Table of Contents

Appendix A

Characteristics of Pilot Study Sites

Characteristics of Pilot Study Sites

This appendix describes the criteria used to select the pilot study sites and presents a overview of the characteristics of the 18 SFAs that participated in the study.

The Meal Cost Methodology Study was conducted in a purposive sample of 18 SFAs. The original plan called for a sample of 20 SFAs clustered in four states; however, two SFAs dropped out of the study prior to data collection and were not replaced. The sample was not intended to be a nationally-representative sample of SFAs. Rather, the sample was selected so that it included variation along several dimensions which were hypothesized to affect meal production costs (such as size and type of production system used) and the feasibility of implementing the direct measurement approach.

Selection of States

The resulting sample of SFAs was clustered in four states. Clustering the SFAs within states served several objectives:

- reduced the travel costs between SFAs thereby maximizing the information obtainable with limited study resources;

- allowed for the selection of SFAs that operate under a range of state cost reporting requirements, and in particular allowed for the selection of states that practice some form of full-cost accounting for their Child Nutrition programs; and

- simplified the recruitment of selected SFAs by reducing the number of contacts required.

The clustering of SFAs within states did not affect the study's ability to include both urban and rural SFAs, as well as variation in those SFA characteristics that were hypothesized to affect meal production costs.

FNS selected 12 states as potential sites for the study: Arizona, Florida, Kentucky, Louisiana, Maryland, Michigan, Mississippi, New Jersey, New Mexico, New York, Pennsylvania, and Utah. Study staff interviewed the State Director (or their designees) in each of these states to determine the type of cost-accounting practices used by the state and to identify the information about individual SFAs that was available at the state level. The interview also addressed state-specific issues that would affect the feasibility of conducting the study in their state. Based on these interviews, the following four states were selected for participation in the Meal Cost Methodology Study:

- *Full-Cost Accounting States*: Florida and Maryland;

- *Other States*: New Jersey and Arizona.

Four of the 12 States identified by FNS as potential sites for the study use some form of full-cost accounting: Florida, Maryland, Kentucky, and Mississippi. Of these, Florida and Maryland have the most extensive cost accounting systems in terms of level of detail and supporting documentation required. In addition to the relative sophistication of the cost accounting systems used in these states, the proximity of Maryland to FNS headquarters in Alexandria, Virginia made it feasible for FNS staff to accompany study staff on at least some of the site visits to observe the data collection activities.

Of the remaining states, New Jersey is the only state that does not require some form of uniform cost reporting.[1] While Florida and Maryland were selected to provide a test of the methodology in SFAs that routinely maintain a great deal of supporting documentation on food service costs, the absence of any uniform cost reporting system in New Jersey allowed for a thorough test of the methodology in SFAs that do not ordinarily maintain detailed records of food service costs.[2]

Arizona was selected to increase the geographic diversity of the study sample. Arizona requires SFAs to submit an simple Annual Financial Statement using uniform reporting categories.

Selection of SFAs and Summary of SFA Characteristics

With only 20 SFAs to be included in the study sample only a limited number of characteristics could be used in the selection criteria. Two factors were viewed as most likely to affect the feasibility of implementing the methodology in an SFA and the reliability of the data produced: SFA size and the type of meal production system used. Meal production systems are defined in terms of the relationship between the serving site and the production site. On-site production refers to the system where meals are both produced and served at the same location, typically a school. Satelliting refers to the system where meals are produced at one location, a base or central

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[1]Under uniform cost reporting, SFAs are required by the state to report their costs using a standard format specified by the state. By contrast, states using full cost accounting systems attempt to capture all of the costs of production. Full cost accounting is a measurement as opposed to a reporting system.

[2]Since a large proportion of SFAs in New Jersey use food service management companies to operate their food service or have vended meals, the selection of New Jersey also allowed for the inclusion of such SFAs in the study sample.

kitchen and served at another location, a satellite school. For the most part, satellite schools have limited kitchen facilities and staff because the meals are produced elsewhere. The following two way classification system based on these two measures was used in recruiting 16 of the 20 sites for the study:

- large SFA, little satelliting;
- large SFA, significant satelliting,
- small SFA, little satelliting, and
- small SFA, significant satelliting.

Approximately one SFA in each of the four states was selected in each of these categories. The remaining four SFAs were chosen to include one SFA with an enrollment of 100,000 or more; one SFA that uses a food service management company (FSMC); one SFA with vended meals; and one SFA without a breakfast program.

SFAs were classified as large or small using the median enrollment in each state. The type of production system used by an SFA was measured by the percentage of serving sites that were also production sites. In Florida and Arizona, where there is relatively little satelliting, SFAs in which less than 90 percent of the serving sites were production sites were classified as having significant satelliting. In New Jersey and Maryland SFAs tended to use on-site production or satelliting (i.e., a bi-modal distribution). In these states the ratio of on-site production sites to satellite sites was used to classify SFAs as all or mostly on-site production or all or mostly satellite production.

The selection of sites for each category was based on a review of SFA characteristics provided by the states and information contained in the QED school district data base.[1] The following variables were considered in the selection process:

State Data

- district enrollment;
- number of schools in the district;

[1]Quality Education Data is an educational products marketing firm (located in Denver, Colorado) that maintains an extensive data base on school district characteristics. This data base is updated annually.

Table of Contents

- proportion of schools with a breakfast program; and
- proportion of children approved for free or reduced-price meals.

QED Data

- grade span (i.e., K-12, K-8 (or 6));
- racial mix (i.e., % white, % black, % hispanic);
- per pupil expenditures on instructional materials;
- metropolitan status (urban, suburban, or rural); and
- enrollment shift (i.e., % change in enrollment since 1982).

The 20 sites initially included in the sample offer considerable variation on each of the selection factors:

enrollment:	760 to 150,668,
number of schools:	3 to 165,
proportion of schools with SBP:	0% to 100%,
grade spans:	includes both K-12 and K-8 (or 6),
proportion of children approved for free or reduced-price meals:	1.7% to 63.9%,
percentage white:	51% to 93%,
percentage black:	0% to 35%,
percentage hispanic:	1% to 47%,
metropolitan status:	includes urban, suburban, and rural school districts, and
enrollment change since 1982:	-(21%-30%) to +(21%-30%).

Exhibit A.1 presents a summary of the 20 SFAs included in the initial sample (and identifies the two SFAs that dropped out of the study).

Exhibit A.1

Summary of SFA Characteristics

							Racial Mix						
SFA	State	Enroll-ment	No. of Schools	No. w/ SBP	% F/RP	Grade Span	White	Black	His-panic	Materials Expend. Category	Metro Status	Enrollment Change Since 1982	Type of Meal Production System
01	FL	150,668	165	161	29.3%	K-12	63%	28%	7%	7	urban	+11-15%	Little Sat.
02	MD	12,587	25	12	13.6%	K-12	92%	6%	1%	5	suburban	no change	Little Sat.
03	MD	5,505	12	9	23.9%	K-12	63%	35%	1%	8	rural	+6-10%	Sig. Sat.
04	MD	11,140	24	23	37.3%	K-12	96%	2%	1%	8	rural	-6-10%	Sig. Sat.
05	NJ	18,999	29	25	70.4%	K-12	14%	58%	27%	7	urban	+6-10%	Vended Meals
06	FL	21,277	25	25	37.2%	K-12	64%	33%	2%	4	suburban	+16-20%	Sig. Sat.
07	FL	19,587	26	20	37.4%	K-12	74%	7%	18%	7	rural	+11-15%	Little Sat.
08	FL	4,679	9	4	46.3%	K-12	76%	21%	2%	5	rural	+1-5%	Sig. Sat.
09	FL	1,858	3	3	49.2%	K-12	84%	14%	1%	5	rural	+6-10%	Little Sat.
10	FL	120,364	145	141	40.8%	K-12	68%	21%	9%	5	urban	+1-5%	Little Sat.
11	AZ	3,768	7	6	63.9%	K-6 (or 8)	74%	4%	20%	8	suburban	+6-10%	Sig. Sat.
12	AZ	1,997	5	2	29.0%	K-6 (or 8)	91%	0%	8%	8	rural	+21-30%	Little Sat.
13	AZ	1,357	3	3	41.4%	K-12	51%	1%	47%	7	rural	no change	Sig. Sat.
14*	AZ	1,199	3	2	1.7%	K-12	92%	1%	5%	2	rural	-21-30%	Little Sat.
15	AZ	1,102	3	3	41.9%	K-12	72%	1%	27%	7	rural	+1-5%	Sig. Sat.
16	NJ	3,913	10	10	67.9%	K-12	61%	33%	3%	5	urban	+6-10%	Sig. Sat.
17	NJ	2,562	5	4	7.6%	K-12	93%	1%	4%	8	rural	+1-5%	Little Sat.
18	NJ	760	3	3	33.8%	K-6 (or 8)	69%	8%	22%	6	suburban	-6-10%	Little Sat.
19	NJ	3,641	8	6	51.9%	K-12	50%	32%	16%	8	urban	+1-5%	FSMC
20*	NJ	1,662	5	0	5.4%	K-12	94%	2%	2%	8	suburban	-6-10%	Little Sat.

*SFA 14 dropped out of the study following a change in its food service director. SFA 20 could not schedule the site visits during the study's field period (November 1990-March 1991) and had to be dropped from the study.

Table of Contents

APPENDIX B

DISTRIBUTING COST TO FOOD SERVICE FUNCTIONS

Table of Contents

Distributing Cost to Food Service Functions

A System of Functional Accounts

Commonly used in business, a system of functional accounts is designed to provide management with information regarding the cost of each of the organization's activities. In general, an organization's activities fall into two broad categories: 1) the production of end products for sale to customers, and 2) management and service activities that support the production of end products. A system of functional accounts also facilitates the determination of the **full cost** of each of the end products.

The cost of management and service activities are viewed as **indirect product costs** in that they are not traceable to specific end products. In full-cost accounting, a share of the cost of each of the management and other service activities is allocated to each of the organization's end products. For example, in manufacturing it is common to distribute management and plant supervision costs in proportion to the number of employees engaged in the production of each product, while distributing maintenance costs in proportion to the value of the equipment used in the production of each product.[1] Despite the variation among SFAs in size, type of meal production/serving systems used, and organizational complexity, the major activities that form the basis for a system of functional accounts are relatively simple.[2] The major SFA activities are: lunch production; breakfast production; and non-meal production activities (including SFA administration space, storage and transportation of food, and transportation of meals). In the functional cost analysis, all non-meal production activities are seen as activities in support of meal production. The cost of these non-meal production activities must be distributed to lunch and breakfast production. The full cost of lunch and breakfast includes the direct cost of lunch and breakfast production plus a share of the cost of non-meal production activities.

The distribution of line-item cost elements to functional activities involved a combination of direct attribution (e.g., food costs from production records) and allocation. Food and labor are most amenable to direct attribution. Meal production records were used to identify those foods used in lunch and breakfast production; recipes were used to identify the ingredients included in

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[1]The concept of functional cost accounting and the issues involved in allocating the cost of management and other support activities to end products is contained in standard texts on managerial accounting. See Shillinglaw, Gordon and Phillip Meyer, **Accounting: A Management Approach** (Homewood, IL: Richard D. Irwin, Inc., 1983).

[2]An SFA with several production and/or serving sites might want to classify each such site (or type of site) as a cost center. This would enable the SFA to compare unit costs at each such site. Such distinctions were beyond the scope of the present study.

those foods; while invoices were used to identify the prices paid. Similarly, a time study was used to identify the labor costs attributable to each activity.

Costs other than food and labor that are not traceable to specific SFA activities were allocated across SFA activities. Two bases were available for this allocation: 1) the proportion of total labor costs attributable to each activity; and 2) the proportion of total direct costs attributable to each activity. The labor cost basis is the most predominant method used by business. It avoids allocating a disproportionate share of these costs to lunch and breakfast production that would result from using the direct cost basis (since food costs are exclusively direct meal production costs)[1]. Both methods were tested in this study.

The procedures used to distribute total food costs between lunch and breakfast production and the procedures used to distribute labor costs across SFA activities are discussed below.

Distributing Food Costs Between Breakfast and Lunch

During the on-site visits the cost of food used in lunch and breakfast production was directly measured during one observation week in a sample of meal production sites in each SFA. The proportion of total food costs at these sites used in lunch and breakfast production was then used to allocate the SFA's total annual food costs between breakfast and lunch production.[2] The following procedures were used.

1) *Identify each menu item produced and served at breakfast and lunch.* Menus and production records were used to identify the quantities of each of the items produced and served.

2) *Use standard recipes to identify the quantities of the ingredients used in each menu item.* For example, assume that an SFA produces and serves lasagna at lunch. The recipe for a 6 oz. portion of lasagna might contain: 3 oz. noodles; 2 oz. cheese; and 1 oz. tomato sauce. If 1,000 servings were produced, this would mean that a total of 3,000 oz. of noodles; 2,000 oz. of cheese; and 1,000 oz. of tomato sauce were used in the production of the lasagna.

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[1]Fultz, Jack F. **Overhead: What it is and How it Works** (Cambridge, MA: Abt Books, 1980).

[2]Every effort was made to avoid atypical weeks (e.g., weeks with school holidays or special menus). The sample week should be representative of the average school week.

Table of Contents

3) *Use information from invoices to obtain the price paid for each ingredient. USDA assigned value is used for donated commodities.* These prices are then used to compute the cost of food in each menu item produced. Continuing the lasagna example, assume the relevant prices are: noodles, $0.03/oz.; cheese, $0.06/oz.; and tomato sauce, $0.02/oz. The cost of food in the 1,000 portions of lasagna is computed as:

3,000 oz. noodles @ $0.03/oz.:	$90.00
2,000 oz. cheese @ $0.06/oz.:	120.00
1,000 oz. tomato sauce @ $0.02/oz.:	20.00
Total cost of lasagna ingredients:	$230.00
Food cost per serving:	$0.23

Algebraically, the total food cost in the production of menu item i is expressed as:

$$TFC_i = \Sigma_j (Q_{ij} * P_j) \qquad (1)$$

where,

Q_{ij} = quantity of ingredient "j" used in the production of menu item "i", and

P_j = price of ingredient "j".

The total cost of food used in the production of lunches during the sample week (TFC_L) is simply the sum of TFC_i for all menu items produced and served at lunch. Similarly, the total cost food used in breakfast production (TFC_B) is the sum of TFC_i for all breakfast menu items produced and served. Finally, the total annual food cost obtained from the SFA's annual financial statement was allocated to lunch and breakfast production in proportion to the estimated ratios for the sample week.[1]

[1]Breakfast and lunch food costs include the cost of food prepared **jointly** for the other programs (e.g., on-site child care centers or senior meals). If food is prepared **separately** for other programs then the food cost for these programs (TFC_O) is the sum of TFC_i for all items separately prepared for these other programs.

Distributing Lunch and Breakfast Costs Between Reimbursable and Non-Reimbursable Meals

The full cost of lunch and breakfast production was distributed between reimbursable and non-reimbursable meals in proportion to the food costs attributable to reimbursable and non-reimbursable meals. It is not possible to directly measure the labor cost attributable to reimbursable and non-reimbursable meals due to joint production. Procedures for the direct measurement of NSLP and SBP food costs were based on observations and measurements made during a 5-day sample period. Ratios based on the direct measurement of food costs during the sample period were then applied to total annual lunch costs (TLC) and to total annual breakfast cost (TBC) to obtain an estimate of the costs attributable to the production of NSLP-lunches and SBP-breakfasts.[1] The distribution of the costs attributable to the production of NSLP-lunches and SBP-breakfasts involved the following steps.

1) *Estimate the sales of each item which are part of NSLP-lunches.* This estimate was based on the direct observation of foods taken by students as part of the NSLP and records of the number of reimbursable lunches served during the observation period.

   To continue the lasagna example, assume observation of sample of 200 students at lunch who take the NSLP-lunch. Assume that 100 of the students that take the NSLP-lunch take lasagna as a component of their lunch. Fifty percent of NSLP-lunches would be estimated to contain lasagna as a component. If

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[1]Total food costs and the proportion of food costs attributable to reimbursable meals may be affected by "in-house" baking. As baking is a relatively labor intensive activity, labor costs would be relatively higher and food costs relatively lower in SFAs that do a substantial amount of in-house baking. However, since in-house baking would include both reimbursable items (e.g., rolls) and non-reimbursable items (e.g., cookies), the magnitude and the direction of the affect of in-house baking on the food cost ratios is not clear. In future applications it may be desirable to modify the methodology in SFAs that do a considerable amount of in-house baking. The Daily Time Record (see Chapter IV) could be expanded to include **each individual item baked in-house** as a separate activity. This would allow for the identification of the labor costs attributable to each baked product. These costs could then be added to the food costs of each baked product to make the food costs more comparable to commercially purchased baked goods. The potential gains from such a modification would have to be balanced against the operational difficulties introduced. For example, the Daily Time Records would vary from school to school and from day to day to allow for the baking of different items. In addition, the potential for recording error increases as the number of activities on the time record increases (and the position of the activities on the time record changes).

Table of Contents

school records indicate that 800 NSLP-lunches were served that day, an estimated 400 (.50 x 800) would contain lasagna. Algebraically, the number of portions of each menu item contained in NSLP lunches is expressed as:

$$NSLP_i = PCT_i * N \qquad (2)$$

where,

PCT_i = proportion of NSLP-lunches observed that contain menu item "i", and

N = total number of NSLP-lunches served on the day of observation.

2) *Compute the proportion of total lunch food costs attributable to the NSLP.* Having computed the food cost of a serving of each menu item (TFC_i), the total number of servings of each item contained in NSLP-lunches ($NSLP_i$), and the total food cost of lunches produced (TFC_L), the proportion of lunch food costs attributable to NSLP-lunches would be computed as:

$$NLPCT = \Sigma_i(NSLP_i * TFC_i)/TFC_L \qquad (3)$$

3) *Compute the cost of NSLP-lunches.* The ratio of the NSLP food cost to the total food cost is multiplied by the total lunch cost (TLC, as discussed above) to estimate the total NSLP lunch cost:

$$\text{NSLP Cost} = TLC*NLPCT. \qquad (4)$$

4) *The total annual NSLP-lunch cost is divided by the total annual number of NSLP-lunches to compute the average cost per NSLP-lunch.*

The same procedure was used to obtain a direct measure of SBP-breakfast costs.

Exhibit B.1 summarizes the analysis of the full cost of meal production. The top panel shows that the full cost of lunch and breakfast production is equal to the direct meal production cost plus a share of non-meal production costs. The bottom panel shows that these costs are then distributed between reimbursable and non-reimbursable meals.

Table of Contents

Exhibit B.1

Summary of the Analysis of the Full Cost of Meal Production

Cost Element	Meal Type: Breakfast Production	Meal Type: Lunch Production	Meal Type: Total SFA Costs
	$	$	$
Total Direct Meal Production Costs			
Share of Non-Meal Production Costs			
Share of SFA Administration Costs			
Share of Occupancy Costs			
Share of Storage and Food Transportation Costs			
Share of Meal Transportation Costs			
FULL COST OF MEAL PRODUCTION	Total	Total	Total
Reimbursable Meals			
Other Meals			
TOTAL	Total	Total	Total

Table of Contents

Appendix C

Effect of Failing to Record A La Carte Items on Menu and Production Record

Table of Contents

Illustration of A La Carte Problem

The methodology tested in this study relies heavily on five key parameters:

B_r = estimate of reimbursable breakfast food costs for the study week;

B_{nr} = estimate of non-reimbursable breakfast food costs for the study week;

L_r = estimate of reimbursable lunch food costs for the study week;

L_{nr} = estimate of non-reimbursable lunch food costs for the study week; and

TFC_{sy} = total food costs for the school year, obtained from the SFA's annual financial statement.

The study week estimates of the food cost components are used to estimate four ratios which are then applied to total annual food costs, TFC_{sy}. These ratios are:

1. Breakfast food costs as a proportion of total food costs

   $= (B_r+B_{nr})/[(B_r+B_{nr})+(L_r+L_{nr})]$.

2. Lunch food costs as a proportion of total food costs

   $= (L_r+L_{nr})/[(B_r+B_{nr})+(L_r+L_{nr})]$.

3. Proportion of breakfast food costs that are reimbursable

   $= B_r/(B_r+B_{nr})$.

4. Proportion of lunch food costs that are reimbursable

   $= L_r/(L_r+L_{nr})$.

The feasibility of using the study methodology to reliably estimate the cost per reimbursable breakfast and the cost per reimbursable lunch therefore depends upon the ability to accurately measure the five key parameters. In the test of the methodology in 18 SFAs, three of the four parameters estimated for the study week (B_r, B_{nr}, and L_r) appear to have been measured reliably. However, the fourth parameter, non-reimbursable lunch food costs (L_{nr}), was measured less reliably. It is clear that in many instances study data collectors and SFA kitchen managers failed to record some (or all) of the non-reimbursable food items served at lunch. This omission results in an **over-estimate** of the cost per reimbursable breakfast and the cost per reimbursable lunch. The illustration below shows how the under-reporting of non-

Table of Contents

reimbursable lunch food costs affects the study estimates. An alternative approach to estimating the cost per reimbursable breakfast and lunch is then presented. This approach relies on the three parameters which were measured reliably, and eliminates the effect of the parameter that was less reliably measured by replacing it with a more reliable alternative estimate. This alternative approach was used to produce the final meal cost estimates for the pilot study sites that are included in this report. It should, however, be emphasized that an awareness of the potential for under-reporting non-reimbursable lunch food costs can eliminate this problem in future applications of the methodology.

ILLUSTRATIVE EXAMPLE

For illustrative purposes assume the following are the true values of the key parameters for the study week:

- B_r = \$95;
- B_{nr} = \$5;
- L_r = \$600; and
- L_{nr} = \$300.

Assume further that each parameter is measured with perfect reliability. The following estimates of the four ratios would then be obtained:

1. Breakfast food cost as a proportion of total food costs = 0.10;
2. Lunch food cost as a proportion of total food costs = 0.90;
3. Proportion of breakfast food costs that are reimbursable = 0.95; and
4. Proportion of lunch food costs that are reimbursable = 0.67.

Finally, assume the following statistics for the school year:

- TFC_{sy} = \$2,450,000,
- Number of reimbursable breakfasts = 500,000, and
- Number of reimbursable lunches = 2,500,000.

Applying the study methodology to these data yields the following school year estimates for this school district:

Table of Contents

Breakfast Estimates

1a. Total breakfast food cost for school year

= (.10)x($2,450,000) = $245,000.

1b. Total reimbursable breakfast food cost for school year

= (.95)x($245,000) = $232,750.

1c. Food cost per reimbursable breakfast for school year

= $232,750/500,000 = $0.466.

Lunch Estimates

1d. Total lunch food cost for school year

= (.90)x($2,450,000) = $2,205,000.

1e. Total reimbursable lunch cost for school year

= (.67)x($2,205,000) = $1,477,350.

1f. Food cost per reimbursable lunch for school year

= $1,477,350/2,500,000 = $0.591.

Suppose, however, that the data collectors record only 1/2 of the non-reimbursable lunch food costs during the study week (L'_{nr} = $150). If other things remain the same, the following estimates would be obtained for the four key ratios:

1. Breakfast food cost as a proportion of total food costs = 0.12.

2. Lunch food cost as a proportion of total food costs = 0.88.

3. Proportion of breakfast food costs that are reimbursable = 0.95.

4. Proportion of lunch food costs that are reimbursable = 0.80.

The effect of under-reporting L_{nr} is a large relative increase in breakfast food costs as a proportion of total food costs (from 0.10 to 0.12); a small relative decrease in lunch food costs as a proportion of total food costs (from 0.90 to 0.88); and a very large increase in the proportion of lunch food costs that are

Table of Contents

reimbursable (from 0.67 to 0.80). There is no effect on the estimate of the proportion of breakfast food costs that are reimbursable.

When these ratios are applied to the school year food costs there is a marked **increase** in the estimated cost per reimbursable breakfast and the estimated cost per reimbursable lunch as shown below.

Breakfast Estimates

2a. Total breakfast food cost for school year

= (.12)x($2,450,000) = $294,000.

2b. Total reimbursable breakfast food cost for school year

= (.95)x($294,000) = $279,300.

2c. Food cost per reimbursable breakfast for school year

= $279,300/500,000 = $0.559.

Lunch Estimates

2d. Total lunch food cost for school year

= (.88)x($2,450,000) = $2,156,000.

2e. Total reimbursable lunch cost for school year

= (.88)x($2,156,000) = $1,724,800.

2f. Food cost per reimbursable lunch for school year

= $1,724,800/2,500,000 = $0.690.

The estimated cost per reimbursable breakfast for the school year increases because substantially more of the school year total food costs are being allocated to breakfast (the proportion reimbursable is unchanged). Even though less of the school year total food cost is being allocated to lunch, the estimated cost per reimbursable lunch increases because the proportion reimbursable has increased substantially, resulting in an increase in the estimate of total reimbursable lunch food costs.

ALTERNATIVE APPROACH

As indicated above, of the four parameters estimated during the study week, the problem appears to be confined to the estimate of non-reimbursable lunch food costs. Data collectors and kitchen managers were able to accurately identify all of the reimbursable foods being served at breakfast and lunch. These foods are usually listed on the planned menu for the day (or week). While there are substitutions, these are usually notes on the kitchen manager's copy of the planned menu. In addition, kitchen managers are well aware of what is being prepared for the reimbursable meals and will readily identify substitutions when **probed** by the data collector.

Non-reimbursable food items (e.g., items available only a la carte or sold only to adults) are usually **not** listed on the menu. Data collectors must probe to identify these a la carte items. In addition, because these data were collected by the kitchen managers in the non-observation schools, it its likely that in these schools the kitchen managers simply did not think of the a la carte items being served when they prepared the menu and production records for this study. It is, however, unlikely that much (if any) a la carte food was omitted at breakfast. For the most part, breakfast consists of reimbursable items served to free and reduced-price children. The foods served to these children tend to be reimbursable items with very few strictly a la carte food items available at breakfast. Non-reimbursable food costs at breakfast are almost entirely food items taken by adults.

Many schools serve a large number of a la carte items at lunch. These items which are available to both students and adults may represent a large portion of the total food cost at lunch. Thus, the potential for missing a la carte food items is much greater at lunch than at breakfast. The analysis suggests that these a la carte items were not reliably recorded on the menu and production record.

Meal observers were able to accurately record the food items taken on reimbursable breakfasts and lunches at the observation schools during the study week. Because these items **were** recorded on the menu and production records we were able to reliably estimate the **food cost per reimbursable meal** at these schools for the study week and when these are weighted obtain a reliable SFA-level estimate of food costs per reimbursable breakfast and reimbursable lunch for the study week. These data can be used with the data for total food costs for school year (from the annual financial statement) to produce more reliable estimates of the total cost per reimbursable meal for school year. This alternative approach avoids the need to use the unreliable data on L_{nr}. Discussed below are the steps involved in producing this more reliable estimate. Data for SFA 06 are used to illustrate the alternative approach.

Table of Contents

ILLUSTRATION FOR SFA 06

Step 1

Estimate the total reimbursable breakfast food cost for SY 1989-90 using study week estimates of food costs per reimbursable breakfast. For SFA 06, food cost per reimbursable breakfast for the study week were $0.361. This SFA served a total of 547,793 reimbursable breakfasts in SY 1989-90 (SFA records). The product of these two figures provides an estimate of the total reimbursable breakfast food cost for SY 1989-90:

($0.361)x(547,793) = $197,753.

Step 2

Estimate total breakfast food cost for SY 1989-90 using the study week estimate of the proportion of breakfast food costs that are reimbursable. As discussed above, we believe that the study week estimates of B_r and B_{nr} were reliably estimated. The study week estimate of the proportion of breakfast food costs that are reimbursable (.9416) should therefore be a reliable estimate. Dividing the estimate of total reimbursable breakfast food costs for SY 1989-90 (from Step 1) by the estimate of the proportion of breakfast food costs that are reimbursable provides an estimate of the total breakfast food cost for SY 1989-90:

($197,753)/(.9416) = $210,081.

Step 3

Estimate total lunch food costs for SY 1989-90 using the estimate of total breakfast food costs and total reported food costs for SY 1989-90. Total lunch food costs are estimated as the difference between total reported food costs for SY 1989-90 (from the annual financial report) and estimated total breakfast food costs for SY 1989-90 (from Step 2):

$2,016,761 - $210,081 = $1,806,680.

Step 4

Estimate the total reimbursable lunch food cost for SY 1989-90 using study week estimates of food costs per reimbursable lunch. As in Step 1, estimate the total reimbursable lunch food cost for SY 1989-90 as the product of the study week estimate of the food cost per reimbursable lunch ($0.579) and the total number of reimbursable lunches served in SY 1989-90 (from SFA records):

($0.579)x(2,285,539) = $1,323,327.

Step 5

Estimate the proportion of SY 1989-90 lunch food costs that are reimbursable using estimates from Steps 3 and 4. As discussed above, the study week estimate of this ratio is unreliable. Step 3 provides a reliable estimate of total lunch food costs for SY 1989-90, while Step 4 provides a reliable estimate of total reimbursable lunch food costs for SY 1989-90. The ratio of these estimates should provide a reliable estimate of the proportion of lunch food costs that are reimbursable:

($1,323,806)/($1,806,680) = .7325.

This estimate is substantially lower than the estimate of this ratio for the study week (.8672), which was affected by the under-reporting of non-reimbursable food costs.

Step 6

Compute total direct breakfast and lunch costs using the estimates of total breakfast and lunch food costs derived above. Use the proportion of direct costs to allocate costs other than food and labor to breakfast and lunch. As in the planned approach, total direct meal production costs are equal to the sum of total labor and total food costs attributable to each meal. The proportion of total direct costs attributable to breakfast and lunch are used to allocate all costs other than food and labor to breakfast and lunch.

Step 7

Estimate the proportion of total meal costs that are attributable to reimbursable meals using the proportion of food costs that are reimbursable to make the allocation. This is the same procedure as used in the planned approach, but uses the more reliable estimate of the proportion of lunch food costs that are reimbursable to make the allocation.

Application of this alternative approach produces more reliable, and more reasonable estimates of the total cost per reimbursable breakfast and reimbursable lunch than the planned approach. The following table compares the estimates of **reported** cost per reimbursable breakfast and lunch obtained from the planned approach and the alternative presented above.

Reported Cost per Reimbursable Meal	Current Approach	Alternative Approach
Breakfast	$1.287	$1.060
Lunch	1.441	1.260

Table of Contents

APPENDIX D

METHODOLOGY FOR ESTIMATING LUNCH EQUIVALENTS*

*This Appendix is taken from R. St.Pierre, et al., **Child Nutrition Program Operations Study: First Year Report** (Cambridge, MA: Abt Associates Inc., 1991).

LUNCH EQUIVALENT METHODOLOGY

Because most school food services produce outputs (e.g., breakfasts, a la carte meals) in addition to reimbursable lunches, the average cost of a lunch is not well-defined. A resolution of this problem that has fairly recently come to be accepted as the standard approach is the definition of a "composite output," containing specified proportions of all the outputs. The most common practice is to use the mean proportions of all outputs in defining the composite output. The cost of this composite output is termed "ray average cost" (RAC); its variation with output provides a measure of economies of scale. The Department of Agriculture, however, has particular concern for just one output, the reimbursable lunch. An alternative to RAC that takes lunches, rather than a composite, as its point of departure is therefore of greater interest in this context.

In 1985, analysts at Abt Associates defined a measure of "lunch equivalents" (LEQs) as a means of expressing the relationship between SFA costs and lunches served.[1] This measure produces reasonable results, but its derivation is difficult to understand. Further, it is possible that the underlying relationship between lunches, breakfasts, and a la carte sales has changed over the past half-dozen years. Therefore, the present study estimated a new measure, which is termed LEQ2 in this appendix, to differentiate it from its predecessor (LEQ1). It is defined as the number of lunches necessary to generate an expected cost equal to the expected cost of the SFA's actual number of lunches, breakfasts, and other items.

This measure relies, as did LEQ1, on an estimated cost function for SFAs. If the true cost function is written as:

$$\text{Cost}_i = f(L_i, B_i, A_i) \qquad (1)$$

where L represents total lunches served, B represents total breakfasts served and A represents a la carte sales in dollars by SFA i, then LEQ2 for the SFA is defined by the identity:

$$f(LEQ2_i, 0, 0) = f(L_i, B_i, A_i). \qquad (2)$$

[1]Glantz, F.B. and R.G. St.Pierre. **Evaluation of Alternatives to Commodity Donation in the National School Lunch Program: Study of Food Acquisitions, Volume 2.** Cambridge, MA: Abt Associates Inc., 1985.

Table of Contents

Defining LEQ2 is thus a fairly simple matter once the requisite cost function has been estimated.

A Cost Function for SFAs

Three distinct cost functions were estimated using 1,180 observations for which complete cost data are available from the Year Two SFA Manager survey (for SY 1988-89). Each cost function was used in turn to predict total cost for SFAs for Year One (SY 1987-88). The specification exhibiting the smallest mean square prediction error was chosen as the basis for the construction of LEQ2.[1] OLS estimates of the chosen cost function are presented in Exhibit D.1.

The estimated form of this model was used to construct LEQ2 for each SFA, as defined by equation (2), above. That is, each SFA's actual number of lunches, breakfasts, and a la carte revenues were entered in the general model, which was solved for the expected cost for that SFA. Using the SFA's expected cost and setting the number of breakfasts and a la carte items equal to zero, the equation was then solved for LEQ2 (i.e., the number of lunches that would yield the same expected cost). In practice then, solving for LEQ2 required simple application of the quadratic formula to the following equation (recalling that E[COST] is known) for each SFA.[2]

$$E[COST] = 5{,}296 + 1.69 \cdot LEQ2 + 7.2 \times 10^{-9} \cdot LEQ2^2$$

The unweighted cost per LEQ2 was computed for each SFA. The distribution of each is described below. Note that "reasonable" values are generated throughout the empirical distribution of cost per lunch equivalent.

	Unweighted Cost Per LEQ2
Mean	1.57
Median	1.53
20th Percentile	0.99
25th Percentile	1.28
75th Percentile	1.80
90th Percentile	2.17

[1]The mean squared prediction error for the selected cost function was substantially lower than that of the other two specifications, so that the choice of a "preferred" model was clear.

[2]Note that a negative root is always discarded.

Table of Contents

The estimated model can be used to solve for the conversion of breakfasts to lunches. Setting the total differential of the cost function to zero, solve for δLUNCH/δBREAKFAST:

$\delta C = 1.71\delta L + 14.4x10^{-9} \cdot L \cdot \delta L + 0.40\delta b - 6.6x10^{-9} \cdot B \cdot \delta B$

This assumes that δ(OTHREV) is set to zero and that the SFA is producing breakfasts so YBRK=1.

Solving for δL/δB:

$\delta L/\delta B = -[0.4 + 6.6 \times 10^{-9} \cdot B]/[1.71 + 14.4 \times 10^{-9} \cdot L]$

If L and B are both zero, this figure turns out to be 0.23 (a lunch is worth just over 4 breakfasts). If L is set to 819,000 and B is set to 151,000 (their mean values), then dL/dB (expressed to two decimal places) is still 0.23. Hence, the conversion of breakfasts to lunches can, for all practical purposes, be treated as a constant.

Variables included in the final cost function are listed below:

Variable	Mean	Definition
LMEALS	818,887	Number of lunches served
BMEALS	151,386	Number of breakfasts served
OTHREV[1]	230,191	Revenue from other cafeteria sales (prmarily a la carte items or adult meals)
YBRK	0.46	=1 if BMEALS > 0; 0 otherwise

Coefficient estimates are presented in Exhibit D.1.

[1]Properly speaking, the volume or count of individual a la carte items belongs in the cost function. Revenue from these sales does not. It is included here as the only available measure of SFA output other than breakfasts and lunches.

Table of Contents

Exhibit D.1

OLS Estimates of SFA Cost Function

Dependent Variable	Total SFA Cost
Intercept	5,296 (0.1)
LMEALS	1.69* (15.4)
$LMEALS^2$	$7.2x10^{-9}$* (11.8)
BMEALS	0.40* (1.7)
$BMEALS^2$	$3.3x10^{-8}$* (7.2)
OTHREV	1.12* (4.7)
$OTHREV^2$	$-1.8x10^{-7}$* (-5.2)
YBRK	138,028 (1.5)
YBRK · LMEALS	0.019 (0.2)
YBRK · OTHREV	0.38 (1.4)
R^2	0.98
N	1,180

*Statistically significant at the .10 level.

Note: t - statistics appear in parentheses.

Table of Contents

APPENDIX E

ESTIMATES OF COST PER LUNCH BY TYPE OF SFA

Table of Contents

ESTIMATES OF COST PER LUNCH BY TYPE OF SFA

Exhibit E.1 presents a comparison of the direct and indirect estimates of meal cost by type of SFA. It should, however, be noted that the sample size for each type of SFA is extremely small. Because of this the estimates of the average cost are quite sensitive to sampling variation, and cannot be viewed as reliable estimates of the average cost by type of SFA.

Examination of the average reported cost for small SFAs with on-site production illustrates the sensitivity of the average cost estimates to sampling error. The reported cost per NSLP-lunch for SFA 18 ($1.03) is considerably less than that of SFA 04 ($1.52) and SFA 09 ($1.47). The relatively low cost for SFA 18 reflects the fact that this SFA operated with a key staff vacancy and had unusually low labor costs. However, with only three SFAs in the sample, SFA 18 exerts a strong influence on the average cost for this group. With a larger sample, one would expect that the effect of SFA 18 would have been offset by an SFA with unusually high costs.

While one would like to examine the differences in average cost by type of SFA, the extremely small sample sizes preclude any meaningful comparisons. Tests for differences in averages costs (both reported cost and full cost) were made using simple t-tests. None of the differences in average costs shown in Exhibit E.1 is statistically significant even at the .25 level of confidence). Chapter IV provides sample size guidelines for use in future studies of meal costs, including recommended sample sizes for obtaining cost estimates by type of SFA.

As noted in Chapter IV, while cost per LEQ is a reasonably good proxy for the direct measure of reported cost per NSLP-lunch when estimating the average cost for a group of SFAs, it is not a good proxy measure for individual SFAs. This point is well illustrated in Exhibit E.1. In several study sites the difference between the two measures is quite large, however, across the 18 sites the average ratio of reported cost per LEQ to reported cost per NSLP-lunch is 0.96. This suggests that with a large sample of SFAs the indirect measure will provide a reliable estimate of the average reported cost per NSLP-lunch.

Table of Contents

Exhibt E.1

Comparison of Direct and Indirect Estimates of Cost Per Lunch by Type of SFA

		INDIRECT MEASURE	DIRECT MEASURES		RATIOS OF DIRECT TO INDIRECT MEASURE	
TYPE OF SFA	SFA ID	REPORTED COST PER LEQ	REPORTED COST PER NSLP-LUNCH	FULL COST PER NSLP-LUNCH	REPORTED COST	FULL COST
Small/On Site Production:	04	2.160	1.521	1.658	0.704	0.767
	09	1.685	1.474	1.680	0.875	0.997
	18	0.944	1.034	1.235	1.095	1.308
	Mean	1.597	1.343	1.524	0.891	1.024
	Std. Dev.	(0.613)	(0.269)	(0.251)	(0.196)	(0.271)
Large/On Site Production:	02	1.638	1.437	1.713	0.877	1.046
	07	1.645	1.579	1.777	0.960	1.080
	12	1.098	1.243	1.489	1.132	1.356
	17	1.207	1.435	1.721	1.189	1.425
	Mean	1.397	1.424	1.675	1.039	1.227
	Std. Dev.	(0.286)	(0.138)	(0.127)	(0.145)	(0.192)
Small/Satelliting:	03	1.633	1.280	1.398	0.784	0.856
	08	1.563	1.623	1.833	1.038	1.173
	13	0.887	1.302	1.572	1.468	1.772
	15	0.868	1.098	1.587	1.265	1.829
	Mean	1.238	1.326	1.598	1.139	1.407
	Std. Dev.	(0.417)	(0.218)	(0.179)	(0.295)	(0.472)

Table of Contents

Exhibit E.1 (continued)

TYPE OF SFA	SFA ID	INDIRECT MEASURE	DIRECT MEASURES		RATIOS OF DIRECT TO INDIRECT MEASURE	
		REPORTED COST PER LEQ	REPORTED COST PER NSLP-LUNCH	FULL COST PER NSLP-LUNCH	REPORTED COST	FULL COST
Large/Satelliting	06	1.506	1.263	1.473	0.839	0.978
	11	1.369	1.199	1.753	0.876	1.280
	16	1.470	1.484	2.236	1.009	1.521
	Mean	1.448	1.315	1.821	0.908	1.260
	Std. Dev.	(0.071)	(0.150)	(0.386)	(0.090)	(0.272)
Very Large:	01	1.758	1.353	1.739	0.770	0.989
	10	2.136	1.704	1.987	0.798	0.930
	Mean	1.947	1.528	1.863	0.784	0.960
	Std. Dev.	(0.267)	(0.248)	(0.175)	(0.020)	(0.042)
Vendor/FSMC:	05	1.840	1.221	1.698	0.664	0.923
	19	1.466	1.288	1.652	0.879	1.127
	Mean	1.653	1.254	1.675	0.771	1.025
	Std. Dev.	(0.265)	(0.047)	(0.033)	(0.152)	(0.144)
	Overall Mean	1.493	1.363	1.678	0.957	1.187
	Std. Dev.	(0.381)	(0.181)	(0.220)	(0.210)	(0.302)

APPENDIX F

GLOSSARY OF TERMS

Table of Contents

Glossary of Terms

1. **SFA activities** - refers to the "outputs" or the business of SFAs. SFA outputs include breakfast production, lunch production (together referred to as "meal production") and non-meal production activities (efforts to support meal production however cannot be traced to a specific meal. These include activities like SFA administration and the transportation of meals).

2. **Direct measurement** - an approach which identifies the actual cost related to various SFA activities and allocates these costs specifically to the activity (or purpose) for which they were incurred. For instance, food cost for breakfast is calculated by identifying the costs of foods served for breakfast only and not by applying an algorithm to distribute total food costs among breakfast and lunch based on meal participation, sales or some other factor.

3. **Indirect measurement** - in contrast to direct measurement, an approach which identifies and allocates costs for different SFA activities by portioning out total costs based on a specified algorithm, model, or other arbitrary allocation rule. The lunch equivalent (LEQ) is an example of an indirect measurement and allocation approach.

4. **Direct meal production costs** - costs which are directly traceable to the production of breakfasts or lunches. These include such costs for food, SFA labor, and other identifiable production costs (e.g., supplies used for lunch only).

5. **Non-meal production costs** - costs which support meal production but are not directly traceable or attributable to a specific meal. These costs can be incurred at the SFA level and school district level. For example, at the SFA level, these costs include labor for food service administration and other SFA support activities, the cost of facilities occupied by the SFA, storage and transportation of foods, and transportation of meals within the district.

6. **Full cost of meal production** - all costs incurred for meal production activities (includes direct meal production costs and non-meal production costs). In addition to costs that appear on the SFA expense statement and charged to the SFA, the full cost includes costs that are not charged to the SFA which may be subsidized by the school district or other groups, the value of in-kind services and donated equipment, and the use of volunteers.

7. **Reported meal production costs** - costs which appear on the annual SFA expense statement indicating that the SFA paid for them.

8. **Uncharged/unreported costs** - meal production costs that are not charged to the SFA and often do not appear on an annual expense

Table of Contents

statement. These costs are often subsidized by the school district. Examples of uncharged costs include space, some labor, transportation, and equipment depreciation. These costs may also be referred to as "hidden" costs.

9. **Indirect costs** - a specific category of non-meal production costs (costs which support meal production but not directly traceable to one specific meal). Indirect costs may be included in an indirect cost rate which identifies a portion of school district costs that are attributable to food services. Indirect costs are often referred to as "overhead".

10. **Reimbursable costs** - costs attributable to a meal reimbursed by the NSLP or the SBP. For example, labor and food costs associated with an NSLP lunch.

11. **Lunch equivalent (LEQ) approach** - a method to convert SFA outputs other than lunch (e.g., breakfasts, adult meals, and a la carte meals) into the equivalent of a NSLP lunch in efforts to estimate the cost to produce a reimbursable meal. There are a variety of techniques to construct a LEQ measure. Researchers have relied on econometric modelling of the joint production process to construct an algorithm that can be used across SFAs to estimate the number of LEQs produced. The method solves for the number of reimbursable NSLP lunches necessary to result in the same predicted costs as the configuration of lunches, breakfasts, and other revenues actually produced by the SFA. See the Child Nutrition Meal Cost Methodology Study Final Report for further explanations and the construction of LEQs.

12. **Meal Production System** - There are for basic types of meal or food production systems:

    1. Independent or On-site Kitchens prepare and serve food for the facility in which it is located.

    2. Base Kitchens produce meals for service on-site and for delivery to satellite or receiving kitchens.

    3. Commissaries/Central Kitchens prepare food and transports it to satellite or receiving kitchens.

    4. Satellite or Receiving Kitchens receive and serve meals produced elsewhere ready-to-serve, or in a form requiring some heating, thawing or other final preparation.

Table of Contents

This study groups SFAs into five categories which combine the type of system (in terms of the extent of satelliting) and the size of the system (school district enrollment):

- small/little satelliting - SFA with an enrollment less than the state's median enrollment and 90% of the production sites were base or independent kitchens.
- small/significant satelliting - SFA with an enrollment less than the state's median enrollment and less than 90% of the production sites were base or independent kitchens.
- large/little satelliting - SFA with an enrollment greater than the state's median enrollment and 90% of the production sites were base or independent kitchens.
- large/significant satelliting - SFA with an enrollment greater than the state's median enrollment and less than 90% of the production sites ere base or independent kitchens.
- very large - SFA with an enrollment over 100,000 pupils.

Table of Contents

APPENDIX G

REVIEWERS' COMMENTS AND AUTHORS' RESPONSE

Table of Contents

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December 20, 1991

Ms. Susan Batten
Program Analyst
Office of Analysis and Evaluation
Food and Nutrition Service
United States Department of Agriculture
3101 Park Center Drive, Room 202
Alexandria, Virginia 22302

Dear Susan:

Enclosed is a copy of my comments on the report of the USDA's Child Nutrition Meal Cost Methodology Study. Please let me know if there is anything else which you would like me to include in my report.

I enjoy working with you.

Sincerely,

Donald Liu

Donald J. Liu
Assistant Professor

DJL:cdp

Enclosure

Table of Contents

CHILD NUTRITION MEAL COST METHODOLOGY STUDY: COMMENTS

Author:

Donald J. Liu
Assistant Professor
Department of Economics
Iowa State University

Child Nutrition Meal Cost Methodology Study: Comments

Donald J. Liu

The Child Nutrition Meal Cost Methodology Study did an excellent job in measuring the full cost of school meal programs. The study thoroughly identified various cost items, especially for unreported costs, and allocated costs to various meal activities in a logical fashion. The whole project appears to have been well planned and well executed, and the experience gained from this project may prove to be very useful in future applications.

At issue is the recommendation of using a two-phase procedure that relies on indirect measurement in a nationally-representative sample of SFAs, coupled with direct measurement in a subsample of these SFAs. Indirect measurement captures only part of the program costs, whereas direct measurement attempts to account for full costs. The study suggests using the indirect approach as a cost-effective alternative for the more expensive direct full-cost measurement approach. This suggestion is based on the observation that there is a high correlation between the LEQ cost figures and the cost figures obtained from the direct method. Since the indirect LEQ approach does not measure the full cost of the program, the study presents a statistical procedure to adjust for the discrepancies by "scaling up" the LEQ measure.

I question the validity of the analysis on which the recommendation is based. I also doubt the wisdom of applying the short-cut approach of measuring only part of the full cost to an issue of such immense importance (identifying per meal production costs). Before giving the reasons for my inclinations, however, I would first like to clarify the issue which I debate.

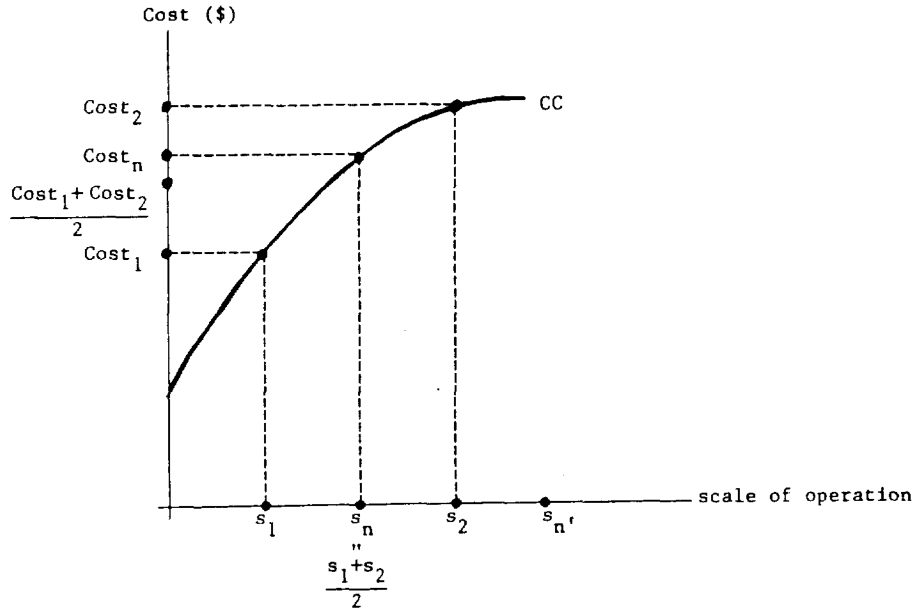
The Issue

The issue I am debating is not whether one should go for the LEQ cost measure or go for the full cost measure. An LEQ cost measure can be a full cost measure if full cost data are used. For a given data set, there are several ways of measuring the cost of school meal programs. For example, one can simply take the average of the costs across different school units and, hence, obtain an average cost figure. Alternatively, one can estimate a cost equation and compute an LEQ cost figure or cost figures of other definitions.

One advantage of the cost function approach over the simple averaging approach is that the former can somewhat account for the nonlinear nature of the cost structure. Figure 1 shows a nonlinear cost function. The vertical axis measures the cost (in $) while the horizontal axis measures the scale of operation (e.g., the number of meals served). The nonlinear relationship between the cost and scale is depicted by the cost curve CC.

Table of Contents

Figure 1 Nonlinear Cost Function



For illustrative purposes, suppose that the nation consists of only two school districts, #1 and #2. School district #1 operates at scale s_1 and school district #2 at scale s_2. From the graph, the corresponding cost figures for the two school districts are $cost_1$ and $cost_2$, respectively. The average scale of the nation is $(s_1 + s_2)/2$, which is denoted as s_n in Figure 1. Given the average scale of s_n, the graph indicates that the average cost figure of the nation is $cost_n$. Now, notice that $cost_n$ is different from the simple average of the two individual cost figures, $(cost_1 + cost_2)/2$.

The choice between the cost function approach and the simple averaging approach depends on the purpose of the research. In general, the cost function approach is more useful because it allows one to answer "what if" type questions. For example, one can use the cost function in Figure 1 to predict the cost figure of the nation if the average scale of operation increases from s_n to $s_{n'}$.

At any rate, as far as the data collection process is concerned, the issue is not between the cost function approach (e.g., LEQ cost function) and the simple averaging approach. Rather, the issue is whether one should collect

(1) full cost data with detailed breakdown of information into SBP breakfast, NSLP lunch, and non-program meals, or

(2) partial cost data with little breakdown of information into SBP breakfast, NSLP lunch, and non-program meals.

Table of Contents

The pilot study collected full cost data for different SFAs, from which some average cost figures are computed. Presumably, the study could have also estimated an LEQ cost function and derived the corresponding LEQ cost figures. On the other hand, the SFA Manager Mail Survey contains only partial cost data with little breakdown of information. The study used this data set to estimate an LEQ equation and derived the corresponding LEQ cost figures. Presumably, the simple averaging approach could have been adopted instead.

To reiterate, the issue is not whether one should use the LEQ cost function approach or the simple averaging approach. Rather, the issue is whether one should collect the full cost data or the partial cost data. The LEQ cost function can be estimated from the full cost data set as well.

Definitively, collecting the partial cost data is less expensive. However, if the goal is to measure the full cost of the program, the short-cut approach of collecting only partial cost data is justifiable scientifically (but not necessarily economically) only if the relationship between the full cost measure and partial cost measure is, in a sense, "stable". With a "stable" relationship between the two, one can somehow estimate this relationship and then adjust the partial cost measure upward by the estimated relationship to arrive at the full cost level.

The study suggests that the relationship between full cost and partial cost measures is "stable". The justification is due to a high correlation between the cost figures based on full cost data and those based on partial cost data. In particular, the correlation coefficient between LEQ partial cost figures and NSLP full cost figures is 0.56. Hence, the study proposes to collect only the partial cost data from a nationally-representative sample as an alternative to the more expensive direct measure approach. A subsampling procedure is proposed to obtain information on the adjusting factor to scale up the partial cost measure from the national sample to the full cost level.

I question the validity of the study's analysis on which the recommendation is based. First, I do not agree with the estimated LEQ equation from which the LEQ partial cost figures are computed. Second, I have observed some empirical "irregularities" which prevent me from ruling out the possibility that the correlation between the full cost and partial cost figures are spurious. Third, I do not agree with the sampling procedure proposed by the study in scaling up the partial cost measure to the full cost level. Given the cited problems, my conclusion is that:

The best way to collect what one intends to measure is to collect directly what one intends to measure.

THE ESTIMATED LEQ EQUATION

It is very likely that the estimated LEQ equation is misspecified and has not been estimated by an appropriate statistical procedure for the following reasons:

1. The study fails to incorporate into the equation those school characteristic variables important to the identification of the cost structure of a school or school district. The cost of producing school meals depends not only on the amount of food produced but also on such factors as efficiency and available equipment of the operating unit.

   For example, to account for the cost effect of the absolute efficiency of a school unit, one might want to include into the equation the enrollment of the school. Likewise, to account for the cost effect of the relative efficiency of a school unit, one might want to include into the equation the percentage of students in the school participating NSLP and SBP. In addition, one might want to include into the equation the type of kitchen facilities and the location of the kitchen to account for the cost effect of the equipment.

   Presumably, data on some of the school characteristic variables are available from the SFA Manager Mail Survey. Those variables should be incorporated into the LEQ equation to the extent appropriate. Without accounting for the cost effect of such school characteristics, the estimated LEQ equation is biased. In addition, without accounting for the local school characteristics, the national LEQ equation should not be used to generate LEQ cost figures for the pilot states.

2. The study also fails to include into the equation appropriate interaction terms to account for joint production aspects of the problem. Basically, the production of SBP breakfast, NSLP lunch, and "non-program food" is a joint production process (joint inputs and joint outputs) and a lot of interactions can occur among the three activities. Without accounting for the possible interaction effects, a lot of richness of the model is lost and the equation is misspecified.

   For example, to account for the scale effect of one activity (say, SBP breakfast) on the cost structure of the other activity (say, NSLP lunch), one perhaps wants to include into the equation an interaction term involving the product of the scales of the two activities (say, BMEALS * LMEALS).[1]

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[1]The inclusion of YBRK * LMEALS in the reported equation does not consist of a scale interaction term because YBRK is a zero-one dummy variable, rather than a variable depicting the scale of breakfast operation.

Table of Contents

The interaction effects can also occur among the omitted school characteristic variables. For example, it is not difficult to envisage an interaction effect between the efficiency factors and the equipment factor mentioned previously in item 1.

3. The statistical technique used in estimating the LEQ equation (OLS: ordinary least squares) is most likely inappropriate for the problem at hand. Typically, the variances of the error term in the LEQ equation are not constant across the survey units and, hence, the classical statistical assumption for good estimation results is violated.

   For example, for the problem at hand it is not uncommon to find the variance of the error term to be proportional to the scale of the operation or to the size of the school. In this case, the appropriate estimation technique should be WLS (weighted least squares), rather than OLS. When a wrong estimation technique is used, a wrong estimated equation results.

The above three points highlight my concerns toward the credibility of the estimated LEQ equation appearing in the report. Basically, the study should consider the inclusion of other relevant explanatory variables, try alternative functional forms to account for interaction effects among various economic activities, and entertain the likelihood of a nonconstant variance in the equation's error term. In determining the "best" equation, a set of evaluation criteria should be specified explicitly and the evaluation result should be interpreted judiciously. Alternatively, it is useful to entertain several LEQ equations and see if the conclusion of "high correlation" is robust among the various specifications.

Empirical Irregularities

With respect to the empirical comparison of direct and indirect cost figures, I have the following comments:

1. Exhibit E.1 presents the LEQ cost figures computed from the SFA Manager Mail Survey data. Also reported are the NSLP full cost figures computed from the pilot study data. Since the SFA Manager Mail Survey data contain only partial cost information, one would expect the LEQ cost figures reported in the exhibit to be lower than the NSLP full cost figures reported there.

   However, a causal examination of the cost figures in Exhibit E.1 shows that the reported LEQ costs are higher than the NSLP full cost figures for SFAs #4, #9, #3, #6, #1, #10, and #5. Why is there inconsistency? This inconsistency further cast doubt on the credibility of the LEQ equation used in computing the LEQ cost figures. Obviously, more discussion on the empirical results is needed to make them "believable."

2. Since an LEQ lunch is not the same as an NSLP lunch, comparing the two is in a sense comparing oranges with apples. As such, the correlation between the two can be only spurious. To appropriately compare the direct cost measure with the indirect cost measure, the two should be put on the same footing first.

   Is it possible to estimate an LEQ equation using the pilot study data? Then, one can compare the resulting full-cost LEQ figures with the partial-cost LEQ figures estimated from the SFA Manager Mail Survey data.

3. Is the correlation of 0.56 really high enough for one to conclude "comfortably" that there will be no significant amount of uncertainty associated with the estimation of the scaling factor? A high correlation between two variables does not necessarily imply that the relationship between the two variables can be estimated with little uncertainty.

   It might be useful to actually estimate this adjusting factor using the 18 SFAs' cost data (two sets of data). Then, one can examine the standard deviation of the β (i.e., the estimated adjusting factor) resulting from this estimation. It is also useful to examine the property of the estimated equation as a whole.

4. More importantly, the high correlation between full cost and partial cost measures really pertains only to the geographical area covered by the original 18 SFAs. Given that the 18 SFAs not consist of a random sample, can one safely conclude that this high correlation will hold for the national sample?

   If fact, it is very dangerous to base one's judgement solely on the correlation coefficient. Even though the scaling factor can be estimated with great confidence, one still needs to examine whether the scaling procedure itself makes sense.

The Scaling Procedure

There are several problems associated with the proposed scaling procedure.

1. There is a catch-22 problem. If the subsample used in finding the adjusting factor to scale up the partial cost measure to the full cost level is not representative nationally, the resulting adjusting factor is not representative nationally. Then, how is it appropriate to use that adjusting factor at the national level?

   On the other hand, if the subsample used in finding the adjusting factor is representative nationally, then why do we need the first-phase national sample for partial cost collection anyway? In this case, we can simply go directly to the subsample and collect the full cost data.

2. In determining the optimal sample size for future applications, equation (2) in Chapter IV is the basis. In arriving at this equation, a lot of covariance terms are ignored. Specifically, the four variables in the right-hand-side of the scaling equation (1) are stochastic and their covariances are missing.

   To what extent does equation (2) approximate the true equation? That is, how reliable is the formula used in the study? Is it of $O(1/n^2)$ at least?

3. At any rate, the sample sizes suggested for future application are not valid. This is because their determinations depend, in part, on the result from the pilot study which was not randomly sampled. What are the alternatives now?

Final Remark

The sheer magnitude of the money expended on the SBP and NSLP programs makes it an extremely important issue to have good measures of the programs' costs. Measuring only part of the costs renders the mission half done and limits the usefulness of the collected data. My discussion argues that attempts to adjust for partial cost measures to the full cost level will not be straightforward and the result may not be satisfactory. Therefore, a direct full-cost measurement is more desirable.

RESPONSE TO REVIEWER'S COMMENTS

The Meal Cost Methodology Study developed a methodology for the *direct measurement of the full cost of producing reimbursable meals* in the school lunch and breakfast programs. The methodology was designed for use as a management tool by individual school districts and for use by FNS in future national studies of meal costs. The methodology was pilot tested in 18 school districts. The results of the pilot test indicate that the methodology can be used to obtain reliable estimates of the full cost of producing reimbursable lunches and breakfasts. We are pleased that Professor Liu agrees with our assessment of the results of the pilot test.

Professor Liu, however, disagrees with our recommendation regarding the design for a future national study of meal costs. In considering a design for future national studies, AAI recommended using a two-phase sampling approach that relies on indirect measurement (i.e., the LEQ approach) in a nationally-representative sample of school districts coupled with direct measurement in a representative sub-sample of these school districts. Our recommendation is based on the relatively large difference in data collection costs between the direct and indirect measurement approaches. As Cochran (1977) notes, the optimum allocation of the sample must consider the cost of taking measurements on each sample unit. The objective is to maximize the precision of the estimates for a specified cost of collecting the data or minimize the data collection cost to obtain a specified level of precision. Professor Liu rejects the recommended two-phase sampling approach, concluding that it is always best to measure meal costs directly. Unfortunately, Professor Liu fails to consider the very real differences in data collection costs between the direct and indirect approaches. The cost of taking measurements on each sample unit with the direct measurement approach are about 50 times greater than with the indirect measurement approach. Recognizing this relatively large difference in data collection costs between the direct and indirect approaches, we believe that the recommended two-phase sampling approach represents the most cost-effective design for a national study of meal costs.

Professor Liu questions the validity of the analysis on which our recommendations are based. He raises three issues:

- the specification of the estimated LEQ equation,
- empirical "irregularities" with respect to the comparison of direct and indirect estimates of meal costs for the pilot study sites, and
- the sampling procedures proposed in scaling up the partial cost measure to the full cost level.

Each of these issues is addressed below.

SPECIFICATION OF THE COST FUNCTION

Before responding to the reviewers arguments regarding the estimation of the cost function, we feel that we should emphasize that the current study is intended as the first phase of a national study and not a component of that study. The first phase of the recommended two-phase approach involves the estimation of a cost function. The full national study would clearly require extensive analyses of alternative specifications of the SFA cost function, and of the behavior of the variance of cost with enrollment or volume. *Such analyses were not part of this project and await further studies.*

To reiterate, the specification and estimation of a meal cost function were beyond the scope of the Meal Cost Methodology Study. However, because the resource requirements of the direct measurement approach may make it infeasible for use in a large scale study of meal costs, it is useful to know how well the indirect methods approximate the results that are obtained from the direct measurement approach used in the Meal Cost Methodology Study. To make this comparison AAI used the cost function that was estimated as part of the Child Nutrition Program Operations (CNPO) Study.

All of the reviewer's comments on the estimation of costs and lunch equivalents focused on the proper selection of regressors and on the nature of the error term. Our responses appear below.

1) The reviewer questioned the omission of SFA characteristics in the specification of the meal cost function used in the computation of lunch equivalents. We agree that the inclusion of such characteristics would tend to raise the explanatory power (in the sense of R^2) and that further exploration along these lines is warranted. In this instance, however, the CNPO study was explicitly striving for a reduced-form interpretation to the results, since it could not predict in advance what types of information are sure to be available for any SFA for which we wish to compute lunch equivalents (LEQ). Suppose, for example, that as the total number of lunches served in a SFA rises, the probability that central kitchens will be used also rises; suppose also that use of central kitchens tends to reduce cost, other things constant. If one could be sure that the presence or absence of a central kitchen would always be known in any situation in which the computation of LEQ was desired then the inclusion of this variable in the cost function would be desirable. In the absence of such assurances, the best empirical strategy is to allow the variation of cost with the presence or absence of central kitchens to be captured, insofar as it may be,

by the variation in the number of lunches.[1] Whether the reduced explanatory power that results from the omission of these SFA characteristics from the estimated cost function is worth the enhanced ability to estimate LEQs in situations in which data on characteristics are lacking is a policy issue that warrants further discussion.

2) The absence of full interaction terms in the estimated cost function was also questioned by the reviewer. As noted above, the estimation of the cost function was not carried out under this project, so details of the construction of LEQ were not presented here. In fact, alternative specifications of the cost function were estimated, some of which included full interaction terms in breakfasts, lunches and other revenues. In most cases, the coefficients of these interaction terms were statistically significant at conventional levels. Each alternative specification was estimated using the first year of data and used to predict cost for the second year, given the values of lunches, breakfasts and other revenues for each of the SFAs in that year. The selected specification (which does not contain interaction terms, as the reviewer notes) was chosen because it minimized the sum of squared prediction errors. That is, it predicted SFA cost in the second year better than other specifications containing interaction terms. While we share the reviewer's inclination to prefer functional forms which include interaction terms, the superiority of the specification used in the report was clear.

3) The reviewer's third point is well-taken. We agree that some form of weighted least squares is almost surely superior to ordinary least squares for the problem at hand. We do claim, however, that his assertion that the estimation technique is "wrong" is overstated and misleading. The OLS estimates are consistent and unbiased; they minimize the sum of squared errors and are known to be robust to departures from underlying assumptions. In this case, however, they probably are not minimum-variance estimators which is surely what the reviewer intended to say. That is, a proper weighting scheme could produce estimates with a smaller margin of error than those produced by OLS.

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[1] The issue of bias, raised by the reviewer, is tricky in this context. If central kitchens tend to reduce cost but do not themselves affect the demand for SFA meals then the estimated coefficients (which do not attempt to hold the existence or non-existence of central kitchens constant) are not biased. The threat of bias arises only if an omitted characteristic affecting cost is itself a determinant of lunches, breakfasts or other revenue.

Table of Contents

The increase in precision resulting from the correction of this problem cannot be gauged at this point. While we agree with the reviewer's main argument on this issue, a complete investigation of error variances was beyond the scope of this project.

EMPIRICAL IRREGULARITIES

The reviewer observes some empirical "irregularities" in the comparison of direct and indirect estimates of meal costs. These so called irregularities lead him to conclude that the correlation between the full cost and partial cost figures may be spurious. Each of his concerns is addressed below.

1) Exhibit E.1 presents a comparison of direct and indirect estimates of cost per lunch for the 18 pilot study sites. Professor Liu notes that there are several seeming inconsistencies between the direct and indirect meal cost estimates for some of the school districts. Specifically he notes that the reported cost per LEQ (a partial cost measure) is higher than the full cost per NSLP-lunch for SFAs 4, 9, 3, 6, 1, 10, and 5. He correctly notes that one would expect the reported cost measure to be lower than the full cost measure. These seeming irregularities simply reflect the fact that *for any individual SFA* reported cost per LEQ is not a reliable measure of the reported cost per NSLP-lunch. For the 18 pilot study sites, the mean reported cost per LEQ is $1.493 with a standard deviation of $0.381. However, *for a group of SFAs*, the mean reported cost per LEQ is a reliable estimate of the reported cost per NSLP-lunch. As we noted in the report, for the 18 pilot study sites the mean reported cost per LEQ ($1.493) is not significantly different from the mean reported cost per NSLP-lunch ($1.363), even at the 0.10 level of confidence. The correlation between the direct measure of reported cost per NSLP-linch and the indirect measure of reported cost per LEQ is 0.65. This leads us to conclude that for a group of SFAs, the indirect measure of reported cost per LEQ is a reasonably good proxy for the direct measure of reported cost per NSLP-lunch.

   Similarly, while the reported cost per LEQ is greater than the full cost per NSLP-lunch for some of the SFAs in the pilot study, the *mean* reported cost per LEQ is significantly lower than the *mean* full cost per NSLP-lunch. The "irregularities" noted by the reviewer are in fact not irregularities, but simply reflect the variability of the estimates. Across the pilot study sample, the means of the various estimates are quite consistent with expectations-- the partial cost estimates are always significantly lower than the full cost estimates.

2) The reviewer states that an LEQ is not the same as an NSLP lunch, and that comparing the two is inappropriate. We agree that an LEQ is not the same as an NSLP lunch; however, we disagree that comparing the two is inappropriate. An LEQ is a statistical construct that is designed to convert other outputs (i.e., breakfasts and a la carte items) into the equivalent of an NSLP lunch. The use of LEQs allows one to compare the output levels of SFAs producing differing product mixes. While as noted above, one can debate the specification of the model used to estimate the cost function used in the construction of LEQs, conceptually an LEQ is equivalent to an NSLP lunch.

   Professor Liu suggests that it would have been better to estimate the cost equation using the pilot study data rather than use the model that was estimates as part of the Child Nutrition Program Operations Study (CNOPS). We agree, however, the small sample size (18) for the pilot study precluded such a modeling effort.

3) The reviewer questions whether the correlation of 0.56 between the reported cost per LEQ and the full cost per NSLP-lunch is high enough to conclude "comfortably" that there will be no significant amount of uncertainty associated with the estimation of the scaling factor. As discussed below (in the context of the scaling factor), the issue is not the absolute value of the correlation coefficient, but the value of the correlation coefficient relative to the data collection costs for the direct and indirect approaches. To reiterate, the objective of the proposed design is to maximize the precision of the estimates for a specified cost of data collection or minimize the cost of data collection for a specified level of precision.

4) The reviewer questions whether the correlation between direct and indirect measures observed in the pilot study will hold for a national sample. Clearly the correlation observed in a national study may be higher or lower than that observed in the pilot study. The purpose of conducting a pilot study is to obtain information that will inform the design of the national study. The alternative is to design a national study using guestimates of key design parameters. In our view the pilot study estimates are preferable to using uninformed guestimates.

Table of Contents

Scaling Procedure

The reviewer raised several issues concerning the two-phase sampling approach and the use of a scaling procedure. These concerns are addressed below.

1) Two-phase (double) sampling for regression or ratio estimation is a well established sampling technique (Cochran, 1977; Jessen, 1978; Kish 1965; Raj 1968). The United Nations (1950) definition of two-phase sampling given below is widely accepted: "It is sometimes convenient and economical to collect certain items of information on the whole of the units of a sample, and other items of information on only some of these units, these latter units being chosen as to constitute a sub-sample of the units of the original sample. An important application of multi-phase sampling is the use of the information obtained at the first-phase as supplementary information to provide more accurate estimates (by the method of regression or ratios), of means, totals, etc., of variates obtained only in the second phase." That is, when it is difficult or costly to collect information on a variable (e.g., cost per reimbursable lunch), this can be done at the second-phase sample. For the larger first-phase sample, simpler, less costly ancillary information (e.g., LEQ) can be collected. The first-phase ancillary information can then be used to improve the efficiency of the second-phase information by the ratio estimator, or as suggested by Abt Associates, the regression estimator.

   Abt Associates recommended drawing a national probability sample of SFAs for the first-phase sample. Following standard sampling practice, the second-phase sample of SFAs would be a random subsample of the first-phase sample.

   The gain in efficiency from using a two-phase sample of n and n SFAs over a single-phase sample of only n SFAs, that only uses the cost per reimbursable lunch measure, is a function of the correlation between LEQ and cost per reimbursable lunch. Equation 4 on page 41 shows that the sampling variance of the two-phase regression estimator of the mean cost per reimbursable lunch will be less than for the mean cost per reimbursable lunch estimator based on the second-phase sample alone, unless the correlation equals zero. Based on the pilot study, the correlation between full cost per reimbursable lunch and LEQ is expected to be 0.56.

   If we also consider the difference in cost of collecting the two variables (the cost per reimbursable lunch measure is estimated to be fifty times more expensive to collect than the LEQ measure), then an equation from Cochran (1977) can be used to show a considerably lower correlation of 0.28 is the point at

Table of Contents

which the sampling variance of the two-phase sample of n and n′ becomes equal to that of a single-phase sample of n SFAs. In other words, given a 50 to 1 cost ratio, a correlation of only 0.28 is needed to make two-phase sampling more economical. This means that if the correlation in the full study is lower than the correlation experienced in the pilot study, the regression estimator will still be more efficient than the single-phase sample estimator as long as it does not fall below 0.28, a considerable drop from 0.56. Conversely, if the actual correlation is higher than 0.56, which is possible if a better LEQ regression model is developed, then the efficiency of the regression estimator will be better than planned.

If one decided to use the cost per reimbursable lunch measure, based on a single-phase sample, a sample size of 25 SFAs would be needed to meet the desired coefficient of variation, at the 95% confidence level, of 0.05. This compares with a first-phase sample of 89 SFAs and a second-phase sample of 19 SFAs. Using the 50 to 1 cost ratio, we can see that the single-phase survey would be 20% more expensive to conduct than the two-phase sample. If a twenty percent increase in cost is not considered important, then we agree that a single-phase sample should be used.

2) Equation 2 on page 41 is an adequate and simple approximation for the sampling variance of the regression estimator and is widely used for sample size estimation purposes (Kish, 1965). It represents the large-sample variance of the regression estimator, that is, simple random sampling is assumed, and 1/n and 1/n′ should be negligible with respect to one. This variance formula suffices for the purposes of this study because the above conditions hold sufficiently.

3) The determination of the sample size of SFAs needed to meet a desired level of precision requires that assumptions be made about several factors -- the element variance of cost per reimbursable lunch, the correlation between LEQ and cost per reimbursable lunch, and the ratio of costs for obtaining the two measures. When a pilot study has been conducted, we are in the fortunate position of not having to make guesses about these factors. Although the pilot study estimates are subject to sampling error and are also potentially biased, they offer the best information available of what is likely to occur in the full study. To the extent they are in error, the actual variance of the mean cost per reimbursable lunch will either be higher or lower than the desired level of precision. The departure from the desired level of precision is however likely to be less extreme compared with a design based on guesses.

Table of Contents

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Appendix H

Food Service Consultant's Comments Regarding the Assignment of Space and Utility Costs

Table of Contents

HOSPITALITY CONSULTANTS, INC.
118 Great Road, Suite 215
P.O. Box 269
Stow, MA 01775

September 22, 1991

Mr. Fredrick Glantz
Senior Economist
ABT ASSOCIATES INC.
55 Webster Street
Cambridge, MA. 02138

Dear Fred:

Please accept my apologies for the delay in responding. I have reviewed the questions regarding the assignment of facility energy costs and there proper distribution to the food service program at each school.

I spoke with engineer colleagues in our industry to ascertain if there is a formula that might be used to determine an appropriate percentage of these costs assignable to the school food service programs.

The general consensus is that because there are so many variables related to these cost assignments an accurate general percentage cannot be used.

Based on the information I received I have concluded that the assignment of energy costs should be based on the percentage of assigned square footage of the department including the production, storage, service and dining areas.

If the individual school wishes to install separate meters to more accurately assign energy costs some thought might be given to establishing several prototype school classifications to conduct a study for determining formulae applicable to schools with similar characteristics.

If would seem to me that because of the use of heavy duty equipment, refrigeration of perishables and frequency of vendor deliveries that a general percentage assignment of cost to the food service program of twenty to twenty five percent of the total would be initially fair. Subsequent studies could dictate adjustment to these estimates.

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Table of Contents

I had hoped to receive more precise data from the engineering discipline but the question had not previously been posed. I hope this information will be of some help in your study.

Sincerely yours,

John Callahan

John M. Callahan
President

JMC:dc

Table of Contents

HOSPITALITY CONSULTANTS, INC.

118 Great Road, Suite 215
P.O. Box 269
Stow, MA 01775

September 27, 1991

Mr. Fredrick Glantz
Senior Economist
Abt Associates, Inc.
55 Webster Street
Cambridge, MA. 02138

Dear Fred:

When determining what cost assignment should be made for space, the following recommendations are made.

Assignment of Costs for Space and Utilities

1. Determine the actual square footage of space assigned to the food service activities including administration office space, storage, production, service and dining areas.

2. If dining rooms are used for multi-function activities deduct a percentage of the assigned space by applying a percentage of other uses based on a typical 40 hour week.

Example:	Study Periods	=	10 hours per week
	School Lunch	=	20 hours per week
	Scheduled Mtgs.	=	10 hours per week
			40 hours

School Lunch portion is 50%

3. If the receiving dock is used for all school deliveries, determine a pro-rate share of space by applying the same formula as paragraph 2.

4. Use the current cost per square foot of construction rather than current rental value of space. This construction cost should be based on replacement of similar materials and regional cost of labor. The amortization schedules of facilities will vary depending on the type of construction and method of accounting used but as a general rule a thirty year amortization period is reasonable.

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Table of Contents

5. Electrical utility cost can be separately measured through departmental meters. However, it may be impractical to install meters in aged school facilities. I would suggest using the percentage of square footage to the total square footage to apply against electrical and other utility costs. The source formula for determining the space assignment could be used for ensuring consistency.

These calculations are not intended to be micro-matically precise, however they are intended to give an approximate reasonable assignment of cost to the food service use of facilities.

Because of the variable nature of the economy periodic indices may be applied to the established square footage base cost.

These recommendations are made with the implication that it is not prudent to conduct an expanded study of all absolute costs of space and utilities.

Sincerely yours,

John M. Callahan

JMC:dc