Staff Papers Series

Staff Paper P79-30 August 1979

A PRIMER ON NUTRITION POLICY
IN THE UNITED STATES

by

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July 1979

Staff papers are published without formal review within the Department of Agricultural and Applied Economics.
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INTRODUCTION

Recently students and makers of agricultural policy have been struggling with an issue which raises fundamental questions about the basis for and direction of U.S. agricultural policy: Can nutrition knowledge be used as a basis for planning food production and distribution in the United States? The current leadership in the USDA has publicized its belief that government should move in this direction. Carol Tucker Foreman, Assistant Secretary of Agriculture and leading administration advocate for nutrition policy, describes the view from the top:

Secretary Bergland has made a number of speeches in which he has repeated the same theme, that this country needs to develop a policy around human nutrition, build a food policy from that, and use those policies as a framework around which the build the Nation's farm policy. He

** Dairy Division, Agricultural Marketing Service, U.S. Department of Agriculture. The views expressed in this paper are the author's and do not represent official USDA policy. The author greatly appreciates comments (on an earlier draft) by Professor Willard W. Cochrane, Professor Benjamin Saxauer, Professor Jean Kinsey, Thomas C. Thompson, Jean C. Sussman, and Anastasia Tenzutuo Navele.

usually follows by saying, "The trouble, folks, is that we've been going it backwards all these years." 2/

In other words, it's not "what's good for farmers" that should guide agricultural policy; rather, it's "what's good for consumers." (Presumably, these two guides may sometimes lead to the same result.)

The logic behind proposals for a nutrition-based food policy may be summarized: "Food is produced in order to feed people. Therefore, the overall effectiveness of a food production system can be measured scientifically, objectively, by measuring people's nutritional status." This logic is flawed. Food is consumed for pleasure as well as nutrition; people may freely choose to consume nonnutritious food. Under some circumstances, improvement in nutrition for one individual may be at the expense of another group's nutrition. The goal of improved nutrition is at odds with other public policy goals. For these reasons, nutrition knowledge cannot provide an objective, "scientific" basis for guiding food policy decisions. Good nutrition may well be a leading goal of agricultural policy, but it cannot be the only goal. Difficult subjective or political decisions must be made about the trade-offs between opposing goals.

Foreman makes clear her conviction that agricultural policy should be transformed from a farm-oriented policy to a nutrition-oriented policy. She is less specific about the mechanics of such a transformation. Presumably, Foreman's nutrition policy 3/ would proceed as follows:

3/ Ibid., p. 17.
(1) determine how much and what kinds of food are necessary to meet nutritional needs here and abroad,
(2) adjust farm policies to bring about production of the desired quantity of each type of food,
(3) make food available at a reasonable price, and
(4) ensure that the poor have incomes high enough to allow adequate nutrition.

In this paper, I will examine the problems and potentialities for transforming a farm-oriented agricultural policy into a nutrition-oriented agricultural policy.

The first two sections of this paper will define the nutritional problem in the United States from a nutritionist's point of view and set forward the tenets of nutrition science on which the rest of my discussion is based. I believe that these tenets are sufficiently general to be accepted by most nutrition experts. If anything, my outline of nutrition knowledge underestimates the possible contribution of nutrition science to agricultural policymaking.

The third section of the paper will contain an economist's redefinition of the nutrition problem in the United States. Economists do not agree with nutritionists about the definition of the term "optimal nutrition." The economic justifications for government intervention to improve nutrition will be discussed in this section. The fourth section will review the economics literature on programs to improve nutrition. Traditional remedies for the nutrition problem may be divided into poverty programs and education programs.
An effective nutrition policy could be designed using only programs to improve nutrition among the poor and nutrition education programs. The recent suggestions about a nutrition-based food policy go far beyond espousal of food stamps and nutrition education programs, which do not directly affect food production decisions. A nutrition-based food policy, as the term usually is used, implies a wholesale reworking of agricultural policy affecting production and distribution of food.

In the fifth section, we will examine the feasibility of designing an agricultural policy for which the only objective is good nutrition. There are insurmountable problems in defining and dictating and ideal levels of food production and consumption.

Section six will indicate how the goal of improved nutrition can be considered as one of several, often opposing, goals of agricultural policy. To this end, economists and nutritionists must give policy-makers better estimates of the nutritional impacts of policy alternatives. The nutritional effects of various policies could be estimated, with some well-directed effort, by extending agricultural sector forecasting models to include behavior by classes of consumers and by evaluating the desirability of expected changes in nutrition for these classes.

THE NUTRITION PROBLEM IN THE UNITED STATES

Because of the food they eat, Americans do not lead as long or as healthy lives as they might. This is the nutrition problem as a nutritionist might define it. The statement is simple; the problem itself is complex.
The nutrition problem in the United States encompasses two opposing aspects. Some Americans (the poor minority) are malnourished because they do not get enough food to eat. Some Americans (the affluent majority) are malnourished because they eat too much of the wrong kinds of food.

At various times and by various nutritionists, both of these aspects of the nutrition problem have been singled out for special consideration. The 1969 White House Conference on Food, Nutrition, and Health focused on hunger:

"Recent reports have shown that a large number of our poor live in a deplorable state of malnutrition and many of them are hungry.... The time has come to develop a national nutrition and food distribution policy, a policy based on human need and not predicated by agricultural subsidies. The White House Conference on Food, Nutrition, and Health ... will meet to lay the foundation for such a national nutrition policy. 4/"

Other studies stress the problem of obesity and poor nutrition among the rich.

"It should be apparent that Americans already eat too much food.... It is inevitable that nutritional policy will increasingly emphasize limitation of intake of certain foods and food constituents and moderation of dietary habits. 5/"

The contradictions inherent in the nutrition problems are obvious: We cannot encourage a widespread increase in the food consumed lest the


overfed majority eat more; we cannot encourage a widespread decrease in food consumed lest the hungry minority eat less. Neither part of the problem is imaginary; neither group can be ignored. In the United States, the more common affliction is overeating. Ignoring the nutrition problems of the poor is wrong; it may also be politically unwise. In spite of appearances to the contrary, perhaps the affluent person is, and should be, concerned about the condition of his or her hungry neighbor.

The complexity of the nutrition problem is increased by the fact that nutrition is a cumulative process, not an event. A person's health and nutritional status at any given time period depends upon his nutrition in all previous time periods. A policymaker must consider not only the immediate effects of a policy but also the effects on nutrition in future periods.

Period-to-period fluctuations in nutritional status must be weighed along with average nutrition levels. A policy which moves average nutrition closer to ideal nutrition over time but which increases year-to-year fluctuations around the average may be a nutritionally harmful policy.

I should also point out that, for the purposes of this paper, I am making a distinction between the nutrition problem and the issue of food purity or wholesomeness. Undeniably, this is an important problem. However, here it is an unnecessary complication. If food purity is to

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6/ "Obesity, the most widespread nutritional disorder in the United States, ... currently affects about 30 percent of middle-aged American males and 40 percent of the females."

M. Rupert Cutler and Syd Butler, Testimony before the Nutrition Subcommittee of the Committee on Agriculture, Nutrition, and Forestry, U.S. Senate, February 22, 1978, released by the U.S. Department of Agriculture, Washington, D.C., 1978, p. 15. Mr. Cutler is Assistant Secretary of Agriculture for Conservation Research and Education. Mr. Butler is Deputy Assistant Secretary of Agriculture for Food and Consumer Services.
be improved by federal government action, much of the responsibility will fall on the Food and Drug Administration, which enforces standards for acceptable levels of chemicals and contaminants in food. USDA programs (especially the inspection and grading programs) do have an impact on food purity. In the proposal for analysis of nutritional impact of government programs, there is room for considering this impact, but this paper will not focus on it.

THE "STATE OF THE ARTS" OF NUTRITION SCIENCE

Before going very far in our analysis of nutrition's proper role in the agricultural policymaking process, we have to take a closer look at nutrition science itself. Does nutrition science provide a sufficiently solid basis on which to build a nutrition policy? In particular, we ask of nutrition science that it be able to label objectively any change in food consumption as a good change, a bad change, or no substantive change.

Nutrition science is modern, in many ways a fledgling science. As Hegsted says, "Nutrition is an inexact science." 7/ On specific issues (for example, the dangers of cholesterol), there is a good deal of disagreement among nutritionists. 8/ This lack of scientific concurrence about the ideal levels of nutrient intake must constrain, but needn't

7/ Hegsted, op. cit., p. 16.
8/ For a good example of this lack of scientific concurrence, see Council for Agricultural Science and Technology, Dietary Goals for the United States: A Commentary, Report No. 71, November 30, 1977. This report takes exception to some of the findings of the Senate Select Committee on Nutrition and Human Needs.
paralyze, the policymaker who sincerely desires to improve the public welfare.

There are 10 statements which I believe will find general acceptance among nutritionists and which should be understood by policymakers interested in improving nutrition:

1. A person's health is affected by his or her diet.
2. Nutrients—those elements of food which affect health—can be identified and measured.
3. Nutrient content of foods—the level of each nutrient which is available from a food in the form in which the food leaves the supermarket—can be measured.
4. The level of nutrients actually derived from a food may be different from the potential nutrition available because of the way the food is prepared and the amount of the food which is discarded.
5. The optimal level of nutrient intake—that level which provides the longest, healthiest life—can be approximately determined for an individual.
6. Optimal levels of nutrient intake will differ between individuals. The optimal level of nutrient intake for an individual depends on, among other things, the individual's age, physical activity, current health, past diet, and other demographic characteristics, such as race, physiological state (infancy, pregnancy, etc.).
7. For certain demographic groups (say, for example, school-age children from low-income households), nutritional needs are sufficiently similar for nutritionists to define a
band of optimal intake which applies to all members of the group. If average nutrient consumption for the group is more than the maximum or less than the minimum of this band, such consumption can be said to be sub-optimal.

(8) Current levels of nutrient intake can be and are measured for demographic groups.

(9) The nutritional well-being of an individual or of a demographic group is not determined solely by the consumption of a single nutrient; rather, it depends upon the complete diet. Therefore, any change in food consumption cannot be judged as a good or bad change on the basis of the change in intake of any single nutrient.

(10) For an individual or group, nutritional problems, i.e., intake above or below the "acceptable" band, can be ranked in importance by nutrient.

**Nutrition Affects Health**

This is the most basic and most universally accepted of the 10 tenets. It is a fact comprehended by all animals; even in its most sophisticated expression, the fact is a part of informal folk wisdom and not a scientific postulate. Yet, it is this fact that makes nutrition an applied rather than a moot or esoteric science. Moreover, it is this fact that motivates the policymaker.
**Nutrients**

In order to describe the relation between food and health more scientifically or analytically, nutritionists have identified certain nutrients—elements of food which affect health. To date, nutritionists have isolated some 40 to 50 of these attributes. They may be grouped as calories, protein, fats, carbohydrates, minerals (iron, calcium, etc.), vitamins (riboflavin, Vitamin C, etc.), and others (water, fiber, etc.). These nutrients can be measured in grams or international units, for example. To a large extent, the contribution of each nutrient in combatting or fostering diseases can be identified. These contributions are the subject of much current research in nutrition science. The relationship between nutrients and health may never be fully comprehended; enough is known, however, to provide a firm basis for policy action.

**Nutrient Content of Food**

A given amount of any food in a particular form can be described in terms of these nutrients. Evidence of this is as near as the closest box of breakfast cereal. Thus, one food can be compared with another in terms of these nutrients.

**Nutrient Intake**

Unfortunately, the policymaker cannot be sure that the consumer will actually ingest the entire amount of nutrients available. A boiled carrot yields nutrients different from those of a raw carrot. A policymaker cannot infer from the amount of food bought by a consumer the exact level of nutrients received by that consumer; it is nutrients actually
ingested that define nutrition. The policymaker, however, need not despair at this. The whole of nutrition science is not so precise that an approximation of nutrient intake will not suffice. Enough is known about consumer habits that the nutrients available in a "normally" prepared quantity of food will serve as a workable approximation of the nutrient intake from such a food.

**Ideal Levels of Nutrient Intake**

For an individual, a nutritionist can prescribe an ideal diet—a diet that will ensure the individual as long and as healthy a life as possible. This is not a totally precise process. Different nutritionists may prescribe slightly different diets for the same individual. Here again, the failure of nutrition scientists to be in complete agreement need not deter the policymaker; approximations would do.

**Nutritional Differences Between Individuals**

More troublesome is the fact that no two individuals are exactly alike in their nutritional needs. One's ideal diet will differ, sometimes substantially, from another's. There is not a single optimal American diet. The individual's ideal diet will depend on a number of factors, the most important of which are age, sex, past nutrition and current state of health, level of physical activity, physiological state, and climate. The difference between individuals can be large. For example, a young adult male lumberjack may require three times as many calories (4,600
kilocalories per day) as an elderly housewife (1,550 kilocalories per day).

Because of these differences, national average nutrient intake does not adequately measure the current nutritional status of the country, nor do changes in the average permit us to evaluate changes in society's nutrition. Suppose that for a society consisting only of a lumberjack and an elderly housewife, we observe an average calorie intake of 3,000 kilocalories per day. If the lumberjack is getting 4,400 kilocalories per day and the housewife 1,600 kilocalories per day, then calorie intake in the society is very nearly optimal. If, on the other hand, the 3,000 kilocalories per day average represents a situation where both the lumberjack and the housewife eat 3,000 kilocalories per day, there is a major nutritional problem in the society. Just as average intake reveals nothing about the extent of malnutrition, a change in the average (to 3,075, for example) could signal an improvement (lumberjack from 4,400 to 4,600 and housewife from 1,600 to 1,550) or a deterioration (lumberjack steady at 4,400, housewife from 1,600 to 1,750). 10/

Aggregating Individuals into Demographic Groups

Because nutritional needs vary so much between individuals, national averages do not help either in identifying nutritional problems or in

10/ Recommended nutrient requirements and allowances are usually formulated to provide a guide in planning for the nutrient needs of the average healthy individual or, more appropriately, of a particular population group. Unless an individual meets the criterion of the "average" man, such dietary standards should not be used as a yardstick for nutritional assessment without making the necessary adjustments.

indicating whether the situation is improving or deteriorating. Yet, it would be absurd for the government to try to monitor the diets of every individual in order to perfect nutrition policy. However, there is a middle road.

While no two people are "nutritionally identical," we can identify demographic groups in which all members of a group are very similar in nutritional needs and nutritional status. Because the variance within any group is relatively small, the group can be treated (for policymaking purposes) as a single individual, with the group averages representing the real and ideal nutrition situations for that individual.

As pointed out in the above section, nutritional needs differ with age, sex, activity, and physiological state. The U.S. nutritional standards are published for some 17 groups divided by sex and age with two special categories for pregnant women (see Appendix A). The British standards break the population up into 26 groups, making distinctions in some age and sex groups between different levels of physical activity.

Within each of these groups, there may be reasonable homogeneity in nutritional needs but quite a bit of variation among individuals in actual diet. Diets may differ between individuals because of income differences, differences in tastes and preferences, or because the individuals face different sets of relative prices. In general, I believe that we can safely disregard differences in relative prices in the United States since such differences are small in comparison to the imprecision inherent in this categorization process. If there are important differences in relative prices, they are likely to show up in comparisons of rural-to-urban prices. Differences in tastes and preferences are more significant but almost impossible to categorize. The most important and most easily
quantifiable cause of differences in diet is income. Even broadly defined, income class breakdowns greatly reduce the variances of nutrient intake within each "nutritional-need" group.

Given these differences, we may want to divide each nutritional-need category into urban and rural subcategories with three income classes for each subcategory. Six subdivisions in each of the 26 nutrition groups on the British list would give us 156 total groups. Within each group, both nutritional needs and nutritional status would be sufficiently homogeneous for the policymaker to define the extent of the nutrition problem and to identify improvements in society's nutrition. One hundred fifty-six sounds like a lot of groups, and in fact this may be an unnecessarily fine breakdown. By examining figures on requirements and consumption, we could identify likely combinations of groups, thereby lowering the total number of categories.

The needs of a group's members may not be so homogeneous that nutritionists can define a single, exact optimal amount of nutrient intake. However, nutritionists can agree on an optimal band of nutrient intake for each of these groups. It may be more realistic (i.e., it may preclude a good deal of picayune debate among nutritionists) to talk about zones or bands of optimal nutrient intake rather than a single quantity. If actual nutrient intake for a group moves toward (or away from) this optimal band, the change would be an improvement (or a deterioration) in nutrition. Movements within the band would signal no significant difference in nutrient intake. (All of this assumes intake of other nutrients remaining constant.)
Measurement of Nutrient Intake

The recommended daily allowances tell us the optimal nutrient intake of each demographic group. In order to determine the extent of the nutrition problem, we must know how far actual nutrition of these groups is from ideal nutrition. We also need a surveillance system to monitor changes in nutritional status. The surveillance mechanism exists. 11/

The U.S. Department of Agriculture conducts the nationwide Food Consumption Survey every 10 years. (The latest published figures are for 1965.) Among other things, this report gives figures on actual nutrient intake as a percent of recommended intake for 22 sex and age groups, three income groups, and two geographical areas (see Appendix B). The Department of Health, Education, and Welfare has conducted a "10-state nutrition survey," concentrating on nutrition among the poverty stricken and has followed with a not-yet-published Health and Nutrition Examination Survey (HANES).

Nutrition Depends on the Total Diet

It may seem trivial at this point to observe that a person's (or a group's) nutritional status cannot be determined by examining the intake of only one or two of the 40 or 50 nutrients. This observation is necessary because it is often overlooked. Studies of nutrition in developing countries commonly use calorie intake alone (or, more recently, calorie and protein intake) as an index of a country's nutrition problem. In developing

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countries, this simplification may be warranted because health problems relating to other nutrients (such as blindness, rickets, or gum disease) pale beside starvation (the "disease" related to calorie or protein deficiency).

In the United States, the simplification is not justified. No single nutrition-related disease is of commanding importance. Different nutrition problems compete for the policymaker's attention. Without careful thought and specific intent, it would be a mistake to design a nutrition policy around any one of these problem areas, yet such tunnel vision focusing on a single nutrient is fairly common among observers of the nutrition problem in the United States. Recognition that competing forces exist in nutrition is of vital importance to the policymaker. Whenever possible, we wish to alleviate one problem without exacerbating any other.

This utopian solution is not always possible; at times we must choose to favor one problem over another. In part, this favoritism involves a political choice—one age-sex-income-geographic group must be favored over another, and, in part, the favoritism involves a nutritional choice—attainment of optimal intake levels for one nutrient takes precedence over attainment of optimal levels for another.

**Ranking Nutrition Problems**

On this point, nutritionists have not yet concentrated their research efforts. For any given demographic subcategory, nutritionists should be able (and, when they put their minds to it, are able) to rank the nutritional concerns in order of importance to health. 12/ We should be able to say,

12/ Langier suggests that, at least in poor countries, the importance of a nutrient can be measured by the extent of its deficiency. Jose David Langier, *Economical and Nutritional Diets Using Scarce Resources*, Michigan State University, East Lansing, Michigan, 1969.
for example, that for 20-34 year-old females in middle- and upper-income
groups the most important concern is iron intake; the second most im-
portant problem is calcium intake; the third, calories, etc. This would
allow policymakers to compare, within any group, an improvement in iron
intake with a deterioration in calorie intake and an improvement in iron
intake for one group with a deterioration of iron intake in another
group.

* * * * * * * * * * * * *

A farmer, speaking in a forum sponsored by the Farm Foundation, said:

I agree that nutrition should have a major policy role—an
increasing role. But the discussion this morning reaffirmed
my fear that we're not ready. The evidence from research is
not ready to play a major role in decisions on food policy
in the near term. And I'm frightened that policy will go too
far without an adequate information base. We farmers get
very frustrated with the mixed, so-called facts, research, and
statistics that the nutrition and the medical professions use
to evaluate our product and our futures. 13/

I disagree with this view. 14/ Nutrition science is not perfect.
It does not provide exact and unassailable measures of nutritional status
on which to base and evaluate a nutrition policy. Nutrition science is
advanced enough to point policymakers in the right direction and to
identify certain clear and pressing problems. 15/ The tenets of nutrition

13/ William J. Richards, "Implementing an Expanded Food and Nutrition
Policy: A Farmer's Point of View," in Increasing Understanding of Public
Problems and Policies, op. cit., p. 35.
14/ Joining me in this opinion are H. S. Olcott, in American Journal
of Agricultural Economics, op. cit.; Jean Mayer, in Hearings before the
Select Committee on Nutrition and Human Needs of the U.S. Senate, Part I,
J. Perisse, and P. Francois, "Need for Food and Nutrition Policies," in
Man, Food, and Nutrition, M. Rechcigl (ed.), CRC Press, Cleveland, Ohio,
15/ Select Committee on Nutrition and Human Needs, U.S. Senate,
Dietary Goals for the United States, U.S. Government Printing Office,
science provide warnings and restrictions as well as guideposts, however. We must keep in mind.

1. that nutritional value of food purchased is not equal to the nutritional value of food actually ingested,
2. that nutritional needs differ between demographic groups, and
3. that nutrition problems differ between and within demographic groups.

THE NUTRITION PROBLEM—AN ECONOMIST'S REDEFINITION

Looking back on the previous section on nutrition science, we see that the word "optimal" is used in a way quite different from the way economists use the term. The "optimal level of nutrient intake" was that level which insured an individual the longest and healthiest life possible. Any movement away from this optimum, either by increasing or decreasing nutrient intake, results in a shorter and less healthy life. A graph of this situation might look like this:

Index of longevity and health

Level of nutrient intake
When nutrient intake is below the optimum level \((x^*)\), an individual makes his life longer and healthier by eating more of the nutrient. The individual who overconsumes will improve his nutrition by eating less of the nutrient.

If nutrition were the only reason for eating, then economists could abstract from this argument to the more comfortable ground of utility analysis. We need simply to define the index of longevity and health as a measure of utility. We then could speak of the problem in the more familiar terms of utility optimization. However, the economist's conception of optimal utility differs from the nutritionist's concept of optimal nutrition.

In economics, utility is optimized subject to some wealth constraint. Utility is not derived from one commodity alone but from a wide range of commodities, and because everyone has a finite amount of wealth with which to purchase these commodities, no one can afford to consume all of these commodities at the satiation point (assuming one exists), where the marginal utility equals zero and is declining. Utility will be optimized subject to the wealth constraint when the marginal utility, derived from the consumption of another unit of each commodity, is declining and is equal to the commodity's price. With concave utility functions and prices greater than zero, we would find the economic optimum consumption level to be less than the satiation point \((x^*)\) for every commodity.

There are circumstances under which the economic optimum is the same as the nutritional optimum. In the above discussion, it was assumed that the relation between longevity and nutrient intake was concave (the
function shows decreasing marginal utility, or a further step toward optimal nutrition improves health less than the last step) and that utility and longevity were simply different words for the same thing so that the utility function was also concave, but there is no law of nature requiring every utility function to have a declining marginal utility. It may be that every step closer to perfect nutrition brings an ever-increasing satisfaction. This could occur under two conditions. The longevity function could be convex—each step closer to perfect nutrition adds more years to life than the last step. Or, an individual may value the increase in expected longevity from 72 years to 73 years much more highly than the increase in expected longevity from 22 to 23 years.

The relationship between utility and nutrient intake may be convex:

Convex utility functions - increasing marginal utility

Concave utility functions - diminishing marginal utility
In this case, we would expect consumption of the nutrient to be at the nutritional optimum, at point \( x^* \) (if income allows, income divided by price is greater than or equal to \( x^* \)). As long as marginal utility is higher than price, the individual will get more value, per additional unit purchased, than the unit costs; therefore, he will consume the additional unit of the good up to the nutritional optimum, \( x^* \), where marginal utility suddenly becomes negative. However, the notion of a convex relation between utility and nutrient intake seems unrealistic. Nutritionists favor the idea of decreasing marginal longevity as nutrient intake approaches the optimum level, and one might think that an additional year of life means more at age 20 than at age 80.

In any event, this analysis only indicates that the economic optimum nutrient intake will be less than or equal to the nutritional optimum. How can we explain the behavior of overeaters, who consume at levels where marginal utility (measured only by nutrition) is negative?

We eat, not just for nutrition, but for pleasure. Utility derived from food is not measured adequately by an index of nutrition derived from food. Food provides two sources of utility; we cannot optimize one utility or the other separately; they must be optimized jointly. 16/ If pleasure derived from food is satiated at a much higher quantity than the optimal nutrition level, we may find that total utility continues to increase beyond the nutritionally optimal amount:

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There is good reason for supposing that pleasure from some foods peaks at a much higher quantity than nutrition derived from the foods. Often, the foods we like are not the foods that are good for us. A recent poll of servicemen shows that the most popular foods are generally

17/ The 15 best-liked foods were as follows:

(1) milk  (9) ice cream
(2) grilled steak  (10) milk shake
(3) eggs to order  (11) bacon
(4) corn on the cob  (12) spaghetti with meat sauce
(5) orange juice  (13) spaghetti with meatballs
(6) strawberry shortcake  (14) beer
(7) French-fried potatoes  (15) bacon-lettuce-tomato sandwich
(8) fried chicken

The 15 least-liked foods, in order of declining preference, were as follows:

(1) carrot-raisin-celery salad  (9) prune juice
(2) canned figs  (10) French-fried carrots
(3) boiled pigs' feet  (11) mashed rutabagas
(4) baked yellow squash  (12) low-calorie soda
(5) kidney bean salad  (13) fried parsnips
(6) creamed onions  (14) skimmed milk
(7) French-fried cauliflower  (15) buttermilk
(8) stewed prunes

high in fat and sugar, two of the most dangerously over-consumed nutrients in the United States. 18/

Here again, under certain circumstances, the fact of joint utilities derived from food does not imply, automatically, that the economic optimum differs from the nutritional optimum. One set of circumstances under which the nutritional optimum coincides with the economic optimum occurs when total utility for food is convex and reaches a peak at the nutritional optimum, $x^*$. A second set of circumstances occurs when total utility for food is concave but total marginal utility equals price at $x^*$. A third, a more interesting, possibility is the lexicographic utility ordering.

When lexicographers put together a dictionary, they order or rank the words alphabetically. All words beginning with "A" come before all words beginning with "B." Within the "A's," "aardvark" comes before "abacus," which comes before "accent." This notion of alphabetical ranking has been applied to the theory of utility maximization with interesting results.

Conceivably, an individual might say, "For me, good nutrition is of overriding concern. Only when I have optimized nutrition will I be concerned with the pleasure component of food." Such an individual would put at the top of his ordering list a situation represented by the word "aardvark," where both the nutrition component (represented by the first letter of the word) and the pleasure component (represented by the second letter of the word) receive scores of "A." If the "aardvark" situation was not possible, a situation represented by "avarice," with optimal

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18/ According to the Senate Select Committee, Dietary Goals, op. cit.
nutrition and little pleasure, would be ranked above a situation represented by "baboon," with optimal pleasure and only slightly suboptimal nutrition. For an individual with such a lexicographic utility ordering, we would expect the economic optimum to be the same as the nutritional optimum, as long as the individual's income was high enough to purchase this amount, $x^*$. 

If the lexicographic utility concept is realistic, it is so only up to that quantity of nutrient essential for survival. 19/ It is in these cases, where many people are struggling day to day for survival, that emphasis on calorie and protein intake among the very poor becomes economically justified. However, for people in the United States, the lexicographic utility function probably has little real applicability.

From an economist's standpoint, there is no a priori reason for alarm (or government intervention) about the fact that some nutrients are consumed at less than the optimal amount by some groups and that some nutrients are overconsumed. To a nutritionist's warning, "People in the United States do not eat as well as they should," an economist might reply, "So what? People are maximizing their utility from food (subject to a wealth constraint). The situation is as good as it can be. Why should government intervene?"

Political economists and social philosophers have attempted to define the proper role for government in a free market economy. In general, they

19/ According to Abraham Maslow, people have a "hierarchy of needs" with physiological needs (food for survival) taking precedence over social needs (food for pleasure). A. H. Maslow, Motivation and Personality, Harper and Row, New York, 1970.
say, when the conditions of perfect competition exist, the best strategy for a society is simply to allow every member of that society the opportunity to pursue their own selfish ends. The decision for government intervention can never be justified by looking only at people's choices, leaping in whenever necessary to correct what the authorities believe are people's mistakes. Such an intervention should be advised only after an examination of the circumstances in which these choices are made. Do the conditions of perfect competition exist? If not, government intervention may be justified.

Government intervention to improve nutrition can be justified on three counts or because of three failures in the perfectly competitive framework:

1. When "externalities" exist, i.e., when people who are affected by a decision have no way of influencing the decision maker, the government may intervene to force the decision maker to take into account these external effects.

2. When society wishes to help its unaffluent members, the government may act as the agent.

3. When private decisions are based on misinformation or on imperfect information, the government may wish to intervene in order to improve the quality of these decisions.

One of the assumptions of perfect competition is that prices will be negotiated so that total marginal utility is balanced with total marginal cost. All costs of production are borne by the seller, and all utility will accrue to the buyer. If there are costs external to this negotiation
process, the resulting price will be too low to cover the total cost of producing the last unit. If there are external benefits, the quantity produced will be too low to meet the true demand for the good. When externalities occur, economists often urge the government to intervene in the negotiation, taking the part of the unrepresented individual or group by imposing a tax equal to the amount of the external marginal cost or a subsidy equal to the external marginal utility.

In situations where near-starvation is widespread, external benefits from good nutrition include improved physical performance by laborers, improved learning by students, and higher intelligence among babies. In the United States, starvation is not widespread and these externalities are insignificant. 20/

The most obvious externality of poor nutritional decisions is in the area of health care. If every individual had to bear the total cost of treatment for nutrition-related diseases, then each individual's nutrition decisions would take these costs into proper consideration, but, in the United States, we don't pay our own ways in health care. We belong to health insurance plans of one sort or another (health maintenance organizations, private, or government-sponsored insurance plans), under which treatment for any member of the group is paid for by the entire group. The unhealthy take more out of the kitty than they contribute.

20/ Barry Popkin, "Economic Benefits from the Elimination of Hunger in America," Public Policy, Winter 1972, pp. 133-153, estimates these benefits for the United States in the late 1960's. In the last 10 years, there has been a vast improvement in nutrition among the poor in the United States. The current figures are likely to be much lower than Popkin's estimate of $14 to $50 billion.
Thus, we might find that the healthy members of an insurance plan would be willing to bribe the less healthy members to "eat better" in order to save on insurance premiums.

This externality is addressed properly in a general forum; the problem is not an adjunct of the nutrition problem. Rather, it is merely one manifestation of an "insurance problem"—in any insurance program, there must be losers and winners. All participants are betting that they will have a need for the insurance greater than the insured group's average. In discussions of the insurance dilemma, the nutrition problem should be considered, but on par with the problems of smoking, exercise, and tension. The existence of a health cost externality may (but does not necessarily) justify government action in the area of insurance; it certainly does not necessarily justify intervention in the area of nutrition.

The second economic justification for government intervention in nutrition decisions—income is distributed so badly in the United States that some people are malnourished because they are too poor—does not grow out of any direct contradiction of the explicit assumptions of perfect competition. Perfect competition does not require perfect equality of wealth or income; on the contrary, it implies that income will be distributed unequally.

The third of Harberger's "Three Basic Postulates for Applied Welfare Economics" states:

When evaluating the net benefits or costs of a given action ..., the costs and benefits accruing to each member
of the relevant group ... should normally be added without regard to the individual(s) to whom they accrue. 21/

Obviously, guided by this postulate, society would refuse to undertake any program to help the poor since any such program would have, in this view, net benefits of zero at best, i.e., with zero administrative costs. If we take one dollar from a rich man and give it to a poor man, society is no better off since the poor man gains one dollar's worth of utility only at the expense of one dollar of the rich man's utility.

Underlying this traditional "value-free" concept of society's utility is the primary assumption that the total utility of the society (W) is equal to the unweighted sum of the incomes of every individual of the society (I_i):

\[ W = \sum_{i=1}^{n} I_i \quad \text{for individuals } i = 1 \ldots n \]

This primary assumption contains three necessary secondary assumptions:

1. The utility of all individuals in the society is valued equally. Or, the appropriate functional form to describe the relation between society's utility and individuals' utilities is the one given—an unweighted summation of individuals' utilities.

2. Income is a valid proxy for utility.

3. Utility of any individual is independent of any other individual's utility.

By altering any of these three assumptions, we can arrive fairly quickly at the conclusion that society benefits from government programs which help the poor.

At first glance, it may seem natural to compute society's utility simply by adding together the utilities of every individual. If, in the two-person society described in the previous section, the lumberjack had an income of $5 and the little old lady had an income of $15, then the total utility of the society would be 20 units, but this means that the society's utility is the same whether income is distributed equally ($10 to each) or not ($20 to one, nothing to the other). This conclusion seems "unreasonable" to most people—it offends their sense of justice or morality. 22/

A common way of making the definition of society's welfare more "realistic" is to change the formula for computing society's utility from a given set of individual utilities. The two most commonly suggested alternative forms for the total utility function are

(1) computing total utility as a product of individual utilities 23/ and

23/ \[ W = \prod_{i=1}^{n} I_i \] for individuals 1 = 1 ... n.

(2) setting total utility equal to the utility of the poorest
individual in society. 24/

If total production of the society is given, under either of these methods of computation, society's welfare will be maximized when income is distributed with perfect equality. Let us suppose that we want to distribute $20 in a society of two people in order to maximize the society's welfare. If we measure society's welfare by multiplying the income of the first individual by the income of the second, welfare is maximized when we give $10 to each. If we measure society's welfare by the income of the poorest individual, again we find welfare maximized when each individual gets $10.

(A more sophisticated form of these computational formulas, though a form less dogmatic in its policy implications, would make total output \( \left( \sum I_i \right) \) a function of the distribution of the \( I_i \)'s., depending, perhaps, on the variance, skewness, and kurtosis of the income distribution.

This change takes into account the work-disincentive effects of progressive taxes and welfare payments by which the income redistribution is affected. If this computational form fairly represents the process society uses in valuing its utility, then the government will wish to redistribute income up to some point short of perfect equality.)

\[ 24/ \quad W = \text{Min } I_i \quad \text{for individuals } i = 1 \ldots n. \]

Although in the simple case above they both prescribe total income equality as the way to maximize society's welfare, the two alternative formulas for computing total utility (product of individual utilities or minimum of individual utilities) are not identical. When complete equality is not a viable alternative, the two formulas may differ in their description of optimal income distribution. 25/

In fact, both formulas are special cases of the more general functional form,

\[ W = \sum a_i I_i, \]

where \( a_i \) is a measure of the relative importance of each individual's utility to the society as a whole. 26/

\[ a_i = \frac{\Pi I_i}{n}, \]

For the maximin formula, \( a_i \) is 1 for all individuals at the very bottom of the income scale and is 0 for all others:

\[ a_i = 1, \text{ for all } I_i < I_j \quad \text{for all } j \neq i; \]

\[ a_i = 0, \text{ for all } I_i > I_j \quad \text{for any } j \neq i. \]

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In general, if the society assigns heavier weights to the poor \( (a_i > a_j \text{ when } I_i < I_j) \), then society's utility will be enhanced by government action which robs rich Peter to pay poor Paul.

In the preceding discussion, the words "income" and "utility" were used interchangeably. We may wish to make a distinction between these two concepts. Pure-hearted policymakers will be disturbed by the arbitrary way in which the weights can be assigned to each person's utility. Given the general definition of welfare, \( W = \sum a_i I_i \), any income distribution can be demonstrated to be the best distribution, simply by assigning an appropriate set of weights.

On a more rigorous level, this weighting problem has disturbed economists. Arrow has argued that there is no objective way to assign weights and preserve logical consistency in the welfare rankings. Little's reply points out that the assignment of weights need not be "dictatorial"—reflecting the value system of only one individual—but instead can be based on some more objective "convention" or set of rules.

One such convention is the concept of diminishing marginal utility of money, which relaxes the assumption that utility equals income. This concept says that $100 brings a lot more happiness to a man with $1,000 than it does to a millionaire. According to this approach, it is acceptable to measure society's utility as the unweighted sum of individual utilities \( (W = \sum U_i) \) as long as we recognize that utility and income are not synonymous but rather that utility is a steadily diminishing function of income:

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By properly specifying the function \( f \), we can arrive at exactly the same conclusions as the weighted sums of income approach, though by a more circuitous and, arguably, more "scientific" route: 

\[
U_i = f(I_i) \quad \frac{\partial U_i}{\partial I_i} > 0 \quad \frac{\partial^2 U_i}{\partial I_i^2} < 0
\]

By relaxing the third assumption implicit in the original specification—that an individual's utility depends solely upon his own income and is not influenced by the utility of others—we discover a qualitatively different alternative justification for government programs to help the poor. This is Harberger's "basic needs" approach to cost-benefit analysis of poverty alleviation programs. Again, we let total utility be the un-weighted sum of individual utilities, but now we allow for existence of externalities: An increase in the standard of living among some very poor individuals in a society will not only make these individuals happier but will also provide a sense of satisfaction (external utility) to other members of society:

\[
W = \sum U_i = \sum f(I_i) = \sum a_i I_i \quad a_i > 0 \quad \frac{\partial a_i}{\partial I_i} < 0
\]

Again, the choice of weights is subjective, but the choice must conform to the restrictions given.
\[ W = \sum U_i \quad \frac{3U_i}{3U_j} > 0 \quad \text{for some } i \text{ and } j \quad U_j < U_i. \]

If individual \( j \) has a level of consumption below that level which is necessary to provide certain basic requirements for human survival (represented by \( U^* \)), then other members of the society will get some satisfaction from helping Mr. \( J \) to acquire these basic needs.

To sum up, government programs to assist the poor can be justified under two circumstances:

1. There is a diminishing marginal utility of income.
2. Positive external utilities are derived from any action which brings a poor individual closer to fulfillment of his basic needs.

The third, and in the United States perhaps the most important, possible justification for government intervention in the area of nutrition is the impertinence of another basic assumption of perfect competition. The perfectly competitive ideal relies on the ability of individuals to correctly determine and undertake those actions which best serve their self-interest. When an individual is making decisions with imperfect information or misinformation about their consequences, we cannot expect these decisions to be optimal from the society's standpoint (since we cannot expect them even to be optimal in the eyes of the individual who makes them). When such an "information problem" exists, the government may be justified in acting to correct this problem.
Clearly, in the nutrition area, we have such an information problem. Nobody has perfect information about the nutritional value of the food they eat. By improving people's knowledge about nutrition, government acts to improve the nutrition and the utility of the society.

For two reasons, I have gone into considerable detail to explain the circumstances under which government intervention may be justified. First, those who ask, "What business does the government have trying to regulate nutrition?" deserve a complete and, to the extent possible, a logically consistent answer. Second, a good understanding of the reasons for a government nutrition policy is necessary if we are to evaluate alternative government programs for improving nutrition.

GOVERNMENT PROGRAMS TO IMPROVE NUTRITION—A REVIEW OF PROPOSED REMEDIES

The economic literature on nutrition falls fairly neatly into the two groups suggested by the above discussion:

(1) proposals for improving the nutrition of the poor and

(2) proposals for improving nutrition information.

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I would be remiss here if I failed to mention an extremely important (perhaps devastating) caveat regarding the justifications for government intervention in the economic decision-making process. Underlying much of this discussion is the notion: Since the world of perfect competition is a "perfect world," if the conditions of perfect competition do not hold, the government should act, to the extent possible, to create these conditions. The apparent logic of this notion is demolished by the Theory of the Second Best, which demonstrates that piecemeal pursuit of perfect competition will not usually lead to optimal allocation of resources. See W. J. Baumol, "Informed Judgment, Rigorous Theory, and Public Policy," Southern Economic Journal, October 1965, pp. 137-145.
Proposals for improving the nutrition of the poor usually advocate some variant of these four measures:

(a) income transfers (welfare payments),
(b) in-kind transfers (food distribution),
(c) coupons (food stamps), and
(d) price adjustments to encourage better nutrition among the poor.

As Harberger points out, the way in which we justify government action to help the poor will dictate our opinions about the relative propriety of these four measures. Advocates of the diminishing marginal utility of income concept will favor income transfers. The basic needs school will favor the other three options although, as we shall see, under certain circumstances, distribution of food stamps is a method of income transfer.

In the United States, many of the undernourished poor can afford an adequate diet:

The "poor" in the United States, with some exceptions, could be well nourished ... if they selected the proper foods. They could buy the components of a nutritionally adequate diet ... if palatability and variety were not factors in their choices. But choosing unpalatable foods would be irrational since they would not be eaten.


Both the diminishing marginal utility school and the basic needs school believe that American society should assist their undernourished poor. They disagree about the means of assistance, as mentioned above, and about the goals of such assistance. The basic needs school is the more parsimonious of the two. Suppose we are faced with a relatively poor individual who could afford adequate nutrition but chooses to under-consume certain necessary nutrients in order to buy an unnecessary luxury. The believer in diminishing marginal utility of income would be inclined to argue, "Let him eat cake if he wants to. Even if he spends some of the money we give him for nonnecessities, he will get more satisfaction out of that money than we rich folks would." The basic needs disciple might say, "Let him eat bread, not cake. The rest of us don't get any satisfaction by buying him luxuries. We don't mind helping him reach a minimum level of nutrition, but let's stick to the basics." As Harberger observes, the attitudes of most Americans (and of most economic analysts of the nutrition problem) seem to be reflected in the basic needs approach, more so than in the diminishing marginal utility approach. 33/

Of course, a collection of economists' suggestions about the nutrition problem is a biased sample. Believers in the concept of diminishing marginal utility of income would be unlikely to single out nutrition for special emphasis. To them, malnutrition is a symptom of the poverty problem and, as such, would receive little attention in a discussion of

33/ Harberger, "Basic Needs," op. cit.
remedies for the disease—unequal income distribution. The diminishing marginal utility school will endorse any effort to help the poor (as long as the increase in welfare exceeds the administrative costs). This school will prefer, however, direct income transfers, and some analysts have suggested that the current food stamp program be replaced by increased cash payments to welfare recipients.


35/ "While concerned laymen who observe people with shabby housing or too little to eat instinctively want to provide them with decent housing and adequate food, economists instinctively want to provide them with more cash income." James Tobin, "On Limiting the Domain of Inequality," Journal of Law and Economics, Vol. 13, October 1970; reprinted in Economic Justice, Phelps (ed.), op. cit., p. 449.

This review of economic literature about nutrition programs to help the poor will concentrate on the three remaining program approaches: food transfers, coupons, and price changes.

Giving food to the hungry has long been a popular American way of dealing with the nutrition problem. Federal food distribution programs have been of two types—general and targeted.

In the general food distribution programs, the government distributed food directly to the needy. The government maintained warehouses of "surplus" food—farm commodities acquired by the government under various price support programs. The "poor," identified by local welfare agencies, were entitled to pick up a certain amount of food, at no cost, from these government warehouses. The primary goal of these programs was not to improve nutrition but to dispose of surplus commodities. This became apparent especially in the early 1970's when food was scarce and government-held food stocks dwindled. Largely because the general food distribution program as administered did not do an adequate job of feeding the poor, the program was phased out and replaced by the food stamp program.

Targeted food distribution programs are still in operation. In these programs, the government donates food indirectly to certain groups, such as school children or the elderly. The food is funneled through nonfederal organizations or institutions—school districts, homes for the elderly, etc.—which distribute the food to the poor in a ready-to-eat form. Unlike the general food distribution programs, the targeted programs are primarily nutrition programs rather than price support programs. Nutritional needs of the target groups should be reflected in the kinds of food for distribution purchased with P.L. 480, School Lunch, or Section 32 funds.
Of course, a general food distribution program could be administered with nutrition rather than farm price support as its primary objective. This has been suggested: "I think in this country we ought to have surpluses that are at least the right surpluses dictated by nutritional considerations." 37/ There are some rather obvious drawbacks to a general food distribution program.

Unlike targeted food distribution, the actual consumption of the food would not be supervised—the general food distribution would be for home consumption. Because of this, a general food distribution program cannot be guaranteed to improve nutrition of the recipients. If the quantity of a certain food given to a recipient is less than the quantity the recipient would have consumed in the absence of any program, the food donation is unlikely to increase significantly the total amount of the food consumed by the recipient. The recipient will substitute the free food for food he would otherwise have bought. The effect will be exactly the same as a cash grant. In order to be more cost-effective than income transfers, a food distribution program must distribute nutritious food in quantities larger than the amount consumed "normally," i.e., without any program, by the target population.

Even if this condition were met, we are not guaranteed an effective nutrition program. Food is fungible; it can be converted into money or other goods by selling or swapping it. Here again, the food distribution may be little more than an indirect, and complicated, income transfer. Because of transaction costs, we would expect a food distribution program

37/ Mayer, Hearings Before the Select Committee, op. cit., p. 32.
to have some additional effect on nutrition. Not all of the extra food (quantities received over and above the normal consumption levels) will be traded or sold for three reasons. First, it takes time and effort to find a buyer or a trader with whom a recipient can reach a mutually satisfactory bargain. Second, if the recipients are concentrated in pockets of poverty, e.g., sections of large cities, and if the recipient's tastes are similar in any "pocket," certain distributed foods will be offered heavily on the black market, the prices of these foods will drop in the locality, and consumption by the recipients of the items will increase. Third, even if all the distributed food were converted into income, the effects would be the same as an income transfer—some of the additional income would be spent for necessary and nutritious foods.

Insofar as food distribution is an income supplement, either by substituting for existing consumption and freeing up the income previously spent for the distributed foods or by providing a fungible asset which can be converted into money, food distribution in the United States may harm nutrition as well as improve it. If, among the poor, the marginal propensity to consume nonnutritious food (or antinutritious food) is greater than zero (as it undoubtedly is), an increase in income of the poor will increase their consumption of foods which are actually bad for them (soft drinks, snack foods, starches, etc.). In other words, if food recipients normally overconsume any nutrients, income supplements will exacerbate this problem. Also, increased government purchases of nutritious foods will raise their market prices and discourage consumption of these foods by nonrecipients.
A general government food distribution program may also have serious effects on the commercial food distribution system. Even if the government bought the food on the wholesale market in the final packaged form, the retail outlets would be bypassed. A substantial portion of the business of grocers in the poverty areas would be usurped by the government. As grocers in a poverty pocket find the demand for nutritious food dwindling to almost nothing, all local demand now being supplied by the government, we should expect a period of furious price cutting for nonnutritious foods as these grocers struggle to increase the volume of sales in order to pay the rent, and, as the prices of Coke and popcorn go down, local consumption of these harmful foods by the food recipients will increase.

Finally, in our critique of a general food distribution program, we should note its high operating costs. To distribute food, the government must rent warehouse space and hire stockers, checkers, and managers—all this on top of the acquisition costs, transportation costs, and storage costs.

By distributing food stamps or coupons to the poor, we may avoid these last two difficulties (high costs and harm to existing distributors). Under a food stamp program, the food will still be distributed in existing commercial marketing channels. Food stamp programs may be of several different types. The stamps may be redeemable for any food or for certain types of food only. The stamps may be given to recipients, or the recipients may be required to purchase the stamps.

If the recipient population consumes less than the optimal level of all, or nearly all foods, stamps should be redeemable for all foods. If, on the other hand, the recipients are overconsuming certain foods, the food stamps should not be redeemable for these foods. Among the poor
in the United States some foods are luxuries; increasing consumption of these foods will harm, not help, nutrition.

A program of food stamps only for selected foods would be more costly to operate than the general food stamp program. Grocers and checkout clerks would be required to spend more time and effort validating food stamp purchases and would expect to be compensated by the government for this additional time and effort. On paper, at least, a selective food stamp program is not impracticable. The WIC (Women, Infants, and Children) Program is an example of a workable selective food coupon program.

Food stamps, whether for all food or for selected foods, can be given away or can be sold at less than the face value to qualified recipients. If food stamps are given away, they may have the same effects as an income transfer because of substitution and fungibility, as discussed in the case of food distribution. By requiring the purchase of food stamps, we can guarantee that the expenditure by government will result in a higher consumption of nutritious food than an equal expenditure for income transfer. Until recently, the federal food stamp program had a purchase requirement, but allowed purchases of food stamps in one of four sizes only—one quarter, one half, three quarters, or all of the maximum food stamp allotment. The result is a "saw-toothed" budget line, with effects which may be rarely different from the effects of an income transfer. A recent decision eliminated the purchase requirement for food stamps. (See Appendix C for a more complete discussion of alternative food stamp programs.)

In spite of the theoretical reservations we may have concerning food stamps, the empirical evidence indicates that food stamps are effective in improving nutrition. For every dollar of food stamps distributed (under the saw-toothed purchase requirement system), food expenditures increase by 85 to 95 cents. The food stamp program does improve nutrition. 39/

Nevertheless, there is no empirical evidence that a food stamp dollar expenditure is nutritionally preferable to a dollar of income transfer, and there are higher costs of administering a food stamp program separate from the general government income subsidy program. There is the additional cost of printing the food stamps and paying grocers for their redemption. There is the cost of the additional bureaucracy for administering the program. It is for these reasons that the Carter Administration and many other observers have advocated the elimination of the food stamp program and an expansion of income supplement programs.

Peter Timmer has suggested that malnutrition among the poor can be lessened by government policies which lower the prices for some foods relative to other prices. 40/ Timmer investigated the effects of food price policy on nutrition in Indonesia. He concluded that nutrition would be improved by price policies which raised the price of rice relative to the prices of maize and cassava. The effectiveness of such a policy depends upon the production and consumption situation in a country. In Indonesia,

39/ See Benjamin Sexauer, "Food Programs and Nutritional Intake: What Evidence?" in Agricultural Food Policy Review, op. cit., pp. 39-44; Maurice MacDonald, Food Stamps and Income Maintenance, Academic Press, New York, 1977. The newspaper recently carried a report on a Field Foundation report. "Federal food stamp, school lunch, and related programs have ended the national shame of poverty conditions so gross they horrified the public when the issue was publicized in the late 1960's,' the Field Foundation said." Lee Byrd (AP reporter), "Effort to Ease Hunger in U.S. is Huge Success, Study Finds," The Minneapolis Tribune, May 1, 1979, p. 6C.

40/ Peter Timmer, "The Impact of Price Policy on Protein Calorie Intake," unpublished paper delivered at the University of Minnesota, April 1978.
rice is eaten mostly by upper- and middle-income groups. The poor eat maize and cassava. Furthermore, many of the poor are employed in the production of rice. Finally, calorie deficiency is so widespread that it can be regarded as the premier nutrition problem; nearly any increase in food intake by the poor can be regarded as an improvement in nutrition; nutrition of the nonpoor and intake of other nutrients are minor problems when compared to calorie deficiency. Increasing rice prices and holding prices of cassava and maize constant should increase the real incomes of the rice-producing poor and, consequently, improve their nutrition.

These conditions of production and consumption may be fairly common in developing countries. They do not pertain to the United States. The malnourished poor are not mostly food producers. Only 4.4 percent of food stamp recipients live in "rural areas." There is no clear distinction between foods eaten by the rich and foods eaten by the poor. To the extent that certain foods can be identified as being more heavily consumed by the poor, these foods are likely to be contributing nutrients which already are overconsumed by the poor. The foods eaten most predominantly by the poor will have low income elasticities of demand. A list of foods with income elasticities less than 0.1 includes beans, lard, margarine, sweet potatoes, rice, cornmeal, etc. A policy to encourage consumption of these foods would not necessarily improve nutrition of the poor. Unlike the Indonesian poor, the poor in the United States are sufficiently well-fed

so that increased caloric intake is not their sole, or even their primary, nutritional concern. If the poor in the United States eat more of any kind of food, their nutrition will not necessarily be improved. The major nutritional concern of the poor in the United States is the variety of food consumed as much or more than the quantity of food consumed. The circumstances which make the Timmer approach successful in developing countries such as Indonesia do not exist in the United States.

A variant of the Timmer approach would be to lower the relative prices of the foods poor people should eat. This can be accomplished only by shifting the supply curves of these foods down and to the right. Such a shift could be encouraged by the following policies:

1. lowering import restrictions,
2. raising export restrictions,
3. increasing compensatory payments,
4. subsidizing the purchase of inputs into production of these foods,
5. subsidizing technical change, and
6. eliminating market inefficiencies and barriers to free trade.

For foods that the United States imports, domestic prices can be lowered quickly and clearly by reducing or eliminating import restrictions, but the United States is not a net importer of most foods. The few candidates for freer trade that spring to mind are beef, sugar, dairy products, and fresh fruits and vegetables. The first two of these items are of questionable nutritional significance. There is a general feeling among nutritionists that consumption of red meats and sugar, even among the
poor, is too high in the United States. If this is the case, there is no nutritional basis for relaxing import restrictions, lowering domestic prices, and increasing consumption of these items.

Increased consumption of nonfat dry milk and (probably) cheese, would improve nutrition among the American poor. Imports of these items are restricted in order to protect and make workable the U.S. dairy price support program under which the government agrees to buy butter, cheese, and NFDM (non-fat dry milk) at floor prices. At the present, any relaxation of import restrictions would have to be tied to a decrease in these floor prices in order to have any significant impact on prices, but the dairy price support program acts to support prices and ensure an adequate domestic supply of fresh milk as well as NFDM and cheese. Any serious decline in the price for milk paid to farmers could result in seasonal or local shortages in the supply of fresh milk. Thus, the improvement in nutrition due to cheaper NFDM and cheese prices might be offset by higher prices and lower consumption of fluid milk.

Fresh fruits and vegetables are clearly foods which the poor should consume in greater quantities. Restrictions on imports of fresh fruits and vegetables, especially from Mexico, result in higher prices and lower quantities consumed of these products. The results of relaxing import restrictions and lowering prices would be an increase in quantity consumed, an increase in quantity imported, and a decrease in quantity produced domestically. Protectionists, those who favor restrictions to international trade, long have pointed to the last of these effects in support of their
arguments. There is a "strategic" need for domestic production capability, the protectionists say; we cannot rely on the vicissitudes of international relations and third-world politics for meeting our domestic needs. From a nutritionist's standpoint, these arguments cannot be ignored. Good nutrition is a long-range project. If we increase consumption of fresh vegetables this year, only to see next year a vegetable embargo and a drastic cut in vegetable consumption, we will not necessarily be improving nutrition. Increasing export restrictions would lower the quantity exported, lower the domestic price, and increase quantity consumed domestically. An interesting example of increased export restrictions, and one related to domestic agricultural policy, is the raising of support prices to above the world price levels. Assume that the current price is set at the world price level $P$. Current domestic production is $Q_{ws}$, current domestic consumption is $Q_{wd}$, and current exports are $Q_{wx} = Q_{ws} - Q_{wd}$:
If the government raises the support price to $P_g$, domestic production will increase to $Q_{gs}$. Quantity demanded on the market will decline to $Q_{gd}$, but the government will buy quantity $Q_{gq} = Q_{gs} - Q_{gd}$, which can be distributed domestically to the poor.

One strong nutritional argument against export restrictions is the plight of the hungry outside the United States. Increased export restrictions, especially on those products (food and feed grains) in which the United States has a significant amount of the world's trade may raise world prices, lower quantities consumed outside the United States, and generally have a deleterious effect on world-wide nutrition.

A third method of lowering domestic prices for certain foods would be to increase the compensatory payment to farmers producing these foods. A compensatory payment is a per-unit payment to producers above the market price. A compensatory payment of Amount $C$ raises prices to producers from $P^*$ to $P_p$, lowers prices to consumers from $P^*$ to $P_c$, and raises quantity produced and consumed from $Q^*$ to $Q_c$. 

![Diagram](image-url)
Species of the compensatory payment genus exist in the form of "deficiency payments" for primary commodities. Two difficulties present themselves. First, if the commodity is exported and if the price facing domestic consumers is the world price, an increase in the compensatory payment would subsidize only foreign consumption—domestic nutrition would be unaffected. Second, compensatory payments require increased government spending, which, in turn, may lead to higher taxes, inflation, or both. The nutritional effects of these requirements may offset partially the gains in nutrition caused by the increase in compensatory payments.

Another way of lowering prices and encouraging consumption of nutritious food is to subsidize production of these foods by lowering the prices of inputs into the production process. The simplest and most obvious

Price received by farmers increases from $P^*$ to $P_p$. Price paid domestically remains at the world price $P_c = P^*$. Quantity produced and quantity exported increase by an equal amount, $Q_c - Q^*$, and quantity consumed domestically remains at $Q_d$. 

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\begin{array}{c}
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\end{array}
\]
way of subsidizing purchases of inputs is by means of a tax write-off or
coupons with the purchase of inputs redeemable by certified producers for
cash from the government. It would also be possible to subsidize the
production and consumption of animal products (meat, dairy, eggs, etc.)
by lowering the price of the feed input, i.e., by lowering domestic prices
of feed grains.

The government could also encourage production and consumption of
nutritious food by sponsoring research which results in cheaper production
costs for nutritious food. This research should concentrate either on
ways of producing more nutritious food as cheaply (or of producing equally
nutritious food more cheaply) or on ways of increasing or maintaining nu-
tritional value of foods in processing. Government research into both of
these areas has received considerable attention and criticism. 43/

A final way, oft mentioned in the literature propounding nutrition
policy, of lowering prices of nutritious foods is to discourage "unnecessary
processing, unnecessary sales promotion, proliferation of products, and
restrictive trade practices. 44/ Processing, advertising, and proliferation
of products are "unnecessary" only when the consumer is tricked
into paying for them. The solution to these difficulties is improved
consumer information (discussed in the next section).

43/ See Jim Hightower, Hard Tomatoes, Hard Times, Schenkman Publishing,
Cambridge, Massachusetts, 1973; and "Report of Panels on Traditional
Foods and New Foods to the White House Conference on Food Nutrition and
Health," published in The White House Conference on Food Nutrition and Health:
pp. 101-128.
44/ "Comments of Consumer Task Force," White House Conference,
op. cit.
On the issue of restrictive trade practices, the government could more actively prosecute those restrictive trade practices it already opposes or less actively support restrictive trade practices it currently succors.

Elimination of monopoly profits to middlemen would improve nutrition and bolster farm income at the same time. However, there is some question about whether such monopoly profits exist. A study by the National Commission on Food Marketing (NCFM) in the mid-1960's reported profits of middlemen for 21 different food items. In only three cases (cheese, canned corn, and breakfast cereals) did total middlemen profits exceed 6 percent of the retail price. 45/ On the other hand, the Federal Trade Commission (FTC), reporting to the NCFM, found, "Since the early 1950's, the profits of food manufacturers have generally increased.... Firms selling in highly concentrated markets earned substantially higher profits than firms selling in less concentrated markets." 46/ Perhaps nutrition could be improved by a stricter antimonopoly policy, but this policy falls outside the scope of this paper, which is agricultural policies to improve nutrition.

Some critics claim that there are current agricultural programs which encourage "restrictive trade practices." Usually singled out for attention are market orders, cooperatives, and supply restrictions.

Under the market order programs for milk and some fruits and vegetables, classified pricing structures may be instituted. A classified pricing system sets different prices for a commodity according to its use. Higher prices are charged to users who convert the raw farm commodity into a consumer good with a relatively low demand elasticity. Lower prices are charged when the final form of the commodity has an elastic demand curve. Classified pricing results in higher prices for fluid milk products and for fresh fruits and vegetables. For this reason, market order programs have been attacked as detrimental to nutrition. The White House Conference on Food, Nutrition, and Health recommends, "We urge the removal of artificial barriers of all kinds in the pricing and marketing of milk." 47/

Certain members of the panel were more specific:

We recommend elimination ... of unnecessary premium prices paid by consumers to dairy farmers in order to make milk more economical and thereby encourage its consumption ... especially among the poor .... Federal milk orders are ... being used against the public interest. 48/

The evidence is not compelling that market orders harm nutrition. By reducing the uncertainty about farm prices, the program may encourage the adoption of new, more economical production techniques and may, therefore, result in lower long-term prices. 49/ By dampening the seasonal price fluctuations which would occur in a free market, market orders may actually improve nutrition by encouraging steady consumption throughout

the year instead of a feast-or-famine consumption pattern. Finally, it should be noted that the classified pricing system may provide a unique opportunity for changing relative prices to improve nutrition. Prices for milk used in nutritionally desirable products (fluid milk) could be lowered to encourage consumption. Farm prices and milk production could be maintained at current levels by raising the price charged for milk used in nonnutritious products (ice cream). The extent to which this strategy would work will depend on relative demand elasticities for the different products.

The USDA fosters the growth of cooperatives by providing information about the best ways to organize and operate a farm cooperative and the advantages of cooperative membership. The USDA is also responsible, under Section 2 of the Capper-Volstead Act, for identifying and prohibiting monopoly practices (undue price enhancement) by cooperatives. If any unduly enhanced prices received by co-ops are passed on to the co-op members and if no supply restrictions are put on farm production of co-op members, the monopoly prices will be short-lived as the supply of the commodity increases and a competitive equilibrium is restored. ⁵⁰/ Monopoly power among co-ops will raise food prices and adversely affect nutrition only if the co-ops do not distribute monopoly profits to their member-owners or if co-ops can impose supply restrictions on their members. On the first

point, farmer-members do not receive the total dollars received by a co-op. Deductions are made for administrative and marketing costs for advertising and promotion, for political contributions, for co-op expansion, and toward a revolving fund which will pay out in the future money received today. In most cases, these expenditures are justified—they are not indications of a monopoly power existing solely for the benefit of the management bureaucracy. On the second point, co-ops cannot enter into any supply-restricting agreement with their members without violating antitrust laws. 51/

Supply restrictions may be imposed and administered by the federal government. In the past, government-sponsored supply control programs have included acreage allotments (limiting the number of acres a farmer can plant in a certain crop), marketing quotas (limiting the quantity of a commodity which a farmer can sell each year), and soil conservation or set-aside programs (requiring farmers to take a number of acres out of production). These programs result in higher prices for food and lower quantities produced and consumed. The government could improve nutrition among the domestic poor by reducing or eliminating supply restrictions on those commodities which are presently underconsumed by the poor. At the present time, however, supply restrictions are not an important element in agricultural policy and do not have a significant detrimental impact on nutrition.

We have looked at six methods by which the government could reduce prices for foods which the poor should eat in greater quantities. Because

demand for food is very inelastic, however, a price change will have to be very large in order to have a large impact on nutrition. For example, most age-sex groups do not get enough calcium to meet recommended daily requirements. If we wish to lower the price of fresh milk in order to increase calcium consumption by 15 percent, we will have to lower the price of milk by 43 percent (given a price elasticity of -0.345545).\footnote{Demand elasticity for milk as estimated by P. S. George and G. A. King, \textit{Consumer Demand for Food Commodities with Projections for 1980}, Giannini Foundation Monograph No. 26, California, 1971.} If the current price per gallon is $1.75, we would have to lower the price to 99 cents per gallon in order to achieve our nutrition target.

The above discussion has singled out four ways of improving the nutrition of the poor: income transfers, food distribution, food coupons, and relative price changes. A national nutrition policy which focuses only on nutrition of the domestic poor may end up doing more harm than good. The diets of the poor in the United States are sufficient in calories. Many of the U.S. poor eat too much—20 percent of the poor children are obese, according to Mayer.\footnote{Mayer, \textit{Hearings Before the Select Committee}, op. cit.} The principal nutrition problem among the poor in the United States is deficiency in certain vitamins and minerals. It is difficult to improve this situation among the poor without exacerbating nutritional problems of other groups. A policy which encouraged production and domestic consumption only of foods needed by the U.S. poor, for example, liver for iron and milk for calcium, would result in less food (wheat, soybeans, etc.) available for the world's poor, whose principal nutrition problem is calorie and protein deficiency. A policy which encouraged
production of all food would result in lower prices and increased consumption by the rich whose principal nutrition problem is obesity. Nutritional programs to help the poor may have significant harmful effects on the nutrition of nontarget groups.

Information

The second category of nutritional programs includes those which attack the information problem. Imperfect information can be of two types—misinformation or lack of information. Misinformation (the consumer believes that a food is nutritional when it is, in fact, harmful, or vice versa) can be corrected (a) by eliminating sources of misinformation or (b) by providing the consumer with correct information. The Federal Trade Commission (FTC) protects the public from false and misleading advertising. Recently, the FTC has been considering a proposal to eliminate or restrain advertising directed at children by food manufacturers (especially for breakfast cereals, candy, and snacks). Such advertising inflates demand for nonnutritious foods (especially those high in sugar) by assuring children that these foods are "good."

The alternative to prohibiting this type of advertising is to launch a program of "corrective" advertising. The government could purchase air time and run advertisements informing children that these sugary foods are not good for them. A study comparing these two alternatives indicates that prohibition of advertising is less effective than corrective advertising in lowering consumption. 54/

An important cause of the nutrition problem in the United States is the lack of understanding about good nutrition. People simply do not know what foods are good for them and what foods are harmful. Four methods have been proposed for getting more nutrition information to people:

(a) mass media advertising, 55/
(b) classroom education and extension, 56/


(c) in-store leaflets and signs, and
(d) labelling.

The first three methods are intended to teach people what nutrients are and how much of each nutrient should be consumed. The final method is designed to inform consumers how much of each nutrient is contained in different foods.

Unfortunately, there is reason to doubt the efficacy of these methods in improving nutrition. More information leads to better decisions only if the information is presented in a usable way. Psychological studies have shown that more information often leads to more confusion and worse decisions:

There appear to be definite limits to the amount of information which can be accommodated and effectively processed during a limited time span by consumers in arriving at purchase decisions. There is considerable evidence to indicate that providing additional information can and sometimes does increase uncertainty. Increases in the amount of information to contend with may eventuate in a decrement in the quality of decision-maker performance.

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Because of this information overload, simply providing consumers with a lot of numbers will not significantly improve nutritional decisions. If it is to be effective, the information must be "condensed" into a form in which the consumer can comprehend and use it. It has been suggested, in the case of therapeutic drugs, that information about their efficacy and safety can be communicated to consumers by banning the sale of dangerous or ineffective drugs. 60/ If banning is an effective way of communicating information, may we not also use the price mechanism to inform consumers about the nutritional impacts of foods? 61/ The government could announce to consumers, "We want to help you make better decisions about the food you eat. To this end, we are instituting a program which will make nutritious foods more attractive to you and nonnutritious foods less attractive. We will do this by raising the prices of harmful foods and lowering the prices of nutritious foods." Such an announcement would have the effect of changing the tastes and preferences of consumers and shifting their demand curves for foods. Currently existing demand elasticities would not accurately measure the likely response of consumers to these price changes. The effective demand elasticities would be higher. Consumers would regard the initial price changes as informative and would react more positively than usual to price decreases and more negatively to price increases.

The traditional methods for dealing with nutrition problems—giving food stamps, coupons, or money to the poor and improving education and labelling—are cornerstones of "nutrition policies" commonly recommended. The other items included in these policies are

(a) more research in the area of nutrition,
(b) increased nutritional surveillance, and
(c) improved food safety.

A nutrition policy could continue to use only these traditional remedies. Increased income supplements or food stamps, in combination with a massive nutrition education program, would have a definite positive impact on nutrition in the United States. Such a policy would be costly, and the traditional remedies are somewhat limited in their effectiveness. Poverty assistance will subsidize consumption of nonnecessities. Because of information overload, education may not improve nutrition to the hoped-for extent.

At any rate, a nutrition policy based on these traditional remedies does not qualify as a "nutrition-based agricultural policy." The traditional remedies are essentially divorced from agricultural farm-price policy. The recent discussion about nutrition policy has included proposals to broaden these traditional remedies and to base farm policy decisions on nutritional impacts: "Human nutrition must be the leading goal for food and agricultural policies.... No one could argue successfully to the contrary." 62/ But can agricultural policy in the United States be

62/ Philip L. White, American Journal of Agricultural Economics, op. cit., p. 803.
designed to meet certain nutritional targets determined objectively by nutrition scientists?

NUTRITION AS THE BASIS FOR AGRICULTURAL POLICY

Finally, we address the problem at hand: Can nutrition knowledge be used as a basis for guiding production and distribution policies for food? The above discussion yields the following premises upon which to build:

(1) The nutrition problem is complex. Different people have different nutritional requirements, different food consumption habits, and different nutrition problems. A person's nutritional status cannot be defined in terms of a deficiency or an oversufficiency of one or two nutrients at any given point in time; the entire diet and nutritional history must be considered.

(2) Nutrition science provides a basis on which to act. Nutrition scientists, though far from unanimity on many questions, can agree on certain urgent nutritional problems.

(3) The government is justified in intervening to influence market decisions in order to improve nutrition. Specifically, it may intervene to improve nutrition among the poor and to provide information about nutrition.

(4) One method of justifiable intervention is adjustment of prices to encourage production and consumption of nutritious foods and to discourage production and consumption of non-nutritious foods.
To these four premises, I would add a fifth:

(5) To increase (or decrease) consumption of a certain food, a program must also increase (or decrease) production of the commodity. We cannot work blindly on only the production side or the consumption side of the market.

This may seem to be a trivial observation, but it is astonishing how often it is overlooked. Some specific suggestions for improving the nutritional impact of government programs fail to consider the whole picture. Eliminating price supports for overconsumed foods, for example, will not necessarily improve nutrition. Suppose that nutritionists tell us that the average American eats too much butter. On this recommendation, we decide to lower the support price on butter. The commercial market price of butter drops and government stocks decline. Buyers of butter on the commercial market—buyers which include the "average American"—purchase more butter at the new lower price. Recipients of government butter—children under the school lunch program and the foreign poor under P.L. 480—consume less butter, but the market purchasers are the overconsumers and the food distribution recipients may well need the calories, protein, and vitamins that butter provides. If this is the case, lowering the butter support price will harm general nutrition.

Other critics have urged programs which encourage production of high-nutrition foods by raising prices of these foods:

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63/ This effect is implied in many statements such as the one by Mayer quoted earlier concerning the need for "nutritional surpluses" (footnote 37).
The production of milk with a lower fat content and a higher protein content should be encouraged by amending milk marketing orders so that milk prices are based on protein content as well as butterfat content. 64/

Such a policy, which results in higher prices to users and consumers of nutritious components of foods, will result in decreased consumption of these components. In 1974, a national grocery chain which bottles its own milk changed its standards for whole milk to decrease butterfat content and to increase protein content. This action, nutritionally desirable, would have been discouraged by the proposed higher prices paid for protein.

Policymakers intent on using nutrition as a basis for agricultural production and distribution policy must have ready answers to all of the following questions:

(1) How much of each commodity should be produced?
(2) How can production at these levels be dictated or encouraged?
(3) How will the food be distributed?

According to Don Paarlberg:

If nutrition were the sole desired objective and the economist were called on to show how it would be achieved, the procedure would be fairly simple. He would prescribe a diet agreed to by nutritionists.... We would then provide this diet to the people, much as I used to prescribe the rations for my cattle in my Indiana feedlot. And it would be a low-cost diet. 65/

64/ D. S. Kronfeld, Supplement to Panel on Traditional Foods, White House Conference, op. cit., p. 108.
In reality, even with this single objective, the procedure would not be simple.

The determination of the nutritional optimum quantity of food produced often is discussed as if it were an objective, scientific process. As mentioned earlier, nutrition science contributes vital information about proper levels of nutrient intake for individuals or groups and nutrient composition of foods. However, scientific facts are not enough; important political decisions or subjective judgments must be made. First, the policymaker must decide how much weight to attach to foreign nutrition problems. How much U.S. food will be shipped abroad? How much responsibility should the United States take toward feeding the world's hungry? These are political questions.

The answers to these will allow the calculation of required amounts of nutrients, but in what form will these nutrients be consumed? Will required protein be made available in steak or as dried milk? Will consumers get their Vitamin C from fruit or in artificial pill form? In Paarlberg's simple procedure, where the policymaker is concerned only with nutrition, no weight is given to palatability: "The calcium might come from calcium phosphate; calcium from milk costs three hundred times as much. The Vitamin A might come from a synthetic fortifier... The protein might be soybean meal." 66/

66/ Ibid., p. 108.
The form in which the nutrients are consumed cannot be determined solely on the basis of production costs per unit of nutrient. Palatability also must be considered. Prohibition of any "traditional" foods because they are not cost-effective nutrient sources will result quickly in a black market supply of these foods, a market patronized by those who eat the food for pleasure. Such a prohibition would also cause unemployment and impoverishment among producers of these traditional foods and suppliers of inputs to these producers and would harm, thereby, rural nutrition. In no way are we assured that prescribing least-cost production of nutrients will result in perfect, or even improved, nutrition.

If, on the other hand, nutrition policymakers opt for the other extreme—ideal palatability—food necessarily will be more expensive, more costly to produce. Improvement of nutrition in the United States will be at the expense of the third-world poor. The obvious compromise is to encourage, but not stipulate, production and consumption of nutritious traditional foods, and to discourage, but not prohibit, production and consumption of nonnutritious foods.

A nutrition policy may have as its goal the production and consumption of exact quantities of foods or may encourage more production and consumption of some foods and less production and consumption of other foods. In either case, a nutrition program must influence both production and consumption.

There are many existing government programs which affect the domestic supplies of foods. The primary ways in which the quantity of a food available for domestic consumption can be affected are as follows:
(1) changing quantity produced domestically by altering farm prices through deficiency payments or taxes,
(2) changing quantity produced domestically by regulating quantities of inputs,
(3) changing quantity available domestically by encouraging or discouraging imports or exports,
(4) changing quantity available to consumers by changing the levels of government-held stocks,
(5) lowering quantity available on the market by marketing quotas, and
(6) increasing quantity produced domestically by developing technology which lowers relative costs of production for some foods.

These are problematic solutions. Economists' empirical knowledge of producer responses is not sufficiently advanced to permit accurate predictions of the effect on the total food supply of wide-ranging changes in, for example, prices received by producers. The most serious shortcoming is the lack of complete information on cross-elasticities of supply—how do producers of one food react to changes in price of another food?

A second difficulty exists when a nonnutritious food is a joint product with a nutritious food. How can we encourage production of non-fat dry milk and discourage production of butter or increase liver production while decreasing meat production? To some extent, as mentioned above, classified pricing systems which allow different prices for components of a commodity based on their nutritional value may be used to address this problem. In some cases, such as healthful egg whites tied to harmful egg yolks,
no solution is possible. In cases where classified pricing could have an effect, the impact is likely to be minimal.

A third issue which must be faced in defining a nutritional food production policy is the naturally occurring, year-to-year fluctuations in food supply due to varying weather conditions and other unpredictable "shocks" to the system. Assuming that ideal production levels can be established and assuming that any given level of production can be dictated, on average, by government policies, should the target averages be set exactly at the ideal production levels with the full assurance that actual production will be sometimes above, sometimes below this ideal level? Or, should the target average be set so that actual production will be at or above target levels most of the time? When the commodity in question is storable for long periods of time, it may be possible to make ideal levels of the commodity available on the market every year by means of a system of government-sponsored stocks. For perishable commodities, random supply fluctuations present a real and vexing problem.

Finally, a production policy must be wary of placing control of the food supply in the hands of individuals whom the government cannot control. Heavy reliance on foreign food supply, or concentration of domestic supply in the hands of a few huge producers, could result in monopoly prices and, in the long run, could be detrimental to nutrition. 67/ If suppliers of food organize into a cartel, there is no effective way to protect consumers from a food shortage—a deliberate tightening of quantity of

food supplied in order to extract higher prices. The issue here is broader
than the traditional desire of countries to be self-sufficient in food
production. Food suppliers, whether foreign or domestic, must remain
responsive to the common weal as dictated by consumers or voters.

As noted earlier, programs designed only to influence production
often will have the opposite of the desired effect on consumption. For
example, increasing government purchases in order to spur production will
increase domestic consumption only if the increased purchases are distributed
domestically.

The simplest method (conceptually) of controlling distribution of
food is some form of government rationing. The government could act as
the ultimate middleman, requiring that all food sold be sold to the
government and all food bought be bought from the government. The government
would sell, to each consumer, that amount of food which is his or her
nutritional optimum. Alternatively, the government could require each
individual to exchange a certain portion of his or her income for food stamps
which are redeemable only for nutritional quantities of foods. Food would
be sold only for stamps under such a plan. In either program, black markets
would thrive. To discourage trading or selling of food between individuals,
the government would have to design some method of supervising the actual
consumption of food. Any attempt on the part of the government to coerce
American citizens into consuming nutritional foods would fail; Americans
would not accept government dictatorship of their diets. As Paarlberg
says of rationing:

68/ In his article, Paarlberg mentions only "self-sufficiency" as a
goal which may be in opposition to the goal of nutrition.
That this would improve nutrition is beyond doubt. It has worked well for cattle and chickens, which, in this country, are fed at a better nutritional level than are the people. The reason we can do it for cattle and chickens, of course, is that they can't vote....' Obviously, the American people will reject a prescribed diet, however nutritious. 69/

Policymakers could maintain the appearance of free consumer choice by eschewing direct quantity rationing and adopting instead a program of trial-and-error adjustments in consumer food prices—adjustments which continue until consumers "freely" choose to consume foods in nutritionally optimal quantities. Such a program of price adjustments would require an extensive and enormously complicated system of taxes and subsidies.

A price policy to stipulate optimum nutrition would be ridiculously complex. To be effective, such a policy must discourage or eliminate black markets in food and coupons. The government is forced either to subsidize the purchase of nonnecessities or to supervise food consumption. The "correct" price must be determined and administered for each individual in the economy. Prices for different forms of a basic commodity must be nutritionally balanced: What shall the price of butter be, relative to the prices of nonfat dry milk and whole milk; what should be the difference between the price of raw carrots and the price of carrots in a TV dinner? Quantities demanded of "finished" consumable food must be balanced with quantities of raw commodity produced. Since demand for food is relatively inelastic, the government would be forced to alter radically the existing food price structure in order to have a significant impact on nutrition.

69/ Paarlberg, op. cit., p. 108.
The administrative and enforcement costs of this program would be absurdly high. Furthermore, rationing by price is not fundamentally different from other forms of rationing and thus is equally objectionable from the standpoint of personal freedom. Is it any less an impingement on freedom of personal choice to dictate quantities consumed by taxing or subsidizing until the desired quantities are reached than to dictate those quantities by some direct method?

Finally, we should consider the effects of a nutrition-based agriculture on government economic goals. As Mr. Richards, the Ohio farmer, reminds us, "Agriculture's role has changed. It's not just a matter of feeding people, but also supporting the economy. Any agricultural policy in the future has to be heavily weighted to the export market, the balance of payments, and the support of the dollar." A nutrition policy might also be inflationary, raising the average price paid for food.

We are led ineluctably to the conclusion that nutrition cannot serve as the only basis for food production and distribution policy.

— Nutritionally optimal quantities of foods cannot be determined objectively but must be determined politically.
— Economic knowledge about behavior of producers and consumers is not sufficient to our needs—we cannot reliably dictate, by means of a pricing system, quantities of foods produced and consumed.

70/ Richards, in Farm Foundation, Increasing Understanding, op. cit., p. 35.
The Holy Grail of nutrition, when pursued, leads us to oppose other goals of agricultural policy—preservation of the small farmer, maintenance of food security, charity for the world's poor, and liberty.

THE GOAL OF NUTRITION IN AGRICULTURAL POLICY

This does not mean, however, that nutrition cannot serve as one of several conflicting goals of agricultural policy. The resolution of the natural conflicts between domestic and foreign nutritional goals, between nutrition and freedom of choice, between nutrition and the maintenance of the small farmer—these conflicts properly are resolved by political compromise; the final policy decisions properly are made by the citizenry or their representatives. The important task facing the nutrition science and economics professions is that of providing policymakers with useful information about nutritional impact of their decisions.

There exist already macro models of the agricultural production sector which can be used to project the probable impacts of government policy decisions on agricultural production. Attention should be given to expanding these models in order to include the decisions of consumers and the nutritional impacts. Timmer has indicated a way of effecting this expansion.

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71/ For a description of how these models are put together, see George E. Rossmiller (ed.), Agricultural Sector Planning, Michigan State University, East Lansing, 1978.
72/ Timmer, op. cit.
For any individual (or group of similar individuals), the amount of any food consumed during a period will depend on the price of that food, the prices of other goods, the income of the individual, and the tastes and preferences of the individual. Agricultural programs can influence the amount of a given food eaten by the individual by affecting any one of these four factors:

(1) The price of the food in question can be raised or lowered in many ways—the support price, the deficiency payment, the set-aside requirement, federal order minimum prices, import and export policies, and agricultural research; all affect the consumer price of food.

(2) By similar methods, prices of other foods can be influenced.

(3) An individual’s income can be affected by prices of farm commodities (if the individual is a farmer) or by food stamps.

(4) Regulation of food advertising, inspection and grading, and nutrition education programs affect an individual's tastes and preferences.

The econometric model can estimate the impact of a given government action (1) on these four determinants of food consumption and, thereby, (2) on the quantity of each food consumed by each individual or group. These estimates will be made by economists; they will tell us what factors influence food consumption and how government actions influence those factors. These estimates will never be perfectly precise; at first, they may widely miss the mark, but the methodology exists for refinement of these economic predictions.
We will look to nutrition science for answers to the following questions:

1. In the above analysis on the effects of government policy on food consumption, how shall we define demographic groups with similar nutritional needs and problems?

2. What are the proper levels of nutrient intake for each group?

3. What are the existing levels of nutrient intake for each group?

4. How can we translate food consumption into nutrient intake?

Using answers to these questions, we can quantify the changes in intake of all nutrients caused by anticipated government policy. In addition to this information, policymakers will look to nutritionists for the answers to two more questions:

1. For a given group, does the policy-induced change in intake of a given nutrient represent an improvement or a deterioration in nutrition for the group? 73/

2. For a given group, what nutrition problems are the most important?

In other words, is an improvement in intake of Nutrient A more important than the exacerbation of a problem (intake too high or too low) in Nutrient B?

73/ Instead of requiring that a change in nutrient intake be identified simply as an improvement or a deterioration, we could ask for a quantification—"This nutrient improved 10 units, and that one improved seven units." In my opinion, such a refinement places an unnecessary requirement on the nutrition science profession for unanimity of opinion. Changes in agricultural policy will be sufficiently conservative that resultant changes in nutrient intake will be small; only "marginal changes" in nutrition will be caused by the change in intake of any nutrient.
By incorporating economic and nutritional knowledge into the consumption side of existing econometric models, these models could advise policymakers: "The proposed policy (for example, raising the price of fluid milk) will improve nutrition in Groups A and B (adult men above the poverty line and the poor abroad) and will not harm Groups C and D (wheat farmers, high school-aged children). However, the policy will have deleterious effects on nutrition of Groups E and F (poor mothers, grade school children)."

(For a more formal discussion of how to expand existing econometric models in order to measure nutritional impacts of government policies, see Appendix D.) The policymaker would not be required to adopt or reject the policy change based on this information. The information would be considered along with information on all other effects of the policy (such as the effect on farm size, food security, inflation, balance of payments, etc.) and a subjective, or political, determination would be made concerning the proposed change.

Considerable research will be necessary to improve the validity of projections made by such a model. Demand functions of individual demographic groups for foods must be estimated. Nutritional weights, to be assigned to changes in intake of different nutrients, must be determined.

74/ To effect an agricultural price policy requires price responses for the population as a whole, while a food policy which includes nutrition should have income-specific parameters." Anne Tyler Rosenberger and Harold Alderman, "Estimates of Income-Specific Price Response for Use in Policy Analysis," unpublished paper, Cornell University, Department of Nutrition. Also see Oey Astra Meesook, "The Impact of Price Increases on Different Income Groups," Thammasat University Faculty of Economics Discussion Paper Series No. 48, December 1975.
The job of making the computer model more realistic, especially by improving estimates of group-specific cross-price supply and demand elasticities, will be never-ending. Nutritionists also will be occupied in eliminating some of the ambiguities and uncertainties about what are safe levels of nutrient intake.

In spite of the need for further research, the agricultural sector models could be expanded roughly in the near future, and the consumption-nutrition side of the model could be continually refined as more information becomes available. This kind of compromise approach to nutritional policy should be preferred because it allows policymakers to take nutritional impact into account in making decisions, but it does not require policymakers to ignore other important goals of agricultural policy. Consumer advocates should see in this approach the promise of greater nutrition knowledge input into the decision-making process. Commodity groups, agribusiness, the bureaucracy, and other groups with an interest in traditional agricultural policy should view this approach as a way of avoiding sudden and costly changes in the production and distribution sectors of agriculture.

CONCLUSIONS

The nutrition problem is complex. Nutrition science provides an imperfect but sufficient basis for policy decisions. Economic theory identifies the reasons and possible methods for government intervention and draws attention to the shortcomings of these possible methods. Applied economics is not sufficiently advanced to give reliable advice on the proper ways to manipulate prices in order to achieve a radical change in food
consumption and production patterns. Nutrition cannot be the only goal of agricultural policy; the achievement of nutrition, as a goal, runs contrary to other goals of agricultural policy. Nutrition should be one of several conflicting goals of agricultural policy; it should, perhaps, be *primus inter pares*. The important task facing the nutrition and social sciences is to present information on nutritional impacts of policies so that the political trade-offs can be made with a better understanding of policy consequences.
BIBLIOGRAPHY


APPENDIX A
Table 1. Food and Nutrition Board, National Academy of Sciences–National Research Council Recommended Daily Dietary Allowances, Revised 1974; Designed for the Maintenance of Good Nutrition of Practically All Healthy People in the U.S.A.

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<th>Height (cm)</th>
<th>Energy (kcal)</th>
<th>Protein (g)</th>
<th>Vitamins A (IU)</th>
<th>Vitamin D (IU)</th>
<th>Ascorbic Acid (mg)</th>
<th>Folic Acid (mg)</th>
<th>Niacin (mg)</th>
<th>Riboflavin (mg)</th>
<th>Thiamin (mg)</th>
<th>Vitamin B6 (mg)</th>
<th>Calcium (mg)</th>
<th>Phosphorus (mg)</th>
<th>Iodine (mg)</th>
<th>Iron (mg)</th>
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<th>Zinc (mg)</th>
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Note: The allowances are intended to provide for individual variations among most normal persons as they live in the United States under usual environmental stresses. Diets should be based on a variety of common foods in order to provide other nutrients for which human requirements have been less well defined.

* Kilocalories (kcal) = 4.2 x kilogram.
* Retinol equivalents.
* Assumed to be all as retinol in milk during the first six months of life. All subsequent intakes are assumed to be half as retinol and half as β-carotene when calculated from international units. As retinol equivalents, three-fourths are as retinol and one fourth as β-carotene.
* Total vitamin E activity, estimated to be 80% as α-tocopherol and 20% other tocopherols. See text for variation in allowances.
* The folacin allowances refer to dietary sources as determined by Lactobacillus casei assay. Pure forms of folacin may be effective in doses less than one-fourth of the recommended dietary allowance.
* Although allowances are expressed as niacin, it is recognized that on the average 1 mg of niacin is derived from each 60 mg of dietary tryptophan.
* This increased requirement cannot be met by ordinary diets; therefore, the use of supplemental iron is recommended.

**TABLE 13.1**

*Department of Health and Social Security.*

**Recommended daily intakes of energy and nutrients for the UK, 1969**

<table>
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<tr>
<th>Age range in years</th>
<th>Occupational category</th>
<th>Body weight</th>
<th>Energy (kg)</th>
<th>Energy (MJ)</th>
<th>Protein (g)</th>
<th>Thiamin (mg)</th>
<th>Riboflavin (mg)</th>
<th>Nicotinic acid (mg)</th>
<th>Ascorbic acid (mg)</th>
<th>Vitamin A (µg retinol equivalents)</th>
<th>Vitamin D (µg cholecalciferol)</th>
<th>Calcium (mg)</th>
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<td>750</td>
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<td>500</td>
<td>10</td>
</tr>
</tbody>
</table>

Note: Footnotes are listed on page 83.

The ages are from one birthday to another: e.g., 9 up to 12 is from the 9th up to, but not including, the 12th birthday. The figures in the Table in general refer to the mid-point of the ranges, though those for the range 18 up to 35 refer to the age 25 years, and for the range 18 up to 55, to 35 years of age.

b Average figures relating to the first year of life.

c The body weights of children and adolescents are averages and relate to London in 1965. (Tanner, Whitehouse and Takashita, 1966). The body weights of adults do not represent average values; they are those of the FAO(1957a) reference man and woman, with a nominal reduction for the elderly.

d Average requirements relating to groups of individuals.

e Megajoules (10⁶ joules). Calculated from the relation 1 kilocalorie = 4.186 kilojoules, and rounded to 1 decimal place.

f Recommended intakes calculated as providing 10 per cent of energy requirements.

g The figures are calculated from energy requirements and the recommended intake of thiamin of 0.4 mg/1000 kcal, relatable to groups of individuals.

h 1 nicotinic acid equivalent = 1 mg available nicotinic acid or 60 mg tryptophan.

i 1 retinol equivalent = 1 μg retinol or 6 μg β-carotene or 12 μg other biologically active carotenoids.

j No dietary source may be necessary for those adequately exposed to sunlight, but the requirement for the housebound may be greater than that recommended.

k For all three trimesters.

l These figures apply to infants who are not breast fed. Infants who are entirely breast fed receive smaller quantities; these are adequate since absorption from breast milk is higher.

m For the third trimester only.
Table 2a. Nutritive value of food eaten per person in one day as a percent of the recommended dietary allowances, United States, all incomes. *

<table>
<thead>
<tr>
<th>Sex-age group</th>
<th>Number of persons</th>
<th>Food energy</th>
<th>Protein</th>
<th>Calcium</th>
<th>Iron</th>
<th>Vitamin A</th>
<th>Thiamine</th>
<th>Riboflavin</th>
<th>Ascorbic acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male and female:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 1 year 4/</td>
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<td></td>
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<tr>
<td>4E3</td>
<td>120</td>
<td>259</td>
<td>209</td>
<td>49</td>
<td>303</td>
<td>170</td>
<td>3146</td>
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</tr>
<tr>
<td>1-2 years</td>
<td>817</td>
<td>117</td>
<td>225</td>
<td>116</td>
<td>46</td>
<td>190</td>
<td>130</td>
<td>278</td>
<td>113</td>
</tr>
<tr>
<td>3-5 years</td>
<td>1,403</td>
<td>110</td>
<td>216</td>
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<td>85</td>
<td>158</td>
<td>115</td>
<td>187</td>
<td>123</td>
</tr>
<tr>
<td>6-8 years</td>
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<td>217</td>
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<td>128</td>
<td>107</td>
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<tr>
<td>12-14 years</td>
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<td>200</td>
<td>85</td>
<td>77</td>
<td>116</td>
<td>96</td>
<td>168</td>
<td>156</td>
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<tr>
<td>15-17 years</td>
<td>562</td>
<td>100</td>
<td>190</td>
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<td>94</td>
<td>126</td>
<td>104</td>
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<td>18-19 years</td>
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<tr>
<td>20-34 years</td>
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<tr>
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<td>178</td>
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<tr>
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<td>109</td>
<td>84</td>
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<td>120</td>
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<tr>
<td>18-19 years</td>
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<td>94</td>
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<td>84</td>
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</tr>
<tr>
<td>75 yrs and over</td>
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<td>101</td>
<td>107</td>
<td>64</td>
<td>92</td>
<td>86</td>
<td>84</td>
<td>79</td>
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</tr>
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</table>


4/ Average figures relating to the first year of life.

Table 2b. Nutritive value of food eaten per person in one day as a percent of the recommended dietary allowances, United States, under $3,000. *

<table>
<thead>
<tr>
<th>Sex-age group</th>
<th>Number of persons</th>
<th>Food energy</th>
<th>Protein</th>
<th>Calcium</th>
<th>Iron</th>
<th>Vitamin A</th>
<th>Thiamine</th>
<th>Riboflavin</th>
<th>Ascorbic acid</th>
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<tbody>
<tr>
<td>Male and female:</td>
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<td>122</td>
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<td>186</td>
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<td>120</td>
<td>101</td>
<td>152</td>
<td>73</td>
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<td>6-8 years ........</td>
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<td>Male:</td>
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</tr>
<tr>
<td>9-11 years ........</td>
<td>88</td>
<td>85</td>
<td>161</td>
<td>76</td>
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<td>83</td>
<td>160</td>
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<td>75</td>
<td>88</td>
<td>86</td>
<td>125</td>
<td>131</td>
</tr>
<tr>
<td>15-17 years ........</td>
<td>85</td>
<td>86</td>
<td>154</td>
<td>73</td>
<td>89</td>
<td>99</td>
<td>99</td>
<td>137</td>
<td>85</td>
</tr>
<tr>
<td>18-19 years ........</td>
<td>36</td>
<td>94</td>
<td>162</td>
<td>74</td>
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<td>111</td>
<td>117</td>
<td>107</td>
</tr>
<tr>
<td>20-34 years ........</td>
<td>122</td>
<td>90</td>
<td>161</td>
<td>100</td>
<td>167</td>
<td>93</td>
<td>111</td>
<td>110</td>
<td>103</td>
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<tr>
<td>35-54 years ........</td>
<td>160</td>
<td>94</td>
<td>139</td>
<td>102</td>
<td>154</td>
<td>97</td>
<td>108</td>
<td>106</td>
<td>93</td>
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<tr>
<td>55-64 years ........</td>
<td>140</td>
<td>89</td>
<td>126</td>
<td>86</td>
<td>140</td>
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<td>121</td>
<td>108</td>
<td>78</td>
</tr>
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<td>65-74 years ........</td>
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<td>85</td>
<td>121</td>
<td>87</td>
<td>127</td>
<td>99</td>
<td>103</td>
<td>93</td>
<td>90</td>
</tr>
<tr>
<td>75 yrs and over ....</td>
<td>108</td>
<td>88</td>
<td>101</td>
<td>69</td>
<td>103</td>
<td>71</td>
<td>100</td>
<td>75</td>
<td>68</td>
</tr>
<tr>
<td>Female:</td>
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<tr>
<td>9-11 years ........</td>
<td>74</td>
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<td>77</td>
<td>124</td>
<td>57</td>
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<td>86</td>
<td>87</td>
<td>78</td>
</tr>
<tr>
<td>20-34 years ........</td>
<td>212</td>
<td>92</td>
<td>131</td>
<td>69</td>
<td>66</td>
<td>154</td>
<td>105</td>
<td>103</td>
<td>80</td>
</tr>
<tr>
<td>35-54 years ........</td>
<td>316</td>
<td>88</td>
<td>118</td>
<td>65</td>
<td>59</td>
<td>72</td>
<td>95</td>
<td>85</td>
<td>82</td>
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<td>86</td>
<td>80</td>
<td>85</td>
</tr>
<tr>
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<td>86</td>
<td>105</td>
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<td>100</td>
<td>82</td>
<td>81</td>
<td>95</td>
</tr>
<tr>
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<td>96</td>
<td>59</td>
<td>87</td>
<td>80</td>
<td>78</td>
<td>73</td>
<td>84</td>
</tr>
</tbody>
</table>


a/ Average figures relating to the first year of life.
Table 2c. Nutritive value of food eaten per person in one day as a percent of the recommended dietary allowances, United States, $3,000–$4,999. *

<table>
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<th>Sex-age group (1)</th>
<th>Number of persons (2)</th>
<th>Food energy (3)</th>
<th>Protein (4)</th>
<th>Calcium (5)</th>
<th>Iron (6)</th>
<th>Vitamin A value (7)</th>
<th>Thiamine (8)</th>
<th>Riboflavin (9)</th>
<th>Ascorbic acid (10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male and female:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>257</td>
<td>210</td>
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<td>111</td>
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<tr>
<td>1-2 years .......</td>
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<td>111</td>
<td>211</td>
<td>103</td>
<td>43</td>
<td>188</td>
<td>120</td>
<td>257</td>
<td>95</td>
</tr>
<tr>
<td>3-5 years .......</td>
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<td>205</td>
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<td>85</td>
<td>183</td>
<td>114</td>
<td>178</td>
<td>102</td>
</tr>
<tr>
<td>6-8 years .......</td>
<td>253</td>
<td>94</td>
<td>211</td>
<td>98</td>
<td>103</td>
<td>127</td>
<td>104</td>
<td>159</td>
<td>126</td>
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<td>Male:</td>
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<td>98</td>
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<td>65-74 years ......</td>
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<td>124</td>
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<td>75 yrs and over</td>
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<td>121</td>
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<td>87</td>
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</tr>
<tr>
<td>Female:</td>
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<td></td>
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<td>143</td>
<td>95</td>
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<td>135</td>
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<td>150</td>
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<td>124</td>
<td>52</td>
<td>55</td>
<td>123</td>
<td>87</td>
<td>111</td>
<td>85</td>
</tr>
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<td>18-19 years ......</td>
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<td>75 yrs and over</td>
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<td>118</td>
<td>67</td>
<td>93</td>
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<td>79</td>
<td>79</td>
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</table>


a/ Average figures relating to the first year of life.
Table 2d. Nutritive value of food eaten per person in one day as a percent of the recommended dietary allowances, United States, $5,000 and over.*

<table>
<thead>
<tr>
<th>Sex-age group</th>
<th>Number of persons</th>
<th>Food energy</th>
<th>Protein</th>
<th>Calcium</th>
<th>Iron</th>
<th>Vitamin A</th>
<th>Thiamine</th>
<th>Riboflavin</th>
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<td>20-34 years ..........</td>
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<td>65-74 years ..........</td>
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<td>101</td>
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</table>


a/ Average figures relating to the first year of life.
APPENDIX C
A COMPARISON OF ALTERNATIVE FOOD STAMP DISTRIBUTION SCHEMES

An individual's budget line shows the possible combinations of goods which can be consumed by the individual at given prices. An income transfer shifts the budget line out:

Here, $P_n$ is the price of nutritious food, and $P_o$ is the price of other goods. As the individual's income is increased from $Y$ to $Y^*$, the budget line moves from $B_1$ to $B_2$.

If an individual is given food stamps of a face value $Y^* - Y$, the shift in the budget line will be the same, except maximum consumption of other goods remains constant at $Y/P_o$.
If the value of food stamps is less than the amount of income normally allocated by the individual toward the purchase of nutritious food (if $Y^* - Y < Q_o$), the distribution of food stamps will have exactly the same effect as a distribution of money. This is the substitution problem we examined in the discussion of food distribution programs.

If the value of the food stamps is greater than an individual's normal food budget (if $Y^* - Y > Q_o$), consumption of food may increase more with a food stamp program than with a similar income grant:
An income transfer of $Y^* - Y$ would increase food consumption from $Q_0$ to $Q_2$, but, since food stamps can be used only to purchase food, this tangency point at $Q_2$ is not a possible consumption point for the recipient of $Y^* - Y$ worth of food stamps. The best such a recipient can do (in the absence of arbitrage) is to spend all cash income on nonfood, buying food only with stamps. This will put the individual at the corner of his budget line, consuming quantity $Q_1$ of food.

Food stamps are fungible and the individual can probably trade some, but not all, stamps for cash. In this case, the budget line looks something like $B_2'$, and the quantity of food consumed is $Q_3$, less than $Q_1$, but greater than $Q_2$.

If we allow food stamp recipients to buy $1.25 worth of food stamps with $1 of money, the individual's budget line shifts like this ($B_1$ to $B_2$):
The individual will buy food stamps redeemable for quantity $Q_1$. The value of the stamps will be quantity times price or $Q_1 \cdot P_n$. The cost of the stamps will be $Q'_1 \cdot P_n$ for a total government subsidy of $(Q_1 - Q'_1)P_n = .25 Q'_1 \cdot P_n$ if $1$ will buy $1.25$ worth of food stamps. An income transfer of a similar amount $(Q_1 - Q'_1)P_n$ would result in a lower quantity $(Q_2)$ of nutritious food consumed.
Until recently, the federal food stamp program had a purchase re-
requirement but allowed purchases of food stamps in one of four sizes only—
one quarter, one half, three quarters, or all of the maximum food stamp
allotment. The result is a "saw-toothed" budget line, with effects which
may be rarely different from the effects of an income transfer:
APPENDIX D
EXPANSION OF ECONOMETRIC MODELS TO EVALUATE NUTRITIONAL IMPACTS

Quantity of any food "g" consumed by individual or group "j" is a normal demand function:

\[ F_{gj} = f_{gj}(Y_j, P_{gj}, P_{oj}, P_n, E_j) \]  \hspace{1cm} (1)

where

- \( Y_j \) = income of individual (or group) j,
- \( P_{gj} \) = price of food g to individual j,
- \( P_{oj} \) = price of other foods to individual j,
- \( P_n \) = price of nonfoods, and
- \( E_j \) = individual or group characteristics (tastes and preferences).

Income of each individual or group will be partly exogenous and partly a function of government policy:

\[ Y_j = Y_{je} + Y_{*j} \]  \hspace{1cm} (2)

where

- \( Y_{je} \) = exogenous income level and
- \( Y_{*j} \) = effect of agricultural policy on the income of j.

Agricultural policies can affect an individual's income in two ways:

\[ Y_{*j} = Y_{jm} + Y_{t*} \]  \hspace{1cm} (3)

where

- \( Y_{jm} \) = effect of agricultural policy on farm-related incomes and
- \( Y_{t*} \) = effect on income of transfer payments (food stamps, etc.)
$Y_{jt}^{fm}$ will be determined endogenously in the production side of the model. $Y_{jt}^{t*}$ is a policy variable.

The food prices faced by consumer $j$ will be the market prices adjusted for any subsidies on consumption of food by individual $j$:

$$p_{gj} = p_{g}^m + s_{gj}^*$$  \hspace{1cm} (4)

$$p_{oj} = p_{o}^m + s_{oj}^*$$  \hspace{1cm} (5)

where

$p_{g}^m, p_{o}^m$ = market prices of food $g$ and other foods $o$ and

$s_{gj}^*, s_{oj}^*$ = subsidies (positive or negative) paid to individual $j$

for consumption of food $g$ and other foods $o$.

$p_{g}^m$ and $p_{o}^m$ are endogenously determined. $s_{gj}^*$ and $s_{oj}^*$ are policy variables.

Price of nonfoods, $P_n$, is assumed to be exogenous and the same for all individuals.

Tastes and preferences of individual $j$, $E_j$, are also influenced by government policies:

$$E_j = f_E(E_j^c, E_j^*)$$  \hspace{1cm} (6)

where

$E_j^c$ = exogenous component of preferences and

$E_j^*$ = influence of government policies concerning food advertising and labelling on tastes and preferences of $j$. 
The nutritional status of individual $j$ can be determined from his consumption of food. Intake of nutrient $i$ by individual $j$ is

$$N_{ij} = \sum_{g} B_{ig} F_{gj}$$  \hspace{1cm} (7)

where

$N_{ij} =$ intake of nutrient $i$ by individual $j$,

$B_{ig} =$ amount of nutrient $i$ available from each unit of food $g$, and

$F_{gj} =$ quantity of food $g$ consumed by individual $j$.

We can compare actual nutrient intake, $N_{ij}$, to ideal nutrient intake, $S_{ij}$, where

$$S_{ij} = f_i(H_j, A_j, V_j, J_j, S_{j,t-1})$$  \hspace{1cm} (8)

where

$S_{ij} =$ ideal level of nutrient for individual or group $j$,

$H_j =$ health status of $j$,

$A_j =$ activity level of $j$,

$V_j =$ environmental influences on $j$,

$J_j =$ genetic factors influencing $j$, and

$S_{j,t-1} =$ nutritional status in previous time period.

$H_j$, $A_j$, $V_j$, and $J_j$ are exogenous.

A certain policy option will result in nutrient intake of $N_{ij}^*$, different from current intake $N_{ij}$. If the policy moves intake of nutrient $i$ by group $j$ closer to the ideal level $S_{ij}$, the policy improves the nutrition of the group, *ceteris paribus*. If the policy moves actual intake away from ideal intake, the policy harms nutrition, or the policy may have no decisive impact on nutrition, either because the change in $N_{ij}$ is
negligible or because the ideal level is indeterminant and the change from

\( N_{ij} \) to \( N_{ij}^{*} \) is of debatable help or harm.

If \( |S_{ij} - N_{ij}^{*}| < |S_{ij} - N_{ij}| \), let dummy variable \( D_{ij} \)
take the value of 1.

If \( |S_{ij} - N_{ij}^{*}| > |S_{ij} - N_{ij}| \), let \( D_{ij} = -1 \).

If the nutritional consequences of a change from \( N_{ij} \) to \( N_{ij}^{*} \)
are unknown or debatable, let \( D_{ij} = 0 \).

Now, we look to nutrition science to tell us which nutrition problems
are the most important for group \( j \). By assigning a weight, \( W_{ij} \), to the
importance to group \( j \) of changing intake of nutrient \( i \), we can get a figure
which measures total nutritional impact of a policy change on group \( j \).

\[
I_j = \sum W_{ij} D_{ij}
\]

where

- \( I_j \) = impact of a policy change on nutrition of group \( j \),
- \( W_{ij} \) = importance of nutrient \( i \) to group \( j \), and
- \( D_{ij} \) = dummy variable showing the effects of the policy on
  intake of nutrient \( i \) by group \( j \).

If \( I_j > 0 \), the policy change will improve nutrition of group \( j \). If
\( I_j < 0 \), nutrition of group \( j \) will be harmed. If \( I_j = 0 \), the policy does
not change the nutritional status of group \( j \) in any way.