1967

Expenditure forecasting for the Department of Defense

Sanford S. Ackerman

Joel T. Presby

Expenditure Forecasting for the Department of Defense

By Sanford J. Ackerman and J. Thomas Presby

The effect of government expenditures on the state of the national economy makes expenditures a crucial element of federal fiscal policy. In order to execute fiscal policy successfully the Federal Government must rely on expenditure forecasts of its agencies, and forecasts of tax receipts. Because the Department of Defense accounts for about one-half of total Federal expenditures, the problem of forecasting Defense expenditures is the most important problem of its kind in the Federal Government.

Recognizing the significance of this problem, Robert N. Anthony, Assistant Secretary of Defense (Comptroller) and Joseph S. Hoover, Principal Deputy Assistant Secretary of Defense (Comptroller) provided the impetus for the construction of a computer-based model and information system of forecasting Defense expenditures. The system was constructed during the summer of 1966 under the direction of Melvin H. Baker, Director of Plans and Systems in the Program / Budget group of the Defense Department and Sheldon W. Taylor, Director of Financial Analysis and Control in the Program / Budget group. Touche, Ross, Bailey & Smart participated in the design and implementation of the system as contractors to the Defense Department.

The system is consistent with the innovations in government financial planning and control that have originated in the Department of Defense, such as programming, planning, and budgeting systems (PPBS). This method of forecasting is applicable to other Federal agencies as well as to state and local governments.

This article suggests the kind of work that should be done to forecast expenditures as a part of all basic planning and budgeting procedures in government. It deals specifically with a sophisticated department of the Federal government — Defense. Although the most obvious and most publicized examples of governmental budgeting, authorization, and spending processes are at the Federal level, they regularly occur at every level of government. There are considerable differences in the specific procedures followed and in the constitution of the authorizing bodies, but the basic problems of budget review, appropriation, and authorization are the same. For that reason, discussion of the Federal processes is appropriate background and introduction to a discussion of expenditure forecasting.

The Federal Processes

The President's Budget is submitted to Congress as

J. Thomas Presby, manager in our New York office, spent two years in the Dayton office before moving to New York in 1965. He received a B.S. in electrical engineering at Rutgers University in 1961, an M.S. in industrial administration at Carnegie Institute of Technology in 1963, and the following year studied accounting at the University of Dayton. Mr. Presby is a member of the American Institute of CPA s, the Ohio Society of CPA s, the New York Society of CPA s, and the Institute of Management Services.

Sanford S. Ackerman is a principal in the New York office. He graduated from the University of Delaware in 1953 with a BMB degree, and from Cornell in 1958 with an MS in Industrial Engineering. The author of numerous published articles dealing with management services. Mr. Ackerman has developed an expert knowledge in computers and spends considerable amount of time working with governmental agencies.

the starting point for review and debate. Ultimately, the Congress enacts Obligational Authority (OA) which is made available to the various federal agencies through the proper authorities. The agencies obligate the funds by hiring personnel, letting contracts, and other actions necessary to carry out operations. Payment takes place sometime after obligation, depending on delivery schedules, percentage of completion and similar stipulations. For example, $100 million may be obligated for an office building in a given year. It may take five years to spend the $100 million, however, as the building is completed.

The Federal budget is reviewed, enacted, and accounted for in a framework of appropriation accounts. The appropriation accounts represent a functional breakdown of OA and expenditures. Examples of some appropriation accounts are:

Housing and Urban Development
- Salaries and expenses
- Urban planning grants
- Urban studies and housing research
- Administration expenses, mass transportation demonstration

Department of Defense
- Military personnel, Army
- Retired pay, Defense
- Operation and maintenance, Army
- Procurement of equipment and missiles, Army

Each appropriation account is designated as either an annual or a no-year account. The OA appropriated to annual accounts must be obligated during the fiscal year of appropriation. Annual account OA that is unobligated at the end of the fiscal year of appropriation, automatically expires at the end of that year. On the other hand, OA appropriated to no-year accounts is available for obligation any time subsequent to appropriation without regard to fiscal year. Generally, personnel and similar types of period accounts are included in annual accounts; accounts with long lead-times and investment items, such as missiles, are designated as no-year accounts.

The control over OA that resides with the Congress is not equivalent to control over expenditures. Congress can determine the amount of OA to be granted for the fiscal year 1968. Neither Congress nor anyone else, however, can determine the amount of cash to be expended during that period because of the uncertain time lag between granting of OA and expenditure. Nonetheless, accurate forecasts of each expenditure are crucial to the execution of government fiscal policy, and the business-like management of any government. At the Federal level, expenditure forecasts in conjunction with revenue forecasts are required for fiscal planning and determination of Federal economic policy. The same principle holds true for state and local governments. Accurate expenditure forecasts are needed for planning changes in tax rates and issuance of debt.

Expenditure forecasts are also required for various other planning functions. Forecasts for a month or a quarter are required to anticipate short-range cash management problems. Long-range forecasts are required for effective planning of governmental policy. Tnis article describes the method used by the Department of Defense in the preparation of one- and two-year expenditure fcrecasts. It also describes the system designed with the assistance of TRB&S that facilitated preparation of expenditure forecasts during review of the fiscal year 1968 defense budget.

DESCRIPTION OF THE MODEL

Approach

There are at least two ways of viewing the expendi-

ture process for the purpose of forecasting. A first, detailed approach would begin with obligational authority granted by Congress. Next, the rates of obligation for each appropriation would be forecast. For instance, appropriations for heavy equipment such as missiles and research efforts are generally obligated much more slowly than appropriations for military personnel or maintenance. After forecasting the funds to be obligated in the year of appropriation and following years, the spending rates of the obligated funds would be used to calculate expenditure forecasts as the final step in the process.

A simpler way of approaching the problem is to forecast expenditures directly from obligational authority. This technique avoids the intermediate step of forecasting obligations from OA.

This second approach was selected for use at the Department of Defense. The main reason for adopting this method was the difficulty encountered in obtaining uniform current obligation rate data. A model using the simpler method which relates expenditure and obligational authority directly also proved easier to update and maintain by a small staff group, while it apparently sacrifices little in forecast accuracy.

The Model

The basic forecasting unit used in the model is the appropriation account-program year. It identifies an account in the Department of Defense appropriation structure, such as, "Military Personnel, Army". Program year also identifies the fiscal year of appropriation. Thus, Military Personnel, Army-1966 program refers to the amount of obligational authority appropriated to Military Personnel, Army, for the fiscal year 1966.

Each expenditure forecast is a forecast of total cash to be expended in either the current or the following (budget) fiscal year for a specific appropriation account. The forecast for either year of any appropriation account is composed of program-year components; each component represents anticipated expenditures from funds appropriated in past program-years. A sample expenditure forecast is shown for Fiscal Year (FY) 1968 of "Appropriation Account X" in Figure 1.

The first four components (1965-1968) in Figure 1 represent expenditures from individual program years. The fifth component (1964 and all prior years) represents expenditures from an aggregation of program year appropriations that are nearly totally expended. This last component, representing a number of program years, is called the "Prior" component.

Figure 1

APPROPRIATION ACCOUNT X

FY	*Funds Appropriated*	*Forecast Expenditure for FY 1968*
1968	150	81
1967	140	32
1966	100	12
1965	150	7
1964 & All Prior Years	600	2
	Total FY 1968 Forecast	144

The number of program years requiring individual identification varies with appropriation accounts and is a function of the speed with which obligational authority is used. Funds for personnel, for example, are expended very rapidly. These appropriations, which are generally annual type accounts, require separate identification of only three individul program years. Shipbuilding appropriations, on the other hand, are expended over the several years required to construct a ship. The shipbuilding account requires individual identification of seven program years.

The program year components of each forecast are computed by successive multiplication of two factors and the amount of OA appropriated for each program year. The two factors are called the Ultimate Expenditure Factor and the Pattern Factor.

Ultimate Expenditure Factor

Obligational authority is almost never totally expended. If Congress grants $100 of OA for a given appropriation account, some amount less than $100 will be spent in the year of appropriation and all subsequent years. This phenomenon occurs for two reasons: First, Federal statutes impose severe penalties on individuals responsible for spending in excess of appropriated amounts. Each program year appropriation is maintained as a separate accounting entity in order to determine that total expenditures do not exceed program year OA. Consequently, administrators tend to underspend OA in order to avoid overspending.

The second reason for underspending OA is that plans often change before all monies can be expended. Specific projects originally intended within the appropriation

may be cancelled, or rescheduled through "reprogramming".

The ultimate expenditure factor converts program year OA to the estimated amount of total ultimate expenditures. Figure 2 is an example of the use of ultimate expenditure factors for a fictitious appropriation Account X.

Figure 2

APPROPRIATION ACCOUNT X

FY	*Funds Appropriated*	*Ultimate Expenditure Factor*	*Expected Total Ultimate Expenditures*
1968	150	.98	147
1967	140	.90	126
1966	100	.96	96
1965	150	.94	141
Prior	600		

No ultimate expenditure factor for the prior component is required. The OA in the prior component is, by definition, nearly exhausted: A judgmental forecast of expenditures from these funds is therefore used and this avoids the need for ultimate expenditure computations.

Pattern Factors

Pattern factors are multipliers used to compute the amount of each program year's ultimate expenditure for each year of the expenditure forecast. Thus, the product of the OA, ultimate expenditure factor, and pattern factor for each program year equals the expenditure forecast component. The example in Figure 3 shows the complete computation of the FY 1968 expenditure forecast for Appropriation Account X.

APPLICATION OF THE MODEL

The above examples describe forecasts for a fiscal year for which funds have already been appropriated. The same concepts are applied to future years for which funds have not been appropriated by preparing a separate forecast of OA, the ultimate expenditure factor and pattern factor. This is the method used for budget year (one fiscal year in the future) expenditure forecasts.

The model is historically-based and in some cases it may not be appropriate to reflect changes in expenditure or obligation rates expected to occur because of policy or other management-caused changes. In order to incorporate these types of changes in the expenditure forecasts, an additional forecast component called a Judgement Adjustment can be used. This component is added to the other components to permit knowledgable managers to adjust expenditure forecasts for trends not reflected in the historical data, and to preserve the separate identities of the historically-derived forecast and the management adjustments.

Figure 4 includes a current year (CY) and budget year (BY) expenditure forecast for the example appropriation account. The Judgement Adjustment shown indicates that management believes the CY and BY forecasts, which are historically-based, to be understated 10, and overstated 12, respectively.

Figure 3

APPROPRIATION ACCOUNT X

FY	*Funds Appropriated (OA)*	*Ultimate Expenditure Factor*	*Expected Total Ultimate Expenditures*	*Pattern Factor*	*Forecast Expenditures for FY 1968*
1968	150	.98	147	.55	81
1967	140	.90	126	.25	32
1966	100	.96	96	.13	12
1965	150	.94	141	.05	7
Prior	600				2
					144

Figure 4

APPROPRIATION ACCOUNT X

FY	Funds Appropriated (OA)	Forecast of OA	Ultimate Expenditure Factor	Expected Total Ultimate Expenditures	Current Year (1968) Pattern Factor	Current Year (1968) Expenditure Forecast	Budget Year (1969) Pattern Factor	Budget Year (1969) Expenditure Forecast
1969		200	.95	190			.55	109
1968	150		.98	147	.55	81	.25	37
1967	140		.90	126	.25	32	.13	16
1966	100		.96	96	.13	12	.05	5
1965	150		.94	141	.05	7		
Prior	600					2		3
				TOTAL		144		170
				JUDGEMENT ADJUSTMENT		10		−12
				ADJUSTED FORECAST		154		158

Determination of Factors

The ultimate expenditure and pattern factors can be estimated from historical expenditure data by a curve-fitting and estimation procedure of four steps:

1. Express expenditures, by month, as cumulative proportions of OA.
2. Plot percent cumulative expenditures versus time.
3. Estimate the ultimate expenditure factor from the level at which the curve ceases to climb.
4. Estimate the pattern factors by computing the percent of total expenditures in each year subsequent to appropriation. Adjust for the ultimate expenditure factor.

The curves that result from the above procedures are similar to the logistic ("growth") curves. Figure 5 is an example of a program year "growth" curve, showing the ultimate expenditure and pattern factor estimates. A formal method of plotting and reading these curves, known as the "logistics grid method" has been devised to improve the precision of curve reading and extrapolation.

The Department of Defense has about 50 appropriation accounts, each with an average of about four program year components per forecast. This requires between 100 and 200 graphs and analyses similar to the one illustrated in Figure 5.

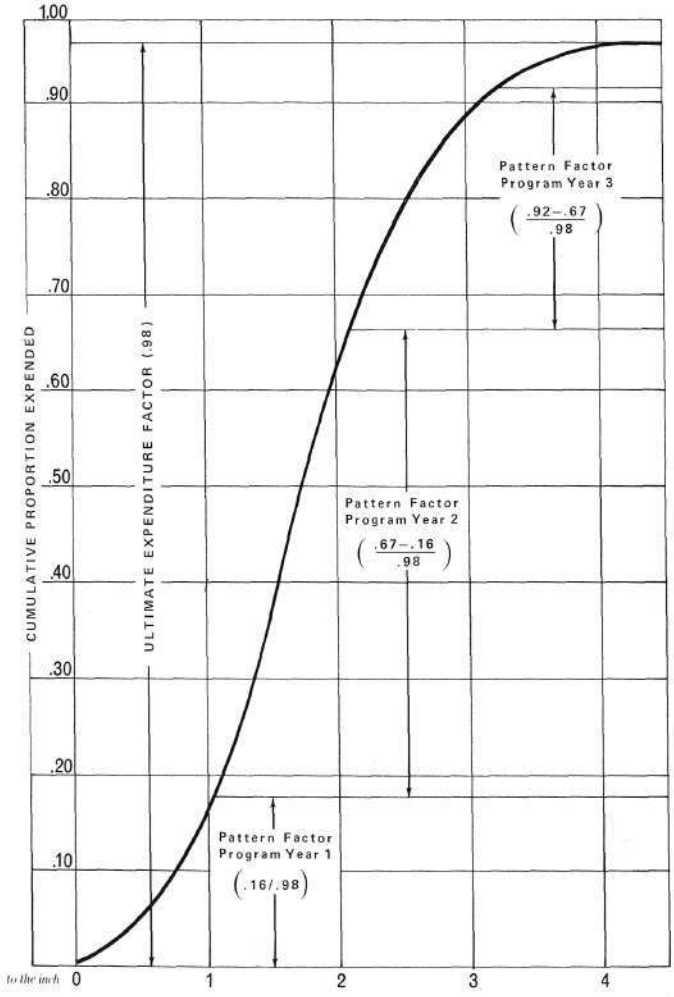

Figure 5
EXAMPLE GROWTH CURVE

DESIGN OF A COMPUTER-BASED SYSTEM

During the course of budget review at the Department of Defense, as many as 50 expenditure forecasts may

be required within a three month period. The factors used for these forecasts are determined prior to budget review so that extensive curve fitting analyses are not required during the budget review period. Generally, the differences between the expenditure forecasts produced during budget review arise from changes in forecasts of anticipated OA from Congress and Judgment Adjustments.

The design of computer-based systems for expenditure forecasting was divided into two phases corresponding to the two separate phases of the forecasting procedure itself:

1. Factor derivation (curve fitting)
2. Forecast computation

A system for performing the computation phase of the expenditure forecasting procedure was designed and successfully implemented for the FY 1968 budget review period. This review took place during October, November, and December of 1966. A system for performing the factor derivation phase is currently being designed and programmed for implementation during the FY 1969 budget review.

The existing forecast system computes and aggregates expenditure forecasts for the current and budget fiscal years for each of the 50 or so appropriation accounts in the defense budget. The computer-based system produces in less than one hour, the equivalent of several man-weeks of computation. It gives the Defense Budget Group a new dimension of flexibility in that they can test the cash expenditure impact of alternative courses of action. The system also produces control reports for input error detection and summary reports for management.

The potential accuracy of the project expenditure forecast is limited because OA balances and factors are prepared at the appropriation account level, except for a few accounts that have been sub-divided into two parts. It would be desirable to sub-divide the appropriation accounts to a lower level of detail because most appropriation accounts contain heterogeneous groupings of transactions. For instance, the account, "Procurement Equipment and Missiles, Army," includes appropriations for items ranging from nuts, bolts, and washers to missiles. The differences in time-lapse between decision to buy, obligation of funds, and expenditure of funds are extremely large; yet the differences are merged by treating the account as a single forecasting entity. If separate forecasts were prepared for groupings with homogeneous spending patterns, the precision of the forecasts could increase substantially. This can only be achieved after the curve fitting procedures for factor derivation have been automated.

RESULTS AND CONCLUSIONS

The expenditure forecasting methods described above were successfully applied by the Department of Defense. Computer-generated reports now supplement existing reports and are used routinely as a measure of the effects of decisions made at the highest levels of the Defense Department.

Obviously, there is only one Defense Department, and few government or private entities would have to use a large-scale computer to meet the volume and timing requirement of this application. However, the need of forecasting expenditures in future time periods is inherent in the planning and budgeting processes of thousands of public agencies. In many of these agencies, forecasting is not presently done, but could be done manually. If the potential of efficient management through PPBS and other modern methods is ever to be realized at any but the topmost levels of the Federal government, basic management accounting and planning within the present appropriation and budgeting structures must be modernized. Expenditure forecasting is one small part of the improvement that must be made.