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Applying Experimental Economics to Obesity in the Family Household

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The objective of this study is to identify experimental economic tools that can be employed to explain the role of economic behavior in overweight and obesity in the household. We identify three economic experiments that can be used to understand how parent-child economic relationships relate to obesity. Loss aversion experiments are discussed as a tool to understand challenges some individuals face in achieving a healthy diet. Finally, testbed experiments are introduced as a means to test and understand new policies and incentives for better health at the household level.

Key Words: “carrot stick,” child obesity, discount rate, generosity, loss aversion, parent-child, punishment, trust

JEL Classifications: I19, Q18, D01, D63

It is increasingly accepted that both the environment and behavior affect the propensity of overweight and obesity in the household (French, Story, and Jeffery; Friedman 2003, 2004; Hill 1998, 2003). It is less clear how such factors interact with the economic characteristics of the household. Economists have considered the effects of prices and government policies on the propensity toward obesity for certain demographic groups. For example, overweight and obesity is more prevalent in low-income households, Hispanic and African American households, and households with working mothers (Anderson, Butcher, and Levine 2003; Sigman-Grant 2003). Although

general macroeconomic analyses of the problem can tell us *who* is obese, it does not tell us *why* they are obese or explain heterogeneity within the demographic groups.

The need is clear and present to understand which decisions and behaviors, including economic behavior, lead to overweight and obesity in the household. Childhood overweight and obesity (COO) is of special concern because we have yet to realize the full consequences of early overweight and obesity in life. Over the last 20 years, COO has increased from 4% to 17% among children and adolescents between 2 and 19 years of age in the United States¹ (Centers for Disease

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¹ Overweight and obesity is categorized by the Body Mass Index (BMI), which is determined by the formula: weight/height² (kg/m²). Among adults, overweight is classified by a BMI between 25.0 and 29.9, whereas a BMI greater than or equal to 30.0 defines obesity (CDC 2004a). Overweight in children is typically not referred to as “obesity,” although these terms will be used interchangeably in this paper. Overweight in children is defined as a BMI that surpasses the 95th percentile of a fixed distribution for a child’s age and gender (CDC 2004a).

Control and Prevention/National Center for Health Statistics (CDC 2004a,b, 2006a,b; Institute of Medicine; Ogden et al.). Currently, 61% of overweight children have at least one additional risk factor for heart disease and are at greater risk of Type II diabetes. They also have higher probability of sleep apnea and social and psychological problems (CDC 2006b; Mokdad et al.). In the future, we will see an increased occurrence of life-threatening illnesses affecting children and adolescents, such as early kidney failure, coronary heart disease, and limb amputations (Ludwig). This is of import to policy development because society (not just obese individuals) incurs the costs of obesity through third-party insurance and government programs such as Medicare and Medicaid. As of 2003, obesity contributed to \$75 billion in medical expenditures in the United States. The state-level annual Medicaid costs ranged from \$23 million in Wyoming to \$3.5 billion in New York. Annual Medicare costs ranged from \$15 million in Wyoming to \$1.7 billion in California (CDC 2004c). Experts predict the costs of obesity will jeopardize the solvency of Medicare in the future (Ludwig).

The objective of this study is to outline experimental economic tools that could help explain the effect of economic behavior on overweight and obesity in the household. Over the last 25 years, economists have used experiments to develop policies relating to problems such as pollution and environmental regulation (e.g., Cason; Cason, Gangadharan, and Duke 2003; Cherry, Crocker, and Shogren), airline deregulation (Smith), and accounting issues (e.g., Kachelmeier and Shehata). These experiments shed light on important behavioral considerations beyond institutional constructs, which improve market allocation efficiencies and policy outcomes. In this spirit, we discuss the behavioral dimensions that other fields find relevant to the obesity epidemic. We then identify possible economic behaviors, their relevant experiments, and which tools can be used for understanding these behaviors.

Background

Although family genetics do influence an individual's susceptibility toward overweight and obesity, the rapid change in its prevalence is evidence of changing behavioral and environmental factors affecting individual weight outcomes (French, Story, and Jeffrey; Friedman 2003, 2004; Hill 1998, 2003). These behavioral and environmental factors are broad and far-reaching. Thus far, many researchers outside of economics have focused more on micro- rather than macro-level issues and variables. Specifically, different dimensions of parent-child and family relationships are identified as key elements to understanding child health outcomes (Agras and Mascola; Birch and Fisher; Fiore et al.; Gable and Lutz; Patrick and Nicklas; Stang, Rehorst, and Golicic; Strauss and Knight).

Recent literature focuses on parent feeding styles with their child. Family attitudes and beliefs relating to food determine when, where, and how children eat, even beyond the preschool years (Birch and Fisher; Faith et al.; Stang). Whether or not families eat together influences the child's food knowledge and habits, especially with regard to fruit and vegetable consumption (Cooke et al.; Davison, Francis, and Birch; Mamum et al.; Schroeter, House, and Lorence; Variyam, Shim, and Blaylock; Wardle, Carnell, and Cooke). When feeding children, it is important that parents are not excessive in restricting access to unhealthy foods, do not overly encourage the eating of certain foods, and limit the use of food as a reward (Ritchie et al.). This style of feeding has been defined as "authoritative"—parents encourage healthy eating, but the children are given the ultimate choice in deciding what they eat (Davison, Francis, and Birch; Patrick et al.). Two other feeding styles are "authoritarian" and "permissive." Authoritarian parents exercise extreme control over eating. This can be negative if parents limit children's abilities to self-regulate their food intake (Ritchie et al.). On the other hand, permissive parents often allow the child too much freedom over food eating without

structured meal settings, which also leads to increased risk of overweight and obesity.

In addition to parent feeding behavior, parent-child physical fitness relationships are also important. Children's physical fitness is shaped by their parents' physical fitness behavior and attitudes (e.g., Epstein et al.; Lindsay et al.). Parents model active behavior when they engage in sports and actively play with their child. Other behaviors that contribute to sedentary behavior, such as television viewing, could be influenced by family, too (Lindsay et al.).

So far, the role of economics becomes more obvious at the macro level when considering environmental variables influencing obesity and overweight. Economists find changing values of time, food costs, food technology, and physical activity all coincide with increasing overweight and obesity in the household. Over the past two decades, higher wages in the workplace led to a decrease in the household time devoted to family meal preparation (Capps, Tedford, and Havlicek; Chou and Grossman). Convenience and fast food demand has increased because of a higher number of women working. A factor contributing to the increased demand for food away from home is the doubling of the per capita number of fast food restaurants between 1972 and 1997, reducing the search and travel time for food (Chou, Grossman, and Saffer).

As time increased in value, food costs fell because of production technology improvements and agricultural policy incentives. Agricultural policies and the switch from individual to mass food preparation have reduced the price of food energy consumed (Drenowski; Pollan). At the same time, technological change lowered real food prices while shifting the work environment from manual to sedentary labor (Lakdawalla and Philipson; Philipson and Posner). Of each consumer dollar spent, food accounted for 13 cents in 2003, down from 32 cents in 1950 and 43 cents in 1901 (Atkinson).²

²Recent estimates by the U.S. Department of Agriculture/Economic Research Service (USDA/ERS) suggest that the share of disposable income spent on food is about 9.9% (2006).

Unfortunately, these price reductions have nonmarket costs linked to them. The resulting lower cost energy sources have been noted for their high fat and sugar content (Drenowski). High-calorie foods have assumed a main role in the U.S. food supply because they are good-tasting, cheap, and convenient to consume (Drenowski and Levine). Although the number of calories consumed has increased, calories expended have remained relatively constant since the 1980s (Cutler, Glaeser, and Shapiro). The resulting energy imbalance manifested itself in higher weight.

Other, noneconomic environmental variables affecting overweight and obesity include changes at home and in schools. These variables include the physical structure of the neighborhood and school food policies, in particular the availability of soda and vending machine snacks (Anderson and Butcher; *Economist*).

Economic Experiments and Obesity

The existing economic literature does not determine *who* is most susceptible to changes (such as a "fat tax") in the economic environment or *how* they translate to specific household behavior.³ We believe a better understanding of the economic behaviors underlying the obesity epidemic is necessary to formulate effective policy interventions. We identify several economic behaviors related to obesity, and their relevant experiments are presented in Table 1. Four economic experiments (dictator, ultimatum bargaining, trust, and "carrot stick" experiments) could be employed to understand how parent and child economic relationships relate to obesity. Food policy research suggests time preference is important in the timing and consistency of food purchases in the household (Shapiro; Sigman-Grant). A basic time preference experiment is identified as a tool to measure individuals' discount rates and how they relate to overweight and obesity in the household.

³Several states plan to impose or broaden sales taxes or "fat taxes" on soft drinks or syrups and to adjust taxes on other food items (Uhlman).

Table 1. Dimensions of Economic Behavior and Related Economic Experiments

Obesity-Linked Issue	Economic Behavior of Interest/Issue	Economic Experiment
Parent control relating to food	Power and control in the household	Bargaining and negotiation experiments
Irregular food consumption over monthly period	Hyperbolic discounting	Time preference/hyperbolic discounting
Unhealthy eating habits continue	Loss aversion	Loss aversion
Poor incentives to be healthy	Incentive design	Testbed experiments

Loss aversion experiments are discussed as a tool to understand the challenges some individuals face in achieving a healthy diet. Finally, testbed experiments are introduced as a means to test and understand new policies and incentives for better health at the household level.

Bargaining/Negotiation Experiments

Children differ from adults in that they are not primarily price-takers in the market. Children typically receive the food they eat from their parents. As the literature suggests, the way in which this transfer occurs can vary dramatically from family to family (Birch and Fisher; Fiore et al.; Gable and Lutz; Patrick and Nicklas; Stang, Rehorst, and Golicic; Strauss and Knight). Economists can use economic experiments to determine how differences in parenting styles might also be reflected in differences in economic behavior between the parent and child. The dictator game, ultimatum bargaining game, and carrot stick experiments measure generosity, fairness, and punishment and reward expectations between individuals. In this two-player dictator game, a dictator is endowed with an allocation, x , and decides what portion of x to give the other player, the recipient. The Nash equilibrium prediction is that the dictator will give the recipient nothing through self-interest. Yet, the standard experimental result rejects the notion of complete self-interest. Instead, the dictator gives the recipient at least some small portion of the allocation (Davis and Holt). This indicates that there is some level of altruism compelling individuals to share their riches.

The ultimatum bargaining game is like the dictator game, but the recipient has an opportunity to respond to the dictator's offer. The dictator becomes a proposer, and the recipient can either accept or reject the offer made. The Nash equilibrium prediction is that the proposer will make a very small offer, ϵ , and the respondent will accept this offer because it is better than nothing. Again, the Nash equilibrium is rejected in experiments. The proposer offers a substantial portion of the endowment, from 25% to 50%, and the respondent demands a similar amount. The amount offered and accepted depends on the proposer and respondent's social and cultural fairness norms (Henrich et al.; Roth et al.).

Although both of these experiments may be used to measure basic economic behavior in the household, they do not allow continuous interaction between household members. One experiment that does allow for continuous interaction is the carrot stick experiment developed by Andreoni, Harbaugh, and Vesterlund. Unlike the dictator game, the respondent is given the opportunity to punish or reward the dictator after receiving an allocation from the endowment. The respondent can pay the experimenter a small fee (e.g., 1 dollar or token) to give (reward) or take (punish) a notable amount (e.g., 4 dollars or tokens) from the dictator. If the respondent takes earnings away from the dictator, the earnings go to the experiment bank, not directly to the respondent. Likewise, if the respondent gives earnings to the dictator, they are bought from the experiment bank and do not come directly from the respondent. This arrangement makes either giving or taking earnings from the dictator more direct reward or punishment.

The respondent also has the option not to change the dictator's earnings in any way.

Ehmke et al. adapted the carrot stick game to measure control dynamics in the parent-child relationship that could affect COO. The parent is placed in the dictator role and the child is the respondent. The parent is endowed with \$5.00 in \$0.25 tokens. He or she decides how many tokens to send to the child. Once the child receives his or her tokens, the child then decides whether or not to reward or punish the parent. When the game is complete, the child has the option to spend his or her tokens in the experimental store. Following within subject design, the experimental store is stocked with toys and books in the first treatment and with junk food in the second treatment. The experiment is used to test several hypotheses, including whether parental giving is significantly different across treatments on the basis of both child and parental weight status.

The results from the experiment indicate that parental weight is the most important determinant of parental generosity and child control in the game. All parents give an average of 56% of the endowment to their children in the nonfood treatment. This drops to an average of 33% of the endowment given to children in the food treatment. However, giving between healthy (parent BMI ≤ 25) and overweight and obese parents (parents BMI > 25) is significantly different. Parents with higher BMIs give more to their children to spend on junk food. This indicates heavier parents might be less concerned with the consequences of giving their children money to spend on junk food.

Such experiments provide an important link to understanding the connection between economic behavior and other general family health- and nutrition-related behavior. They also provide a potential tie between economics and research in other disciplines, including psychology, sociology, family studies, and health fields.

Time Preference Experiments

One of the challenges for many households is to maintain a healthy and steady nutritional

intake over the course of the month. Young children are not able to make the metabolic adjustments to variations in calorie intake and are more at risk of overweight and obesity (Sigman-Grant). Thus, food insecurity could be a factor in obesity prevalence. Shapiro finds caloric intake among low-income food stamp recipients declines 10% to 15% over the course of a month. The relationship between food stamp use and overweight and obesity is positive for low-income women and young girls, but leads to underweight boys (Gibson). When food stamps are dispersed at the beginning of the month, approximately 90% are spent in the first 3 days of dispersion (Klinefelter). This evidence implies food stamp recipients display a high, if not hyperbolic time preference.

Harrison, Lau, and Williams designed one of the most referenced experiments for measuring time preference. They develop a basic methodology to measure subjects' discount rates. In their study, Danish subjects were asked if they would prefer to have \$100 in 1 month or \$100 + x in 7 months. Subjects answered 15 repeated versions of this question, with x increasing in each question. The researchers aim was to determine the point at which a subject chooses to receive payment in 7 months instead of in the next month. If a subject chooses to receive the money in 7 months, it is implied that their discount rate is $x\%$ over the 6-month period.

This experiment can be adjusted to account for hyperbolic discounting. Individuals exhibit hyperbolic discounting when their discount rate (i.e., internal interest rate) is not consistent over time and actually declining over time (Frederick, Lowenstein, and O'Donoghue). More simply, individuals value short-term gains/losses more than long-term gains/losses. The Harrison, Lau, and Williams experiment can be adjusted to measure the degree of hyperbolic discounting a subject exhibits. Using the Harrison, Lau, and Williams experiment, the subject first decides whether she wants \$100 in 1 week or \$100 + x in 8 days. Then, she is asked whether she would like \$100 in 7 months or \$100 + x in 7 months and 1 day. If she displays hyperbolic discounting,

she will be less willing to wait for x in 8 days, but more indifferent to waiting for it in 7 months versus 7 months and 1 day.

Experimental measures of individual discount rates could help explain the challenges that low-income families face as they allocate food expenditures over a month. It could be that the hyperbolic discounting behavior observed by Shapiro might be measurable in an experimental setting. If there is a relationship between high and/or hyperbolic time preference and an individual's diet composition, economic experiments can explain these relationships. Policy mechanisms might then be better designed to help low-income households with high or irregular time preference to eat a more healthy diet throughout the month.

Loss Aversion Experiments

A healthy diet is one key to a healthy weight. For many, though, "dieting" is often viewed as sacrificing food consumption to gain health benefits, and despite prior plans to make this sacrifice, many fail to actually carry it out. One reason individuals struggle to maintain a healthy diet might be because of an economic phenomenon called loss aversion. Loss aversion is the tendency for people to base decisions on movements away from a current state rather than on the final outcome and to regard losses from that state more than gains (see Kahneman and Tversky, and Kahneman, Knetsch, and Thaler for evidence and model specifications).

If people are loss-averse, atmosphere becomes an important part of their diet struggle. Studies have shown that anticipation of food, whether physical (sight, smell) or psychological (thought of food), can trigger biological responses that prepare the body to digest food (Johnson and Wildman; Mattes; Powley; Simon et al.). If passing fast food restaurants and vending machines can trigger a physiological response, individuals must constantly choose not to consume these products, rather than decide whether and what to eat, as implied by traditional utility theory. Comparison of food intake surveys by the U.S. Department of Agriculture (USDA) shows

that caloric intake during meals has declined, whereas the number of calories during snacks has increased (Cutler, Glaeser, and Shapiro).⁴ Even if a person originally preferred a healthy lifestyle to an unhealthy lifestyle, loss aversion allows an immediate reversal of preferences once snacks or fast food meals become available.

Experiments have been designed to measure loss aversion with riskless and risky choices. One common experiment to test for loss aversion in riskless choices begins by randomly selecting half the participants in an experiment to endow with an object of value. For example, Kahneman, Knetsch, and Thaler endow half their subjects with coffee mugs and ballpoint pens. After allowing all participants to thoroughly inspect the object, willingness to pay is calculated for the group without the object and willingness to accept is calculated for individuals endowed with the object. If the objects are assigned randomly, there is no reason one group would have stronger preferences than the other. However, experiments show that those endowed with the object value the object much more than those not endowed with the object. The ratio of willingness to accept to willingness to pay measures the degree of loss aversion.

Another version of these experiments is to give half of the participants in an experiment one item and half of the participants another item of equal value. After inspection of the items, participants are given the opportunity to switch. If the allocation is random, one would expect either a strong preference for one of the goods (perhaps everyone likes the first good more) or about half the participants to switch. Instead, experiments find a strong bias against switching. Knetsch and Sinden carried out this experiment with a lottery ticket and \$2. This experiment can test for the presence of loss aversion but it cannot measure it.

Perhaps the simplest way to measure an individual's loss aversion occurs under uncer-

⁴ There is a strong link between caloric intake and portion size (Rolls et al. 2002; Nielsen and Papkin 2003; Diliberti et al. 2004)

tainty. Gächter and Johnson ask subjects whether they would be willing to accept a gamble of winning $\$X$ or losing $\$Y$ based on a coin toss. Keeping X constant, they increase Y incrementally until the participant no longer accepts the gamble. For small monetary amounts, they argue that the ratio X/Y measures the degree of loss aversion.

Samuelson and Zeckhauser found evidence of loss aversion in both survey and field data.⁵ In their lab experiments, they provided several scenarios about investment portfolios. In one treatment, they asked subjects in which of four portfolios they would invest a large inherited sum of money. In another treatment, they ask subjects which of the same four investments they would choose, but instead of inheriting money, they inherit one of the portfolios. There is a strong tendency for people not to switch regardless of the portfolio inherited. They find similar evidence in actual decisions between health care and retirement plans.

The presence of loss aversion has direct implications for dietary policy and goals. When framing the dietary discussion, loss averse individuals will be more swayed by what they will have to give up rather than by what they gain. Levin et al. showed this to be true with regard to controlling cholesterol. Participants told the positive benefits of reducing red meat consumption were less likely to reduce their consumption than those given the same information focusing on the negative effects of continuing to eat red meat.

In light of these findings, two things become evident. First, if the goal is to move an individual away from an unhealthy lifestyle, the most effective way might be to focus on the negative effects of the current lifestyle rather than the positive effects of a new lifestyle. Second, in the long run, the best policy might be to develop a “culture of health,” wherein choosing the unhealthy lifestyle means giving something up, rather than the other way around, as most people may currently view it.

⁵ Samuelson and Zeckhauser call the effect “status quo bias.”

Testbed Experiments

A type of economic experiment named “testbed” experiments might be helpful when considering new approaches to align the costs of obesity with the decisions that result in obesity. Testbed experiments are used to implement new processes and ensure that these processes work once they are implemented. Plott (1994) discusses the use of testbedding as it applies to market experiments. Through testbed experiments, market policies are testbedded either to ensure design consistency or to see whether the theory underlying a mechanism correctly explains what the mechanism accomplishes. With market inefficiencies, the experiments can be used to test theoretical explanations of the efficiencies and how the markets could be improved.

Testbed experiments could be useful tools as policy makers and business managers consider new ways to deal with the surmounting but disproportionately dispersed health care costs. If government or private industry want to consider schemes to more closely align costs with the individual (e.g., Medical Savings Accounts are currently being implemented to do this), they can test new approaches with the use of testbed experiments. This can be done as overall policies are developed or as incremental processes needed to achieve these policy are developed (e.g., Plott [1997] uses testbed experiments to understand different steps in the Federal Communications Commission’s auction of licenses for personal communication systems). Furthermore, they could be used to explore what other social factors influence individuals’ support of new insurance and policy schemes (Durant and Puttermann). For example, one question to explore might be whether individuals’ preferences for progressive taxation override the acceptability of a flat tax in the form of a fat tax in order to reduce unhealthy food consumption.

In the case of health insurance and public health programs, testbed experiments could be used to test mechanism design alternatives to increase individual incentives for individual

health and weight reduction. Some programs that have been considered include reducing health care premiums for those who maintain a healthy lifestyle. A testbed experiment could be used to determine what premium reduction would increase participation in such programs and how long a participant would need to participate for insurance companies to benefit. A laboratory experiment could be designed across multiple rounds, with individuals playing the roles of the insured and insurer.

Testbed experiments offer cost advantages to companies and government officials as they develop new experiments. In the case of health care, the costs of implementing new policies are high and the possible costs associated with poor outcomes could be even higher. By testing new policies and incentives in the lab, practitioners could save society substantial loss associated with the costs of implementation.

Conclusions and Recommendations for Future Research

The obesity epidemic has been compared with global warming. Although not all of the scientific evidence is at its full potential, especially with regard to childhood obesity, enough is present to encourage action before the full evidence of potential disaster sets in (Ludwig). As we consider the possible actions to prevent and deal with this looming health threat, economic experiments are a convenient way to test underlying causes of and possible policy solutions for the problem. They could be specifically helpful at the household level to understand underlying economic behavior issues, as well as how households interact with the market for policy design.

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