# Using Food Stamps to Improve Nutrient Intake

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**Short Abstract**

The current Food Stamp Program uses fixed benefit payments that do not provide incentives for participants to improve their nutrient intake. This paper examines an alternative contract using a transfer that increases with expenditures on high nutrient foods as a way to increase nutrient intake among food stamp participants.

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## 1. Introduction

The U.S. Department of Health and Human Service (HHS) reports that overweight and obesity are among the most pressing new health challenges today. Indeed, they may soon cause as much preventable disease and death as cigarette smoking (HHS 2001). According to a recent HHS news release, nearly one-third of all adults in the U.S. are obese, and 15% of children and teens aged 6 to 19 are overweight (HHS 2002). The increase in obesity, particularly among the young, implies an increasing burden to the medical care system. Both genetic and environmental factors contribute to obesity (Jerry and Sandy). Families are not obese just because they share genes, but also because they often create environments that contribute to obesity. As a result, both the HHS and USDA have launched several efforts to arm Americans with the tools they need to eat responsibly and choose healthy behaviors.

The food stamp program, the largest food assistance program in the United States, is "… the most critical component of the safety net against hunger because it provides basic protection for citizens of all ages and household status" (USDA-FNS, p.7). The program covers a large portion of the low-income population's diet supplement, although eligibility criteria and benefit levels have been severely curtailed for groups such as legal immigrants and able-bodied adults without dependents.

Advocates of food assistance programs contend that they improve participants' diet quality and ameliorate public health (Basiotis, Kramer-LeBlanc, and Kennedy). However, food stamps also contribute to unhealthy eating patterns. Food stamp recipients have significantly higher to intake of meats, added sugars, and total fats, but not of fruits (Wilde, McNamara, and Ranney). Also, households receiving food stamps

have lower mean healthy eating index component scores than do low-income nonfood stamp households for all components except dairy, meat and fat (Basiotis, Kramer-LeBlanc and Kennedy).

Other food programs do not have this negative effect on eating patterns. Participants in the women, infants and children (WIC) program have significantly lower intakes of added sugars and do not increase the intake of total fats (Wilde, McNamara, and Ranney). WIC is designed specifically to supplement the diet of infants, children, and pregnant and postpartum women, and includes a substantial nutrition education component. The food stamp program, on the other hand, serves primarily to provide resources for food spending. As an entitlement program, food purchases for recipients are relatively unrestricted. Also, food stamp recipients do not receive individual nutrition counseling along with a referral to other subsidized health services.

The purpose of this paper is to describe an alternative food stamp program that gives food stamp recipients the incentive to eat more healthily. We apply contract theory to develop this alternative program that creates the incentive for food stamp participants to purchase high nutrient foods. Since food stamps are an entitlement program, a key requirement of the alternative program is that it not create an incentive for current food stamp recipients to stop participating. This alternative food stamp program would work well in conjunction with new and existing nutrition education programs that reduce recipients' effort cost for purchasing and preparing high nutrient foods in order to promote a lifestyle based on healthier eating that reduces obesity and associated health problems.

## 2. Conceptual Framework

We develop a principal-agent model to apply contract theory to the problem of using food stamps to improve nutrient intakes among food stamp recipients. The manager of the food stamp program is the principal, who designs the requirements of the food stamp program, and eligible food stamp recipients are the agents. The problem facing the principal is one of moral hazard. If extra food stamp benefits are provided to recipients to improve their nutrient intakes, recipients can hide their actual food purchases and consumption information. As a result of this hidden (asymmetric) information, recipients face a moral hazard situation — they can spend the extra benefits on low nutrient foods. A similar moral hazard problem faces education food assistance programs. Though recipients may attend nutrition education programs and develop food consumption plans, their actual food purchases and consumption remain unobserved.

We compare two different contracts: (i) the current food stamp contract with a constant benefit for households of the same eligibility level and (ii) the alternative food stamp contract with a benefit depending on the household's expenditure share on high nutrient food. To keep the analysis analytically tractable for this conceptual model, we make several simplifying assumptions to capture the essence of the problem without loss of generality (Laffont and Martimort). We relax these assumptions in the empirical section.

### 2.1 Agent Effort, Health, and Preferences

Food stamp recipients exert unobservable effort towards purchasing and consuming food. We use the percentage of the food stamp benefit spent on high nutrient foods as effort and denote this expenditure share as $s$. For the conceptual analysis, we

assume $s$ takes either a high or low value: $\bar{s}$ or $\underline{s}$, where $0 \le \underline{s} \le \bar{s} \le 1$. The share $s$ is unobservable under the current food stamp program, but the alternative contract uses a monitoring technology to makes $s$ observable.

Food stamp recipients produce health $h(s)$ using their food purchases as measured by $s$. If obesity is the focus, a measure such as the body mass index (BMI) is an obvious choice for $h(s)$. For the conceptual analysis, the health outcome is either good or bad, $h(\bar{s})$ and $h(\underline{s})$ respectively. For example, with obesity, the good health outcome $h(\bar{s})$ would be a low BMI and the bad health outcome $h(\underline{s})$ would be a high BMI (either overweight or obese). Because many factors in addition to food consumption determine health outcomes such as obesity, the linkage between the recipient's expenditure share on high nutrient foods and health is stochastic. If the recipient exerts high effort ($s = \bar{s}$), then the good health outcome $h(\bar{s})$ occurs with probability $\pi_1$ and the bad health outcome occurs with probability $(1 - \pi_1)$. If the recipient exerts low effort ($s = \underline{s}$), then the good health outcome occurs with probability $\pi_0$ and the bad health outcome occurs with probability $(1 - \pi_0)$. To ensure that a more nutritious purchasing pattern increases the likelihood of good health, we assume $\pi_1 > \pi_0$.

The principal gives the food stamp recipient a transfer that depends on the program. For the current program, since the food stamp benefit is a fixed amount for all individuals with the same eligibility criteria, we denote the transfer $t = t^*$. For the alternative program, the food stamp benefit depends on the expenditure share: $t = t(s)$. To create an incentive for healthy purchasing and eating patterns, the food stamp benefit is larger when the recipient exerts high effort than when the recipient exerts low effort: $t(\bar{s})$

> $t(\underline{s})$. For the contract, we derive a condition to ensure that this monotonicity condition is satisfied.

Food stamp participants obtain utility from income, health, and effort spent on purchasing high nutrient foods. Without loss of generality, assume utility is additively separable in income, health, and effort and ignore all income other than the transfer (Laffont and Martimort). Let agent utility be $U(t, h, s) = t - c(h) - \psi(s)$, where $c(h)$ is the agent's health cost function and $\psi(s)$ is the agent's effort cost function. The health cost function $c(h)$ monetarizes health outcomes, for example as the cost for medical care or income losses as a result of morbidity. Similarly, the effort cost function $\psi(s)$ monetarizes effort for purchasing high nutrient foods, for example as the cost of time spent on reading food labels, learning new food preparation techniques, additional time spent on preparing food, and related activities. The health cost function $c(h)$ is a decreasing function and the effort cost function $\psi(s)$ is an increasing function, so that $c(\bar{h}) < c(\underline{h})$ and $\psi(\bar{s}) > \psi(\underline{s})$. We assume health care costs are comparable for similar eligible recipients, so that the health cost function $c(h)$ is the same across agent types.

Two types of eligible recipients exist and the principal wants both types to participate. Type *a* agents are unhealthy eaters who as participants in the current food stamp program freely choose a low expenditure share on high nutrient foods ($s = \underline{s}$). Type *b* agents are healthy eaters who as participants in the current food stamp program freely choose a high expenditure share on high nutrient foods ($s = \bar{s}$). The two agent types have different effort cost functions $\psi(s)$. For both types, the effort cost for the low expenditure share $\underline{s}$ is equal: $\psi_a(\underline{s}) = \psi_b(\underline{s}) = \psi$. However, unhealthy eaters find a high expenditure share $\bar{s}$ more costly in terms of effort than healthy eaters: $\psi_a(\bar{s}) > \psi_b(\bar{s})$,

which results in the observed difference in their behavior. Figure 1 illustrates the relationships among $\psi$, $\psi_a(\bar{s})$, and $\psi_b(\bar{s})$.

Among the population of eligible recipients, the proportion of type *a* agents is $\theta$ and the proportion type *b* agents is $(1 - \theta)$. Agent type cannot be determined, and even if it could, the principal cannot legally discriminate by agent type because of the supplementary characteristics of the food stamp program. As a result, the probability that any given recipient is an unhealthy eater (type *a*) is $\theta$ and the probability that any given recipient is a healthy eater (type *b*) is $(1 - \theta)$.

**2.2 The Principal's Problems**

The principal managing the food assistance program minimizes the expected total cost of spending on income transfers and the health care costs of recipients, while maintaining program participation by eligible households. As a result, for the current food stamp program, the principal's objective function for a particular recipient is

$$V_0 = t^* + \theta[\pi_0 c(\bar{h}) + (1 - \pi_0)c(\underline{h})] + (1 - \theta)[\pi_1 c(\bar{h}) + (1 - \pi_1)c(\underline{h})]. \quad (1)$$

All recipients receive the payment $t^*$. However, with probability $\theta$ the recipient is type *a*, and so will choose $s = \underline{s}$ and generate expected health cost $[\pi_0 c(\bar{h}) + (1 - \pi_0)c(\underline{h})]$, and with probability $(1 - \theta)$ the recipient is type *b*, and so will choose $s = \bar{s}$ and generate expected health cost $[\pi_1 c(\bar{h}) + (1 - \pi_1)c(\underline{h})]$.

For the alternative program, the principal develops a technology to make *s* observable with a cost *k* per recipient. For example, recipients could receive their food stamp benefit on a debit card that electronically tracks food purchases and the proportion that qualified as high nutrient foods. At the end of the month or quarter, recipients are

credited with an additional food stamp benefit as a result of their recorded $s$. This electronic approach based on price scanners is similar to those used by the current food stamp and WIC programs, which identify approved items at checkout. The principal's objective function for a particular recipient is

$$V_1 = t(\bar{s}) + \pi_1 c(\bar{h}) + (1 - \pi_1)c(\underline{h}) + k. \tag{2}$$

In equilibrium, both agent types exert high effort, and so all recipients receive the transfer $t(\bar{s})$ and generate expected health cost $\pi_1 c(\bar{h}) + (1 - \pi_1)c(\underline{h})$. Regardless of agent type, the principal pays the monitoring cost $k$.

### 3. Current Food Stamp Program

For the current food stamp program, the principal must find the constant transfer $t^*$ that minimizes the cost $V_0$, yet ensure that both agent types prefer to participate in the program. Without loss of generality, normalize the reservation utility of both agent types to zero (Laffont and Martimort). Thus the participation constraint for both agent types for the current program requires that the expected utility of each type as a food stamp recipient equal or exceed zero:

$$t^* - [\pi_0 c(\bar{h}) + (1 - \pi_0)c(\underline{h})] - \psi \geq 0, \tag{3}$$

$$t^* - [\pi_1 c(\bar{h}) + (1 - \pi_1)c(\underline{h})] - \psi_b(\bar{s}) \geq 0. \tag{4}$$

The principal chooses $t^*$ to minimize $V_0$ as reported in equation (1), subject to conditions (3) and (4). However, we assume that only condition (3) for the unhealthy agent binds, then solve the principal's problem and derive a condition to ensure condition (4) is satisfied.

Since the principal has only one choice variable and a binding constraint, the constraint defines the optimum. Rearranging condition (3) as an equality gives:

(5) $$t^* = \pi_0 c(\bar{h}) + (1-\pi_0)c(\underline{h}) + \psi .$$

Substituting this $t^*$ into condition (4) and rearranging gives:

(6) $$\psi_b(\bar{s}) - \psi \leq \Delta\pi\Delta c,$$

where $\Delta\pi = \pi_1 - \pi_0 > 0$ and $\Delta c = c(\underline{h}) - c(\bar{h}) > 0$. When the upper bound on the effort cost of the healthy agent defined by condition (6) is satisfied, only the participation constraint for the unhealthy agent type binds. Figure 1 illustrates this upper bound on the difference between the healthy eater's effort cost when exerting low and high effort. Finally, substituting the optimal $t^*$ into the principal's objective and rearranging gives the principal's costs for the current program at the optimum:

(7) $$V_0^* = \pi_0 c(\bar{h}) + (1-\pi_0)c(\underline{h}) + \pi_1 c(\bar{h}) + (1-\pi_1)c(\underline{h}) + \theta\Delta\pi\Delta c + \psi .$$

**4. Alternative Food Stamp Program**

For the alternative food stamp program, the principal must find the transfer schedule $t(\bar{s})$ that minimizes the cost $V_1$, yet gives unhealthy eaters the incentive to purchase (and consume) high nutrient foods, without losing the participation of either agent type. Since in this case both agent types will exert high effort and the transfers can differ, the respective participation constraints become

(8) $$t(\bar{s}) - [\pi_1 c(\bar{h}) + (1-\pi_1)c(\underline{h})] - \psi_a(\bar{s}) \geq 0,$$

(9) $$t(\bar{s}) - [\pi_1 c(\bar{h}) + (1-\pi_1)c(\underline{h})] - \psi_b(\bar{s}) \geq 0.$$

In addition to these participation constraints, the principal also faces agent incentive compatibility constraints. For the alternative program to achieve its goal, both

agent types must prefer exerting high effort and receiving the high transfer $t(\bar{s})$ to exerting low effort and receiving the low transfer $t(\underline{s})$. The specific constraints are

(10) $t(\bar{s}) - [\pi_1 c(\bar{h}) + (1 - \pi_1)c(\underline{h})] - \psi_a(\bar{s}) \geq t(\underline{s}) - [\pi_0 c(\bar{h}) + (1 - \pi_0)c(\underline{h})] - \psi,$

(11) $t(\bar{s}) - [\pi_1 c(\bar{h}) + (1 - \pi_1)c(\underline{h})] - \psi_b(\bar{s}) \geq t(\underline{s}) - [\pi_0 c(\bar{h}) + (1 - \pi_0)c(\underline{h})] - \psi.$

The principal chooses $t(\underline{s})$ and $t(\bar{s})$ to minimize $V_1$ as reported in equation (2), subject to the participation constraints reported in conditions (8) and (9) and the incentive compatibility constraints reported in conditions (10) and (11). Again, we assume that only the conditions for the unhealthy agent type bind, then solve the principal's problem and derive conditions to ensure that the conditions for the healthy agent type are satisfied. Since the principal has only two choice variables and two binding constraints, the constraints define the optimal choice variables.

When condition (8) binds, solving the equality for $t(\underline{s})$ gives:

(12) $$t(\underline{s}) = \pi_0 c(\bar{h}) + (1 - \pi_0)c(\underline{h}) + \psi \, .$$

Substituting this optimal $t(\underline{s})$ into condition (10) and solving the equality for $t(\bar{s})$ gives:

(13) $$t(\bar{s}) = \pi_1 c(\bar{h}) + (1 - \pi_1)c(\underline{h}) + \psi_a(\bar{s}) \, .$$

Substituting this optimal $t(\bar{s})$ into condition (9) and rearranging gives:

(14) $$\psi_a(\bar{s}) - \psi_b(\bar{s}) \geq 0 \, .$$

Similarly, substituting the optimal $t(\underline{s})$ and $t(\bar{s})$ into condition (11) and rearranging also gives condition (14). Thus, as long as the unhealthy agent type has higher cost for exerting high effort, then only the participation and incentive compatibility constraints for the unhealthy agent will bind for the alternative food stamp program. Figure 1 illustrates this lower bound on the difference between agent effort cost. Finally, substituting the

optimal $t(\bar{s})$ into the principal's objective gives the principal's payoff for the alternative program at the optimum.

(15) $$V_1^* = 2[\pi_1 c(\bar{h}) + (1-\pi_1)c(\underline{h})] + \psi_a(\bar{s}) + k .$$

**5. Program Comparison**

Comparing equation (5) and (12) indicates that $t(\underline{s}) = t^*$. Thus, for the alternative food stamp program, recipients with low expenditure shares on high nutrient foods receive the same food stamp benefit as they would in the current program. However, recipients who spend their food stamp benefit with a high expenditure share on high nutrient foods receive the larger benefit $t(\bar{s})$. Using equations (12) and (13), the food stamp benefit increases in the expenditure share: $t(\bar{s}) > t(\underline{s})$, if $\psi_a(\bar{s}) - \psi > \Delta\pi\Delta c$. Examining condition (14) indicates that if it is satisfied, then this condition ensuring the transfer increases with the recipient's expenditure share is satisfied. Figure 1 also provides a graphical illustration. Thus the alternative program creates the incentive for food stamp recipients to purchase high nutrient foods by increasing their food stamp benefit. The policy question remaining is whether the additional cost of this additional transfer and of monitoring exceeds the benefits of reduced expected health care costs for food stamp recipients.

To determine whether the principal prefers the current food stamp program to the alternative program, substitute equations (7) and (15) into the condition $V_1^* < V_0^*$ and rearrange to obtain

(16) $$k \le (1 + \theta)\Delta\pi\Delta c - [\psi_a(\bar{s}) - \psi].$$

If the monitoring cost *k* exceeds this upper bound, then the principal prefers the current program to the alternative program, otherwise the alternative program is preferred.

The derivatives of the optimal transfers with respect to the health care costs gives the following: $\frac{\partial t^*}{\partial c(\bar{h})} = \pi_0$, $\frac{\partial t^*}{\partial c(\underline{h})} = 1 - \pi_0$, $\frac{\partial t(\bar{s})}{\partial c(\bar{h})} = \pi_1$, and $\frac{\partial t(\bar{s})}{\partial c(\underline{h})} = 1 - \pi_1$. Since $\pi_1 > \pi_0$, when the health care cost for the good health state $c(\bar{h})$ increases, the alternative food stamp program will increase the food stamp benefit for health eaters more than the current food stamp program. On the other hand, the health care cost for the poor health state $c(\underline{h})$ increases, the alternative food stamp program will not increase the benefit as much as the current program. This result is consistent with the goal of the alternative program to promote healthy purchasing and eating patterns using the food stamp benefit.

The derivatives of the principal's optimal value function with respect to the health care costs gives the following: $\frac{\partial V_0^*}{\partial c(\bar{h})} = \pi_0 + \pi_1 - \theta\Delta\pi$, $\frac{\partial V_0^*}{\partial c(\underline{h})} = 2 - (\pi_0 + \pi_1 - \theta\Delta\pi)$, $\frac{\partial V_1^*}{\partial c(\bar{h})} = 2\pi_1$, and $\frac{\partial V_1^*}{\partial c(\underline{h})} = 2(1 - \pi_1)$. Examining these derivatives shows that the principal suffers a greater cost increase with the alternative food stamp program than with the current program if the health care cost of the good health state increases. On the other hand, if the health care cost of the poor health state increases, the principal suffers a greater loss with the current food stamp program than with the alternative program. This latter case seems more likely, so that this alternative foods stamp program has the added advantage of suffering smaller increases in cost as health care costs increase.

## 6. Empirical Model

This conceptual model shows that this alternative food stamp program has the potential to address the problem of obesity. The model captures the essence of the problem and indicates that at least theoretically, the food stamp program could be augmented to focus on other social needs without abandoning its primary goal of providing food security. However, several simplifying assumptions were used to gain analytical tractability without loss of generality (Laffont and Martimort). In order to evaluate its practical relevance, we are working to develop a more satisfying empirical model. This section describes our plans for this process. However, the optimal empirical solution will have the same essential characteristics as this conceptual model.

To evaluate the simple conceptual model, estimates of various costs and probabilities are needed. These include health care costs under different health conditions ($c(\bar{h})$, $c(\underline{h})$); the probabilities of healthy outcomes under different purchasing patterns ($\pi_0$, $\pi_1$); the effort costs for different agent types ($\psi_a(\bar{s}), \psi_b(\bar{s}), \psi$); and the proportion of unhealthy eaters among the population of eligible food stamp recipients ($\theta$). Published literature can provide some of these estimates. For example, the estimate reported by Finkelstein, Fiebelkorn and Wang that the increase in adult per capita medical spending attributable to obesity is $732 can be used for $\Delta c$.

However, not all parameters can be obtained from published literature. The 1994-96 Continuing Survey of Food Intakes by Individuals (CSFII) survey data are available for estimating some of the relationships needed for this model. Fro example, the health outcome function $h(s)$ can be obtained by using the CSFII data to estimate how nutrient

intakes, as measured by the healthy eating index, relate to health outcomes, as measured by the body mass index.

The CSFII data are quite extensive for the approximately 8,000 households participating in the survey. Collected information at the household level includes usual food expenditures, participation in the food stamp program and other food assistance programs, and the level of food sufficiency within the household. The survey is a nationally representative survey conducted in response to the National Nutrition Monitoring and Related Research Act for continuous national data on the dietary status of the U.S. population. The CSFII provides multiple days of dietary data, the most currently available, together with socio-demographic and health-related data for over 15,000 Americans of all ages. So in general, the sample sizes for each sex-age group can provide sufficient level of precision to ensure statistical reliability of the estimates.

Given these estimated continuous functions, the discrete nature of the conceptual model can be relaxed, since variables such as health performance and food expenditure shares are continuous. Furthermore, the simple structure of the agent's utility functions can be relaxed to incorporate risk aversion. In addition, agent type as indicated by the effort cost function can be made continuous as well.

**7. Conclusion**

The current food stamp program contract is a fixed transfer contract that only considers household income and assets to determine the food stamp benefit. The current program effectively fights hunger, but does not provide incentives for participants to improve their nutrient intakes. Programs that promote health and nutrition education for participants only partially reduce the cost of purchasing and preparing high nutrient food.

To increase the probability that food stamp recipients develop healthier life patterns, the program should provide additional incentives for participants to purchase high nutrient foods. In this paper, we proposed an alternative food stamp benefit contract in which the transfer payment varies according to the participants' expenditure share on high nutrient foods. Our conceptual model uses simplifying assumptions to capture the essence of the problem without loss of generality. We show that with this alternative contract, food stamp participants whose food purchases have a low share of high nutrient foods will receive the same food stamp transfer under the proposed contract as with the current food stamp program. Food stamp participants whose food purchases already have a high share of high nutrient foods will receive a higher food stamp benefit. In this way, the alternative contract creates incentives for participants to improve their purchasing patterns.

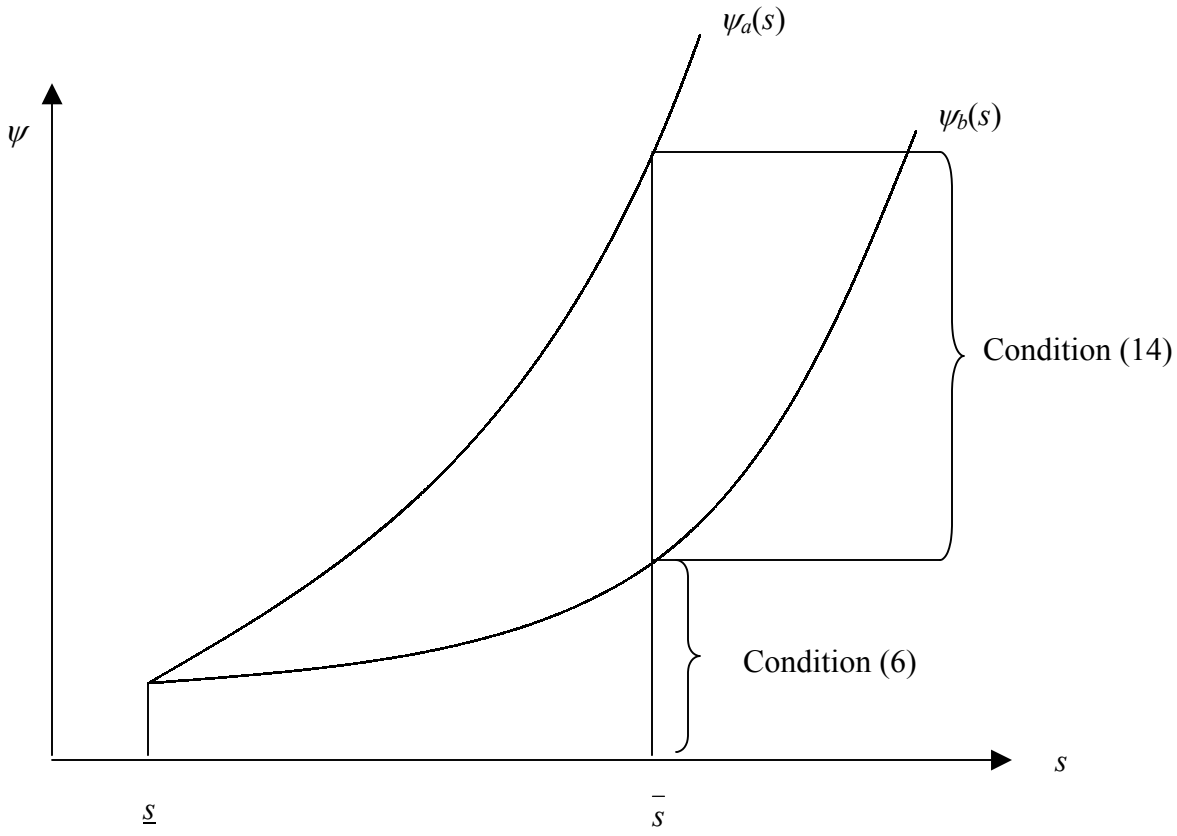


Figure 1. Effort cost $\psi$ as a function of the expenditure share $s$ on high nutrient foods for both unhealthy (type $a$) and healthy (type $b$) food purchasers.

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