Taxing Food to Improve Health: Economic Evidence and Arguments

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Many observers have suggested that tax policy can be used to change the relative prices of foods in ways that will produce desirable health outcomes. We briefly review the economic evidence regarding such claims, and discuss several conceptual and pragmatic issues surrounding the use of such interventions to achieve public health objectives.

Key Words: nutrition, diet, food subsidies, fat tax, obesity

A perceived epidemic of obesity in most of the developed world, and increasing incidence of obesity in poorer countries, has ushered in a new era of concern for dietary health. In recent years there has been an international debate on what, if anything, governments should do to decrease both the social and private costs associated with overconsumption and poor food choices. Many commentators have suggested that fiscal interventions should be a key tool in the arsenal that policymakers use to attack the problems of obesity and dietary-related disease. The most familiar of these policies is the "fat tax" approach, which targets either individual food items or macronutrient content across food items. The most commonly discussed form of fat tax is a levy on high-calorie or high-fat food, designed to achieve reductions in the incidence of obesity and chronic diseases (Schmidhuber 2004). Some researchers have argued that a tax need not change consumption significantly to improve public health outcomes, as such taxes can effectively generate revenue to fund health promotion programs (e.g., Jacobson and Brownell 2000). Subsidies designed to make healthier foods more accessible to consumers have also been proposed.

Much of this debate has proceeded with minimal input from economists, although recent work in the published and "gray" literature has begun to provide evidence to inform this discussion. This paper briefly reviews some of that literature, and highlights some of the theoretical and pragmatic issues around such interventions. We do not claim to be particularly comprehensive or objective in our treatment of this issue, but rather intend only to draw attention to some of the relevant work and considerations that should be brought to bear on this topic.

Is There a Role for Government?

According to a recent World Health Organization (WHO) report on prevention of non-communicable diseases, consumers should limit energy intake from fat and shift consumption from saturated and trans-fatty acids; increase consumption of fruits, vegetables, legumes, whole grains, and nuts; limit the consumption of free sugars; limit salt intake; achieve energy balance for weight control; and engage in adequate levels of physical activity throughout life (World Health Organization 2003). Let us assume for now that society accepts these goals as desirable, and furthermore that consumers are unlikely to achieve them if left to their own devices. Before decision makers try to turn these dietary goals into policy goals, we should still ask two key questions: Can govern-

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ment effectively force healthy diets on consumers, and even if so, should it?

Economists usually answer the latter question by arguing that government intervention into the public realm is justified in the presence of market failures (and only if the cost of the intervention is outweighed by the benefits). Such failures include imperfect market competition, high external costs or benefits to third parties, imperfect information, and the provision of public goods. All of these failures may be evident to some extent in the market for health and wellness. In regards to food policy and health, the most salient failure is probably the lack of full information, especially on the part of consumers. In the absence of standardized labeling requirements in most countries, consumers would generally be unaware of the nutritional characteristics of the food they eat. Even if consumers read the contents of the labels that their governments have insisted be made available to them, they are not necessarily aware of the implications of consuming that item for their health. Given that for many products and nutrients there is little consensus even within the scientific community, and that the information that does reach consumers is often fragmented or even conflicting, this is hardly surprising.

The high societal costs of diseases related to food consumption, particularly publicly financed health care costs, are also frequently cited as a reason for government involvement. The total annual direct costs of obesity in Canada were estimated by Katzmarzyk and Janssen (2004) to be $1.6 billion in 2001 Canadian dollars; other estimates are higher but similar. In the United States, annual medical costs attributable to obesity and overweight in 1998 may have been as high as $92.6 billion in 2002 dollars, approximately half of which were paid by Medicare and Medicaid (Finkelstein, Fiebelkorn, and Wang 2003). Intervention is further justified by indirect costs faced by third parties, such as those incurred by employers through lost productivity or increased insurance premiums.

Additional theoretical insight into this line of argument can be gained by borrowing a few key concepts from environmental economics, the subfield of economics that most frequently confronts questions of externality. One useful idea is the "polluter pays" principle. On its face, taxing the consumer of less desirable foods would seem to be a natural analog to this concept, in that the "polluter" here is the individual who contributes to the public costs of health care by increasing her risk of disease through consumption of a less healthy diet.

What, then, is the appropriate tax? We may accept *some* damaging behavior, but we should reduce the level of damage because the market for food ignores the external health care costs associated with consumption of less healthy foods. Outright bans are justified only when these costs completely outweigh the private benefits of buying and selling "junk" food. The generally accepted rule for achieving an optimal social outcome in the face of negative externality is to tax the damaging activity at a rate equal to the marginal external cost at the optimal level of provision. In practical application to food products, however, the marginal damage of a unit of unhealthy food is very difficult to determine, and may be zero for many consumers, in that even unhealthy food choices may pose negligible risk in the context of an otherwise healthy diet. In other words, the proper Pigovian tax would be on changes to overall dietary composition and not on food items *per se*. As the former is probably impossible to implement, one might reasonably conclude that fat taxes are unlikely to achieve optimal outcomes. The question is then whether or not they can provide a higher level of welfare than the status quo.

Although some observers of a libertarian bent may see the market failure model as being too inclusive, many health professionals would argue that it is either too narrow or irrelevant. In medicine, an intervention is something that is introduced to the patient by a caregiver, and interventions are justified by weighing the possibility of improving the health of the patient against the risks of intervening. In this view, as long as the intervention is justified on medical grounds, one could argue that it makes little difference whether the agent of change is a family physician or a government program.

There have also been calls to broaden the theoretical justification for food price interventions beyond the traditional market failure model from within economics. O'Donoghue and Rabin (2006) investigate whether food taxes can create welfare gains when some consumers exhibit self-control problems, which they implicitly define as con-

sumption of a good beyond the point that satisfies the consumer's own intertemporal utility-maximization problem. Their model suggests that food price interventions can be not just welfare-enhancing, but can even create Pareto improvements if proceeds are returned to consumers. Empirical support of this view can be drawn from the work of Richards, Patterson, and Tegene (2004), who suggest that carbohydrates, fat, protein, and sodium are rationally addictive goods, in accordance with the theory described by Becker and Murphy (1988).

The Economic Evidence

Fat Taxes

We now briefly turn our attention to the economic evidence addressing the question of whether governments can achieve desirable dietary goals through food price interventions. Some recent studies suggest that fat taxes may be effective in reducing unhealthy food consumption. Schroeter, Lusk, and Tyner (2007) created a microeconomic model to estimate the effects of a tax on high-calorie food. They conducted empirical analysis by obtaining statistics for price and income elasticities and using energy accounting to come up with weight elasticities. One of their findings was that a tax on high-calorie soft drinks would cause a decrease in weight through decreased soft drink consumption. Other researchers who have focused their studies on soft drinks have similarly found that a tax on soft drinks may effectively decrease their consumption (Gustavsen 2005, Tefft 2006). Tefft (2006) used a reduced-form linear approximation to estimate the effect of a tax on soft drinks. He found that a tax on soft drinks may result in decreased snack food consumption and increased revenue due to increased expenditure. It is important to note that he measures expenditures rather than quantities. Richards, Patterson, and Tegene (2004) used household scanner data in a random coefficient (mixed) logit RCL model to test if rational addiction to food nutrients may be a cause of obesity. They found that a rational addiction to carbohydrates, fat, protein, and sodium exists and concluded that fat taxes may be more effective than information-based policies. Using a linear approximate almost ideal demand system (LA/AIDS) to simulate tax effects on intake, Santarossa and Mainland (2003) found that price increases on certain food groups may be an effective way to induce people to substitute harmful nutrients for healthier ones.

Other researchers are not as hopeful. Kuchler, Tegene, and Harris (2004) simulated health outcomes of a fat tax by using reduction in weight as a measure of health. They calculated the effects of a tax on different levels of consumer responsiveness to price. For each elasticity scenario, four possible tax rates ranging from 0.4 to 30 percent were considered. They were able to calculate reduction in caloric intake for each scenario, assuming that nothing was substituted for the salty snacks and that all food purchases were consumed. From this they calculated reduction in body weight (3500 kcal per pound of body weight). Their results show that a small tax of 0.4 or 1 percent would not significantly affect consumption or health outcomes. In later work, the same authors further estimated demand functions for potato chips, all chips, and other salty snacks. Using the resulting elasticity estimates, they explored the effects of a 1, 10, and 20 percent tax on each snack category. They found that a small tax on salty snacks would not impact diet very much and that even a relatively large tax would not appreciably affect the diet quality of the average consumer (Kuchler, Tegene, and Harris 2005).

Smed, Jensen, and Denver (2005) combined econometric models of food consumption behavior in socio-demographic groups with models for conversion between food consumption and nutrient intake. They conducted simulations of four different scenarios: a tax on all fats, a tax on saturated fats, a tax on added sugar, and a subsidy on fibers. These are taxes on nutrients rather than types of food. They found that a tax on fats would decrease fat intake but increase sugar intake, while a tax on sugar would decrease sugar intake but increase fat intake. Although these tax scenarios predict a decrease in energy intake, the authors conclude that a tax or subsidy alone could not solve the obesity problem. They suggest combining a tax with other regulations, such as information campaigns, since there might be an interactive effect.

Boizot-Szantaï and Etilé (2005) used data from a French food expenditure survey to model the

effects of different food group prices, income, and demographics on BMI (body mass index). Their results suggest that the effectiveness of a fat tax may be limited in the short run. Clark and Levedahl (2006) used a generalized addilog demand system (GADS) to estimate a demand-characteristic system for beef, pork, and poultry. According to their estimates, a tax that would increase the price of pork would increase the consumption of fat from pork and may contribute to obesity. They suggest that policies to raise income would be more effective at decreasing fat consumption.

The state of Maine had a snack tax between 1991 and 2001. Oaks (2005) used this as a natural experiment to evaluate the effect of a snack tax on obesity outcomes. The design of his project is an interrupted time series comparison group. His analysis revealed no relationship. He argued that although his study fails to support the hypothesis that a snack tax reduces obesity rates, the revenues observed from the snack tax could have been used to support other programs that may be more effective at reducing obesity.

Thin Subsidies

One area of research that has not been fully explored but holds much potential is the analysis of "thin subsidies." Although such subsidies would require government outlays, this money would be returned to taxpayers in the form of lower food prices. The goal is to promote a better diet by making healthier food options more accessible. In turn, lives would be saved through decreased incidence of diet-related diseases, lessening the burden on the health care system. For example, Schroeter, Lusk, and Tyner (2007) analyzed several price change scenarios in their simulation analysis, and found that the most effective scenario to decrease weight was a subsidy on diet soft drinks.

Cash, Sunding, and Zilberman (2005) estimated the health potential of thin subsidies, using epidemiological evidence on the efficacy of fruits and vegetables in reducing heart disease and stroke. They ran simulations using intake and socio-demographic variables from the 1994–96 U.S. Continuing Study of Food Intakes by Individuals. Health outcomes were estimated by using dose-response functions for the protective effects of vegetables and fruits. According to their simulation, a 1 percent decrease in the price of vegetables and fruit could be associated with almost 10,000 prevented cases of coronary heart disease and ischemic strokes in the United States. They concluded that a thin subsidy could be an effective way to provide health benefits, especially to disadvantaged consumers. Their estimates of the cost per statistical life saved, shown in Table 1 below, compare favorably with the costs associated with other U.S. government programs.

Asfaw (2007) used data from a 2007 household survey conducted in Egypt, which included food expenditure. His model estimation used mother's BMI as the outcome variable, which he explained as a function of different food prices, controlling for age, male/female headed households, education, family size, urban/rural, monthly expenditure, and distance to nearest bread shop. His results imply that lower prices on healthier foods such as fruit, milk, and eggs are associated with a lower BMI and that lower prices on energy-dense food items such as sugar and oil are associated with a higher BMI. These results suggest that a thin subsidy may be an effective way to decrease BMI in a developing country context.

Gelbach, Klick, and Stratmann (2007) analyzed how body weight is affected by the price of healthful foods relative to unhealthful foods. They used individual-level data on obesity and demographics from the National Health Interview Survey (NHIS) for the years 1982–1996 and combined them with regional-level food price data. They created price indices of healthful and unhealthful foods, and used the ratio of the two as the key regressor. They also controlled for many demographic variables such as education, race, age, and region. Their regressions show a significant, positive relationship between the relative prices of healthful foods and BMI. Furthermore, their analysis suggested that this is a causal relationship. Although the relationship was statistically significant, the coefficients were modest. On balance, this study suggests that a tax on unhealthful foods or a subsidy on healthful foods would cause a decrease in body weight, but not an economically significant one.

In the public health and dietetics literatures, Simone French and colleagues have reported several experimental studies involving environmental interventions (French et al. 1997a, 1997b, French

Table 1. Present Value of Cost per Life Saved by Avoiding Heart Disease and Stroke Through Small Fruit and Vegetable Subsidies

Commodity	All Incomes	Low Income	Medium Income	High Income
Fruit and vegetables	1.29	1.02	1.19	1.45
Fruit	2.19	1.82	2.17	2.31
Vegetables	1.80	1.33	1.62	2.12

Source: Cash, Sunding, and Zilberman (2005).

Note: "Low income" refers to families below 130 percent of the poverty income guidelines, and "high income" to households above 300 percent of this level. All numbers are in millions of 2002 U.S. dollars.

et al. 2001, Jeffery et al. 1994). French et al. (1997a) set up environmental interventions to determine the effects of pricing strategy on fruit and vegetable purchases in school cafeterias. They made fruit, carrots, and salad in each school cafeteria about 50 percent cheaper during the intervention period and advertised these new prices. During the intervention period fruit sales increased by about fourfold and carrot sales approximately doubled. Salad sales were not significantly different. With the increased sales from lower prices, sales revenue was not significantly reduced. This study suggests that decreasing the price of fruits and vegetables with minimal promotion may be an effective way to increase sales of these items to high school students (French et al. 1997a). Jeffery et al. (1994) conducted a similar experiment in the cafeteria of a university office building. In addition to reducing the prices of fruits and vegetables, they increased the selection. The results suggest that increasing selection and decreasing the price of fruits and vegetables may be an effective way to increase the amount of fruits and vegetables that adults purchase (Jeffery et al. 1994).

French et al. (2001) used an experimental design to determine the effects of decreasing the price of low-fat snacks relative to regular snacks in vending machines. Four levels of pricing were examined. They found that a 10 percent decrease in price of low-fat snacks increased the percentage of snacks sold that were low-fat without increasing sales volume, which suggests that customers may have been substituting low-fat snacks for regular snacks. This is a positive result from a public health perspective. Decreasing the price of low-fat snacks by 25 or 50 percent caused an increase in sales volume, which suggests that consumers may be buying more snacks from the vending machine, which could imply a negative net health outcome. Another possibility is that more consumers were attracted by the price decrease to those particular vending machines used in the study. It is difficult to evaluate the overall efficacy of these interventions because it is not known how the consumers ate throughout the day. An interesting finding of the last study is that lower prices on low-fat snacks were not associated with smaller profits, suggesting that this may be an inexpensive intervention (French et al. 2001). Environmental interventions in a restaurant setting have yielded similar positive results (Horgen and Brownell 2002).

Distributional Effects

A common concern is that fat taxes may be regressive. In the simplest form of the argument, it is probably sufficient to note that low-income consumers spend a larger portion of their income on food, so that any policy that broadly raises food prices will have the greatest relative impact on poor households. Food energy price studies, such as the one conducted by Drewnowski and Specter (2004), have indicated that there is a huge gap between the cost per calorie of energy-dense, nutrition-poor (EDNP) food items such as sugar, and healthier food items such as vegetables and lean meats. Figure 1 shows the results of a similar study we conducted for 56 food items across a sample of 20 Edmonton supermarkets. In this study, we found a tenfold difference in the price per energy unit of fish and poultry ($18.82 CND/1000 KCal) compared to the price of fats, sugars, and oils ($1.42 CND/1000 KCal). Across individual food items, there was approximately a sixty-

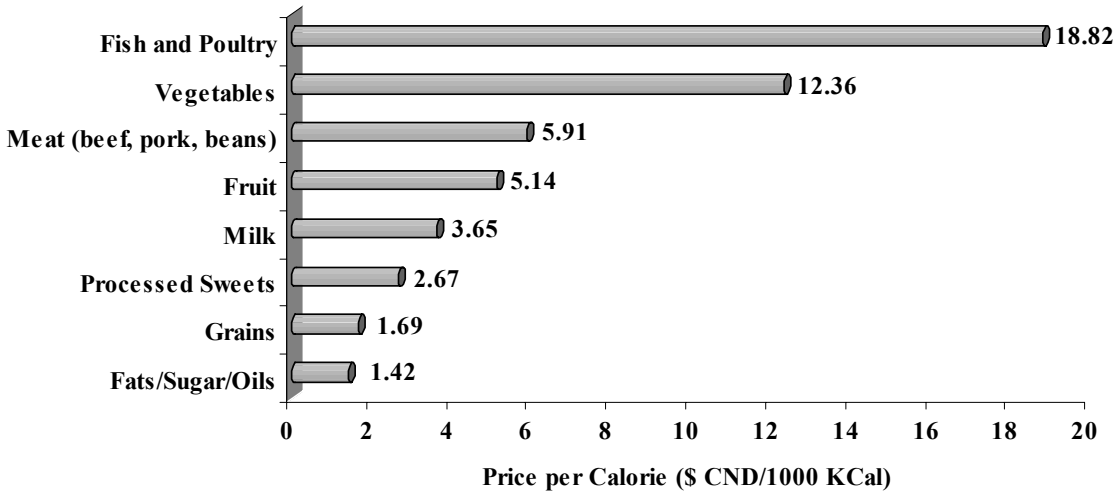

Figure 1. Average Price per Thousand Kilocalories for Various Food Groups in Edmonton Supermarkets

Source: Cash and Lacanilao (2007).

fold difference in energy cost between turkey slices ($25.79 CND/1000 KCal) and sugar ($0.44 CND/1000 KCal) (Cash and Lacanilao 2007). If one accepts that meeting basic energy needs will come before other nutritional concerns, this vast difference in food energy prices suggests that at least for the lowest-income consumers, there is already considerable price pressure to buy EDNP foods. In this context, raising the prices of precisely those foods that provide food energy at the lowest cost is very likely to be regressive.

This premise was also examined by Leicester and Windmeijer (2004), who used data on dietary intake and household income from the 2000 UK National Food Survey to investigate how macronutrient intake varies across the income spectrum. Their analysis suggests that a flat tax targeting fat, sodium, and cholesterol would have an effective tax rate of 0.7 percent for the poorest consumers, but only 0.25 percent for those at median income, and as little as 0.1 percent for the wealthiest households. Another study, investigating a tax on fat content in dairy products, similarly found that such a tax would be regressive in nature (i.e., the elderly and poor would suffer the greatest welfare losses) (Chouinard et al. 2007).

Other studies have indicated that policies designed to make a healthy diet more affordable may be most effective among those with lower socioeconomic status (Darmon, Ferguson, and Briend 2002, Cash, Sunding, and Zilberman 2005). In contrast, Gustavsen and Rickertsen (2004) found that households that consume high amounts of vegetables are more sensitive to vegetable price than low-consuming households, suggesting that a thin subsidy on these products may nonetheless have the greatest benefit to high-income consumers.

Discussion: A Practical Critique of Fat Taxes

The evidence cited above offers conflicting policy prescriptions, in that the estimates of the population health effects of food price interventions vary widely. Even those studies that do suggest that health benefits can be achieved through taxation policy often find that modest taxes will produce only modest health benefits. Any consideration of larger price changes should be viewed cautiously. Those studies that attempt to use elasticity estimates to simulate substantial price changes are often committing two inferential sins: applying a marginal measure inappropriately, and predicting values well outside of the observed range of the data.

In addition to the concerns raised in some of the studies cited above, there are many practical

considerations that arise when one contemplates the implementation of food price interventions.

The Targeting Problem

The actual implementation of any tax requires very specific criteria. One cannot simply instruct retailers and restaurants to tax the less desirable food items that they sell. Specific guidelines must be developed as to what categories of food will be included, and which will not be affected. For example, soft drinks are often touted as a likely candidate for health-based taxation—but the precise definition of a soft drink is not self-evident. Is it a carbonated drink with a certain number of grams of sugar per serving? This would cover cola, but exclude lemonade. If we include non-carbonated beverages, this would also include fruit juices. If we exempt beverages with any fruit juice content, we could prompt consumers to switch to reformulated products that no longer meet the standard for taxation, but are not any more benign for dietary health than the products they favored previously.

Similarly, we must also acknowledge that it is difficult to address population heterogeneity with a point-of-purchase tax. The possible regressiveness of such taxes has been noted above. Furthermore, a certain energy-dense food may be a poor choice for much of the population, but an absolute boon to the health of a long-distance runner the day before a race. The saturated fat content of whole milk may seem a likely candidate for taxation for adults, but parents are advised to give their young children whole milk. It is obviously impractical to tax a product differently on the basis of who in the household may be consuming it.

The targeting problem points to a critical asymmetry between fat taxes and thin subsidies. When a healthier food choice is subsidized, it is relatively easy to predict an increase in the consumption of the targeted food. In contrast, when an individual food item is differentially taxed, the potential universe of substitutes is quite large. While economists may be reasonably capable of predicting substitutions across broad categories of food, or within narrow categories, our ability to predict and track substitutions across tens of thousands of products is hampered both by methodology and data availability. While a high tax on saturated fat content may seem like a definable task, the reality is that people choose food items, not macronutrients. We can say very little on how diets would change under a regime of broadly imposed tax increases. Ineffective and even perverse outcomes of such programs are not just theoretical possibilities.

Producer Responses

Levying taxes requires authorities to draw "bright lines" around the products that will be taxed, which allows producers to reformulate the product to avoid the tax. If regulators choose to tax only the most egregious products, producers will step just over the line, with perhaps negligible improvement in health outcomes. If regulators instead choose to cast a wider net to guarantee that product reformulations do not easily render the taxes moot, many relatively benign products will also be affected. In the latter case, the policy will impose considerable costs that do not directly lead to improved health outcomes.

It is also important to note that some food ingredients that may be targeted are produced in tandem with others that would not be directly subject to the proposed taxation schemes. For example, taxing the consumption of saturated fat content in dairy will not change the fact that a certain amount of milk fat is present in unprocessed cow's milk. Producers will not destroy commodities or by-products that can be sold elsewhere. If producers are not able to sell these products easily in domestic markets, they will export them, thus increasing the availability of these products elsewhere. Alternatively, these products will find their way to domestic consumers through another avenue in food processing, and still may be consumed by the public—either in food items that have been exempted from the tax, or in items that exhibit lower own-price elasticities.

A useful illustration of how policy changes can prompt this sort of reformulation is provided by Cash, Wang, and Goddard (2005). In the years after 1 percent fluid milk was first made available in 1990 to consumers in Canada's tightly regulated dairy markets, it quickly gained market share from both whole and 2 percent milk, reaching a consumption level of 20 liters per capita per year by 2003. During the same time period, sales of

butter went down, but sales of total cream and variety cheeses increased substantially. It would appear that Canadian consumers dutifully drank less milk fat once they had the option to purchase 1 percent milk, and proceeded to eat some of it instead—with the largest increase appearing in relatively expensive variety cheese products.

Existing Price Distortions

It is also important to note that food prices in much of the world are already affected heavily by existing taxes, trade restrictions, transportation policy, energy taxes, food assistance programs, environmental policies, and other interventions. Several observers have noted that agricultural policies in the United States, Canada, and Europe influence food prices in ways that are often incompatible with public health goals (Alston, Sumner, and Vosti 2006, Cash, Goddard, and Lerohl 2006, Lobstein 1998). If improving health is the priority, it would seem reasonable that removing the barriers to healthy diets posed by such policies should take precedence over the introduction of new taxes. If health concerns are not preeminent over all other social goals, then it must be noted that fat taxes may have undesirable consequences for the outcomes that these other programs are supposed to achieve.

Conclusion

There are several other issues around the implementation of fat taxes beyond the ones discussed above. The political feasibility of any such program is unclear, particularly if large price changes are suggested. The evaluation of every existing and new food product for macronutrient-based taxation schemes would be a huge administrative task that would likely take years to implement. Legal challenges from affected producers, retailers, and possibly consumer groups could prove to be very costly and time-consuming, and lobbying efforts to win exemptions would be intense. All of these costs ultimately detract from the potential welfare gains of even a successful attempt to improve health through taxation.

The economic evidence on food price interventions to improve health outcomes is far from complete. More of this work is underway, and economists will also play an important role in assessing the success of any policies that are actually implemented. However, other approaches to improving diets also raise inherently economic questions, as they are all attempts to modify the behavior of individual consumers. As Philipson et al. (2004) note, "Individuals make [food] choices in the context of limited time and income available in the presence of competing goods and activities with the objective of attaining multiple outcomes or goals, only one of which is health. The discipline of economics studies people's choices under precisely these circumstances." The widespread debate over fat taxes has increased awareness of this relevance both within and beyond our profession. Few people today question the role that diet plays in the burden of non-communicable disease, and there is considerable opportunity in this realm for economists to make a positive contribution to health and well-being.

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