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Problem Definition

The basic problem in budgeting a governmentally subsidized service is that the total cost of the service usually remains unknown, leading to a discrepancy between the subsidy and the real cost of offering the service. This problem is complicated by a difficulty common to all budgeting: the need to constantly revise budgets to reflect changing conditions conflicts with the need to construct them for a fixed period of time.

The purpose of this article is to develop a full-cost pricing scheme for a service whose fixed costs (those associated with making the service available) may change over time, but whose market price must include variable costs (those associated with offering the service). This is tantamount to determining the time path of future subsidies for offering this service. The approach needs to be

a. dynamic, so that it can determine the amount of subsidy needed at each decision point in time,
b. derived from an understanding of subsidies and economic theory, and
c. compatible with standard accounting systems.

Such a model would be generalizable to any service subsidized in any fashion, including in-house services (e.g., consulting) that firms provide to other cost centers in the same organization and to systems where a subsidy is permanently needed such as when subsidized services are never expected to reach break-even volume.

The Method

Two cost questions are paramount:

1. What portion of fixed costs should the service-granting organization bear?
2. What should the service cost be?

The answers depend, first, on prior decisions that may be non-economic. A service exists to satisfy demand, and in the long run the user commonly bears part of the total cost of the service; but how much the user bears depends upon the type of service. A health care facility for the indigent, for example, may be subsidized completely, while a technology transfer center will be expected to recoup its service cost eventually. A model, then, must be flexible enough to provide for a range of payback assumptions. While ignoring the subjective measurement of social benefit, our model allows the long-run percentage of fixed costs subsidized (i.e., the loading factor) to vary between 0 and 100 percent.

A graphical linear breakeven model of a subsidized service appears in Figure 1, with:

FC = Fixed Costs
V = Variable Costs
TR = Total Revenue

TC = Total Costs

Q* = Long-Run Expected Activity. The program was to be subsidized until volume reached the "break-even" point.

q_1 = Actual Usage

R_1 = Revenues Necessary to Breakeven at q_1

R_2 = "Expected" Revenues During "Initial" Subsidy Period

MC = Marginal Cost of the Service

P = Transfer Price of the Service (i.e., slope of TR)

$R_1 - R_2$ represents the required subsidy at usage level q_1.

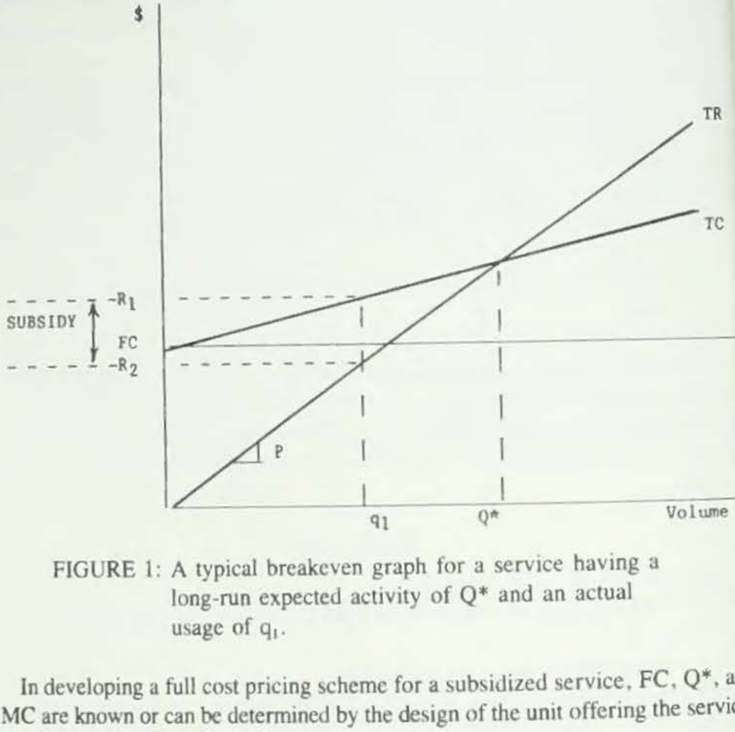


FIGURE 1: A typical breakeven graph for a service having a long-run expected activity of Q* and an actual usage of q_1.

In developing a full cost pricing scheme for a subsidized service, FC, Q*, and MC are known or can be determined by the design of the unit offering the service, but P must be determined. In general,

1) $P = MC + LF(FC - S)$,

where S is the subsidy for the service, and LF is the per unit loading factor for the fixed costs.

The subsidizing agent will often use inefficient trial and error approaches to solve Equation (1), selecting among three possible actions:

1. Alter the user fees (i.e., P)
2. Alter the subsidy (i.e., S)
3. Alter the expected activity (i.e., FC)

Many public sector and non-profit organizations have experienced significant problems because they used short-run budgets and plans for subsidized services. For example, during the 1960s, the Ford Foundation spent $2 million to help establish Monteith College at Wayne State University as an "honors college" for "non-honors, average students." The concept of unstructured education was innovative and expensive. When the subsidy expired, Monteith's demise was not far behind [Riesman, Gusfield and Gamson, 1970].

Budgeting's Role in Solving the Problem

Horngren (1985, p. 123) defines a budget as a quantitative expression of an action plan with the usual planning and control period of one year. A good budget helps management plan, coordinate, implement, and evaluate operations.

Our dynamic budgeting model has significant advantages over the three types of budgets that the public sector generally uses: line-item veto, zero-based budgets (ZBB) and incremental budgets. Under a line-item veto, the executive can unilaterally delete expenditures unless the legislature overrides the decision (usually requiring a two-thirds majority). While the governors of 43 states and many other governmental executives e.g., county commissioners have this power, other than applying incremental budgeting actions e.g., veto any appropriation exceeding 2%, above the rate of inflation, the line-item veto method is seldom applied systematically and is often subject to partisan pressure.

ZBB is said to have originated in 1924 when C. Hilton Young advocated rejustifying budgets annually (Buck [1934, p. 172]). However, it was not until the early 1970s that ZBB became the watchword for effective control of the management process. After "successfully" applying this concept as Governor of Georgia, President Carter asked each federal agency to develop its 1979 fiscal year-end budget using a ZBB system (Herzlinger [1979]).

Many experts have criticized the ZBB concept of rejustifying all expenditures "from scratch" each year. Robert Anthony [1977] stated that the concept was not workable. In general the concept proved impractical because of the massive time required for implementation (e.g., ranking and consolidating programs). In 1981, President Reagan cancelled the ZBB requirements. While some private corporations and municipalities (e.g., see Connel [1980]), universities (e.g., see Bennett, Owen and Warner [1980]) and CPA firms (e.g., see Brown [1981]) have experienced some success with the ZBB concept, implementation has remained a problem.

Incremental or priority incremental budgets require the government agency to concentrate each year's review on proposed increases while the "base" (current level of spending) receives little scrutiny. Again, however, the process may be difficult to implement because immediate priorities often overrule long-term objectives, and the process generally ignores long-term considerations.

The budgeting model reported here is superior to these three approaches in that it considers the long-run effects of offering a subsidized service, and it can then alter the subsidy or price based upon changes in demand or other priorities.

Model Development

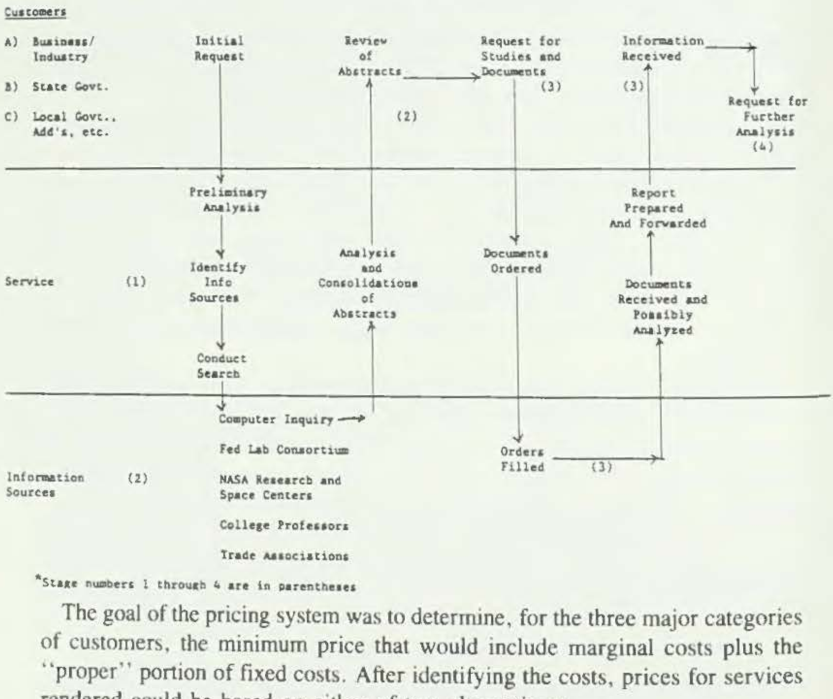
The following case study demonstrates an application of the model summarized by Equation (1) for a full-cost pricing scheme for a subsidized service. The model was implemented for a government-sponsored program whose goal was to transfer technology from its data bases to state and local government units and to private industry. The initial pricing strategy was to charge users only the variable costs of the service, with the government subsidizing the fixed costs. Total costs were absorbed and fees were then raised to cover actual costs as demand changed, with the long-run goal of eliminating the subsidy. While the government never expected to recover this subsidy, subsequent additions to capacity were to be funded by other means. Thus, a short term marginal cost pricing scheme provided the necessary pricing and subsidy information.

The marginal costs of primary interest are associated with the actual process of supplying customers with the requested information. In our application all search procedures consist of two stages: (1) identifying the problem and reviewing the abstracts, and (2) analyzing the relevant information and reporting the results to the users. As outlined in Figure 2, four steps are required to provide this service:

1. Develop the problem and design the search strategy.
2. Initiate the search process, conduct the initial data analysis, and prepare a report.
3. Supply documents.
4. Conduct ex-post analysis and additional report preparation.

The costs of obtaining the above information generally varied by the type and complexity of question asked.

FIGURE 2
FLOW OF SERVICES*



*Stage numbers 1 through 4 are in parentheses

The goal of the pricing system was to determine, for the three major categories of customers, the minimum price that would include marginal costs plus the "proper" portion of fixed costs. After identifying the costs, prices for services rendered could be based on either of two alternatives:

1. Cost ranges can be used to ascertain minimum and maximum charges on the cost of the service, with the agency absorbing (or receiving) any costs exceeding (less than) the quoted range.

2. A single, weighted average quoted price can be used, again with the service-granting agency absorbing the differences.

Although we used the second alternative for pricing purposes, the model also may be calibrated using the first alternative.

The objective of the analysis is to determine a price (P_j) for service j:

(1–a) $P_j = MC_j + LF_j(FC - S)$

where

MC_j is the marginal cost associated with service j.

LF_j is the fixed charge loading factor for allocating fixed costs among the three customer services j (i.e., $\sum_{j=1}^{3} LF_j = 1$).

FC is the fixed cost of offering the service.

S is the subsidy (i.e., $TC_j - TR_j$).

The pricing scheme represented by equation (1-a) is general in that

1. if $S=0$, P_j is the breakeven price at Q_j^*; however, $S = 0$ only if designed capacity equals actual capacity;
2. if $S = FC$, the subsidy equals the fixed cost of offering the service, and the user pays only the marginal cost associated with its use;
3. if $0 < S < FC$, then the offering agent agrees to absorb a percentage, S/FC, of the cost of the service, which generally occurs under "normal" initial situations.

Defining Q_j^* as the long-run expected activity of the service at the break-even point,

2) $Q_j^* = D_j$

where D_j is the demand for the service j. In general, D_j is a function of the price, P_j, and the utility of the service, U_j, as follows:

3) $D_j = f(P_j, U_j)$

Since the goal is to price a non-profit service (i.e., equation (2) holds) by specifying D_j, P_j could be determined by substituting (3) into (1-a). In the problem investigated, as with most new services, a lack of "history" of product demand prevented determining a functional form for equation (3). Instead, a marginal cost pricing scheme was used to determine MC_j and LF_j.

Since marginal cost equals the average variable cost when the latter is at the minimum, estimating fixed costs and minimum variable costs insures that the result is a minimum price for the service that fully absorbs all costs minus the subsidy. To obtain a full-costing loading factor LF_j,

$$LF_j = \frac{VC_j}{\sum_{J=1}^{N} VC_i} \qquad \text{for } j = 1,2,\ldots N$$

where N is the number of services offered.

Colantoni, Manes and Whinston [1969] provide the rationale for allocating fixed costs based solely upon variable costs, as used in this subsidized services model. Generally, fixed costs should be allocated based upon the "right" to use a service (i.e., the long-run capacity to provide the service). For example, fixed maintenance costs are allocated based upon relative square footage—regardless of actual maintenance used. However, in pricing decisions, their methodology yields the total minimum price which can still absorb all fixed costs. That is, it satisfies the least price criteria goal of the services.

Application

The results of a work methods study helped estimate the long-run activity of Q* and the associated variable costs. Each technician accumulated the elapsed time to completion for each request and categorized the data according to the stage of the analysis. Following a 100% sampling for six weeks, 179 inquiries helped form preliminary cost and time estimates.

Table 1 shows the variable cost estimate that results for each type of request—state and local government and industry, respectively. For example, the state government's requests at Stage 1 averaged \$8.13 and totaled \$49.00.

TABLE 1

AVERAGE VARIABLE COSTS AND
FIXED COST LOADING FACTORS

	Agency			
	State Government	Local Government	Business and Industry	Total
Average Variable Costs [for the Technology Transfer Service by the Requesting Agency]				
Stage 1	8.13	8.44	24.50	
Stage 2	40.87	45.90	45.35	
Total	\$49.00	\$54.34	\$69.85	
Fixed Costs Loading Factors				
Actual Variable Cost (as a ratio of total variable costs)	.28	40	32	1.00
Full Utilization Load (Based Upon Actual Time Studies)	250	230	230	710
Loading Factor per Job	.00112	.00174	.00139	.0014

Based upon a six-week pilot study of time estimates, computations and work study information, it was estimated that the unit could handle 710 typical requests per month—with the state governments, local governments and business and industry normal activity at 250, 230 and 230 monthly requests, respectively. However, during the start-up period, the unit operated at approximately 20 percent of capacity, with actual variable costs for the three service classes comprising 28, 40, and 32 percent, respectively, of all variable costs. As also noted in Table 1, the loading factor per job (LC_j) equals the above quotient of costs divided by the expected long-run activity for each service class [i.e., (average variable cost as a ratio of total variable costs)/(long-run expected activity for that agency)].

Combining the information from Table 1 yields the prices charged for the subsidized services, where P_1, P_2 and P_3 represent state government, local government and business/industry, respectively.

$P_1 = \$49.00 + .00112(FC - S)$

$P_2 = \$54.34 + .00174(FC - S)$

$P_3 = \$69.85 + .00139(FC - S)$

By analyzing the variance of expected revenues over time, a time path of price and subsidy as a function of utilization can be determined. If the demand for the service grows as expected, the subsidy will reach zero, and the price equals the actual variable costs plus a portion of fixed costs. However, if the actual subsidy exceeds the planned subsidy, FC must be decreased, or demand increased to meet long-run objectives.

Conclusions

This paper presents a method for planning subsidies over time for a not-for-profit service. In particular, we showed by actual case history how to estimate a full cost pricing scheme.

The relationship $P_j = MC_j + LF_j(FC - S)$ yields a price for service j given a subsidy. As time "progresses," the effect of changes in the subsidy can be analyzed. The objective is to reach a zero subsidy level. By Figure 1, we see that this is at the long-run expected capacity Q^*. If Q^* is not attainable, the model can be used to forecast the required subsidy given q, or be used to determine the new price given actual utilization. In either case the model can predict the budget impact by utilizing the interrelationship between price and subsidy.

Thus, the developed budgeting model is superior to conventional models in that it sets a long-run perspective, provides a method for continual change, and terminates with (a) a zero or minimum subsidy, or (b) costs of maintaining the subsidy incorporated into the decision model.

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