National School Lunch Program Menus: A Moral Hazard Problem

Kristen Capogrossi[1] and Wen You[2]

Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2013 AAEA & CAES Joint Annual Meeting, Washington, DC, August 4-6, 2013.

[1] Economist at Christensen Associates, Email: klcapogrossi@LRCA.com; Voice: (608)231-2266
[2] Assistant Professor at Virginia Tech, Email: wenyou@vt.edu

I. Introduction

Newspaper headlines read "Senate Saves the Potato on School Lunch Menus" (Pear 2011) and "Putting Nutrition at the Head of the School Lunch Line" (Alderman 2010) as the National School Lunch Program garners more media attention regarding the nutritional content of school meals. Decisions are made daily concerning many facets of the school meal programs at the federal, state and local levels, but how are decisions made with regard to the actual choice of foods on school lunch menus?

The National School Lunch Program (NSLP) is a federally assisted school meal program operating in public and nonprofit private schools to provide nutritionally balanced, low-cost or free meals to children. As of 2009-2010, the program covered over 101,000 schools with over 31.7 million children participating each day and costing $10.8 billion in FY 2010 (USDA 2010). According to a report published by the Economic Research Service in 2008, a balancing act of three different objectives determines the success of the NSLP: "serving a nutritious meal, getting children to purchase *and* eat the meal, and doing it all on a limited budget". However, in a 2007 School Lunch Report Card, the Physicians Committee for Responsible Medicine found that 80% of schools do not meet USDA nutrition requirements for school meals (PCRM 2008).

Other research finds that NSLP participation is associated with higher proportions of food energy coming from fat and saturated fat as well as higher than recommended amounts of sodium (Burghardt, Gordon and Fraker 1995; Gordon, Devaney and Burghardt 1995). Specifically, the third School Nutrition Dietary Assessment Study (SNDA-III) finds that as of 2004/2005 80% of schools failed to meet the guidelines for total fat in an average lunch, and

70% of schools serve meals with more than 10% of calories coming from saturated fats. Further research finds that NSLP participants consume more calories on average from low-nutrient, energy-dense solid foods such as pizza compared to nonparticipants (Briefel, Wilson and Gleason 2009; Cole and Fox 2008; Gordon et al. 2007), while other studies conclude that NSLP contributes to better nutrient intake of certain vitamins and minerals among participants (e.g., Bhattacharya, Currie and Haider 2006; Gleason and Suitor 2003; Kennedy and Davis 1998). Taking this research a step further, a handful of studies have analyzed the impact of current program participation on child weight with mixed results (Millimet, Tchernis and Husain 2010; Schanzenbach 2009; Gunderson, Kreider and Pepper 2009). In order to change the nutritional quality of school meals, research needs to be conducted on the decision-making process regarding school lunch menus.

School Food Authorities (SFAs) are administrative bodies governed above the school level (usually aligned with school districts) providing food services to schools. They are responsible for contracting with companies that provide foods to schools (including vending machines and fast food establishments as well as foods offered through the school meal programs), establishing meal program menus and ensuring that meals meet federal nutrition requirements among other responsibilities. They also receive reimbursements and agricultural commodities for school meals from the federal government. Currently, SFAs must meet nutrition requirements of the 1995 School Meals Initiative (SMI) through one of five meal planning systems and must demonstrate that lunches meet nutrition standards for specific age/grade groupings averaged over each school week. These five meal planning systems include: Nutrient Standard Menu Planning, Assisted Nutrient Standard Menu Planning, Enhanced Food Based Menu Planning, Traditional Meal Pattern, and any other reasonable

approach. The SMI regulations require that schools are evaluated on a weighted analysis of the nutrient content of their lunch menus over a typical school week.[3]

Implementation of nutrition standards is monitored through an audit of each SFA at least once every five years. Detailed information on the expected number of meals served, the actual number of meals served, and portion sizes for each of the grade groupings served within a school are reported. In addition, SFAs are required to provide a school food authority profile, a record of weekly milk usage, menus for the week being reviewed, standardized recipes, production records, nutrition facts labels on purchased products, and a meal component worksheet. If an SFA fails to meet standards, it is required to develop improvement plans for meeting SMI goals with technical assistance from the Education Service Center Program Specialist. According to The School Meals Initiative Implementation Study Third Year Report (SMIIS III), 62% of SFAs that underwent compliance review in 1998/1999 required improvement plans; however, the proportion of SFAs devising improvement plans varied extensively among states suggesting an absence of consistency in upholding the standards. Another repercussion for failing to meet standards is that reimbursement payments for meals can be eliminated. However, if it is believed that the SFA is trying to abide by SMI nutrition requirements, reimbursements are not affected.[4]

While accountability measures are in place to satisfy the SMI, the penalty for failing to comply is negligible: this is a disincentive for providing more costly meals that meet nutrition requirements. In addition, sizable implementation costs are another disincentive. The Federal Register (2011) estimates that the SMI requirements will increase food costs by $3.4 billion from FY 2012 through FY 2016. Furthermore, once the 100 percent whole grain requirement

[3] Nutrients are weighted by the proportion of students who select the food item.
[4] I could not find data on whether reimbursement payments had been withheld from any schools

takes effect, the increase in food costs is estimated at $1 billion annually. Because healthier foods require more on-site preparation, labor costs are also expected to increase by approximately the same amount as food costs. Therefore, the Federal Register estimates that total costs of SMI implementation may increase by $6.8 billion through FY 2016. This is equivalent to about 14 cents for each reimbursable school lunch. The entirety of these costs is incurred by local and state agencies that contribute to school food service accounts.

No study that we are aware of examines the incentives and barriers among the SFAs decision-making process with regard to the provision of healthier lunch menus. The issue faced by SFAs is a classic moral hazard problem: a SFA's effort and concern for the provision of healthy menu options is unknown (i.e., asymmetric information). SFAs can accept federal funds and agricultural commodities to provide healthy lunches while districts create school wellness policies "requiring" minimum nutritional quality of school-provided foods, but the overall quality of implementation is relatively unknown.

The significance of this study is highlighted by the undeniable health and economic implications of childhood obesity and the quality of school meals affecting millions of children. If the NSLP contributes to a positive impact on child health, the program will provide useful policy tools that will be easy to execute. If the program contributes to a negative impact on child health, then this research gives policy analysts knowledge and the opportunity to implement incentives to ameliorate the problem. Therefore, this research has the following objectives: (1) Address the need for an impact analysis of NSLP on child health using economic theory and estimation methods to identify the underlying mechanisms of this relationship; (2) Utilize the Principal-Agent (PA) framework to model efforts put into healthy eating and

providing healthy foods on the part of the school meal program at the level of the School Food Authority; (3) Examine potential incentives and costs for SFAs to adopt healthier lunch menus.

II. Conceptual Framework

In the PA framework, the SFAs are the agents that put forth an unobservable level of effort to contract with food service management companies, verify the eligibility of children for free and reduced-price meals, establish meal program menus, and conduct yearly on-site reviews of each school within its authority to ensure the validity of meals claimed for reimbursement. According to SMIIS III, the three most difficult tasks for SFAs to implement are entering and analyzing recipes, entering and analyzing menus, and obtaining missing nutrient information. Each of these tasks is integral to the provision of healthier foods and can be incorporated as part of incentives for SFAs.

We use the nutritional quality *(n)* of the food served to measure the effort level of the agents with regard to the provision of healthy food choices. This nutritional level serves as a proxy for the decision making process on the part of the SFAs. Because exact nutritional quality can differ considerably depending on the meal options served on any given day, we use discrete values of low and high for the average nutritional value of a day's worth of lunch options: $n \in \{n_{low}, n_{high}\}$ where $0 \le n_{low} \le n_{high} \le 1$. While most schools do not provide nutritional information of meal options at point of sale[5], this would be relatively easy to implement as part of Local Wellness Policies. Nonetheless, according to the SMI, SFAs should have a record of nutritional information of all meals served.

[5] Some school districts, such as Montgomery County and Fairfax County schools, post calorie information next to the item in the school cafeteria, and others post nutrition information online for parents.

A meal is considered to be of low nutritional value *(n_{low})* if any of the following nutrition regulations are not met:

- No more than 30% of a meal's calories come from fat
- Less than 10% of a meal's calories come from saturated fat
- Meal must provide one-third of the Recommended Daily Allowance of protein, Vitamin A, Vitamin C, iron, calcium and calories

The school meals provided through the SFA for the NSLP produce a child health outcome that is measured by child weight $W(n)$. We assume that other factors contributing to child weight such as exercise and food consumed outside of school are accounted for in $W(\cdot)$ and that child weight is a discrete outcome: overweight, W_{OW}, or healthy weight W_H. If an SFA exerts low effort to make meals healthy for students $(n = n_{low})$, then the probability that the child is of healthy weight is π_0 while the probability that the child is overweight is $(1-\pi_0)$. If a SFA exerts high effort to make meals healthy for students participating in NSLP $(n = n_{high})$, then the probability that the child is of healthy weight W_H is π_1, and the probability that the child is overweight is $(1-\pi_1)$. We assume that the provision of school meals with higher nutritional quality from the higher effort levels of SFA agents increases the probability that the child is of healthy weight: $\pi_1 > \pi_0$.

Because SFAs receive reimbursements for school meals, we denote *r* as the reimbursement transfer that the principal (i.e., the federal government) gives to the agent. We focus on the reimbursement for free lunches which is currently $2.77 for each free lunch provided and is given to all SFAs (USDA 2010). We denote this current level of reimbursement as $r = r_c$. One possible incentive contract to provide more nutritious school

meals is to make the reimbursement rate dependent on the nutritional quality of school meals: $r(n_{high}) = r_{high}$ and $r(n_{low}) = r_{low}$ where $r_{high} > r_{low}$. This incentive contract rewards SFAs on the provision of healthier school meals. Some policy analysts and school officials have called for an increase in the reimbursement rates for all SFAs which we denote as $r = r_i$, where $r_i > r_c$; however, higher rates would not necessarily results in healthier meals as will be shown.

Since studies show that the most difficult task faced by SFAs is the analysis of meals' nutritional content, we also establish an incentive contract where the principal (i.e., the federal government) provides menus meeting requirements that all SFAs must follow. These meals are designed to minimize costs of the SFAs (i.e., choosing foods that can be purchased in bulk at a reasonable price) while still meeting nutrition requirements of the SMI. They are designed so that SFAs have no incentive to produce the meal at a lower nutritional value in order save money. These meals also have to appeal to children who are participating in the program. With this incentive contract, SFAs lose the flexibility of meal planning and are responsible for procuring all foods necessary for the selected meals; however, the SFAs effort to meet nutrition standards is decreased drastically since the burden of nutrition analysis for recipes and menus is no longer an issue. We assume that the SFAs will not incur higher costs in food purchases or large difficulty in obtaining foods needed for the federally devised menus.

School Food Authorities (the agents) obtain utility/disutility from income, child health costs, effort costs on providing nutritious meals to children, food costs and other fixed costs associated with providing children with meals. For our purposes, we ignore all other income other than the reimbursement from school meals *r* since this income accounts for a little over half of school food service revenues (Neuberger and Namian 2010). Low academic performance and attendance rates are taken into account through *c(W)* which are the costs

associated with child weight since school funding is now often tied to academic performance and attendance rates (Averett and Stifel 2010; Glewwe, Jacoby and King 2001; Meyers et al. 1989; Murphy et al. 1998).

SFA utility is defined as $U(r,w,n) = mr - c(w) - \varphi(n) - V(n) - F$ where *m* is the number of free meals served, $\varphi(n)$ is the agents' effort cost in providing healthy meals, *V(n)* is the cost of food that varies depending on the nutritional value of the meal and *F* is the fixed cost for providing a meal such as the kitchen facilities, cleaning, labor, etc. These fixed costs account for approximately 63% of total costs, while the variable food costs account for approximately 37% (USDA 2008). As the child weight outcome moves from overweight to healthy weight, the agent's cost decreases: $c(W_H) < c(W_{OW})$.[6] In addition, the effort cost $\varphi(n)$ associated with providing healthy school meals attaches a dollar amount to the SFAs disutility from the effort required to offer these meals. This includes the cost of time spent entering and analyzing recipes, entering and analyzing menus, obtaining missing nutrient information, and stress caused by the SMI and audits. These effort costs increase with higher nutritional quality: $\varphi(n_{high}) > \varphi(n_{low})$.

We also categorize SFA agents as efficient and inefficient. The efficient agents are the ones who have already adapted their school meal programs to meet SMI nutritional standards $(n = n_{high})$. These more efficient agents will exert less effort for a small increase in nutritional value compared to the inefficient agents; therefore, their effort cost is lower $\varphi_{eff}(n_{high})$. This is a realistic assumption because once a SFA has adopted a menu planning system, established several menu options and contacted suppliers, incorporating an additional meal that meets standards will require less effort. Inefficient agents are those who have not adapted their school

[6] From now on, we refer to these costs as c_H and c_{OW}.

meal program to meet the nutrition standards $(n = n_{low})$. The effort costs of these agents are $\varphi_{ineff}(n_{low})$. Among the SFAs, the proportion of inefficient agents is θ, and the proportion of efficient agents is $(1-\theta)$. The principal managing the SFAs does not observe agent type, but we assume that he knows the distribution of agent types or the probability that a SFA is efficient or inefficient.

The principal (i.e., the federal government) wants to minimize the expected cost of spending on the school meal program as well as health costs associated with childhood overweight. For the current program, the principal minimizes the total cost TC_c :

$$TC_c = mr_c + Z(n) + \theta_c[\pi_0 c_H + (1-\pi_0)c_{OW}] + (1-\theta_c)[\pi_1 c_H + (1-\pi_1)c_{OW}] \quad (1)$$

where *Z(n)* is the cost in agricultural commodities provided to SFAs which depends on the nutritional quality of the foods provided. Each SFA receives its proportion of *Z(n)* and mr_c which depends on how many meals its schools serve. The probability that the SFA is inefficient and will choose $(n = n_{low})$ is θ_c which produces the expected child health cost $\pi_0 c_H + (1-\pi_0)c_{OW}$. The probability that the SFA is efficient and will choose $(n = n_{high})$ is $(1-\theta_c)$ and produces the expected child health cost $\pi_1 c_H + (1-\pi_1)c_{OW}$.

If the principal chooses to make reimbursement rates dependent on the nutritional quality of school meals $r(n_{high}) = r_{high}$ and $r(n_{low}) = r_{low}$ for SFAs. The incentive to comply is higher due to higher reimbursement rates which lower the cost of implementation for SFAs. The principal's cost minimization of TC_d is

$$TC_d = mr_{high} + Z(n) + D_d + \pi_1 c_H + (1-\pi_1)c_{OW} \quad (2)$$

because in equilibrium, both efficient and inefficient agents will exert high effort. D_d is an additional fixed cost for implementing changes to the program which mostly consist of

monitoring costs in determining whether schools are eligible for high or low reimbursement rates. In this case, all SFAs receive the high reimbursement, and the expected health cost is $\pi_1 c_H + (1-\pi_1)c_{OW}$.

If the principal chooses to provide all the SFAs with nutritious school menus, then the principal will minimize the total cost TC_p:

$$TC_p = mr_p + Z(n) + D_p + \pi_1 c_H + (1-\pi_1)c_{OW} \quad (3)$$

In this case, the reimbursement rate is r_p, and the federal government incurs the additional fixed cost of designing and analyzing meals D_p which considerably decreases the effort cost of the agents. Therefore, both efficient and inefficient agents will exert high effort generating the expected health cost $\pi_1 c_H + (1-\pi_1)c_{OW}$.

III. Program and Incentive Designs

3.1 Current Reimbursement Rate

From research it is evident that the current reimbursement rate is not enough incentive to guarantee compliance with the SMI since SNDA-III finds that as of 2004/2005 80% of schools failed to meet nutrition requirements. The participation constraints for the inefficient agents are not being met under current conditions. The participation constraints require that each agent's expected utility (efficient and inefficient) at least equals his/her reservation utility. However, the inefficient agent's participation constraint is not binding in the current program because the incentive mechanism is not large enough to require compliance. First, we derive the current model to determine why there is minimal compliance.

The principal must find a reimbursement rate (r_c) that minimizes the cost TC_c while ensuring that both efficient and inefficient agents will comply to nutrition standards. We

assume that the principal and agent are rational actors, cost minimizers and utility maximizers, respectively; therefore, the participation constraints (i.e., individual rationality constraints) must be satisfied. The inefficient SFAs that provide the least healthy meals exert low effort, whereas the efficient SFAs that provide healthier meals exert high effort. The participation constraints of the inefficient and efficient agents from the utility reservation, respectively, can be normalized to zero and are the following:

$$mr_c - [\pi_0 c_H + (1-\pi_0)c_{OW}] - \varphi_{ineff}(n_{low}) - V(n) - F \geq 0 \tag{4}$$

$$mr_c - [\pi_1 c_H + (1-\pi_1)c_{OW}] - \varphi_{eff}(n_{high}) - V(n) - F \geq 0 \tag{5}$$

The principal's cost minimization problem is subject to the above participation constraints. However, because efficient agents will likely provide healthy meals without extra incentives, we assume that only the inefficient agent's participation constraint is binding (i.e., the Spence-Mirrless single-crossing property). The optimal reimbursement rate is

$$r_c^* = \frac{[\pi_0 c_H + (1-\pi_0)c_{OW}] + \varphi_{ineff}(n_{low}) + V(n) + F}{m} \tag{6}$$

This makes the principal's cost for NSLP

$$TC_c^* = (1+\theta_c)[\pi_0 c_H + (1-\pi_0)c_{OW}] + (1-\theta_c)[\pi_1 c_H + (1-\pi_1)c_{OW}] + \varphi_{ineff}(n_{low}) + V(n) + F \tag{7}$$

Substituting the optimal reimbursement rate into the efficient agent participation constraint we have the upper-bound on the gap between the effort costs of the two types of agents under the current program's reimbursement

$$\Delta\pi\Delta c > \varphi_{eff}(n_{high}) - \varphi_{ineff}(n_{low}) . \tag{8}$$

Some policy analysts are advocating for increased reimbursement rates for all SFAs. In deriving this current contract, we show why an increase in the reimbursement rate for all SFAs is not sufficient by itself to considerably increase compliance. A mere increase would result in

similar conclusions as the current contract where not all SFAs would meet standards. While an increase in the federal reimbursement rate of school meals is a feasible policy objective, we show that it does not guarantee complete compliance.

3.2 Reimbursement Rates Dependent on Nutritional Quality

For the contract that makes the reimbursement rate dependent on the nutritional quality of the meals, the principal chooses the reimbursement rate $r_d = \{r_{low}, r_{high}\}$ to minimize the total cost TC_d while ensuring that efficient and inefficient agents comply with program requirements. In this scenario, the expected utility from the dependent contract must equal or surpass the expected utility from the current reimbursement making both agent types efficient in equilibrium. The inefficient and efficient agent participation constraints, respectively, are the following

$$r_{high} - \frac{[\pi_1 c_H + (1-\pi_1)c_{ow}] - \varphi_{ineff}(n_{high}) - V(n) - F}{m} \geq r_c^* - \frac{[\pi_0 c_H + (1-\pi_0)c_{OW}] - \varphi_{ineff}(n_{low}) - V(n) - F}{m} \quad (9)$$

$$r_{high} - \frac{[\pi_1 c_H + (1-\pi_1)c_{ow}] - \varphi_{eff}(n_{high}) - V(n) - F}{m} \geq r_c^* - \frac{[\pi_1 c_H + (1-\pi_1)c_{OW}] - \varphi_{eff}(n_{high}) - V(n) - F}{m} \quad (10)$$

In addition, the incentive compatibility constraint must be satisfied where the incentive is strong enough that both types of agents decide to provide school meals of high nutritional quality to receive the larger reimbursement

$$r_{high} - \frac{[\pi_1 c_H + (1-\pi_1)c_{ow}] - \varphi_{ineff}(n_{high}) - V(n) - F}{m} \geq r_{low} - \frac{[\pi_0 c_H + (1-\pi_0)c_{OW}] - \varphi_{ineff}(n_{low}) - V(n) - F}{m} \quad (11)$$

$$r_{high} - \frac{[\pi_1 c_H + (1-\pi_1)c_{ow}] - \varphi_{eff}(n_{high}) - V(n) - F}{m} \geq r_{low} - \frac{[\pi_0 c_H + (1-\pi_0)c_{OW}] - \varphi_{eff}(n_{low}) - V(n) - F}{m} \quad (12)$$

Once again, the participation and incentive compatibility constraints for the efficient agents (Equations 11 and 13) are assumed to be non-binding, and the principal must minimize his cost subject to the binding constraints of the inefficient agents. The following are the optimal high and low reimbursement rates paid by the principal:

$$r_{high}^{*} = \frac{[\pi_1 c_H + (1-\pi_1)c_{OW}] + \varphi_{ineff}(n_{high}) + V(n) + F}{m} \tag{13}$$

$$r_{low}^{*} = r_c^{*} = \frac{[\pi_0 c_H + (1-\pi_0)c_{OW}] + \varphi_{ineff}(n_{low}) + V(n) + F}{m} \tag{14}$$

where $r_{high}^{*} > r_{low}^{*}$. The optimal low transfer (r_{low}^{*}) is the same as the optimal transfer of the current program (r_c^{*}) indicating that agents who continue in noncompliance will receive the same level of reimbursement as they currently receive. The principal's cost for this incentive program is

$$TC_d^{*} = 2[\pi_1 c_H + (1-\pi_1)c_{OW}] + \varphi_{ineff}(n_{high}) + Z(n) + V(n) + F + D_d \tag{15}$$

Substituting the optimal reimbursement rates into the efficient agent participation constraint we have the upper-bound on the gap between high and low effort costs of the inefficient agents under a contract where reimbursements depend on nutritional quality

$$\varphi_{ineff}(n_{high}) - \varphi_{ineff}(n_{low}) \geq \Delta\pi\Delta c \tag{16}$$

.

Therefore, as long as the inefficient SFAs have higher effort costs for their higher efforts, then the Spence-Mirrless property holds and only the constraints of the inefficient agents need to be considered. Substituting the optimal reimbursement rates into the efficient agents' incentive compatibility constraint gives

$$\varphi_{ineff}(n_{high}) - \varphi_{ineff}(n_{low}) \geq \varphi_{eff}(n_{high}) - \varphi_{eff}(n_{low}) \tag{17}$$

which holds as long as the effort to provide healthy meals for inefficient SFAs is larger than the effort needed by the efficient SFAs. Figure 1 depicts that the Spence-Mirrless condition should always be satisfied with our inefficient and efficient agents.

3.3 USDA Devised NSLP Menus

In this scenario, because all agents who participate in the program must use the devised meal plans, the expected utility from the contract must equal or surpass the expected utility from the current reimbursement contract making both agent types efficient in equilibrium with the following inefficient and efficient agent participation constraints, respectively

$$r_p - \frac{[\pi_1 c_H + (1-\pi_1)c_{ow}] - \varphi_{ineff}(n_{high}) - V(n) - F}{m} \geq r_c^* - \frac{[\pi_0 c_H + (1-\pi_0)c_{OW}] - \varphi_{ineff}(n_{low}) - V(n) - F}{m} \quad (18)$$

$$r_p - \frac{[\pi_1 c_H + (1-\pi_1)c_{ow}] - \varphi_{eff}(n_{high}) - V(n) - F}{m} \geq r_c^* - \frac{[\pi_1 c_H + (1-\pi_1)c_{OW}] - \varphi_{eff}(n_{high}) - V(n) - F}{m} \quad (19)$$

However, in this scenario there is no incentive compatibility constraint because all agents are required to provide high nutritional quality. The principal's cost minimization problem is subject to the above participation constraints. Because efficient agents would provide healthy meals without the designed lunch menus, we assume that only the inefficient agent's participation constraint is binding (i.e., the Spence-Mirrless single-crossing property). The optimal reimbursement rate for this incentive contract is

$$r_p^* = \frac{[\pi_1 c_H + (1-\pi_1)c_{OW}] + \varphi_{ineff}(n_{high}) + V(n) + F}{m} \quad (20)$$

making the principal's cost at the optimal reimbursement level:

$$TC_p^* = 2[\pi_1 c_H + (1-\pi_1)c_{OW}] + \varphi_{ineff}(n_{high}) + Z(n) + V(n) + F + D_p \quad (21)$$

Substituting the optimal reimbursement rates into the efficient agent participation constraint we have

$$\varphi_{ineff}(n_{high}) - \varphi_{ineff}(n_{low}) \geq \Delta\pi\Delta c \tag{22}$$

This condition is satisfied as long as the effort cost for inefficient agents to provide meals of high nutritional value is larger than the effort cost to provide low quality meals.

IV. Policy Implications

Next, we must determine when each of the incentive contracts is preferred by the principal. It is integral to know whether the additional costs incurred by the federal government from the reimbursement rates, nutrition analysis and menu creation outweigh the benefits of healthier school lunch menus. Both the reimbursement dependent contract and the government designed menus increase the provision of healthier school lunch menus by SFAs. Both result in similar average child health costs because of the incentive to comply with nutrition requirements: $\pi_1 c_H + (1-\pi_1)c_{OW}$. Under the current program where there are minimal incentives to provide healthier meals, the average child health cost is $\theta[\pi_0 c_H + (1-\pi_0)c_{OW}] + (1-\theta)[\pi_1 c_H + (1-\pi_1)c_{OW}]$. Therefore, when incentives exist for providing more nutritious meals, the benefit in child health costs is

$$B = \theta\Delta\pi\Delta c \tag{23}$$

where *B* is the average health cost savings. This particularly impacts low-income and rural populations since nearly 20 million of the 31.6 million meal program recipients receive free and reduced-price lunches, and the rates of participation in NSLP are about 37% higher for rural children compared to non-rural children (Wauchope and Shattuck 2010). Therefore, the expected child health benefits would be higher for these needy populations.

In addition to benefits from the incentive contracts, both alternatives also require higher optimal reimbursement rates than the current level of reimbursement. The increase in reimbursement rates with regard to changes in effort costs is

$$\Delta r = \varphi_{ineff}(n_{high}) - \varphi_{ineff}(n_{low}) - \Delta\pi\Delta c. \tag{24}$$

Therefore, the principal must consider the health benefits (B), reimbursement costs (Δr) and the fixed costs of program changes (D_j) where benefits outweigh the costs when choosing a version of the program to implement:

$$B > D_j + \Delta r \text{ where } j = d, p \tag{25}$$

The main difference in costs of the contracts to the principal is the fixed costs of program changes. Because the principal wants to minimize total costs, he will choose the program with the smaller fixed costs (D_d versus D_p). If the principal chooses the reimbursement dependent contract, monitoring costs must increase significantly because the nutrition content of meals within each school would have to be examined annually to determine whether the SFA was entitled to high or low reimbursement rates for that year. If the principal chooses to establish uniform menus for SFAs, then the federal government will encounter larger up-front costs with analyzing the nutrition content of meals, devising all available meal options for SFAs and dispersing the information.

In the short-run, the reimbursement dependent contract is more flexible because it allows SFAs to make incremental changes to their menus. There is no deadline for meeting certain nutrition standards; however, the better the nutritious value of the meal, the more income the SFA will obtain through reimbursements. If the federal government were to institute uniform menus, then SFAs would not have the luxury of changing their menus at their own pace. However, the advantage of this contract is that the effort costs of entering and analyzing

recipes, entering and analyzing menus and obtaining missing nutrient information is diminished which are the three most difficult tasks for SFAs to implement according to SMIIS III.

When choosing which program to implement, the increase in utility of the SFAs is important in addition to the cost minimization problem of the principal. When comparing the current program, dependent reimbursement contract and the devised menus contract, the optimal expected utilities of efficient SFAs when providing nutritious meals are the following:

$$U^*_{eff|c} = \frac{(1-\pi_0)\Delta c + V(n) + F + \varphi_{ineff}(n_{low}) - \varphi_{eff}(n_{high})}{m} \tag{26}$$

$$U^*_{eff|d} = U^*_{eff|p} = \frac{(1-\pi_1)\Delta c + V(n) + F + \varphi_{ineff}(n_{high}) - \varphi_{eff}(n_{high})}{m} \tag{27}$$

The optimal utility of an agent is higher under either of the contracts compared with the current program. However, the larger the change in effort costs for inefficient SFAs $\Delta\varphi_{ineff} = \varphi_{ineff}(n_{high}) - \varphi_{ineff}(n_{low})$, the higher the incentives needed from the principal to encourage more nutritious meal planning. This is a critical point of interest in all contracts.

V. Data Needed

Although we do not actually conduct the cost-effectiveness analysis for the National School Lunch Program, we discuss the data that is necessary for such an examination. First, the cost-benefit aspect (Equation 26) is extremely important for the analysis; therefore, the average child health cost saving (B) and additional costs incurred by the principal $(\Delta r, D)$ from the new incentive contracts are needed for decision-making. In order to obtain the costs and benefits, researchers need several pieces of data. Researchers would need to know the proportion of efficient and inefficient SFAs (θ), individual child health cost savings (Δc), the change in probability of a child being healthy weight when inefficient SFAs provide more nutritious meals

$(\Delta\pi)$, the change in effort costs for inefficient SFAs to provide healthy meals $(\Delta\varphi_{ineff})$, and additional fixed costs of the principal from changing the program (*D*).

The proportion of efficient/inefficient SFAs (θ) can be gathered from previous research since both SNDA-III and the Physicians Committee for Responsible Medicine find that 80% of schools do not meet USDA nutrition requirements for school lunches. According to this statistic, $\theta = 80$ since 80% of our agents are inefficient at providing school meals of high nutritional quality.

The SNDA-III data is representative of all public SFAs that offer NSLP, schools within those SFAs and students within those schools. In the data set, SFA directors provide information on district-wide policies including menu planning and operations such as food purchasing. School foodservice managers completed a Menu Survey on detailed food descriptions, portion sizes, number of servings provided in reimbursable meals and competitive foods available near the foodservice area. Students provided a 24-hour dietary recall as well as information on their school meal consumption, opinions about school meals, dietary supplement use, recreational activities and exercise. The data set also contains demographic, socioeconomic, and health-related information (including BMI measured by field staff) along with whether children participate in NSLP, how many times per week and if they receive free- or reduced-price lunches or pay for meals in full. From this information, we could estimate a model that would predict the probability that a child is of healthy weight $(\Delta\pi)$ using participation status in the NSLP as well as whether the SFA is considered efficient or inefficient as predictors while controlling for demographic, socioeconomic, dietary and exercise information.

Because the SNDA-III does not gather information on medical expenditures, the Medical Expenditure Panel Survey (MEPS) could be used in conjunction with the SNDA-III for individual child health costs (Δc). The MEPS collects data on health care costs/expenditures, children's health and children's health insurance coverage. While some of the SNDA-III data may be useful in understanding $(\Delta\varphi_{ineff})$, it would be more helpful to collect first-hand data on questions directly related to $(\Delta\varphi_{ineff})$ and (D).

VI. Conclusion

The National School Lunch Program is a wide-reaching federal program providing meals to millions of children each day. While the program is successful in feeding children, 80% of participating schools do not meet nutrition requirements of the 1995 School Meals Initiative. School Food Authorities are the bodies responsible for analyzing nutritional content and devising meals for the program; however, they lack incentives to abide by the SMI since penalties for non-compliance are negligible. The goal of this paper is to provide some understandings of the decision-making process of SFAs regarding the provision of school meals as well as develop several incentive contracts to address the issue.

We present two modifications to the current program and reimbursement rate levels that address the moral hazard problem: a reimbursement dependent contract and a designed menu contract. In deriving the current contract, we show why an increase in the reimbursement rate level for all SFAs is not sufficient by itself to considerably increase compliance. The reimbursement dependent contract makes the reimbursement rate for school provided meals dependent on the nutritional quality of school meals where meals not meeting requirements garner very low reimbursement rates. For the designed menu contract, the principal analyzes

the nutritional content of potential meals and provides SFAs with menus that are cost efficient and are eligible for reimbursement.

Our results show the mechanisms behind each of these contracts, under which conditions each would be the most effective and the data necessary for empirical evaluation of such an analysis. The crucial element is the additional effort cost that is needed for inefficient SFAs to provide more nutritious meals. If these effort costs outweigh the benefits in child health costs, then the contracts will be unsuccessful in incentivizing SFAs. However, detailed data are needed for true effectiveness of each of the contracts.

We would like to recognize that our model is merely a first look at the decision-making process behind SFAs only taking into consideration the free lunch program and income derived from the reimbursement of free meals. In future research, income from reduced-price meals and paid meals as well as other state and local agencies should also be taken into account. In addition, because the variable food costs are nutrition dependent, there is likely a threshold that SFAs are willing to spend on these food costs that is also unknown to the principal which can be incorporated in the model. With regard to the costs and benefits, the state level influence on SFAs should be considered more thoroughly. All of these are avenues for future research in an area where minimal investigation has been conducted.

References

Alderman, L. (2010), 'Putting Nutrition at the Head of the School Lunch Line', *The New York Times*, B6.

Averett, S. & Stifel, D. (2010), 'Race and gender differences in the cognitive effects of childhood overweight', *Applied Economics Letters* **17**, 1673-1679.

Bhattacharya, J.; Currie, J. & Haider, S. (2006), 'Breakfast of Champions? The School Breakfast Program and the Nutrition of Children and Families', *The Journal of Human Resources* **41**, 445-466.

Briefel, R.; Wilson, A. & Gleason, P. (2009), 'Consumption of Low-Nutrient, Energy-Dense Foods and Beverages at School, Home, and Other Locations among School Lunch Participants and Nonparticipants', *Journal of the American Dietetic Association* **109**(2), S79-S90.

Burghardt, J.; Gordon, A. & Fraker, T. (1995), 'Meals offered in the National School Lunch Program and the School Breakfast Program', *American Journal of Clinical Nutrition* **61**(1), 187S-198S.

Cole, N. & Fox, M. K. (2008), 'Diet Quality of American School-Age Children by School Lunch Participation Status: Data from the National Health and Nutrition Examination Survey, 1999-2004', Technical report, U.S. Department of Agriculture, Food and Nutrition Service, Office of Research, Nutrition and Analysis.

Gleason, P. & Suitor, C. (2003), 'Eating at School: How the National School Lunch Program Affects Children's Diets', *American Journal of Agricultural Economics* **85**(4), 1047-1061.

Glewwe, P.; Jacoby, H. & King, E. (2001), 'Early Childhood Nutrition and Academic Achievement: A Longitudinal Analysis', *Journal of Public Economics* **81**, 345-368.

Gordon, A.; Devaney, B. & Burghardt, J. (1995), 'Dietary effects of the National School Lunch Program and the School Breakfast Program', *American Journal of Clinical Nutrition* **61**(1), 221S-231S.

Gordon, A.; Fox, M. K.; Clark, M.; Noquales, R.; Condon, E.; Gleason, P. & Sarin, A. (2007), 'School Nutrition Dietary Assessment Study-III: Volume II: Student Participation and Dietary Intakes', Technical report, United States Department of Agriculture.

Gundersen, C.; Kreider, B. & Pepper, J. (2009), 'The Impact of the National School Lunch Program on Child Health: A Nonparametric Bounds Analysis', *Working Paper No. 09027*.

Kennedy, E. & Davis, C. (1998), 'US Department of Agriculture School Breakfast Program', *American Journal of Clinical Nutrition* **67**, 798S-803S.

Meyers, A.; Sampson, A.; Weitzman, M.; Rogers, B. & Kayne, H. (1989), 'School Breakfast Program and School Performance', *Am J Dis Child* **143**, 1234-1239.

Millimet, D.; Tchernis, R. & Husain, M. (2010), 'School Nutrition Programs and the Incidence of Childhood Obesity', *The Journal of Human Resouces* **45**(3), 640-654.

Murphy, J. M.; Pagano, M.; Nachmani, J.; Sperling, P.; Kane, S. & Kleinman, R. (1998), 'The Relationship of School Breakfast to Psychosocial and Academic Functioning: Cross-sectional and Longitudinal Observations in an Inner-city School Sample', *Arch Pediatr Adolesc Med* **152**, 899-907.

Neuberger, Z. & Namian, T. F. (2010), 'Who Benefits from Federal Subsidies for Free and Reduced Price School Meals?', Technical report, Center on Budget and Policy Priorities.

Pear, R. (2011), 'Senate Saves the Potato on School Lunch Menus', *The New York Times* **A20**.

Schanzenbach, D. (2009), 'Do School Lunches Contribute to Childhood Obesity?', *The Journal of Human Resources* **44**(3), 684-709.

Wauchope, B. and Shattuck, A. (2010), 'Federal Child Nutrition Programs are Important to Rural Households.' Technical report, Issue Brief No. 11, The Carsey Institute at the University of New Hampshire.

USDA (2010), 'National School Lunch Program Fact Sheet', http://www.fns.usda.gov/cnd/Lunch/AboutLunch/NSLPFactSheet.pdf.

USDA (2008), 'School Lunch and Breakfast Cost Study II', Food and Nutrition Service.