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Contents lists available at ScienceDirect

Food Policy

journal homepage: www.elsevier.com/locate/foodpol

Likely effects on obesity from proposed changes to the US food stamp program

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ARTICLE INFO

Article history:

Received 30 September 2007

Received in revised form 11 August 2008

Accepted 23 October 2008

Keywords:

US food stamps

Obesity

Policy change

Healthy food

ABSTRACT

Some have suggested that the US food stamp program (FSP) should be revised with a view to combating obesity among the poor. In this paper, we assess the likely impacts of allowing FSP participants to purchase only healthy foods when using food stamps. Our results indicate that FSP participants would probably increase their consumption of healthy food, but the implications for their purchases of unhealthy food are not clear. Market-wide consequences are even less clear, because changing what may be purchased using food stamps would lead to higher prices for healthy foods and lower prices for unhealthy foods and these price effects would feed back into consumer decisions, with adverse effects on consumption patterns of both participants and non-participants in the FSP. In addition, more restrictive rules on the use of food stamps would discourage participation in the FSP. We conclude that, while reforming the FSP may indeed lead to better diets among participants, it is likely to be an ineffective and inefficient instrument for bringing about desired nutritional outcomes unless accompanied by additional policy instruments.

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Introduction

Links between poverty, policy, and nutritional outcomes are complex. For example, the growing numbers of people who are categorized as obese and overweight are drawn from all socioeconomic, ethnic, and demographic groups, but not uniformly. Several writers have observed that low-income women—including those receiving food stamps—are more likely than the rich to be obese and overweight (Gibson, 2003; Townsend et al., 2001). This observation leads to two questions. First, has the current food stamp program (FSP) contributed to growing obesity among the poor in the United States? Second, could the FSP be redesigned such that it would contribute towards improving diet quality and ultimately reducing obesity?

The first of these questions is a question for careful model-driven statistical analysis of the historical data. Several studies in recent years have yielded a range of results, but the overall message from the published work is that, compared with non-participants, FSP participants tend to spend more on food, and more on food away from home, and are more likely to be overweight or obese. Details differ among studies regarding the size of these effects among different demographic groups—in particular between male and female participants.¹

This paper explores the second question, which has not been subject to as much study though various proposals have been raised.² Specifically, we examine the likely effects on obesity from a particular set of proposed changes to the FSP. We begin with a quick summary of obesity, poverty, and food consumption patterns, followed by a discussion of the FSP and specific changes that have been proposed, aiming to encourage healthier diets among recipients. Next, a simple model of consumer choice is used to show how changes in the FSP to restrict the list of eligible foods might leave some FSP participants unaffected but may cause others to revise their food consumption or to opt out of the FSP. These results are derived from conventional economic reasoning but are not fully appreciated in the food stamp literature.

The remainder of the paper presents less conventional findings that take account of market-level responses. We show how changes in demand induced by changes in the FSP would induce changes in both food quantities consumed and prices. Implied price changes would cause changes in food consumption of both FSP participants and non-participants. In particular, increases in

² Guthrie et al. (2007) suggested that the use of vouchers or bonuses to encourage consumption of “more healthful” foods, such as fruits and vegetables, combined with complementary policies would be a more successful strategy than restricting purchases of “less healthful” foods with food stamps. Guthrie and Variyam (2007) examined one of the complementary policies, nutrition education. Lin and Guthrie (2007) examined the potential quantitative effects of such bonuses in terms of the equivalent price and income effects. In California the state legislature has authorized but not yet approved funding for a program that would provide rebates of food stamps when food stamps were used to purchase fruits and vegetables (http://www.ncsl.org/magazine/extra_foodprogram.htm).

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¹ Examples include Baum (2007), Chen, Yen, and Eastwood (2005), Gibson (2003, 2006), Kaushal (2007), Meyerhoefer and Pylypchuk (2008), Pan and Jensen (2008), Ver Ploeg et al. (2006), Ver Ploeg et al. (2007).

prices of “healthy” food and decreases in prices for “unhealthy” food would mute the healthy food choices of FSP participants and encourage non-participants to consume a less-healthy diet.³ We illustrate effects with a simple simulation model using representative parameter values, and we consider likely short- and long-run market-wide impacts for particular food commodities. The final section summarizes the findings and implications.

The problem of rising obesity in the United States: Trends and linkages

Excessive body weight has been cited by many as *the* key health problem in the United States today (e.g., Townsend, 2006). The prevalence of obesity in the United States doubled between 1971 and 2000 (Zhang and Wang, 2004) and the percentage of children and adolescents who are overweight also increased dramatically, from 5% in 1976 to 16% in 2000 (Ogden et al., 2002). The growing prevalence of obesity has offset some of the gains from healthy changes in American behavior, such as dramatic reductions in smoking and better control of blood pressure, and will continue to do so if current trends continue (Cutler et al., 2007). Obese and overweight Americans generate large additional direct and indirect health care expenses, estimated to be \$78.5 billion in 1998 alone (Finkelstein et al., 2003; Pronk et al., 1999).

High and rising social costs of obesity may call for policy action, but determining the appropriate policy action is not easy, in part because the prevalence of obesity varies among socioeconomic, demographic, and ethnic groups. Individuals who are significantly more likely to be obese or overweight are also more likely to be poor (Mullally et al., 2008). In addition, poor households are often food insecure (Bartfeld and Dunifon, 2005) and food insecurity has been linked to obesity in adults (Townsend et al., 2001) and overweight in children (Alaimo et al., 2001).⁴ Among children, those from low-income households are more likely to be overweight; and, if so, more severely overweight than those from wealthier households.

Reversing obesity trends requires substantially reduced caloric intake over the long term (or substantially more exercise). But the links between policy action and caloric intake are difficult to identify. Food consumption is determined by preferences, which are influenced partly by nutritional information, and by product availability, prices, and consumer income. To change dietary patterns most effectively, policies must target foods that contribute to improved diet quality; and, especially to reduce obesity, policies must overcome preferences for energy-dense foods. Analysis of such policies involves representing the role of the policy in affecting consumer incentives, constraints, and preferences (e.g., see Cash et al., 2005; Miljkovic, 2006; Schroeter et al., 2008).

The US food stamp program, and proposed changes to it

The modern food stamp program grew out of a history of USDA programs designed to stimulate consumption of surplus farm commodities and provide additional calories to recipients who were

poor and likely ill fed (US Department of Agriculture, 1996; Guthrie et al., 2007a). Over time, the food consumption rationale for food stamps grew and the FSP is now the largest element of the USDA budget. Generally, households with incomes at or below 130% of the poverty line are income-eligible for food stamps, and around 50% of eligible individuals have participated historically (Cunyngham, 2004).⁵ Of the roughly 25 million participants in the FSP in 2005, just over half were children under the age of 17, about 17% were elderly, 23% were disabled non-elderly individuals; 45.5% of all participants lived in households headed by white adults, 31.3% in households headed by African-American adults and 13% in households headed by Hispanic adults. Nearly 94% of all participants were US born citizens; only 3.1% were non-citizens. Table 1 reports average gross and net incomes (adjusted using FSP benefit calculation rules), monthly benefits, and household size for the approximately 11 million US households that participated in the FSP in 2005. Average benefits were approximately \$200 per household per month.

Intended and unintended consequences of the food stamp program

Evaluated on the basis of the FSP's original objectives, the program has been very successful; the program has provided food assistance to millions of low-income adults and children, and this assistance has increased food expenditures, reduced food insecurity, increased incomes of the poor, and reduced child poverty (Le Blanc et al., 2007). Studies of the effects of the FSP on food expenditures suggest that the marginal propensity to spend for food stamps is in the range of 0.17–0.47, meaning that an additional dollar of food stamp benefits generated between 17 and 47 cents of additional expenditures on food (Frazao et al., 2007; Fox et al., 2004).⁶ Studies generally find positive effects of FSP participation on the overall *household* availability of food energy and protein (Wilde and Nord, 2005). Fewer studies have explored the relationship between FSP participation and diet composition or quality (e.g., the consumption of carbohydrates and fats, vitamins, and minerals), but the studies that do exist suggest that households of FSP participants generally have greater amounts of nutrients available for consumption. However, several studies suggest that FSP participation has had little or no effect on food consumption of individuals, although a consensus in the literature has yet to emerge (Fox et al., 2004).

FSP participation may also generate a variety of unintended consequences. Kennedy et al. (1995) found that FSP participants eat less-healthy diets than do eligible non-participants and higher-income non-participants.⁷ This difference was especially pronounced for the fruit and food variety components of the healthy eating index (HEI) measure for female FSP participants. FSP participants are more likely to suffer from iron deficiencies and anemia than higher-income and eligible non-participants (Fox and Cole, 2004). FSP participants may also spend less on food away from home.⁸

Overall, the empirical literature has yielded mixed findings on the effects of participation in the FSP on body weight. Studies based on longitudinal data (e.g., Gibson, 2003, 2006) suggest that

³ We use the term “unhealthy” here to identify foods that are likely to be calorie-dense and nutrient-poor, and hence not included on the list of allowable foods in the proposed FSP, and not meeting the requirements of the US dietary guidelines. We understand that most foods can be a component of a healthy diet if consumed in moderation, but we find it convenient to use this shorthand to indicate food that would no longer be subsidized under the proposed FSP.

⁴ However, the link between poverty and obesity may be weakening over time. Jolliffe (2007) reports that the historical trend of higher prevalence of overweight (BMI > 25) among low-income (income < 130 percent of the poverty line) adults in the United States disappeared by 2001–2002, although distribution-sensitive measures of overweight clearly indicated an increased presence of the poor in the tail of the overweight distribution.

⁵ Currie and Grogger (2001) review the literature on food stamp participation.

⁶ Hoynes and Schanzenbach (2007) find somewhat different results for marginal propensities to consume food from money income versus food stamps.

⁷ Diet quality was measured using healthy eating index (HEI) scores. The HEI was created by the USDA in 1995 to measure conformance with the *Dietary Guidelines for Americans*; for details, see <http://www.cnpp.usda.gov/Publications/HEI/healthyeatingindex2005factsheet.pdf>.

⁸ Hoynes and Schanzenbach (2007) found that the introduction of food stamps leads to a decrease in out-of-pocket spending on food, an increase in overall food spending, and a decrease (although insignificant) in the propensity to take meals out. Pan and Jensen (2008) also found that FSP participation reduced the share of food expenditures on food away from home.

Table 1
Average income, benefits, and household size for FSP participants, 2005.

Participant group ^a	Current US dollars			Persons Household size
	Gross monthly countable income ^b	Net monthly countable income ^c	Monthly food stamp benefit	
Total participant population	648	319	209	2.3
Children	768	397	300	3.3
Elderly individuals	690	359	87	1.3
Disabled non-elderly Individuals	802	445	145	2.0
Other households	205	60	146	1.1

Source: Barrett (2006).

^a Classifications refer to households with some members that fit the given description; e.g., “children” refers to households with children.

^b Gross monthly countable income is used to determine eligibility for FSP benefits. It includes most kinds of cash income, and excludes in-kind benefits.

^c Net monthly countable income is used to determine benefit levels under the FSP. It is net of deductions permitted under FSP rules; see Barrett (2006) for a list of allowed deductions.

there is a positive relationship between participation in the FSP and obesity for adult women, whereas no such correlation exists for men. However, these studies assume that the impact of FSP participation on body weight has been constant over time. According to the most recent round of the NHANES survey, the rate of obesity among US adults has continued to increase, while BMIs among FSP participants have declined on average (Ver Ploeg et al., 2006, 2007).⁹ For some socioeconomic groups FSP participation may now be associated with lower expected body weight. Other recent literature suggests that participation in the FSP does affect the likelihood of overweight and obesity, at least for women (e.g., Baum, 2007; Kaushal, 2007; Meyerhoefer and Pylypchuk, 2008).

Proposed changes to the food stamp program

Inflation-adjusted prices of most foods have fallen substantially over the past 40 years (Alston et al., 2006a) and incomes in the United States generally have risen such that the proportion of income spent on food has declined. Furthermore, consumers now spend a much higher proportion of their food dollar on services associated with food than they did in the past. More meals are consumed away from home and, even for meals consumed at home, a higher proportion of food preparation is done elsewhere; this also is true for FSP participants (Mancino and Newman, 2007). These food items are often more caloric than the home-prepared alternatives they replaced (Kuchler et al., 2005).

The current food stamp program allows participants to use the subsidy to consume a diet dominated by energy-dense foods and beverages. A less energy-dense diet will tend to be lower in fat and include more foods that are high in water content such as fruits and vegetables. Eating foods with lower energy density (fewer calories per unit weight) has been shown to reduce overall energy intake and (over time) reduce the prevalence of overweight and obesity. This conclusion is supported by evidence from short-term experimental studies, which consistently find that decreasing the energy density of the diet enhances satiation and lowers energy intake among experimental subjects (Darmon

et al., 2004; Devitt and Mattes, 2004; Rolls et al., 2005; Blass, 2008).

Given the importance of obesity and other new food market circumstances some suggest that it might be appropriate to modify the FSP to better achieve improved dietary quality for the poor, and especially children in poor households. More specifically, it has been suggested that the FSP could be redesigned to promote the consumption of foods like fruits and vegetables, low-fat dairy and meat products, and dried beans and legumes, as a strategy for improving the participants' dietary quality and reducing total calories consumed. Various proposals have been raised and some have been subjected to analysis (e.g., Guthrie et al., 2007a,b).¹⁰

Challenges in determining implications of proposed changes to the FSP

Table 2 sets out a particular set of suggestions regarding foods that would be allowed under a revised FSP, based on a set of changes proposed by Townsend (2006), which we developed to provide a concrete basis for our analysis.

How might the suggested changes to the FSP, disallowing the use of stamps for energy-rich foods, affect the foods consumed by FSP participants? The first challenge in addressing this question is to assess the responses of program participants holding food prices and other things constant. To some degree, participants might simply use cash for the disallowed foods and use food stamps for the foods that remain allowed, leaving the total consumption bundle largely unchanged. But, if consumption patterns of FSP participants were to change we must also consider aggregate market outcomes that affect prices, which feed back into food consumption by participants and non-participants alike.

Given that changing the list of allowable foods and beverages would affect consumption patterns of at least some FSP participants, total market demand would increase for the allowed foods and contract for the disallowed foods. These demand shifts would generally affect both market price and market quantity of each food, where the balance between price and quantity would depend on the nature of supply response in the food industry. Hence, even if we were to know the initial demand response by FSP participants, the equilibrium responses to FSP changes would depend on interactions between the supplies and demands for foods. Of course, consequences for nutritional outcomes such as obesity are even more complex, since these depend on the quantities consumed of foods of each type and the overall implications for caloric intake by all consumers. The remainder of this article uses facts about demand for and supply of particular types of foods to suggest the likely results of a revised FSP.

Likely responses of consumers to proposed changes to the FSP

The proposed changes to the FSP would alter the list of foods that FSP participants could purchase with their food stamps. Standard analysis of the effect of the FSP on food consumption notes that most participants spend more on food than the value of their stamp allotment, and when this is true food stamps act as a pure income supplement with the same effect on food consumption as a cash transfer.¹¹ The reason is that any marginal increase in stamps can be offset with a reduction in monetary outlays for food so that the constraint that the stamps must be spent on food would not restrict the participants' flexibility in choosing food consumption relative to other goods and services. For these “inframarginal”

¹⁰ To our knowledge the USDA is not presently contemplating the introduction of any such changes to the FSP, including those examined in this paper.

¹¹ This result may be derived algebraically or illustrated using graphical analysis of the budget constraints facing participant households (Fraker, 1990; Mullally et al., 2008).

⁹ Kaushal (2007) examines the links between FSP participation and obesity among immigrants.

Table 2
Specific foods for inclusion in the food stamp program: lists for 12 food types.

Food type	Proposed revised FSP
Grains	Only wholegrain bread, rice, pasta, hot, and cold cereals
Dairy products	Cottage cheese, yogurts; all cheese; no cream, cream cheese, butter or dairy desserts
Fruit	No restrictions
Vegetables	No restrictions
Beans and legumes	No restrictions
Nuts and seeds	Only raw and dry roasted nuts, seeds, no nut butters
Meats	Only low-fat cuts of meats (chicken, turkey, lean ground beef, turkey hot dogs, and roasts)
Fish	No breaded and fried fish products
Eggs	No restrictions
Snacks	None allowed
Mixed prepared foods	Pizza, frozen dinners, etc. only allowed if meeting US dietary guidelines for fat, saturated fat, and wholegrain
Milk	Only non-fat, 1%, and 2% milks
Other beverages	Only water and 100% fruit and vegetable juice; no juice drinks, soft drinks or sports drinks

households, food stamps affect food expenditure as would a cash transfer. If the household spends no extra cash on food, however, then the value of food stamps it is allocated does limit food consumption, and more stamps would increase food consumption directly.

Now, suppose food stamps can be used only to purchase healthy foods. Under this revised FSP, foods that are not eligible for purchase with stamps are equivalent to any other non-eligible good or service. If the total value of food stamps is less than the household would have chosen to spend on healthy foods, then once again the food stamps do not add to total consumption of healthy food because the household would be spending all its food stamps and some of its cash income on healthy food. More food stamps simply would mean that the household could use more of its cash income for other goods. Alternatively, suppose that with the current food stamps the household would have chosen a smaller expenditure on healthy food than the total value of the food stamps. In this case, with the switch to revised food stamps, the constraint would be binding and the household would spend the entire food stamp allocation on healthy food, and would use cash income for other goods including the ineligible foods. As a result of the switch to restricted food stamps the household would reduce expenditure on other goods and increase expenditure on food. Hence, as a consequence of being given restricted food stamps rather than generic food stamps, the household would consume more “healthy” food and, most likely, less (but still some) unhealthy food.¹² Some participating households may opt to cease to participate in the FSP if faced with these restricted options.

In summary, if the current FSP were revised as proposed, the consumption of healthy foods by some recipients would most likely increase. However, the effects on total food purchases and the purchases of unhealthy food by recipients are less clear. Some recipients may not change their eating habits, if they are already consuming more-healthy food than the value of their food stamp allotment would permit. Some recipients may increase their consumption of healthy food, using food stamps, but at the same time may reduce their consumption of other goods to allow them to avoid reducing consumption of less-healthy food items. These issues turn on the extent to which the constraint to spend food

stamps only on healthy food is binding on consumption choices, as well as other characteristics of the recipients and their preferences.

Under the current rules, nearly all households fall into the “unconstrained” category: observed food expenditures exceed food stamp benefits. In his review of the food stamp literature, Fraker (1990) reports that between 5% and 15% of beneficiary households purchase food solely through the use of food stamps. Whitmore (2002) estimates this figure to be between 20% and 30%. The proportion of constrained households would undoubtedly increase if the list of allowable foods was revised, since doing so would effectively tighten the constraint on household consumption. For example, suppose the revised FSP focused on promoting consumption of fruits and vegetables. Blisard et al. (2004) report that households with income levels below 130% of the poverty line in 2000 spent about \$24.41 per month on fruits and vegetables, of which \$14.82 was used to purchase *fresh* fruits and vegetables; households with a greater number of members older than 45 years of age spent significantly more on these foods, but no other significant effects of household age structure were observed. The \$24.41 figure represented 10.4% of the average monthly FSP benefit for FSP households with children and 15.4% of the average monthly FSP benefit for all participating households in 2000 (Cunyngham, 2001).¹³ These data suggest that a large fraction of households participating in the FSP would find themselves constrained by the introduction of the suggested revisions to the list of allowable foods, and would change their consumption behavior as a result.

Participation in the FSP has varied quite substantially over the past several decades and for an array of economic and other reasons (Elkin and Turner, 2008; Wilde et al., 2000), some of which are specific to particular socioeconomic groups (Cody, 2004). The conclusion that participants would be likely to increase their consumption of healthy foods is drawn under the assumption that, other things remaining equal, participation in the FSP will not be affected. For households that would find themselves constrained by the proposed changes to the FSP, shortening the list of foods that may be purchased using food stamps would reduce the perceived value of the stamps. As a result, households at the participatory margin might no longer find enrolling in the FSP worthwhile.

Potential market responses to changes in the FSP

So far our analysis of food choices has been conducted under an assumption of constant prices for both types of food and other goods. However, the proposed changes to the FSP would likely generate some increases in demand for the foods included on the revised list of eligible foods, and decreases in demand for foods no longer on the list. These changes in demand would cause increases in both quantity and price of each type of food, with the degree of price increase depending on the supply response for each food product. Supply response in turn depends on factors that affect the added costs of increasing quantities in the market including the length of run (the time allowed for the industry to adjust to the changes). To the extent that increases in demand for more-healthy foods cause increases in their prices, and decreases in demand for less-healthy foods cause decreases in their prices, the second-round or indirect effects of the policy through induced price changes would be to offset the first-round or direct effects. Furthermore, these price adjustments would cause households who do not receive food stamps to reduce their consumption of the eligible foods and increase their consumption of the ineligible

¹² Nothing on the scale of reforming the FSP with the purpose of improving nutrition has been attempted. However, Herman et al. (forthcoming) present evidence from a pilot project in Los Angeles, wherein WIC participants who received vouchers redeemable for fresh fruits and vegetables significantly increased their consumption of fruits and vegetables relative to a control group, at least in some instances.

¹³ Comparing the expenditures estimated by Blisard et al. (2004) to 2005 average monthly FSP benefits (in constant 2000 US dollars) yields approximately the same results (Barrett, 2006).

foods. Consequently, the ability of policy makers to bring about meaningful changes in eating habits among FSP participants and the population more broadly hinges in part on the behavior of farmers, grocery retailers, and other links in the agricultural supply chain.¹⁴

A multi-market model of supply and demand for agricultural commodities

As noted above, the proposed policy, if effective, would affect the demand for all foods and other products. In the illustrative simulation model developed here we assume that the cross-product impacts on the supply side are likely to be negligible and focus attention on the substitution between “healthy” and “unhealthy” foods in demand.

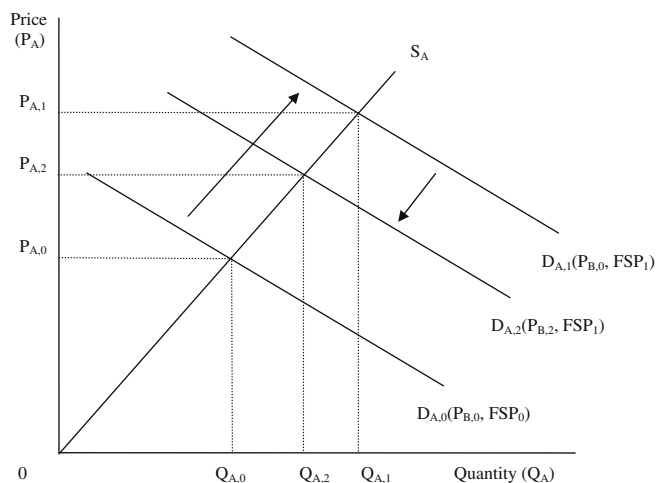
Fig. 1 represents the market for commodity A (a “healthy food” eligible for purchase with food stamps) in panel a, and the market for commodity B (an “unhealthy food” not eligible for purchase with food stamps) in panel b. Now, suppose that, as a result of a change in the food stamp program (indicated by the notation FSP₀ to FSP₁), demand for commodity A increases, from D_{A,0} to D_{A,1} and demand for B decreases from D_{B,0} to D_{B,1}. Holding other factors constant, these demand shifts would cause an increase in price of A from P_{A,0} to P_{A,1} and a decrease in price of B from P_{B,0} to P_{B,1}. However, since the two types of food are substitutes in consumption, the initial increase in price of A would cause a second-round increase in demand for B, and the initial decrease in price of B would cause a second-round decrease in demand for A, in each case offsetting the direct effects of the initial demand shifts. The equilibrium result would depend on the relative magnitudes of the direct (through the proposed FSP changes) and indirect (through the induced price changes) effects on demands for the two goods. We would expect the net effects would be to increase demand for A and reduce the demand for B, but by less than the direct effect alone would imply. In Fig. 1, the equilibrium demand curves reflecting all these effects are depicted as D_{A,2} and D_{B,2}. The corresponding quantities and prices for good A are Q_{A,2} and P_{A,2}, both greater than their initial values, and the corresponding quantities and prices for good B are Q_{B,2} and P_{B,2}, both less than their initial values.

In this analysis, allowing for both direct and indirect effects, the program changes would encourage participants to consume more of the healthier food (i.e., A) and less of the less-healthy food (i.e., B). However, the induced price changes would cause non-participants to consume less of the healthy food (A) and more of the unhealthy food (B). The relative importance of these effects for the different groups of consumers will depend on the relative sizes of the own- and cross-price elasticities of supply and demand.

As noted above the amount of equilibrium change in the diet of participants and non-participants depends on the induced food price changes, which in turn depend on the elasticity of supply. In the extreme short run, supply is likely to be quite inelastic, additional healthy food supplies would not be available and more of the impact in the proposed new policy would show up as an increase in the market prices of healthy foods. Over time, however, as the supplies of each type of food respond to the price incentives, the price changes would be muted and diets would adjust. The nature of supply response to price, and the amount of time it takes for full adjustment to a new equilibrium vary systematically among food products, reflecting differences in the biology and technology of production of the agricultural commodities upon which they are based. Systematic differences may also be found in other factors

¹⁴ While not examined here, changes in food prices may not be spatially uniform (Nord and Hopwood, 2007).

a. The Market for Healthy Food



b. The Market for Unhealthy Food

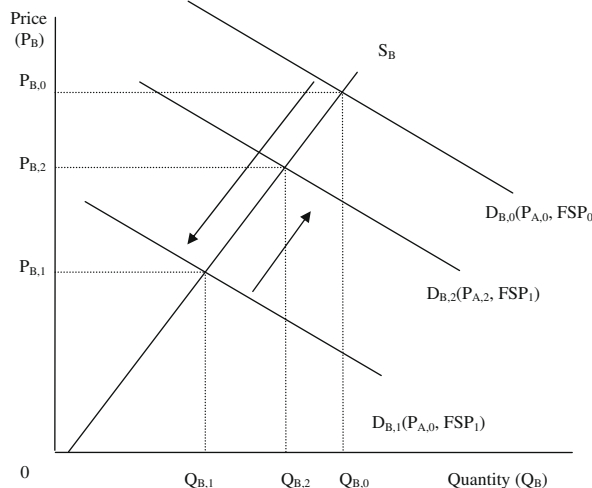


Fig. 1. Multi-market responses to changes in the food stamp program.

that influence price effects of demand changes, including the extent to which products are traded internationally or processed, and the roles of government policies.

Quantitative considerations

An algebraic counterpart of the model represented in Fig. 1 can be used to make our arguments more concrete and, if information on the key parameters can be obtained, to quantify the main effects. The equations of the model include supply and demand equations for each of the two categories of goods. For present purposes, it is of interest to disaggregate each demand into demand by FSP participants and non-participants. Thus the model is given by

$$H_f = h_f(P_h, P_u, A_f) \tag{1a}$$

$$U_f = u_f(P_h, P_u, A_f) \tag{1b}$$

$$H_n = h_n(P_h, P_u) \tag{1c}$$

$$U_n = u_n(P_h, P_u) \tag{1d}$$

$$H = h(P_h) \tag{1e}$$

$$U = u(P_u) \tag{1f}$$

$$H = H_f + H_n \tag{1g}$$

$$U = U_f + U_n \tag{1h}$$

In these equations, H and U denote the quantities of “healthy” and “unhealthy” food, P_h and P_u denote the corresponding prices, subscripts f and n denote demands by participants and non-participants in the FSP, and Δ denotes demand shifters resulting from changes in the FSP rules (these demand shifters are included only in the market for participants, reflecting an implicit assumption for now that participation rates are not affected by the program rules). The first four equations represent the demands by participants and non-participants for healthy and unhealthy food, the next two equations represent the supply equations for healthy and unhealthy food, and the last two equations are market-clearing quantity identities.

Taking logarithmic differentials, the equations of the model can be expressed in terms of proportional changes and elasticities of supply, and demand as follows:

$$d \ln H_f = \eta_{hh}^f d \ln P_h + \eta_{hu}^f d \ln P_u + \alpha_h \quad (2a)$$

$$d \ln U_f = \eta_{uh}^f d \ln P_h + \eta_{uu}^f d \ln P_u + \alpha_u \quad (2b)$$

$$d \ln H_n = \eta_{hh}^n d \ln P_h + \eta_{hu}^n d \ln P_u \quad (2c)$$

$$d \ln U_n = \eta_{uh}^n d \ln P_h + \eta_{uu}^n d \ln P_u \quad (2d)$$

$$d \ln H = \varepsilon_h d \ln P_h \quad (2e)$$

$$d \ln U = \varepsilon_u d \ln P_u \quad (2f)$$

$$d \ln H = \varphi_f d \ln H_f + (1 - \varphi_f) d \ln H_n \quad (2g)$$

$$d \ln U = \nu_f d \ln U_f + (1 - \nu_f) d \ln U_n \quad (2h)$$

These eight equations can be solved for the eight proportional (or percentage) changes in endogenous variables—four quantities consumed (U_f , U_n , H_f , and H_n), two quantities supplied ($U = U_f + U_n$, and $H = H_f + H_n$), and two prices (P_h and P_u)—as functions of parameters representing the proportional exogenous shocks to demand generated by the changes in the FSP rules (α_n , α_u), the elasticities of supply (ε_h , ε_u) and demand (η_{hh} , η_{hu} , η_{uh} , and η_{uu}), and the initial consumption mix ($\varphi_f = H_{f0}/H_0$ and $\nu_f = U_{f0}/U_0$, defined using the specific quantities of healthy and unhealthy food consumed by participants and non-participants prior to the policy change).

Assuming for simplicity that the elasticities of demand are identical between participants and non-participants, the solution for changes in prices is

$$d \ln P_h = (\varepsilon_u - \eta_{uu})\varphi_f \frac{\alpha_h}{D} + \eta_{hu}\nu_f \frac{\alpha_u}{D} \quad (3a)$$

$$d \ln P_u = (\varepsilon_h - \eta_{hh})\nu_f \frac{\alpha_u}{D} + \eta_{uh}\varphi_f \frac{\alpha_h}{D} \quad (3b)$$

where $D = (\varepsilon_h - \eta_{hh})(\varepsilon_u - \eta_{uu}) - \eta_{hu}\eta_{uh}$. Substitution of these results into Eq. (2) yields the corresponding changes in quantities.

The solution to the model is influenced by the fact that the two demand shift parameters, α_h and α_u are not independent. In the case where expenditure on food is constant, any increase in expenditure for “healthy” food must be offset by an equal corresponding decrease in expenditure on “unhealthy” food. This consequence of the budget constraint is reflected in the elasticities of demand. The implication is that $s_u\alpha_u = -(1 - s_u)\alpha_h$, where s_u is the share of the FSP participants’ budget that is spent on unhealthy food. Substituting this result into Eq. (3) and eliminating α_u yields

$$d \ln P_h = \left[(\varepsilon_u - \eta_{uu})\varphi_f - \eta_{hu}\nu_f \left(\frac{1 - s_u}{s_u} \right) \right] \frac{\alpha_h}{D} \quad (4a)$$

$$d \ln P_u = - \left[(\varepsilon_h - \eta_{hh})\nu_f \left(\frac{1 - s_u}{s_u} \right) - \eta_{uh}\varphi_f \right] \frac{\alpha_h}{D} \quad (4b)$$

Own-price elasticities of demand are negative numbers (i.e., $\eta_{hh} < 0$, $\eta_{uu} < 0$), and under most reasonable assumptions the cross-price elasticities will be positive numbers (i.e., $\eta_{hu} > 0$, $\eta_{uh} > 0$) meaning that the two types of foods are substitutes in the household diet. Therefore, if FSP participants were to switch towards more-healthy food, the price of healthy food would rise and

the price of unhealthy food would fall (i.e., $d \ln P_h > 0$ and $d \ln P_u < 0$). Substituting these results into the demand equations, consumption of healthy food by FSP participants would increase and their consumption of unhealthy food would decrease; the opposite for non-participants.

Applying specific values for the parameters, we can simulate magnitudes of changes in prices and consumption implied by the proposed changes in the FSP. Table 3 contains a summary of model results for different values of the initial demand shock (α_h), the own-price elasticity of demand for healthy food (η_{hh}), and the own-price elasticity of demand for unhealthy food (η_{uu}). While the empirical literature on consumer behavior contains a wide range of estimates, the values for food demand elasticities employed in Table 3 represent a range that can reasonably be expected to bracket the true values.¹⁵ It is less easy to define representative values for supply elasticities since they vary among commodities over a much larger range (from zero to infinity) and for a given commodity with changes in the length of run. The elasticities of supply of healthy and unhealthy foods (ε_h , ε_u) are held fixed at 1.0 in these calculations, consistent with an intermediate length of run for most food commodities.

In each case, the initial increase in quantity consumed of healthy food among FSP participants is muted by the implied increase in prices. The magnitude of the change in consumption depends upon the own-price elasticities of demand, η_{hh} and η_{uu} . Holding other parameters constant, greater increases in consumption of healthy foods among FSP participants are associated with a smaller own-price elasticity of demand for healthy foods, or a larger own-price elasticity of demand for unhealthy foods. For non-participating households, larger values of η_{hh} will result in smaller decreases in the consumption of healthy foods following the initial demand shock, and larger increases in consumption of unhealthy foods.

Determinants of price impacts for the main food commodities

The multi-market model presented above is useful conceptually but has some empirical limitations. We have abstracted from the marketing chain between foods at retail and markets for farm commodities used as the raw materials for retail foods (for examples of efforts to empirically examine these links see Lamm and Westcott, 1981; Wohlgenant, 1989, 2001). A practical empirical counterpart would have to include separate equations for many different foods and associated commodities reflecting their different demand and supply elasticities, roles of government policies, international trade, and the food industry, and different roles in the original and revised FSP (e.g., see Abbott, 1999; Jetter et al., 2006). Relevant information for identifying parameters for such an empirical model is not immediately available.

Rather than build such a model we will conjecture about the potential impacts, commodity by commodity, that would result from changes in demand induced by changes in the FSP rules, based on knowledge of the nature of their markets and other relevant factors, and drawing on some related work in previous studies. For this discussion, it is sufficient to know the likely direction of the effect of the change in the FSP rules on the demand for particular commodities, but even that aspect may be hard to judge in some cases given the complex linkages between specific commodities and the foods they are used to produce.

¹⁵ For example, Durham and Eales (2006) surveyed the literature on demand for fresh fruits. The ranges of elasticity estimates they found were bounded by -1.32 and -0.21 , with an average of -0.60 . Huang and Lin (2000) estimate a comprehensive set of demand elasticities using data from the 1987 to 1988 Nationwide Food Consumption survey. Barring a few exceptions, their results are in line with the range of elasticities employed in our model.

Table 3
Quantitative results from the multi-market model.

Elasticity of demand		Initial demand shift (α_h)	Percentage changes in prices		Percentage changes in consumption			
Healthy food (η_{hh})	Unhealthy food (η_{hu})		Healthy food ($d \ln P_h$)	Unhealthy food ($d \ln P_u$)	Participants		Non-participants	
					Healthy food ($d \ln H_n$)	Unhealthy food ($d \ln U_n$)	Healthy food ($d \ln H_f$)	Unhealthy food ($d \ln U_f$)
<i>Parameter values</i>					<i>Percentages</i>			
-0.5	-0.5	1.0	0.25	-0.25	0.75	-0.75	-0.25	0.25
		5.0	1.25	-1.25	3.75	-3.75	-1.25	1.25
	-1.0	1.0	0.27	-0.18	0.77	-0.68	-0.23	0.32
		5.0	1.36	-0.91	3.86	-3.41	-1.14	1.59
	-1.5	1.0	0.29	-0.14	0.79	-0.64	-0.21	0.36
		5.0	1.43	-0.71	3.93	-3.21	-1.07	1.79
-1.0	-0.5	1.0	0.18	-0.27	0.68	-0.77	-0.32	0.23
		5.0	0.91	-1.36	3.41	-3.86	-1.59	1.14
	-1.0	1.0	0.20	-0.20	0.70	-0.70	-0.30	0.30
		5.0	1.00	-1.00	3.50	-3.50	-1.50	1.50
	-1.5	1.0	0.21	-0.16	0.71	-0.66	-0.29	0.34
		5.0	1.05	-0.79	3.55	-3.29	-1.45	1.71

Notes: The above results follow from applying the parameter values to Eq. (2) and Eq. (3). Other model parameters are: $\epsilon_u = 1.0$, $\epsilon_h = 1.0$, $\eta_{hu} = 0.5$, $\eta_{uh} = 0.5$, $\phi_f = 0.5$, $\nu_f = 0.5$, and $S_u = 0.5$.

Grains

We expect the restriction to only whole grain products to cause some price increase initially as mills adjust, but since this restriction would have only tiny impacts on total grain use and since the United States is a major grain exporter, no significant price changes would be expected after the initial brief period of adjustment (Buzby et al., 2005; Vocke et al., 2005).

Dairy products

It is complex to predict the market-wide consequences of a shift in demand towards low-fat dairy products and away from higher-fat dairy products because fat and non-fat solids are produced in fixed proportions in raw milk and US dairy policy maintains a high price of beverage milk products, which causes lower prices for processed products, such as cheese. In this case, there are strong and direct links in production between healthy food (containing non-fat dairy products) and unhealthy foods (containing butter fat). Specifically, given fixed proportions of fat and non-fat components in milk, for a given amount of milk production (at the farm level) a shift to higher consumption of low-fat dairy products by some consumers necessarily would leave more fat to be consumed by others (Alston et al., 2006b). A sustained increase in the demand for lower-fat dairy products will make more-healthy (lower-fat) dairy foods more expensive and less-healthy (higher-fat) dairy foods less expensive to rebalance the consumption to match the ratio of fat to non-fat solids in milk that comes off the farm, although some of the change could be absorbed by increasing (reducing) the milk fat content of US dairy exports (imports).

Sweeteners

Since about the mid-1990s in the United States sweetener use has been divided roughly evenly between sugar and high fructose corn syrup (HFCS) (US Department of Agriculture, 2006a). The direct impact of the proposed changes to the FSP would likely be a decrease in demand for sweeteners, with some corresponding decrease in prices for sweetened products. Such a price effect would be relatively small because of relatively easy supply adjustments in alternative uses for corn and because of the US price support for sugar (Beghin and Jensen, 2008).

Fats and oils

The price effects of suggested changes to the FSP would likely be minimal given that the United States is a major oilseed exporter and the changes in demand would be small relative to the supply

of oilseeds that are used mostly for livestock feed (US Department of Agriculture, 2005).

Meats

Adoption of the revised list of foods that may be purchased using food stamps would encourage greater consumption of low-fat cuts of poultry, eggs, and lean cuts of red meat; fatter cuts of red meat would no longer be included on the list of allowable foods. The adjustments in the supply of beef would take longer than adjustments in poultry or hog markets, but all these supplies are elastic and price movements would be small, especially since the United States is a significant exporter of fatter beef cuts and poultry products and an importer of lean beef.

Fruits, nuts, and vegetables

The proposed changes in the FSP would result in increases in demand for fresh and processed fruits, nuts, and vegetables, implying increases in demand for all commodities in this category. The nature of supply response differs between annual crops (most vegetables) and perennial crops (most fruits and nuts). Supply of perennial crops is relatively inelastic for a several-year horizon so prices would rise for a longer time period than would prices of vegetable products, although vegetables are grown on a specialized land base that would limit supply adjustment for those crops too (LeStrange et al., 1996). Offsetting the relatively inelastic supply is the large share of international trade in the supply and demand for tree nuts, fruits, and processed vegetables.

The general implication is that in the short run there may be some significant induced changes in relative prices for some food commodities, introducing complexities into the adjustment to the proposed policy change, some of which may be counter to the purpose of the change. Although some of these undesired consequences would be sustained, the induced price changes would be largely transitory and within a few years largely eliminated for most commodities. This view is reinforced by previous work that has found that American agriculture has substantial capacity to adjust in response to a demand for a healthier diet. Several authors have estimated the effects on US agriculture of improvements in diet quality. Young and Kantor (1999) concluded that meeting the consumption increase necessary to fulfill the Guidelines would require a 3–4 million acre increase in cropland area planted with fruits, and a 2–3 million acre increase in the area planted with vegetables. This would represent a 20–30% increase in cropland devoted to these crops if all the increase was produced in the

United States (US Department of Agriculture, 2006b, 2007). Jetter et al. (2006) estimated that it would be sufficient to divert approximately 1% of the 218 million acres dedicated to field crops (such as alfalfa, rice, wheat, field corn, and cotton) to supply the increase in fruit and vegetable consumption if the entire US population adopted the *Dietary Guidelines* recommendation of nine servings per day of fruits and vegetables (three to four servings of fruit and four to five vegetable servings). Johansson et al. (2006) estimated changes in production and returns to US agriculture if the American public were to achieve the “Healthy People 2010” goals outlined by the US Department of Health and Human Services. Changes in prices and production were reported relative to baseline USDA forecasts for the year 2010. The estimated losses to US agriculture ranged from 2.4% to 6.7% of net revenues.

Summary and conclusion

Many of the poor are also obese, and increasingly so, and therefore food policies directed at the poor may have implications for obesity that should be considered as part of the policy design. The food stamp program in the United States has hitherto allowed participants to spend food stamps on foods that may have little nutritional value, apart from the provision of calories, and that may have contributed to decreases in diet quality and ultimately increases in obesity among the FSP participants.

Little evidence has been available for assessing the effects of changes in the types of allowable foods, since the guidelines for FSP foods have remained largely unchanged while the number, types, and characteristics of available foods have changed dramatically over the past 40 years. If the FSP were revised to limit purchases to healthier foods, consumers for whom food stamps represent a large share of total food expenditures, and especially those among them who are already consuming a relatively large share of less-healthy foods, would more likely shift to a more-healthy diet, but program participation would also decline. Evaluating changes to the FSP must also consider impacts on the 25 million poor in the United States who do not participate in the program.

The proposed change in FSP rules would be expected to result in some increases in consumption of “healthy” foods and decreases in consumption of “unhealthy” foods and some gradual reduction in obesity of FSP participants. However, the induced changes in prices would result in decreases in consumption of “healthy” foods and increases in consumption of “unhealthy” foods by other consumers. The net effect must be more overall consumption of healthy food and less consumption of the unhealthy foods, but this overall net impact will reflect a complex of mixed effects that differ between rich and poor, participants and non-participants in the FSP, and over time. Effects on obesity are even more complex and likely to be similarly mixed and smaller overall.

In the very short run, changes in the FSP may be absorbed significantly through changes in commodity prices, not just changes in quantities. The sizes of these effects would evolve over time with evolving supply response to price, and the time taken to fully adjust will differ from commodity to commodity. But ultimately, the price effects should be minor for most commodities. Given relatively small induced changes in food prices in the longer run, we expect the proposed changes in the FSP would have significant impacts on quantities of foods consumed and for FSP participants, we would expect their diet quality to improve. The quantity of fruit and vegetable consumption would rise and the overall caloric density of meals would decline. This could lead to reductions in total caloric intake and gradual weight loss for FSP participants. In contrast, eligible non-participants would face increasing prices for most healthy foods and decreases in prices for most unhealthy

foods. Consequently, their diets would deteriorate in quality and overall caloric density would likely increase causing weight gain and more obesity. Furthermore, restricting what can be purchased and increasing the complexity of the program would make the FSP less attractive and the number of participants would therefore decline.

This mixed outcome reflects a fundamental problem with the concept. An important lesson from economics is that if policy has more than one objective, we should use more than one policy instrument. The food stamp program was initially supposed to assist Americans who could not afford an adequate diet (enough calories). It is difficult to use the same policy instrument to achieve another objective—a healthy diet as well as an adequate one—at the same time. Therefore, while a redesigned FSP may lead to healthier diets and reductions in obesity for some FSP participants, in the aggregate, the revised FSP is likely to be ineffective and inefficient, so additional policy instruments would be required. In short, redesigning the list of allowable foods appears to be a poorly targeted intervention for combating obesity among the poor. It ignores the large portion of the poor who do not participate in the FSP, and the consequences of reduced participation incentives. Finally, as discussed by Guthrie et al. (2007a), determining which foods should be on the list of allowable purchases may substantially increase the administrative costs of the FSP, especially in view of the huge and continually changing number of food alternatives in the US food market.

Acknowledgements

We acknowledge helpful research assistance by Abigail Okrent and Grant Aaron. This project was supported by the National Research Initiative of the Cooperative State Research, Education, and Extension Service, USDA, Grant # 2006-55215-16720, and by a cooperative grant from the USDA Economic Research Service. We also gratefully acknowledge further financial and indirect support from the University of California Agricultural Issues Center, the Center for Natural Resources Policy Analysis at the University of California, Davis, and the Giannini Foundation of Agricultural Economics. The opinions expressed in this paper are not necessarily those of the supporting agencies.

References

- Abbott, P., 1999. Agricultural commodity production and trade: a trade economist's view on filling US food supply gaps. *Food Policy* 24, 181–195.
- Alaimo, K., Olson, C.M., Frongillo, E.A., 2001. Low family income and food insufficiency in relation to overweight in US children: is there a paradox? *Archives of Pediatrics and Adolescent Medicine* 155 (10), 1161–1168.
- Alston, J.M., Sumner, D.A., Vosti, S.A., 2006a. Are agricultural policies making us fat? Likely links between agricultural policies and human nutrition and obesity, and their policy implications. *Review of Agricultural Economics* 28 (3), 313–322.
- Alston, J.M., Balagtas, J.V., Brunke, H., Sumner, D.A., 2006b. Supply and demand for commodity components: implications of free trade versus the AUSFTA for the US dairy industry. *Australian Journal of Agricultural and Resource Economics* 50 (2), 131–152.
- Barrett, A., 2006. Characteristics of Food Stamp Households: Fiscal Year 2005. US Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation, Alexandria, VA. FSP-06-CHAR.
- Bartfeld, J., Dunifon, R., 2005. State-level predictors of food insecurity and hunger among households with children. Contractor and Cooperator Report No. 13, US Department of Agriculture Food Assistance and Nutrition Program.
- Baum, C., 2007. The effects of food stamps on obesity. Contract and Cooperator Report No. 34, US Department of Agriculture, Economic Research Service, September 2007.
- Beghin, J., Jensen, H., 2008. Farm policies and added sugars in US diets. *Food Policy* 33 (8), 480–488.
- Blass, E. (Ed.), 2008. *Obesity: Causes, Mechanism, and Prevention*. Sinauer Associates, Inc., Sunderland, MA.
- Blisard, N., Stewart, H., Jolliffe, D., 2004. Low-income households' expenditures on fruits and vegetables. Agricultural Economic Report No. 833, US Department of Agriculture, Economic Research Service.
- Buzby, J., Farah, H., Vocke, G., 2005. Will 2005 be the year of whole grain? *Amber Waves* 3 (3), 14–17.

- Cash, S.B., Sunding, D., Zilberman, D., 2005. Fat taxes and thin subsidies: prices, diet and health outcomes. *Acta Agriculturae Scandinavica Section C* 2, 167–174.
- Chen, Z., Yen, S., Eastwood, D., 2005. Effects of food stamp participation on body weight and obesity. *American Journal of Agricultural Economics* 87 (5), 1167–1173.
- Cody, S., 2004. Food Stamp Program – Elderly Nutrition Demonstrations. Food Assistance and Nutrition Research Program, US Department of Agriculture, Economic Research Service, June 2004.
- Cunningham, K., 2004. Trends in Food Stamp Program Participation Rates, 1976–2002. US Department of Agriculture Food and Nutrition Service. <<http://www.fns.usda.gov/oane/MENU/Published/FSP/FSPPartNational.htm>> (accessed 08.08.06).
- Cunningham, K., 2001. Characteristics of Food Stamp Households: Fiscal Year 2000. US Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation, Alexandria, VA. FSP-01-CHAR.
- Currie, J., Grogger, J., 2001. Explaining recent declines in food stamp program participation. *Brookings-Wharton Papers on Urban Affairs*. The Brookings Press, Washington, DC, pp. 203–229.
- Cutler, D., Glaeser, E., Rosen, A., 2007. Is the US Population Behaving Healthier? Working Paper 13013, National Bureau of Economic Research.
- Darmon, N., Briand, A., Drewnowski, A., 2004. Energy-dense diets are associated with lower diet costs: a community study of French adults. *Public Health Nutrition* 7 (1), 21–27.
- Devitt, A.A., Mattes, R.D., 2004. Effects of food unit size and energy density on intake in humans. *Appetite* 42 (2), 213–220.
- Durham, C., Eales, J., 2006. Demand Elasticities for Fresh Fruit at the Retail Level. Mimeo. <<http://www.ftc.gov/be/seminardocs/061012DurhamEales.pdf>> (accessed 05.09.06).
- Elkin, S., Turner, L., 2008. Longer Run Earnings and Food Stamp Participation. Contractor and Cooperator Report No. 46, US Department of Agriculture, Economic Research Service, July 2008.
- Finkelstein, E.A., Fiebelkorn, I.C., Wang, G., 2003. National medical spending attributable to overweight and obesity: how much, and who's paying? *Health Affairs* 22, 219–226.
- Fox, M.K., Cole, N., 2004. Nutrition and health characteristics of low-income populations. Food Stamp Program Participants and Non-Participants, vol. I. US Department of Agriculture, Economic Research Service, December 2004.
- Fox, M.K., Hamilton, W., Lin, B., 2004. Effects of food assistance and nutrition programs on nutrition and health. Executive summary of the literature review, vol. 4. Food Assistance and Nutrition Research Report No. 19-4, US Department of Agriculture.
- Fraker, T.M., 1990. The effect of food stamps on food consumption: a review of the literature. Mathematica Policy Research Inc., Washington, DC, October 1990.
- Frazao, E., Andrews, M., Smallwood, D., Prell, M., 2007. Food spending patterns of low-income households: will increasing purchasing power result in healthier food choices? *Economic Information Bulletin* Number 29-4, September 2007.
- Gibson, D., 2003. Food stamp program participation is positively related to obesity in low income women. *Journal of Nutrition* 133 (7), 2117–2118.
- Gibson, D., 2006. Long-term food stamp program participation is positively related to simultaneous overweight in young daughters and obesity in mothers. *Journal of Nutrition* 136 (4), 1081–1085.
- Guthrie, J.F., Variyam, J.N., 2007. Nutrition information: can it improve the diets of low-income households? *Economic Information Bulletin* Number 29-6, US Department of Agriculture, Economic Research Service, September 2007.
- Guthrie, J.F., Frazao, E., Andrews, M., Smallwood, D., 2007a. Improving food choices – can food stamps do more? *Amber Waves* 5 (2).
- Guthrie, J.F., Lin, B.H., Ver Ploeg, M., Frazao, E., 2007b. Can food stamps do more to improve food choices? *Economic Information Bulletin* Number 29-1, US Department of Agriculture, Economic Research Service, September 2007.
- Hoynes, H.W., Schanzenbach, D.W., 2007. Consumption responses to in-kind transfers: evidence from the introduction of the food stamp program. *Harris School Working Paper Series* 07.11, Harris School of Public Health, University of Chicago.
- Huang, K.S., Lin, B.H., 2000. Estimation of food demand and nutrient elasticities from household survey data. Technical Bulletin No. 1887, USDA, ERS.
- Jetter, K.M., Chalfant, J.A., Sumner, D.A., 2006. Does 7 to 9 a day pay? The economic benefits to fruit and vegetable industries should people consume the US Department of Agriculture Recommendations, University of California Agricultural Issues Center, Davis, CA. <http://aic.ucdavis.edu/research1/F_&_V_ajae.pdf> (accessed 08.10.06).
- Johansson, R.C., Mancino, L., Cooper, J., 2006. The big picture: obesity, consumption, and food production. *Agribusiness* 22 (4), 491–503.
- Jolliffe, D., 2007. The Income gradient and distribution – sensitive measures of overweight in the US. NPC Working Paper #07-27, National Poverty Center, University of Michigan, September 2007.
- Kaushal, N., 2007. Do food stamps cause obesity? Evidence from immigrant experience. Working Paper 12849, National Bureau of Economic Research, Cambridge, MA, January 2007.
- Kennedy, E.T., Ohls, J., Carlson, S., Fleming, K., 1995. The healthy eating index: design and applications. *Journal of the American Dietetic Association* 95 (10), 1103–1109.
- Kuchler, F., Golan, E., Variyam, J.N., Crutchfield, S.R., 2005. Obesity policy and the law of unintended consequences. *Amber Waves* 3 (3), 28–33.
- Lamm, R.M., Westcott, P.C., 1981. The effects of changing input costs on food prices. *American Journal of Agricultural Economics* 63 (2), 187–196.
- Le Blanc, M., Lin, B.H., Smallwood, D., 2007. Food assistance. How strong is the safety net? *Amber Waves* 5, 40–45 (special feature).
- LeStrange, M., Mayberry, K.S., Koike, S.T., Valencia, J., 1996. Broccoli Production in California. Division of Agriculture and Natural Resources, Publication 7211, University of California, Oakland, CA.
- Lin, B., Guthrie, J., 2007. How do low-income households respond to food prices? *Economic Information Bulletin* 29-5, September 2007.
- Mancino, L., Newman, C., 2007. Who has time to cook? How family resources influence food preparation. *Economic Research Report* Number 40, US Department of Agriculture, Economic Research Service, May 2007.
- Meyerhoefer, Chad D., Pylypchuk, Y., 2008. Does participation in the food stamp program increase the prevalence of obesity and health care spending? *American Journal of Agricultural Economics* 90 (2), 287–305.
- Miljkovic, D., 2006. Obesity: health and food policy dilemma. *Choices* 21 (1, first quarter), 37–40.
- Mullally, C.C., Alston, J.M., Sumner, D.A., Townsend, M., Vosti, S.A., 2008. Proposed modifications to the food stamp program (FSP): likely effects and their policy implications. In: Blass, E. (Ed.), *Obesity: Causes, Mechanism, and Prevention*. Sinauer Associates, Inc., Sunderland, MA.
- Nord, M., Hopwood, H., 2007. Higher cost of food in some areas may affect food stamp households' ability to make healthy food choices. *Economic Information Bulletin* 29-3, US Department of Agriculture, Economic Research Service, September 2007.
- Ogden, C.L., Flegal, K.M., Carroll, M.D., Johnson, C.L., 2002. Prevalence and trends in overweight among US children and adolescents, 1999–2000. *American Medical Association* 288 (14), 1728–1732.
- Pan, S., Jensen, H., 2008. Does the food stamp program affect food security status and the composition of food expenditures? *Journal of Agricultural and Resource Economics* 40 (1), 21–35.
- Pronk, N., Tan, A., O'Connor, P., 1999. Obesity, fitness, willingness to communicate and health care costs. *Medicine and Science in Sports and Exercise* 31 (11), 1535–1543.
- Rolls, B.J., Roe, L.S., Beach, A.M., Kris-Etherton, P.M., 2005. Provision of foods differing in energy density affects long-term weight loss. *Obesity Research* 13 (6), 1052–1060.
- Schroeter, C., Lusk, J., Tyner, W., 2008. Determining the impact of food price and income changes on body weight. *Journal of Health Economics* 27 (1), 45–68.
- Townsend, M.S., 2006. Obesity in low income communities: prevalence, effects, a place to begin. *Journal of the American Dietetic Association* 106 (1), 34–37.
- Townsend, M.S., Peerson, J., Love, B., Achterberg, C., Murphy, S.P., 2001. Food insecurity is positively related to overweight in women. *Journal of Nutrition* 131, 1738–1745.
- US Department of Agriculture, 1996. Nutrition and Food Security in the Food Stamp Program. Ed. Daryl Hall, Mike Stavrianos. FCS Contract No. 53-3198-3-038.
- US Department of Agriculture, 2005. Soybeans and Oilcrops: Trade. *Economic Research Service*. <<http://www.ers.usda.gov/Briefing/SoybeansOilcrops/trade.htm>> (accessed 01.11.06).
- US Department of Agriculture, 2006a. US Consumption of Caloric Sweeteners: Table 49. *Economic Research Service*. <<http://www.ers.usda.gov/Briefing/Sugar/data.htm>> (accessed 01.11.2006).
- US Department of Agriculture, 2006b. Fruit and Tree Nut Yearbook. *Economic Research Service*. <<http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1377>> (accessed 24.09.07).
- US Department of Agriculture, 2007. Vegetables and Melons Yearbook. *Economic Research Service*. <<http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1212>> (accessed 24.09.07).
- Ver Ploeg, M., Mancino, L., Lin, B., 2006. Food stamps and obesity: ironic twist or complex puzzle? *Amber Waves* 4 (1), 32–37.
- Ver Ploeg, M., Mancino, L., Lin, B., 2007. Food and nutrition assistance programs and obesity: 1976–2002. *Economic Research Report* No. 48, US Department of Agriculture, Economic Research Service, September 2007.
- Vocke, G., Allen, E.W., Ali, M., 2005. Wheat Backgrounder. United States Department of Agriculture, WHS-05k-01. <<http://www.ers.usda.gov/publications/whs/dec05/whs05k01>> (accessed 29.07.06).
- Whitmore, D., 2002. What are food stamps worth? Working Paper #468, Princeton University Industrial Relations Section, July 2002. <http://www.irs.princeton.edu/pubs/working_papers.html> (accessed 25.09.07).
- Wilde, P., Cook, P., Gundersen, C., Nord, M., Tiehen, L., 2000. The decline in food stamp program participation in the 1990's. Food Assistance and Nutrition Research Report No. 7, US Department of Agriculture, Economic Research Service, Food and Rural Economics Division.
- Wohlgenant, M.K., 1989. Demand for farm output in a complete system of demand functions. *American Journal of Agricultural Economics* 71, 241–252.
- Wohlgenant, M.K., 2001. Marketing margins: empirical analysis. In: Gardner, B.L., Rausser, G.C. (Eds.), *Handbook of Agricultural Economics*, vol. 1, Part 2, pp. 933–970.
- Wilde, P., Nord, M., 2005. The effect of food stamps on food security: a panel data approach. *Review of Agricultural Economics* 27 (3), 425–432.
- Young, C.E., Kantor, L.S., 1999. Moving toward the food guide pyramid: implications for US agriculture. *Economic Report* No. 779, US Department of Agriculture Economic Research Service. <<http://www.ers.usda.gov/publications/aer779>> (accessed 05.08.06).
- Zhang, Q., Wang, Y., 2004. Trends in the association between obesity and socioeconomic status in US adults: 1971–2000. *Obesity Research* 12 (10), 1622–1632.