A Logit Model for Budget Allocation Subject to Multi Budget Sources

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ABSTRACT

In a complex and extended system such as a government, the proper allocation of the budget to its sub-entities is always a major challenge. As such for cases like governments, a situation in which multiple budget sources with different concerns available to the sub-entities is common. This study develops an applicable model for large-scale cases in which identifying the flow of capital or budget from (multiple) sources to the sub-entities is sought. Since the influential factors to the allocation process may be mingled with some unknown parameters (as well as known factors) a logit model is developed from past panel data. The logit model is based on the concept of utility, which quantifies the advantage of approaching budget-sources for the sub-entities. Then the budget allocation problem of logit form is written as a mathematical programming formulation for which Successive Coordinate Descent (SCD) method is proposed as the solution algorithm. In this paper, the proposed methodology is tested numerically. The results of this study show there is strong evidence that some of the entities’ properties can be altered in order to achieve a better budget allocation.

Keywords: Budget Allocation, Logit Model, Mathematical Programming, Public Sector, Successive Coordinate Descent (SCD)

INTRODUCTION

Budget allocation always is a major challenge to the success of any government. There are several practices handling these challenges advocating by different types of stakeholders. The variety of opinions in any political system and lack of systematic solutions implies that the problem is more of a general issue and differs in various environments, with many unknown but influential parameters. This generality and complexity could be exacerbated as the size of entities increases and may create a situation in which multi budget sources are available to the sub-entities. Governments are entangled within multi budget sources situations:

• On one hand, there are several budget sources with different and various concerns and criterions to release their written budget to the relevant sub-entities. These budget sources are focused on various fields or purposes.

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On the other hand, the sub-entities may be qualified and entitled to approach various budget sources due to their broad, multi-field, or multi-purpose activities.

Capital allocation in banking system can be a clear application of the defined budgeting problem. For instance, imagine a corporate (sub-entity) that is interested in developing a cotton mill. This activity may attract investment attention from agricultural banks as well as industrial banks; each has their own criterion and concerns spanning interest rates to required collateral or security policies. Thus the aforementioned corporation evaluates the utility (or disutility) of the banks in order to decide about its borrowing portfolio. The utility is defined as combination of different influential parameters with various impacts. In the above case, interest rates, cost of borrowing, required securities (or needed collateral) are the most known and influential parameters. However we believe that the complexity of the problem as introduced before is emerged from the fact that there are some unknown parameters affecting the decision process, especially for government. All of these arguments indicate usage of the discrete choice models belong to the consumers’ theory, in which the customers choose the appropriate product according to their maximum expected utility (in our cases, customers and products are the corporate and the banks’ loan respectively). The most widely used and well-recognized discrete choice models are logit models. Logit models are in form of a linear equation of various variables (parameters) with different weights (impact). These functions must be calibrated according to the past observations pertaining to the consumers’ behavior. In different cases, panel data could be the past fiscal budget schemes for the states. In this study, a sample survey of a bank’s customers provides raw data for calibration in this study.

Given the utility functions (as an exogenous element to the algorithm) a mathematical programming framework as well as a solution-finding algorithm is developed. In this study, we have developed an intuitive utility functions for the adopted case-study. We introduce a case-study of Bank-Loan situation, in which the interest rates of the banks products (loan) is a main factor in the utility of the loan-seekers. Since one of the main objectives of this study is to tackle the budgeting problem for real size cases, a large scale dataset for the case-study with highly unpredictable and unbiased characteristics was developed.

As a result, the contribution of each budget-source to the sub-entities’ needs can be examined. Obviously in the case of budget deficit the capital needs of all the sub-entities will not be supplied. The budget deficit cases can be easily addressed by introducing a dummy budget-source associated with capacity of infinity and high disutility. This makes the dummy source the last resort for the sub-entities. A similar structure has been introduced by Spiess (1996), in which traffic trips are split into two trips distinguished by intermediate park-ride destinations.

In addition, this study provides a model to watch the capital flow so as to identify the bottlenecks. Easing (or tightening) some parameters such as interest rate in the case of corporate/bank and providing more/less budget with the budget-sources to facilitate the capital flow, are of the expected result of the proposed methodology. The latter is elaborated as an application of the methodology in the form of a numerical test.

The paper is organized as follows. In the second section of this paper there is a literature review. Following this the third section demonstrates the formalized methodology. The fourth section is dedicated to the adopted solution algorithm. The fifth section presents the numerical tests and discusses the implications of the solutions and results. The seventh section summarizes and concludes the study.

**LITERATURE REVIEW**

One of the most perennial problems that governments face is the optimal allocation of budgets given scarcity of resources (Groves &
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