is.

Of the six administrations, only President Carter's projected less in resources than were realized. It is enlightening, however, to look at the timing and circumstance of those in-excess-of-projected realizations. During President Carter's tenure, the Congress appropriated an average of 4.9 percent more than President Carter requested. The Carter administration projections for his post-tenure years, fiscal years 1982 through 1986, were significantly less than Congress appropriated for those years. President Carter's plans for those post-tenure years were overfunded by an average of 13.8 percent of those plans.

Thus, President Carter's average resource overrun of 10.9 percent compared to his out-year projections can be attributed largely to President Reagan's military buildup. The Carter administration's bias to the low side of those realizations appears to be a result of a changed national security policy and perception.

Conversely, the existence of overfunded plans during President Carter's tenure confirms that it is possible for a President to overcome the systemic fiscal overoptimism of the defense establishment. Of the six administrations analyzed, only the Carter administration presented requests to the Congress that were less than the

Table 5. Correlation of Error Size and Bias

Administration	Absolute Value of Mean Shortfall as Percent of Planned Resource Level (%)	Bias Coefficient (%)
Reagan II	19.5	75.25
Reagan I	13.4	75.24
Bush	11.1	48.72
Carter	10.9	33.38
Ford	5.3	3.22
Clinton	2.5	26.87

amount ultimately appropriated by the Congress. If we conclude that the defense budget process includes a systemic over-optimism, then we are led to conclude that President Carter managed to overcome that systemic bias.

Spinney (1996) offers a description of the pressures to increase budget allocations that the defense establishment can place on a President. His recounting of the pressures and maneuvering leading to the 1996 increases in the future-years program provides considerable insight into the difficulties a President faces in overcoming defense's tendency to optimistic out-year fiscal projections.

Correlation of Projection-Error Size and the Bias Coefficient

Those administrations having the largest projection errors, as measured by Table 4, also exhibit the largest bias coefficients. Consider Table 5. The apparently high correlation is confirmed by a Spearman Rank correlation test. That test, yielding a rank correlation coefficient of .94, is significant on a one-sided test with a type I error of .02.

Thus, over the past 20 years, those administrations that exhibited significant bias (optimistic or pessimistic) in their resource projections, tended also to have relatively large errors in their projections of resources.

Consider Table 6, which is Table 2 reordered from the largest to the smallest projection error, except for the Ford administration. If we accept that President Ford's projection error derived primarily from his directional differences with the Congress, then the evidence becomes more persuasive.

If the bias coefficient is large, then the average predicted change is substantially different from the average realized change. If bias remains a major source of error over time, then the forecasting system is not improving. That is a serious error. The covariance error source should not be expected to approach zero. Were that true,

Table 6. Inequality Proportions Ordered by Size of Projection Error (Except for Ford Administration)

Administration	Bias	Variance	Covariance
Reagan II	.75249	.00044	.24707
Reagan I	.75237	.03787	.20976
Bush	.48722	.05170	.46109
Carter	.33380	.32189	.34431
Clinton	.26872	.43326	.29802
Ford	*.00322*	*.23899*	*.75779*

the line of predictions and realizations would be straight. Such an exact alignment is too much to expect (Thiel, 1971, p. 32).

Efforts to Correct the Bias Error

Bias has been recognized as a serious source of error by an independent commission and within the Department of Defense (Packard, 1986; Gansler, 1989; Spinney, 1996). Recognition within the Department is difficult to document because internal DoD management and financial management policy analyses are not publicly available. Nonetheless, there have been sufficient occasional recognition of fiscal overoptimism as a management problem to support the conclusion that the professional career staff was aware of it and of its deleterious effects (Lewis, 1994; Clark, 1990a; Clark, 1990b; Jordan, 1990).

"Bias has been recognized as a serious source of error by an independent commission and within the Department of Defense"

The Packard Commission (1986) focused intensively on the tendency to overestimate the future resources as a serious management problem. That Commission's report, together with pressure from career executives, fostered a limited recognition within DoD of the need to improve the forecasting of resources.

Conclusions and Recommendations

A tendency exists for the Defense Department to project the availability of significantly more resources than become available. Historically, those administrations having demonstrated the greatest bias in their real growth projections also have experienced the greatest shortfalls in resources. Hence, those administrations having demonstrated the greatest bias in their real growth projections also most seriously handicapped program managers. Projecting significantly more resources than become available directly affects force mix and capability. The force-mix optimization studies used in programming decisions incorporate a resource constraint.

The existence of optimistic bias has spanned administrations. It continues despite changes of administrations—whether the political party of the incoming administration is the same or changes. It appears, therefore, that the bias results from some characteristic of the defense management system; it is a systemic phenomenon. So it appears reasonable to conclude that reducing the optimistic bias will require changes to the planning and budgeting system. In undertaking such changes, it is important to recognize that bias reduction is the goal, not elimination of the projection error.

There clearly is room for improvement in the Defense planning and budgeting system. The analysis in this paper is empirical. It establishes existance of a systemic bias in one of the nation's major accounting and budgeting systems. Gansler (1989) and Clark (1990a; 1990b) each have identified significant costs

arising from budget turbulence in DoD. The systemic bias identified here is a source of that turbulence. It seems reasonable to suggest that other analysts could contribute significantly to the national welfare via rigorous development of improved forecasting methods that would be unbiased. A broad proposal for such research is outlined below.

Changes in the planning and budgeting system to reduce optimistic bias should be based on a review that identifies the decision points and techniques of the system. Techniques include the modeling and projection methodology; for example, regression analysis, auto regressive integrated moving average (ARIMA), or dynamic economic models. Decision points are those places in the process where out-year assumptions are made. Examples of these are whether DoD will receive a greater or smaller share of the U.S. budget, whether the U.S. budget will increase or decrease, and the size of the applicable growth rates.

Because the analysis identifies a period in which the systemic bias was corrected, a comparison of that period to other periods appears potentially fruitful. The first step in such research might be structured interviews with senior officials and analysts who played key roles in the planning and budgeting process under the Carter administration and other administrations.

Three sources of projection error were identified: bias, variance, and covariance. It is reasonable to expect that forecasting systems should exhibit the ability over time to diminish the bias source. Not to do so indicates lack of continuing improvement in the forecasting system. The time trend of bias errors does not indicate any systemic improvement. From a system perspective, the national defense planning system is not functioning as it should.

The variance error source appears to result from the relative consistency of the administration's vision of the national defense versus the consistency of the Congress's vision. Testing and analysis of that hypothesis is deferred, but changes to the forecasting system appear an unlikely way to improve the correlation of the Administration's and the Congress's vision for national defense.

The covariance error source should be expected to continue; further, improvements in the forecasting system that reduce the bias source almost surely will increase the relative size of the covariance error source.

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ENDNOTES

1. The optimistic assumption is production quantity, not slope.

2. Optimization within resource constraints is well established in national security planning. The techniques and theory were set out 30 years ago by Quade and Boucher (1968). The Packard Commission's report (Packard, 1986) clearly reflects the continuation of that practice.

3. A Future Years Defense Program covers a specified 6-year period for which DoD plans. A new FYDP period starts each biennium, thus constituting a rolling coverage of the future.

4. Data are from DoD press releases, Secretary of Defense Annual reports to the Congress, and the National Defense Budget Estimates series published by the DoD Comptroller. Data for earlier years were not available. Although the "Historical FYDP" reaches back to fiscal year 1962, it does not present the original estimates. FYDP data are revised if appropriations change during the year and also to reflect actual obligations through time. In addition, documents presenting the original inflation forecasts are not available and such original projections are necessary to restate the out-year data in constant dollars.

5. Analyses of the congressional budget process are in Joyce (1996) and Shick (1996).