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Nutrition Policy, Nonmarket Failure, and the Obesity Epidemic

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Nutrition Policy, Nonmarket Failure, and the Obesity Epidemic

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Capstone Project

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Executive Summary

The *Dietary Guidelines for Americans*, which are based on the *Dietary Goals for the United States*, represent the federal government's first attempt to improve the nation's health by recommending that Americans avoid certain foods. The *Guidelines* were based on what was perceived, by the government and nutritionists alike, to be solid scientific evidence that consumption of fat and saturated fat in particular, increase the risk of developing heart disease. They also emphasized, and continue to emphasize, the importance of exercise and calorie restriction as the primary means of maintaining a healthy weight. In short, the *Guidelines* sought to correct the market failure of information asymmetry so that Americans could make better food consumption decisions in relation to their health.

My review of the literature indicates that neither hypothesis had any solid scientific evidence to support it at the time. An alternative hypothesis, of which the federal government was aware, posited that refined carbohydrates were the driving force behind increasing rates of heart disease and obesity at the time the *Goals* were published. But, by that time, most of the scientific and medical community was convinced of the supposed dangers of consuming fat, and endorsed the *Guidelines* which advise Americans to consume mostly carbohydrates and limit intake of fat and saturated fat, among other messages. Though, at the time, these recommendations faced some controversy because of the lack of concrete evidence for either hypothesis it has all but disappeared in the interim even though no compelling scientific evidence has surfaced to support them.

I employ a framework based on a volume published by the Brookings Institution to evaluate whether the *Goals* and *Guidelines* should have been pursued as well as Charles Wolf, Jr.'s paper on non-market failure to understand potential reasons for their persistence in their current form. Based on the scientific evidence available at the time, I conclude that there was little justification for publishing the *Guidelines*, according to the Brookings text. A growing body of evidence supports the alternative hypothesis of what leads to obesity, which is sometimes referred to as the insulin hypothesis. There appear to be considerable internalities that may impede the implementation of new recommendations based on the insulin hypothesis, according to Wolf's framework.

To be clear, no robust evidence exists to completely refute either view of this growing public health problem. Using data from the United Nations for 36 countries, I end the paper with a regression analysis, using a fixed-effects model, which attempts to determine whether consumption of refined carbohydrates contributes to increased consumption of total calories. I find that it does and at a statistically significant level. Though I find this evidence somewhat compelling, more rigorous and controlled studies are necessary to better determine the precise relationship between diet and health outcomes. Only then can the *Guidelines* be considered a credible policy document.

Introduction

A starting point for public policy is often the perception of a market failure. One such failure is information asymmetry, in which market participants do not have sufficient information with which to make market decisions. This was the market failure that the *Dietary Goals for the United States* and the *Dietary Guidelines for Americans* that followed were intended to correct. The *Guidelines* were meant to shape Americans' food consumption patterns in a way that was thought to be beneficial to their health. The *Guidelines* were meant to publicize the latest knowledge relating to diet and health so that consumers could make informed decisions about what foods to eat. The federal government recommended that Americans eat certain foods while avoiding others.

The perception of a market failure is only a necessary, and not a sufficient, condition for justifying a nonmarket or government solution to a market failure. To fully justify a government intervention one should prove, as reasonably as is possible, that a nonmarket solution will plausibly correct the perceived market failure once it is implemented. One should attempt to predict possible unintended consequences, positive and negative, that might affect either the policy goal or other aspects of the market or general welfare. Such predictions can be quite difficult to perform accurately, and will be highly dependent on the knowledge of the issue at the time and, importantly, how policymakers perceive the failure and its potential resolution. Despite this uncertainty, constituents may compel policymakers to act on incomplete information, which can result in policy results that are wildly divergent from the intent of the original policy, leading to nonmarket failure. Nonmarket failure arises when a nonmarket solution, rather than or in addition to correcting the market failure, creates an even more inefficient allocation of goods than might have occurred in the absence of intervention.

I will argue that this is what has happened in the case of the *Dietary Guidelines*, which have been published periodically since 1980. Policymakers acted on incomplete information and relied on only one interpretation of the evidence linking consumption of certain foods to health. They failed to fully grasp that there was, at the time, significant controversy surrounding the causes of heart disease, overweight and obesity and even the relationship between diet and health in general. By endorsing the *Guidelines*, the Federal Government bestowed the “aura of established fact” (Taubes 2008 45) upon one interpretation of the evidence and has since cemented it in the consciousness of scientists, health professionals and the public alike that this interpretation has been proven true. Unfortunately, there is ample evidence which suggests that the government acted too hastily and has persisted too long in promoting the ideas that underlie the *Guidelines*. Worse still, the *Guidelines* may be promoting a diet that exacerbates the very problems they seek to correct.

In order to make a compelling case, I will need to show the ways in which the *Guidelines* were mistaken. Fortunately, there have been a number of high quality studies which indicate a relationship between diet, heart disease and obesity that is starkly at odds with the *Guidelines*. Though policymakers were acting in good faith to correct a public health problem, hindsight allows one to evaluate the scientific evidence at the time and since the passage of the *Guidelines*. The conclusion I draw is that there is little strong evidence to support the effectiveness of the *Guidelines* in achieving their intended goals. In fact, a significant amount of evidence supports dietary recommendations that are nearly opposite to current and past *Guidelines*.

Because the policy in question relates to public health, medicine, and science more generally, I address the particular issues which may arise when the uncertainty that often accompanies science clashes with policymakers’ desire for concrete policy recommendations. To

that end, I rely on a volume published by the Brookings Institution which examines the relationship between science and public policy in making health and public safety regulations. It enumerates a series of important questions that one should ask in evaluating possible regulation in those areas. The answers to these questions should have led to serious caution on the part of policymakers in making any dietary recommendations at all, had the relevant parties considered them.

I intend to analyze this apparent nonmarket failure using the framework that Charles Wolf, Jr. outlines in his “A Theory of “Non-Market Failure”: Framework for Implementation Analysis”. In it Wolf examines the predictable ways in which a nonmarket solution can fail to correct a perceived market failure, many of which are highly relevant to this particular case. I will show that the way in which the *Guidelines* were originally formulated, and have been subsequently revised, is indicative of a policy environment well-suited to perpetuating the original nonmarket failure (passing the *Guidelines* in the first place). If it is true that the *Guidelines* were and are incorrect, then the most perplexing question may be: why have they continued to exist, virtually unchanged, for over 30 years? With an understanding of the science surrounding our understanding of nutrition, science’s ideal role in policymaking, and Wolf’s framework, one quickly sees that such an outcome is not surprising at all in hindsight.

Research Design

I intend to perform a descriptive analysis and use the results of that analysis to inform an aggregative data analysis. The descriptive portion of paper consists of a summary of the literature that, I think, shows the discrepancies between the preponderance of scientific evidence and the United States Department of Agriculture’s (USDA) original and current *Dietary*

Guidelines. I will be using *Scientific Basis for Health and Safety Regulation*, the product of a 1978 conference published by the Brookings Institution, as a tool for evaluating the justifications advanced in support of the *Guidelines*. By combining that reading with Charles Wolf, Jr.'s framework for nonmarket failure, I hope to show that one might have predicted what has transpired with regard to nutrition policy and, thus, the state of the United States' public health, especially with regards to obesity, since the first issuance of the *Guidelines*.

By releasing the *Guidelines*, the USDA sought to publicize pertinent scientific evidence that linked diet to various health outcomes so that Americans could make more healthy eating decisions. Of course, if those *Guidelines* promote a diet that is not healthy, then arguably the government has failed in its original goal of promoting health eating patterns via the *Guidelines*. The aggregative analysis is derived from data released by the Food and Agriculture Organization (FAO) of the United Nations (UN).

Scientific Basis consists of a series of case studies about how health and safety regulations interact with the scientific evidence used to support them. Each case study contains testimony from a government regulator, an economist, and a scientist. One common theme to the cases is the friction that often develops between regulators' desire for concrete information to guide regulation and the natural uncertainty that both scientists and economists face in evaluating regulation and alternatives. The book begins with an "Introduction and Summary" chapter that will be especially useful. In a section with the heading "Scientific Issues Underlying Regulation" the editors pose four questions that one should ask in trying to improve the "efficiency and efficacy of health, safety, and environmental regulation" based on these case studies (3):

1. Is there a scientific foundation for government action?
2. Will setting a standard reduce risks to health and safety?

3. Is there enough scientific evidence to provide realistic estimates of the risks and costs of alternative standards?
4. Has sufficient analysis been done to identify uncertainties and to map out a prudent course, given the uncertainties and possible future events?

The *Guidelines* have been published every five years by the USDA, and later jointly by USDA and the Department of Health and Human Services (DHHS), since 1980. A Dietary Guidance Advisory Committee (DGAC) is meant to provide science-based advice to help formulate the guidelines. The *Guidelines* have their roots in the *Dietary Goals for Americans*, published in 1977, a product of the Senate Select Committee on Nutrition and Human Needs, led by Senator George McGovern. Chief among the Committee's recommendations for the American diet were:

- Increase carbohydrate intake to 55 to 60 percent of calories
- Decrease dietary fat intake to no more than 30 percent of calories, with a reduction in intake of saturated fat, and recommended approximately equivalent distributions among saturated, polyunsaturated, and monounsaturated fats to meet the 30 percent target
- Decrease cholesterol intake to 300 mg per day
- Decrease sugar intake to 15 percent of calories
- Decrease salt intake to 3 g per day

Though there have been minor changes in language and emphasis, these recommendations were to be the basis for the *Guidelines* from 1980 up to the present.

As the *Guidelines* show, conventional wisdom perceives obesity as caused by “overeating” and “sedentary behavior”. In the obese individual, calories consumed are in excess of calories expended through movement, which leads to the accumulation of fat. A calorie is a measure of energy, and the total energy provided by a particular food will vary for a variety of reasons, most obviously because of the total quantity of food consumed. In this way, obesity is caused by an imbalance of energy and ought to be corrected by decreasing total calories

consumed and/or increasing energy expended, all else equal. In short, someone whose energy needs are “balanced” ought to maintain a stable weight.

The alternative hypothesis, sometimes called the insulin hypothesis of obesity, flows from the observation that overweight and obesity are problems of fat accumulation, not energy imbalance. The logical question that follows is: what drives humans to accumulate fat? The answer, as scientists learned in the middle part of the 20th century, is, by and large, the hormone insulin. Insulin is secreted by the pancreas, primarily in response to dietary carbohydrates, nearly all of which break down into glucose in the bloodstream (with a few notable exceptions). So according to this hypothesis, it might be logical to expect an increase in carbohydrate consumption to lead to weight gain in the form of fat deposits on the body. I address this hypothesis in greater detail in a later section.

Wolf’s paper contains a number of relevant concepts and predictions reminiscent of the *Guidelines*. The final section, “Implementation Analysis” is especially relevant. The purpose of the paper as a whole, and that section in particular, is to provide “a method of analyzing how public policy (i.e., non-market) efforts to compensate for market “failures” may themselves fail for predictable reasons and in predictable ways (41).” Wolf goes on to say, “*The reasons for implementation shortfalls—for costs to rise and effectiveness to fall ex post—in public policies intended to correct inadequacies of the market lie in the predictable inadequacies of non-market activities themselves* (42).” Chief among the predictable inadequacies of said non-market activities is a failure on the part of policymakers to take full account of the scientific evidence (both at the time of, and since, the initial publication of the *Guidelines*) perhaps because of ‘internalities’ within the policymaking process.

Internalities are the “*goals that apply within non-market organizations to guide, regulate, and evaluate agency performance and the performance of agency personnel* (16).” In a nonmarket organization there is the potential for these goals to diverge substantially from the organization’s intended public purpose, and there is evidence for such a development at the USDA. Although a full-fledged implementation analysis is beyond the scope of this paper, I think that speculating about some apparent internalities that have developed in the nutrition policy arena are illuminating. In short, those who currently make nutrition policy would stand to lose significant material and non-material benefits were the *Guidelines* to reflect the insulin hypothesis of obesity rather than the conventional wisdom. This could serve as a barrier to its serious consideration among policymakers and, in turn, its implementation.

I also evaluate the insulin hypothesis in terms of its ability to predict our current obesity epidemic. Some critics have argued that in the absence of evidence to the contrary, scientists could have reasonably believed that insulin plays a major role in the development of obesity. My analysis does not confirm only one of these hypotheses since carbohydrate consumption and total calorie consumption have both increased substantially since the *Guidelines* were published in 1980, in keeping with both hypotheses. However, I may still be able to compare the explanatory power of the insulin hypothesis and whether it can confidently be rejected. If it cannot, it may further bolster my argument that a non-market failure has occurred.

This is a current problem in the field; it is easy enough to find evidence that supports either hypothesis but, as far as I am aware, no study has been designed to rigorously test the two hypotheses against one another. Performing such a rigorous study, in which individual diet and activity levels are strictly monitored, measured and analyzed would also be very expensive and time-consuming, especially for an issue that the majority of “experts” believe is already settled.

For the quantitative portion of my capstone I examine the relationship between diet and weight in 36 countries since the original publication of the *Guidelines*. The decision of which, and how many, countries to study is based on a 1993 article that appeared in the journal *Circulation* titled “Differences in coronary mortality can be explained by differences in cholesterol and saturated fat intakes in 40 countries but not in France and Finland A paradox”. Though I have chosen to confine my analysis to the relationship between diet and weight, rather than other health outcomes, the 40 countries in this study include several whose obesity rates have increased substantially over the past 30 years and a good mix of countries from around the world in various stages of development. Some countries were not present in the UN data for the entire study period so I have culled the list to 36 countries. Because the descriptive portion of this paper is meant to inform my data analysis, I go into more depth regarding my model and methodology in that section.

Defining the Problem

Before moving forward, I should define obesity, aside from perhaps “possessing excess fat tissue”. Body Mass Index (BMI) is a measure derived from an individual’s height and weight. Under the metric system, it is one’s mass in kilograms divided by height in meters squared. An individual is deemed obese if his or her BMI is equal to or greater than 30. One is “overweight” if BMI lies between 25 and 29.9 and “normal” weight when BMI is in the range 18.5 to 24.9 (Eknoyan 2008).

There are important limitations for BMI since it does not directly measure how “fat” a population is--how much adipose (fat) tissue it has accumulated. It does not take into account the composition of the body and implies that any positive deviation from “normal” weight comes

from the excess accumulation of fat, not muscle. In short, BMI is a useful heuristic for measuring fatness, but it is far from a precise measure of health (Nevill 2006).

Obesity was recognized as a public health problem by the federal government in the 1970s. In 2009-2010, 35.7% of adults were obese, according to self-reported survey data collected by the CDC (Ogden 2012). 16.9% of children and adolescents fell in the same category for the same period. “Fortunately”, these figures are flat compared to 2007-2008. Those percentages translate to 78 million adults and 12.5 million children, respectively. From 1985 (the first year for which the CDC has data for some states) to 1990, no state’s prevalence of obesity exceeded 15%. Granted, over the same period the US went from having 8 states whose prevalence of obesity was between 10 and 14% to over 25 states falling in that range. It is also important to note that the CDC had ‘No Data’ for 29 states though by 1990 that number had dropped to 6. By 1995, the CDC was collecting data for all of the states and no state’s obesity prevalence was less than 10%. From the period 2002 to 2009, only Colorado and Washington, D.C. could ever claim not to have a rate of obesity below 15% and today no state can make that claim. Meanwhile, 12 states, including Kentucky, have rates of obesity of 30% or greater. (Obesity Trends 2012)

Origins of Policy

Although the federal government first took an interest in improving the public’s nutrition in the 1970s, it was the 1950s when University of Minnesota Nutritionist Ancel Keys began popularizing and promoting his ideas about dietary fat, cholesterol and heart disease (Taubes 2008, 16). In 1951, after a trip to Naples and informally interviewing its residents, Keys became convinced that dietary fat “raised serum cholesterol, atherosclerosis, myocardial infarction.” He

announced this belief at a nutrition conference in Amsterdam and, by his own admission, no one in the audience took it seriously. Despite having no experimental evidence to support his hypothesis, by 1952 Keys was already arguing that Americans should cut fat consumption by a third in accordance with what has come to be called the lipid hypothesis (Taubes 2008, 17).

For a full treatment of how Keys's diet-heart hypothesis came to be accepted as the conventional wisdom, I encourage the reader to consult the excellent and thorough *Good Calories, Bad Calories* by Gary Taubes, which explains in great detail the history and science (or lack thereof) behind current nutritional thinking. Suffice to say, professional support for Keys's hypothesis did not abate; it continued to grow to the point of being accepted despite scant supporting evidence. By the time the *Goals* were published in 1977, only two randomized control trials had been conducted that *could* prove the lipid hypothesis. One was conducted in Hungary in 1963 and found that cutting fat to 1.5 ounces per day reduced heart-disease rates. A British trial found, after three years of eating 1.5 ounces of fat per day (one-third the amount in a typical British diet), that such a diet reduced cholesterol readings but found the recurrence of heart disease to be nearly identical to the control group, concluding "A low-fat diet has no place in the treatment of myocardial infarction [heart attack]". Other trials tested the effect of changing the composition of fat in the diet but not the effect of changing the total amount. Nevertheless, in light of the support from AHA, the media, and nutritionists, low-fat diets have been promoted vigorously by most every respected health professional up to the present. (Taubes 2008, 35)

The second questionable aspect of the current *Dietary Guidelines*, especially as they relate to obesity, is their insistence on attributing weight gain to a problem of "energy balance" (United States 2010). Put simply, weight gain is the result of consuming more energy than one expends, all else equal. It can be rewritten as a simple arithmetic equation:

$$\text{Change in Energy Stores} = \text{Energy Intake} - \text{Energy Expenditure}$$

Thus, if the “Energy Intake” term is greater than the “Energy Expenditure” term, the individual will invariably gain weight. Otherwise, weight may be maintained or lost by increasing energy expenditure, decreasing energy consumption, or both. This is not a controversial equation; it is the first law of thermodynamics. What is controversial, to some, is how to interpret and apply it to the human body (Taubes 2008, 293).

Most nutritionists assume that there is some causal information contained within this equation. But, in a healthy weight individual for example, the fact that energy intake is equal to energy expenditure reveals no causal information about *why* the quantities are equal. The logical leap that many make (perhaps without realizing it) is that both quantities are entirely determined by the individual’s conscious decisions about how much energy to consume and how much to expend. It also assumes that the nature or source of the energy consumed is not a relevant consideration to how much energy will be consumed or expended—“A calorie is a calorie” (Taubes 2008, 293).

Government Involvement in Nutrition Policy

The federal government’s involvement in nutrition issues originally pertained to the problems of under and malnutrition in the United States. The United States Select Committee on Nutrition and Human Needs was a select committee of the Senate, sometimes referred to as the McGovern Committee, after Chairman Senator George McGovern, who headed the committee for the entirety of its 9 year existence, from 1968 to 1977 (Hegsted 2005). After making significant and lasting headway on the issues of hunger and malnutrition in the United States, in

1973 the Committee turned its attention to the relationship between diet and disease. It first held hearings in April of that year, titled “Part 1-Obesity and Fad Diets”, followed later that month by “Part 2-Sugar in Diet, Diabetes, and Heart Diseases”. (United States 1973)

The opening statement by Senator McGovern for the first hearing is indicative of the direction and form the *Dietary Goals* and *Guidelines* would eventually take. In it, McGovern says, “Side-by-side with debilitating malnutrition, overweight, or “overnutrition,” represents a tragic contradiction within modern American society...due to a number of factors—bad dietary education and practice, the easy availability and poor quality of snack and junk foods, lack of exercise, and occasional physiological predispositions to overeating—prevalent overweight is generally a reflection of an affluent, sedentary lifestyle.” Over 40 years later, this is a familiar refrain heard from many health professionals; we Americans eat too much and exercise too little, and that is why we are so fat. But, ostensibly, the purpose of this committee was to evaluate the evidence advanced by one proponent of a so-called “fad diet” who disagreed with McGovern’s characterization of the problem completely—Dr. Robert C. Atkins.

Predictably, the McGovern Committee did not heed the testimony of Atkins or other once prominent researchers in the field, such as Dr. John Yudkin or Dr. T.L. Cleave. All three men, among others, made it clear that they disagreed with the validity of the lipid hypothesis and that carbohydrate, especially refined carbohydrates such as sugar and white flour, were the real dangers to Americans’ health. Instead, the McGovern committee listened to nutritionists who believed the lipid hypothesis when it came time to publish the *Goals*.

It was not until a 1990 Act, however, that releasing the *Guidelines* was made an official task of the USDA and the Department of Health and Human Services (DHHS) as part of the

1990 National Nutrition Monitoring and Related Research Act (NNMRRRA). The Act sought to eliminate the redundancy of having the two agencies conduct separate nutritional surveys, partially in an effort to explain why “despite growing awareness of its associated problems, and the wide availability of low calorie, and low or no-fat foods, Americans are gaining weight.” The Act does not give USDA or DHHS exclusive rights to publish dietary guidance but does give them “veto power” over guidelines that other agencies might produce. NNMRRRA does not even require that the *Guidelines* focus on the prevention of chronic disease and only stipulates that they “shall be based on the preponderance of the scientific and medical knowledge which is current at the time the report is prepared.” Although earlier legislation had created the DGAC to review the science and make recommendations about changing the guidelines, NNMRRRA does not spell out how this is to be achieved (Hite 2011, 5).

Because of this lack of clarity, the role of the DGAC has been allowed to change since the passage of NNMRRRA. Prior to 2005, the DGAC essentially wrote the Guidelines with little contribution from the staff of USDA or DHHS. Since 2005, however, the role of the DGAC has changed. “Now, the DGAC submits its report to the agencies, but HHS and USDA staff members are responsible for the production of the *Guidelines*, which are no longer considered to be a scientific document whose audience is the American public, but a policy document whose audience is nutrition educators, health professionals, and policymakers.” Also, “beginning in 2005, the *Dietary Guidelines* document recognizes the contributions of an “Independent Scientific Review Panel who peer reviewed the recommendations of the document to ensure they were based on a preponderance of scientific evidence” (Hite 2011, 7). According to the USDA, this panel “served only to review the concepts in the DGAC report so that it would be understandable for nutrition educators, health professionals, and policymakers.” But, for the

most recently published guidelines “The DGAC Report is “advisory in nature and not the actual 2010 *Dietary Guidelines* for Americans;” the writers of the final *Guidelines* document are under no statutory or regulatory obligation to adhere to its recommendations”. Based on how this legislation is written, “it is unclear how the scientific validity of the *Guidelines* is guaranteed at all.” (Hite 2011, 8)

Possible Internalities

Much of this portion of my analysis is speculative in nature. The troubling linkages and incentives that influence agriculture and nutrition policy are fairly obvious but they do not, in and of themselves, indicate that any of the *Guidelines* are factually incorrect. I hope to argue a subtler point. *If* a scientific study reliably indicated that a carbohydrate restricted diet is healthier than a low fat, calorie restricted diet, would the results be used to design new *Guidelines*? Put more simply, how much resistance would such a drastic overhaul of the *Guidelines* face, from whom, and why? In the context of Wolf, what internalities appear to be motivating the groups who make nutrition policy?

I now turn to Wolf’s concept of internalities, or private goals, which may impede progress in revising the *Guidelines*. To reiterate, these are “*The goals that apply within non-market organizations to guide, regulate and evaluate agency performance and the performance of agency personnel* (16).” Ignoring, for a moment, that RDs are one of the groups of professions who have recommended a low-fat, calorie restricted diet that lacks a solid evidence base, there are other reasons to question the motivations of the Academy of Nutrition and Dietetics (AND) (formerly the American Dietetic Association (ADA)). AND certifies RDs, and its accrediting arm provides accreditation for undergraduate and graduate level nutrition programs. In position

papers posted on the organization's website, the AND indicates its support for both the *Guidelines* and a low-fat diet in general. It supports the low-fat guidelines (20-35% of energy for adults), however, while admitting that the "ADA [sic] and DC [Dietitians of Canada] recognize that scientific knowledge about the effects of dietary fats on human health is incomplete..." Yet it still considers such an approach "prudent" (ADA 2006). In the absence of evidence that dietary fat is harmful to health, I would not consider advising people to avoid it, and to further substitute it with whole grains and fruits, to be "prudent". In my estimation, the relationship between the AND and the USDA could be predicted to breed some internalities which deviate from the AND's stated goal of "Providing Reliable and Evidence-Based Nutrition Information for the Public" ("What Does the Academy Do?").

Regardless of whether the AND or USDA is correct in recommending a low fat diet, both organizations, among others, are quite "invested" in the idea. It is hard to imagine how either group could perform a virtual about-face on the issue of dietary fat and retain any degree of credibility, an important signal as a medical professional. One can hear the spokesman at the press conference now, "Yes, we have been giving poor and unfounded dietary advice for several decades now, but we have it right this time, we promise."

But the AND is invested in promoting diets low in fat and high in carbohydrate in a more concrete way. One needs look no further than its list of corporate sponsors for proof of that. Second on the list of "Academy Partners" is Aramark, "one of America's largest employers of dieticians...Aramark provides award-winning food services....to healthcare institutions, universities and school districts..." Next up is the Coca-Cola Company, followed by the Hershey Center for Health & Nutrition, established in 2005, it "investigates the health benefits of cocoa, chocolate, nuts and other nutritious ingredients." The National Dairy Council acts on behalf of

US dairy farmers and “provides science-based nutrition information...” Abbot Nutrition is one of the AND’s “Premier Sponsors” and it “develops and markets a wide range of science-based infant formulas, medical nutritionals, nutrition and energy bars, and related products...”

Corowise, a product of Cargill, is also a premier sponsor. Corowise is a brand of plant sterols which “have been clinically shown to lower LDL (bad) cholesterol when consumed twice daily with meals as part of diet low in saturated fat and cholesterol.” Corowise is followed by General Mills, Kellogg’s, Mars Incorporated, and Pepsico makers of cereals, snack foods, soft drinks and other food products. Rounding out the list of corporate sponsors are SoyJoy, Truvia and Unilever (Current Corporate Sponsors).

The fact that these large food companies have chosen to sponsor the AND, in and of itself, does not indicate any wrongdoing on anyone’s part. Presumably the AND needs money to operate and corporate sponsorship is certainly a viable approach to raising funds. What this list shows is that the AND is sponsored by organizations which sell products that are, by and large, made from highly refined carbohydrates like sugar, high fructose corn syrup and grains. If the AND were to endorse a new set of guidelines that discourages consumption of such foods it would threaten the bottom line of many of these sponsors. If it seriously believed the insulin hypothesis, the AND would have to decide whether to eschew its sponsors or promote the best dietary advice. Here again there may be internalities which discourage the AND from even investigating its positions in the first place. The AMA, for example, would not find itself in such a position as it does not have any corporate sponsors.

One of the stranger developments in this policy area is that Medicare, in Tennessee at least, has decided to stop reimbursing the obese for counseling by dietitians. TennCare still covers bariatric surgery and even dietary counseling from a physician but, according to

TennCare Chief Medical Officer Wendy Long, “There's really no evidence to support the fact that providing those services would result in a decrease in medical cost, certainly not immediately, and even in the longer term.” So, apparently, RDs are perfectly qualified to advise the USDA on revisions to the *Guidelines*, even though, in practice, their expertise is ineffective. (Associated Press 2011).

I now turn to some apparent internalities within the USDA, which ultimately approves and releases the *Guidelines*. The front page of the agency’s website relays a list of current Secretary of Agriculture Tom Vilsack’s priorities for the USDA. The list appears to be alphabetical so “Agricultural Production” makes the top spot. To that end, “[the USDA] maintain[s] a strong and appropriate safety net for America's farmers, ranchers and growers which includes assistance to struggling industries, disaster assistance, and crop insurance, and provide technical assistance, access to credit, and help producers implement conservation practices. To ensure that America remains the world leader in crop production, we conduct cutting-edge agricultural research” (USDA Agricultural Production).

According to the USDA’s proposed budget, “Income support payments including 2012 direct payments and 2013 counter-cyclical payments and Average Crop Revenue Election (ACRE) payments are expected to total about \$4.9 billion in 2013.” The USDA also “Provides \$9.3 billion for the Federal crop insurance program, an increase of \$5.7 billion from 2012 to reflect timing shifts made by the 2008 Farm Bill. This level of support will protect about \$98 billion in agricultural production from losses due to drought, flooding, and other natural disasters or price declines.” (USDA “FY 2013...” 4)

Though providing crop insurance may be a justifiable role for the federal government, one wonders if this level of support actually reflects the risk faced by American farmers, especially in light of Secretary Vilsack's remarks about the state of the farm economy—"USDA has supported farmers, ranchers and growers so that last year [2011] they enjoyed record farm income (Vilsack 2012)," while most of the rest of the economy floundered. According to the USDA's Risk Management Agency (RMA), total premiums paid for crop insurance over the 2002-2011 period totaled over \$61.8 billion. Of that \$61.8 billion, only about \$25.1 billion (41%) was paid for by farmers. The remainder consisted of subsidies and discounts from the USDA (RMA 2012). These are not the only programs through which USDA promotes agricultural production and reduces farmer risk, but they are indicative of the USDA's means of achieving those goals. Among the crops that the USDA insures are wheat and plants from which sweeteners like sugar and high fructose corn syrup (HFCS) are derived. These are certainly not the only sources of dietary carbohydrate but both are particularly highly refined and their consumption has increased significantly over the years, so I mention them for illustration.

But the largest portion of the USDA's budget, by far, goes to the Food, Nutrition and Consumer Services division— 72%, or over \$115 billion. The vast majority of this money (over \$82 billion) is spent on the Supplemental Nutrition Assistance Program (SNAP), administered by the Food and Nutrition Service (FNS) whose goals are to increase access to nutritious food, and to promote healthy diet and physical activity. This is an admirable goal but SNAP is an in-kind transfer program which does not actually ensure that payments will be spent on nutritious food (or any other type for that matter), only that it is spent on food and nothing else. The Women Infants and Children (WIC) program receives \$7 billion while the CNPP is projected to receive about \$20 billion in FY 2013. Using this money, "Both FNS and the CNPP will continue efforts

to promote healthy eating and active lifestyle behaviors, in part by the use and promotion of MyPlate and the *Dietary Guidelines for Americans*.” In other words, the CNPP is not working especially hard to advance the science of human nutrition, let alone revise the *Guidelines*. (USDA “FY 2013...” 55)

No, human nutrition research is handled by another branch of the USDA, the Agricultural Research Service (ARS) which, along with the ERS, is part of the Research, Education and Economics (REE) mission area, the budget of which “serves to ensure a safe, sustainable and competitive U.S. food, fuel and fiber system and healthy individuals and communities.” The ARS conducts research in a wide variety of areas, including crop production and protection, along with human nutrition. Its 2013 budget proposes spending on human nutrition research to total \$84 million (\$1 million less than 2012), out of a total budget of over \$1 billion. Crop production and crop protection receive \$229 million and \$184 million, respectively. Unlike other government agencies, such as the National Science Foundation (NSF) and the National Institutes of Health (NIH), USDA research is predominantly carried out in-house and by formula funding or earmarked grants. NSF and NIH, in contrast, perform the majority of their research extramurally through competitive grants. According to the Congressional Research Service, only 14% of USDA research was funded through competitive grant in FY2006 (Agricultural Research, Education, and Extension: Issues and Background). The 2008 Farm Bill created the National Institute of Food and Agriculture (NIFA) to help direct research funds more effectively but its two main mechanisms for doing so are “National Program Leadership” and continued formula grants to land-grant and other universities, not competitive grants (NIFA 2012).

If the USDA and others are correct about the health benefits of low fat diets then there may be little reason to direct additional funds to nutrition research. But there is evidence that the

USDA, or our political process more generally, may lead to sub-optimal nutrition policy, even according to the *Guidelines*. An opinion piece in the *New York Times* from late last year, around the time that new rules for the National School Lunch Program (NSLP) were being considered, argues that food companies, including Aramark, are often the “most committed foes” to revisions of school lunch rules (Komisar 2011). Nevertheless, when the changes were announced in January of this year (the first in 15 years), nutritionists and food industry representatives were generally supportive of the new rules (Nixon 2012).

Based on the budget priorities and past actions of the USDA and our elected officials, I think it is clear that the department is most concerned with the well-being of farmers rather than the nutrition needs of the country. There are several internalities, in concert with the conventional wisdom, which might push the USDA in the direction of promoting carbohydrate consumption. First and foremost, a belief in the dangers of dietary fat, above all other macronutrients, means that there is nothing inherently “bad” about subsidizing wheat, or even sugar crops, if policymakers and health professionals simultaneously discourage excessive consumption of calories from refined grains and sugar, the foods often made from such crops. This strikes me as a highly inefficient policy but it does not necessarily mean that people will eat poorly, especially since one effect of subsidizing and otherwise intervening in food and agriculture markets is to raise domestic prices.

But what if the DGAC and/or Independent Scientific Review Panel who review and revise the *Guidelines* decided that the USDA ought to change them and recommend a low carbohydrate diet? Though the USDA is under no obligation to listen to those bodies, with the nation’s health at stake (remember, in this scenario the insulin hypothesis has been proven and the AND supports it), one hopes that it would. The benefits to the nation’s health could be

monumental but so would the costs to farmers, food companies and other groups that lobby the USDA. Groups that could be predicted to benefit from such a move are livestock and egg producers, whose products would likely see an upswing in demand if the public no longer believed they are harmful, while wheat, sugar crop and other farmers could see a drastic fall in demand for their products. Livestock and egg producers are not nearly as influential or economically important as crop farmers, who receive the bulk of the benefits from USDA programs and payments. As with the AND, the USDA would be forced to choose between trying to optimize the nation's health and losing money for its constituents.

Regression Model

Space constraints prevent me from summarizing the evidence that refutes the relationship between diet and health promoted by the *Guidelines* and that which supports the insulin hypothesis. Other authors, including the aforementioned Gary Taubes, have written extensively on this subject and summarized that research in great detail. Unlike Keys, in recent years many researchers have gone so far as to conduct intervention studies of various diets, almost all of which appear to support the benefits of a carbohydrate restricted diet and none of its supposed deleterious effects. I provide citations to some of that research in my references.

The crux of this issue is that the *Guidelines* and the insulin hypothesis use two very different approaches to explain weight gain. The insulin hypothesis perceives carbohydrate, especially highly refined carbohydrates like sugar and white flour, as uniquely fattening. "Overeating" and "sedentary behavior" are seen as effects of excessive carbohydrate consumption rather than causes of obesity. Further, sensitivity to the effects of consuming carbohydrate may depend on a variety of unobservable, individual characteristics such as

genetics and the extent to which the individual is insulin resistant. I attempt to test that hypothesis below.

Originally I had specified a model in which BMI was the dependent variable and the various components of diet were independent variables with the more refined carbohydrates (wheat, sugar) being my explanatory variables of interest. Since the conventional wisdom emphasizes calories, I thought I would have to control for the fact that people were consuming more calories in addition to excessive refined carbohydrates. Eventually though, I realized that this model presents a lot of problems.

Chief among them is that BMI, calories, and refined carbohydrate consumption may be endogenous variables. That is, as BMI increases, energy requirements will increase just to meet the increased energy demands of a larger body. Insulin resistance will lead to an inefficient allocation of energy in the fat cells. Energy stored as fat cannot simultaneously be used by the body for energy, resulting in hunger. Admonished to avoid fat, individuals may continue to eat high carbohydrate diets, which would tend to perpetuate this vicious cycle. Without knowing the precise nature of the relationship between all of these variables, proceeding with an analysis using such a model strikes me as pointless.

It is problematic enough to isolate these relationships among a small cohort of study participants, let alone when employing the country-level statistics that I am forced to use. Though it was tempting to try to devise a model based on country-level BMI data, I decided that such data is so prone to misinterpretation due to a lack of internal validity as to be useless. Knowing what the average BMI for a country reveals little about what is happening to the distribution of peoples' weights. BMI follows clear upward trend in these 36 countries but this

does not mean that all segments of the population are getting fatter at the same rate. Although I doubt it, it could be that a very small proportion of these populations is pulling average BMI upward while the majority of the population remains at a healthy weight.

More fundamentally, the crux of this issue is that epidemiological evidence alone cannot reliably be used to isolate causal relationships in matters of health. Though Keys's hypothesis that saturated fat causes heart disease was reasonable enough when first advanced and his epidemiological evidence supported that belief, in the absence of a randomized control trial there are too many confounding variables to make such a claim (Taubes 2007). Keys was hell-bent on proving this relationship true rather than searching for alternative explanations for the development of heart disease. This clear selection bias meant that Keys tended to study countries which would support his own beliefs, to the exclusion of all others.

After considering the differences between these two models of obesity, I concluded that the question of what increases BMI is a secondary concern. The *Guidelines* view obesity as a behavioral problem that leads people to "overeate" and engage in "sedentary behavior". The insulin hypothesis perceives carbohydrate consumption as leading to both behaviors. Since I do not have country-level data on exercise, which would be subject to the same sorts of concerns as BMI, and the insulin hypothesis does not perceive exercise as causally contributing to weight loss, I test the hypothesis that eating more refined carbohydrates, relative to other dietary components, will lead to increased consumption of calories, overall, in a population.

My data come from the United Nations's Food and Agricultural Organization (FAO) which attempts to estimate daily per capita consumption of a very wide variety of foods. It summarizes its methodology for doing so as such (FAOSTAT):

On the utilisation side a distinction is made between the quantities exported, fed to livestock + used for seed, losses during storage and transportation, and food supplies available for human consumption. The per capita supply of each such food item available for human consumption is then obtained by dividing the respective quantity by the related data on the population actually partaking in it. Data on per capita food supplies are expressed in terms of quantity and by applying appropriate food composition factors for all primary and processed products also in terms of dietary energy value, protein and fat content.

As with data on BMI, there is a lot of room for error in interpreting per capita food consumption data. The fact that the average citizen of a country eats a given amount of food tells one little about the distribution of food consumption. Food consumption decisions are motivated by a variety of factors and to assume that changes in consumption are uniform across an entire population would be ludicrous.

But, unlike average BMI, per capita food consumption changes would seem to reflect real changes in food consumption at the country level. This is because the data is based on country level stocks and flows of food, which are then divided by the country's population. Insofar as those statistics are estimated accurately, it seems valid to conclude that changes in per capita consumption reflect real changes in the demand for, and presumably consumption of, particular foods. As far as I am aware, most of the countries included in this data set are not particularly poor (relative to the rest of the world) nor have they suffered from large-scale malnutrition or famine over the study period so substantial increases in consumption are unlikely to reflect a simple drive to meet energy needs.

Though the insulin hypothesis does not view exercise as an effective approach to losing weight, it does not argue against the notion that exercise expends energy. Thus, increases in average food consumption could reflect an increase in energy needs among the population due to increased physical activity, which poses a threat to the internal validity of my model. I am not

aware of any observations or arguments to that effect in the United States or other Western countries but it may be worth considering in other countries.

Results

My model is based on some of the explanatory variables in the table below. All numbers are taken directly from the FAO, and the unit of measurement is the calorie, except in the case of: ‘carbtotal’, ‘percentrefined’, ‘percentprotein’, ‘percentfat’ and ‘percentcarb’. ‘Carbtotal’ is equal to the difference between ‘calorietotal’, ‘fattotal’ and ‘proteintotal’. ‘Percentrefined’ is the relative proportion of energy coming from sweeteners (sugar, high fructose corn syrup, honey, etc.) and wheat. The rest are computed in a similar fashion. To clarify, the ‘percentcarb’ variable only includes unrefined forms of carbohydrate from foods like fruits and vegetables. The study period goes from 1980, when the *Guidelines* were first published, to 2007. The countries of interest are: Argentina, Australia, Austria, Bulgaria, Canada, Chile, Costa Rica, Cuba, Denmark, Dominican Republic, Ecuador, Egypt, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Mexico, Netherlands, New Zealand, Nicaragua, Norway, Paraguay, Poland, Portugal, Romania, Spain, Sweden, Switzerland, United Kingdom, United States of America, and Uruguay.

Table 1. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
countrycode	1008	112.6111	68.99649	9	234
year	1008	1993.5	8.081757	1980	2007
animalproducts	1008	857.5536	319.4768	160	1448
beer	1008	71.87302	50.42867	1	275
cereals	1008	953.9276	282.5094	507	2143
eggs	1008	41.54067	16.82081	5	88
fruits	1008	116.8552	49.86519	23	335
calorietotal	1008	3121.629	412.8699	1734	3819
meat	1008	334.1121	136.2556	32	682
milk	1008	269.9206	111.2089	46	594
starchyroots	1008	126.0198	70.94674	18	492
sweeteners	1008	397.506	100.6404	179	680
vegetableoils	1008	347.75	138.4684	87	689
vegetables	1008	65.99603	31.7714	5	174
vegetalproducts	1008	2264.079	299.1807	1531	3032
wheat	1008	642.6984	267.9904	87	1486
proteintotal	1008	371.7115	73.13967	167.2	508.4
fattotal	1008	1024.09	295.8109	306.9	1540.8
carbttotal	1008	1725.827	211.7262	1199.8	2542.5
percentfat	1008	.3229625	.0671805	.1391384	.4228976
percentprotein	1008	.1181377	.0126103	.0776569	.1444729
percentcarb	1008	.5588998	.0746146	.4442237	.7660251
percentrefined	1008	.4390897	.1006689	.2976485	.7633174
GDP	1008	18637.45	14802.56	717.36	68570.42

My model attempts to answer the question: “What happens to country level average per capita calorie consumption as the average proportion of energy coming from refined sources of carbohydrate increases?” Since I use panel data, and I am trying to compare the effects of

different levels of food consumption across countries, I use a fixed effects model to control for any unobserved country level effects. I also include GDP per capita as a control variable. I employ an Ordinary Least Squares (OLS) model specified as:

$$Y_{ia} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \alpha_a + \varepsilon$$

Where Y_{ia} is the 'calorietotal' for a given year in a given country, $X_1 - X_5$ represent my five independent variables, β_0 is a constant term, α_a represents the fixed effects within a given country, and ε denotes the random error in the model. The 'percentprotein' variable was dropped due to collinearity. My results are shown below:

Table 2. Results

VARIABLES	(1) calorietotal
percentcarb	-8,628*** (1,304)
percentrefined	635.5** (316.6)
percentprotein	0 (0)
percentfat	-7,756*** (1,283)
GDP	0.0119*** (0.00102)
Constant	9,948*** (1,089)
Observations	1,008
Number of countrycode	36
R-squared	0.190

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Since my explanatory variables are likely to be subject to a high degree of measurement error, I do not attach much importance to the numerical values for these coefficients.

Nevertheless, the relative difference in the magnitude of the computed coefficients is quite striking. Based on the coefficient above, a 1 percent increase in per capita consumption of refined carbohydrate would lead to about 6 more calories being consumed per day ($.01 * 635.5$). Over the course of a year, this would equate to about 2,319 calories. Consuming a greater proportion of fat and unrefined carbohydrates, meanwhile, has a larger and opposite effect. But, by definition, if the proportion of energy coming from refined carbohydrates is increasing, the proportion coming from other sources must be the same or smaller.

Though 6 calories may not seem like a lot, it is important to remember that this data set includes several countries which did not have a high prevalence of obesity at any point during the study period, at least based on average BMI data (Finucane 2011). This may mean that those countries, for whatever reason, have not experienced the sort of metabolic disorders that those in countries like the United States have experienced. In other words, there may be a lot fewer carbohydrate sensitive individuals within many of these countries. Even in the United States it is not as if everyone has this sensitivity. One wonders how the model might differ if the analysis were confined to populations who are obese and/or exhibit symptoms of insulin resistance. If the insulin hypothesis is correct, the coefficient on 'percentrefined' would presumably be larger.

Conclusion

I now return to the previously mentioned questions posed by the Brookings volume, as applied to *Guidelines*:

1. Is there a scientific foundation for government action?
2. Will setting a standard reduce risks to health and safety?

3. Is there enough scientific evidence to provide realistic estimates of the risks and costs of alternative standards?
4. Has sufficient analysis been done to identify uncertainties and to map out a prudent course, given the uncertainties and possible future events?

Based on my assessment of the evidence, the answer to all 4 questions was “no” at the time the *Goals* were published and that answer has remained largely the same all the way to the present. Had Keys performed the type of study which could reliably have shown the relationship between saturated fat and heart disease that he posited, there would be a scientific foundation for the McGovern Committee to proceed with the publication of the *Goals*. Alas, Keys did no such thing.

In the absence of a study which reconciles the discrepancies between the *Guidelines* and the insulin hypothesis, any concrete nutrition policy recommendation would be premature. More, and better, research is required before arriving at satisfactory answers to the above questions. Taubes and others are in the process of forming a non-profit, the Nutrition Science Initiative, aimed at funding precisely that type of research (Taubes 2012).

If Taubes is able to help prove that the insulin hypothesis is a superior way of approaching the obesity epidemic, the internalities at work within the USDA mean that such an approach would face strong resistance and may never be used to design new nutrition policy. Another newly formed non-profit group, the Healthy Nation Coalition (HNC), among others, is working to move the nutrition policymaking process out from under the auspices of the USDA so that nutrition policy is based on better and more defensible scientific evidence instead of observed correlations between diet and health (Healthy Nation Coalition). As far as I can tell, such groups have been largely ignored by the federal government and RDs alike.

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