

The Impact of Performance Budgeting on Defense Resource Allocation

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Abstract: Performance information utilization is an important method to improve budget efficiency and organizational performance. The nature of performance budgeting is to apply performance information to the budgeting process. Research on the impact of government or department performance budgeting on resource allocation has always been controversial. On the one hand, there are many external interference factors in government or department for integrating performance information and budget; on the other hand, there are defects in the generation and quality of performance information of public organizations, and the impact of performance information at different levels on resource allocation is quite different. Therefore, the objective of this paper is to study the impact of based-program performance budgeting within the department on resource allocation. The U.S. Department of Defense, as the largest single department entity in the world, is typical in integrating performance information and budget processes. Using data from the U.S. Department of Defense for fiscal years 2010-2017, this study finds that performance information at the program level within the department has a positive impact on defense resource allocation. Therefore, the integration of performance information into the budgeting process can improve sector budget in spite of political constraints. However, there are many constraints and organizational differences to successfully integrate performance information into the budgeting process in departmental budgeting.

Keywords: Performance Budgeting, Resource Allocation, Defense Program

1. Introduction

Performance budgeting is the usage of performance information in budget process to improve production efficiency and allocation efficiency. Empirical studies have shown that performance budgeting improves the budgeting process by improving production efficiency. Reddick investigated how the performance budgeting system affects the functional expenditure of American states, and found that the performance budgeting system limits discretionary functional expenditure and state total expenditure to a certain extent. [1]

In addition to some positive findings about performance budgeting improves productivity, another important question has attracted very little focus: allocation efficiency. A key goal of performance budgeting system initiatives is the transfer of resources to benefit-maximizing projects. [2] Hou indicates that budget decision makers at the "sub-sectoral" level of a set

allocation may make cost-effective budget decision between Programs. [3] The study of Hou is one of the few empirical studies on the allocation efficiency of Performance based budget systems. Ryu using GPRA performance evaluation and U.S. Department of Commerce (DOC) budget data to test, the study found that performance budgeting will improve the allocation efficiency of sub-departments. [4]

The research results of how different forms of performance budgeting affect resource allocation decisions are also controversial. On the one hand, there is no evidence that spending decisions are significantly influenced by performance information. [5, 6] On the other hand, there is evidence that it is effective. Kluvers investigates the impact of the planning budget of the Australian state of Victoria on local government budget decisions. [7] He found that the information formed by the planning budget was very useful and came to the conclusion that managers could better identify the direct and indirect costs of expenditure by using the

information of the planning budget, and the cost was better controlled in this budget model than in other models. However, he also pointed out that although the information formed by the planning budget is applied to budget decisions, the scope of application is relatively limited. [7]

PPBE (planning programming budgeting and execution system) is a mechanism that uses performance information to influence the priority of resource allocation decisions. [8] PPBE is the forerunner and extension of modern performance budgeting, and it has been applied for a long time in the Department of Defense of the United States. In the past, most of the research methods of PPBE affecting the budget process were based on case analysis and subjective surveys and interviews, but few quantitative data methods were used, which was mainly limited by the availability and feasibility of performance evaluation data and budget. This paper attempts to use the data of the US Department of Defense to study whether performance information affects the resource allocation.

2. Defense Budget Process and Allocation Efficiency

2.1. Defense Performance Budgeting Process

The U.S. Department of Defense is a performance-based organization dedicated to results-driven management and focused on optimizing value to the American public. The PPBE (Planning, Planning, Budget and execution system) of the Department of Defense is an important pillar and decision-making framework of its results-driven management. PPBE is the forerunner and extension of modern performance budgeting. [9] PPBE is developed on the basis of absorbing the core of performance budget and planning budget (program budgeting) in the 1950s and integrating other elements. On the basis of absorbing the planned budget, PPBE pays more attention to improving the classification of budget and the rationality of budget structure. It also has a wide range of objectives to improve the priority, efficiency and effectiveness of expenditure.

From the four stages of the PPBE process, the defense performance budget process is essentially the integration of performance information into the planning, planning, budgeting and implementation process. To this end, in fiscal year 2007, the Auditor General of the Department of Defense established a working Group on performance budgeting (PBTF) in the Office of the Secretary of Defense to promote process integration and improve defense performance budgets.

In the planning phase, the Quadrennial Defense Review (QDR) report meets GPRA requirements, requiring each federal agency to submit a strategic plan. The QDR report forms the basis of the department's overall strategic goal and strategic objectives and is incorporated into the annual performance plan of the Department of Defense. It is necessary to update goals and objectives to reflect changes in strategic vision. At this stage, PBTF also worked with the key

staff assistants of each OSD to begin to develop relevant performance metrics to assess the achievement of each Department of Defense strategic objectives.

During the planning / budget phase, the composition of the Department of Defense forms the proposed plan, allocates resources, and prepares detailed budget submissions to support the department's performance objectives. Department of Defense investments in systems and other programs are clustered to support strategic goals and objectives within the Department of Defense or at the highest level. The Office of the Secretary of Defense uses its programme budget review process to assess whether the Department of Defense agencies meet the National Defense Department performance targets. Department of Defense departments are required to resolve any non-compliance issues in the Program objectives Memorandum (POM) briefing submitted to the Defense Department's high-level forum. Defense agencies are required to complete a budget presentation to determine the offset of resources for each agency's unfunded performance targets. During the budget review, a performance panel (PIT) decides whether the ever proposed performance objectives should be adjusted based on the POM of the Defense Agency or other relevant budget proposal. The final performance objective is recorded by a resource management decision signed by the Deputy Department of Defense.

During the budget implementation phase, the Department of Defense uses a process to collect and evaluate performance results from the Chief Assistant to the Department of Defense and submit results to the Deputy of Defense for management decisions. Taking right action is the last step in the process of departmental performance management. This process enables departments to quickly identify problems, analyze in-depth factors that cause problems, and decisively correct risky areas and narrow performance gaps.

2.2. Allocative Efficiency

Allocation efficiency refers to the government's ability to allocate resources based on the effectiveness of public projects in achieving their strategic goals. [10] It requires the government to have the ability to transfer resources from old priority projects to new priority projects and from ineffective projects to effective projects. Allocation efficiency requires the government to establish and prioritize goals and to assess the actual or expected contribution of public expenditure to these goals.

Some researchers have ever pointed out that it is difficult to measure and attain allocation efficiency, for unpriced public programs. [11, 12] This difficulty appears repeatedly in this article. Allocation efficiency will be optimized while the marginal social cost of delivering a program is equal to the marginal social benefits that reflect clients' preferences and tastes. Resources will be used to developed the program only when its marginal cost equals its marginal benefit. [13] This things also means that the social profits of the program will be optimized. [14] One question is how to measure the marginal benefits of program if no any price mark. Another relative issue is how to optimize the efficiency of multi-level public

programs with various interest metrics.

In another words, it is hard to suppose that performance assessment metrics well measure the marginal surplus of multi-level public programs, even if they are not economic resources, they are linearly related to budgetary resources (such as the United States dollar). But one thing is clear. If resources are reallocated to maximize allocation efficiency, fluctuations in the share of the public programme budget should at least be observed. A previous research suggests a helpful method to show how money flows between programs Table 1 explains the measures developed by Natchez and Bupp. [15]

Suppose there is a fictitious organization that executes three programs, A, B and C in three FY. The third line of Table 1, shows the budget for program for a particular year. The total line is the total sum of all institutional plans for each FY. For

example, \$450 is the sum of all three plans for fiscal year 1. The Plan ratio line is used to measure the relative share of each plan in the total annual amount. For example, the planned proportion of program in the first year is 0.22 (= 100,450). Since the proportion of plans may fluctuate greatly over many years, Natchez and Bupp recommend that the proportion of plans over the years be further standardized. [15] For example, the average Plan ratio line estimates the average of the program part over throughout three years. The average planned proportion of project C will be calculated as 0.46 (= (0.44) 0.55 (0.38) / 3). In the end, Natchez and Bupp calculate the prosperity change score by dividing the plan ratio by the average plan ratio (the last column). For instance, the prosperity change score for program C in fiscal year 1 is 96.85 (= (0.44) 0.46) * 100).

Table 1. Prosperity change score.

Fiscal year	program	budget	total	Program proposition	Mean Program proposition	Prosperity Change score
1	A	100	450	0.22	0.17	130.54
1	B	150	450	0.33	0.37	89.88
1	C	200	450	0.44	0.46	96.85
2	A	0	420	0	0.17	0
2	B	190	420	0.45	0.37	121.98
2	C	230	420	0.55	0.46	119.33
3	A	150	520	0.29	0.17	169.46
3	B	170	520	0.33	0.37	88.15
3	C	200	520	0.38	0.46	83.18

source: Ryu. Performance-Based Budgeting, Allocative Efficiency and Budget Changes: The Case of the US Department of Commerce. *Public Finance and Management*, 2013, 13 (4): 335.

In the study of allocation efficiency, Hou uses the program budget percentage variation range and its standard deviation as an alternative measure of budget reallocation. [16] Intuitively, the measure of Hou is almost the same as the score of prosperity and change. [16] However, the prosperity change score further explains the budget fluctuations in different fiscal years, which is the finer scale of budget redistribution. Ryu validates the link between project performance evaluations implemented by the U.S. Department of Commerce and prosperity change scores. [4] Therefore, this paper uses the measure index of prosperity change score to measure the allocation efficiency.

3. The Influence of Performance Information on Defense Resource Allocation

This paper uses performance evaluation and defense budget data from fiscal year 2010 to fiscal year 2017. In accordance with the requirements of the 2011 GARAMA Act, the Defense Department performance report for fiscal year 2010 began to display the results of performance evaluations, and the primary cause for using data eight-year time is that most of the budget was developed during the Obama era (2008-2016). Implementing agencies usually begin budgeting about 18 months prior to budget approval. Budget resource data are obtained from the Defense Department's Budget request

(overview), generally classified by Defense Plan (program), Budget Authorization (BA), and Budget Expenditure (outlay). The defense program classification is used to match the evaluation score of the defense annual performance report with the budget resources classified by program.

The dependent variable is the Prosperity change score adopted by Ryu [4] formed by Natchez and Bupp [15]. The prosperity change score reflects the rate of change in the allocation of budgetary resources by program classification (defense program), which is calculated as described above, and the prosperity change score is expressed as Y.

The main independent variable is the performance evaluation score related to the relevant budget resources. Information on performance indicators is displayed in the Department of Defense's annual performance report, which is evaluated and analyzed by annual performance goals and results, as shown in Table 2. The performance evaluation score reflects the change of the realization degree of different types of indicators, and the performance evaluation score = (actual value-target value) / target value * 100. As mentioned above, the expected performance evaluation score will have a positive impact on budget allocation.

In addition, there are control variables. Ho reported that whenever more indicators of achievement were available, sector budget manager and project managers were more possible to debate project running and program availability internally. [3] Count1 means the amount of performance indicators for a budget combination in every performance goal

hierarchy. Expected Count1 may be positively correlated with prosperity change scores, as performance-based budget person are more possible to make use of things to improve

allocation decision. The variable is possible to be positively related with prosperity change scores.

Table 2. Performance measure.

Strategic Goal	Strategic Objective	Performance Measures	Annual performance target and result				performance evaluation score
			Fiscal year target	Fiscal year result	Met or exceeded	Did not met	$X=(X_{result}-X_{target})/X_{target}*100$
SG 1	SO 1.1	1.1.1	--	--	--	--	--
	SO 1.2	1.2.1-1F1	--	--	--	--	--
SG2	SO 2.1	2.1.1-1F1	--	--	--	--	--
		2.2.1-1F2A	--	--	--	--	--
SG 3	SO3.1	3.1.1-1F2B	--	--	--	--	--

Source: The Fiscal Year Annual Performance Report (APR) for the U.S. Department of Defense. <http://comptroller.defense.gov>

As the budget increases, budget decision makers may have more room to adjust the planned budget. [17] Budget incrementalists predict that the prior budget is the most critical predictor of the current budget. [18] Other control variables include the organization's budget size by program and the absolute percentage of departmental budget changes (percent). The first variable is expected to be positively correlated with the range of budget changes within the department. With the increase of the size of the departmental budget, the room for adjustment of the internal budget of the department increases, especially in the case of financial pressure. In addition, if there is a significant change (increase or decrease) in the parliamentary budget, a department may have to make a major change in its plan. Finally, the key independent variable X and the control variable program are taken logarithmic form to reduce the estimation deviation caused by different dimensions.

The basic model structure is similar to formula (1)

$$y_{i,t} = \sum_{k=1}^K \beta_k x_{i,t-1,k} + \gamma_i + \delta_t + \varepsilon_{i,t} \quad (1)$$

$y_{i,t}$ represents the prosperity change score of year t cross-sectional i (the type of program program that the Department of Defense matches strategic goals or strategic objectives). For simpler representation, formula (1) and subsequent formula do not cover intercept, but all models are estimated as intercept. k means the number of variables, all of which are included in the panel model with an one-year lag value, γ denotes errors related to cross-sectional i , errors related to t -years, and random errors related to cross-sectional i and t -years (cross-sectional i and t -years). The potential risk in Formula (1) and the following formula is that there may be a unit root, so I ran a panel unit root test based on ImPesaran Shin on all formula. [18]

There may be one important question on method from budget theory. In the public budget, it is widely known that the public choices for this year reflect those of previous years. If so, formula (1) should be similar to formula (2) below.

$$y_{i,t} = \alpha y_{i,t-1} + \sum_{k=1}^K \beta_k x_{i,t-1,k} + \gamma_i + \delta_t + \varepsilon_{i,t} \quad (2)$$

The lagged explained variable shows the non-static feature

of budget selection. But that lagging dependent variables may be related to residual terms, which leads to endogenous problems. Moreover, the type of used data is small T (time series) and large N (cross section) panels as examples. The generalized method of moment (GMM) based on Arellano and Bond can eliminate the non-uniformity of fixed or random effect errors by taking the first difference of formula 2, like in model 3 below. [19] In line with Roodman (2008 and 2009), a virtual variable for the year is added to formula 2. for fear of solve the problem of endogenesis, the classical Arellano-Bond Difference-GMM differential GMM is adopted. [20, 21] Differential GMM also brings the problem of weak tool variables. Then another method, called system GMM, is developed based on Maurice J. G. Bun, Frank Windmeijer. [22]

There are more considerations in the GMM-type model. For fear of the endogenesis mentioned above, the tool is identified so that the inner product of the tool or the error moment in the regression model would be zero. But if the number of moment conditions (i.e. equations) exceeds the number of variables (i.e. parameters), then the moment conditions cannot be fully established in example, and the result is over-identified. Generally speaking, both Sargan test and Hansen test are for the purpose of testing over-recognition. Sargan test is less robust to heteroscedasticity and sequence correlation, when Hansen test is more robust to heteroscedasticity and sequence correlation. However, the Hansen test may be weakened as the number of tools increases. In fact, scholars often would take in the zero hypothesis without over-recognition, because the Hansen test statistics are incredibly close to the p value of 1.000. GMM systems are particularly vulnerable to this risk. [20, 21]

These empirical results support the hypothesis that PPBE integrates performance information to play a role in the allocation of budgetary resources at the plan level, although its success is at the planning level within the department. These findings show that, at least at the departmental project level, PPBE can effectively play the role of budget decision-making tools, which is positive. This also seems to fill a gap about paradoxes. Although many findings documents have shown that PPBE does not affect the allocation decision of the public budget.

Table 3 states statistics feature for all parameters in every

formula. Table 4 reports the results of the linear regression model, the fixed effect model and the dynamic panel model of the ordinary square method. The study found that, compared with other models, the result of the fixed effect model of panel data is more significant, and the performance evaluation score X has a positive and significant impact on the budget allocation at the planning level of the Department of Defense. To control other variables, for every 1% change in performance evaluation score, the change in budget allocation will change by 4.79%. When other variables are constant, the impact of the budget size of the national defense plan (program) on the budget change is a positive significant correlation.

Table 3. Variable statistic.

Variable	Obs	Mean	Std.Dev.	Min	Max
y	64	102.968	29.969	74.743	319.385
x	64	13.519	16.713	0	85.3
program	64	77290.55	83285.62	11748	339000
count1	64	6.094	5.8	0	25
precent	64	11.075	11.794	1.433	42.29

The regression results here also show that after controlling other factors, there is a negative correlation between the changes in the budget at the program level and the number of indicators used to measure performance. There are two possible explanations. First of all, there are more departments based on performance measures that can improve their management style and pay more attention to the public. Finally these sectors may gain greater credibility from constructor and budget person, and they are impossible to meddle and adopt their inside program budgets. Secondly with results-based assessment these sectors may be in a better position to demonstrate the development of various programs and explain how they promote strategy objectives and priorities. So these sectors can acquire less assessment from outside and could attain greater steadiness in their program budget. In fact performance assessment may not achieve more or less money, because some political and financial factors also have an effect on budgeting. These factors suggest that this measurement may make more inside financial steadiness for a sector in the budget.

Table 4. Model result.

	(1) OLS	(2) Panel	(3) GMM
lnx	9.413 -7.1	4.639* -2.48	0.145 -0.79
lnprogram	10.311* -5.94	129.426*** -9.78	12.377*** -2.22
count1	-0.572 -0.67	-0.119 -0.51	0.166 -0.16
L.y			0.041 -0.03
_cons	-30.29 -72.92	-1329.246*** -107.25	-43.529* -24.22
N	64	64	64

Standard errors in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4. Conclusion

If it is correct that the Defense Department PPBE has some positive resource allocation role at the planning level, it will give some enlightenment to public budget and management. First of all, more attention should be paid to the analysis at the program level. This is where public managers do their day-to-day work, and where strategic planning, performance objective and planning and budgeting are linked. [23] This is particularly important for large public sectors such as the Ministry of Defence, where program structures can help support attention to core tasks and many different actions. If local governments are interested in making effective use of the PPBE system, they should first consider how to develop appropriate and available program structure. For scholars interested in analyzing the impact of PBB, more work is needed to study its usage at the departmental level, and PPBE can be regarded as a multi-level exercise. Future research should further explore how performance information affects interdepartmental and intra-department resource allocation decisions.

As seen here, PPBE program focuses on strengthening the management-oriented necessity of the budget. Obviously, within the budget department and department, budget and management are inseparable. Past studies have shown that simply including a large number of performance metrics in budget or departmental reports does not guarantee that decision makers will use this information. In order to attain effective use of performance information, an effective performance management system need managers and budgets to report, review and discuss performance on a regular and disciplined basis.

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