CEREAL AND LEGUME RESEARCH:

ECONOMIC IMPLICATIONS FOR CONSUMERS

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TABLE OF CONTENTS

	Page
I. The Role of Cereals and Legumes in Food Consumption	1
A. Consumer's Preferences	3
B. Innovation and Consumer's Welfare	5
1. Economic Welfare	5
2. Technical and Personal Risks	9
3. Food Innovation: Soy Protein	10
II. Consumer Information and Labeling Regulations	14
III. Summary	19

CEREAL AND LEGUME RESEARCH:
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I. The Role of Cereals and Legumes in Food Consumption

In 1981, U.S. consumers spent $329 billion on food; 11% of that expenditure was for grains and bakery products (USDA, 1982a). The 1977-78 National Food Consumption Survey of U.S. households showed that in a given week, 41 cents out of each dollar spent for food at home was spent for cereals, mixes, bakery products, beans, lunchmeats, and meat extenders (USDA, 1982b). Looking at the nutritional value of foods consumed by individuals in those households revealed that 22% of their protein and 28% of their calories came from legumes or grain products (USDA, 1980). The role of some cereals and legumes in the American diet is increasing while the role of others appears to be decreasing. Nourishment from these sources is not always readily identified because cereals and legumes enter the diet in multiple forms and at multiple stages of processing. Sometimes they enter under their own identity such as for rice and sometimes they are disguised, as in bologna and oftentimes they are one of many ingredients in a complex product like bread. Cereals and legumes are treated to milling, bleaching, extruding, toasting, puffing, isolating, soaking, drying and refrying, among other things, before consumers encounter them as edible food. Consciously or not, however, they continue to provide a stable, relatively inexpensive source of calories and protein for consumers around the world with some promising new developments in process.

Technological innovation in the cereal and legume industry is a long and arduous process beginning in chemistry and biology laboratories where breeding technologies are developed and applied and more recently, genes are isolated, examined and spliced. Biotechnologies that lead to greater crop productivity are one phase of the total innovative effort in food and agriculture. Food processors are continuously trying to design new and better food stuffs that will not only bring them profits but will fill the needs of consumers. Consumers' food needs consist not only of nutritional fuel but of satisfactory taste, variety, and convenience for their life style all at a price they are willing and able to pay. Since food habits are always culture bound and difficult to change a critical extension of technological changes in food production and processing is an examination of what foods consumers want, how they can best be informed about new choices, and how they can best be protected from current and yet unknown hazards to their health and safety.

Consumers' welfare is ultimately changed by how well their preferences are met by the products they consume. Potential changes in consumers' welfare resulting from activities in the cereal and legume industry will be the focus of this paper. First, evidence about consumer preferences for cereal and legume products will be briefly reviewed. The effect of innovations in production and processing on consumers' nutritional and economic well-being will be followed by a discussion of the economics of safety and information as it applies to product labeling. We will see that price effects are critical and that changes in consumers' welfare will depend upon research proprieties and the dissemination of accurate information at all levels of the market.

A. Consumer's Preferences

Looking at trends in consumption of cereals and legumes in the U.S. between 1960 and 1981 (USDA, 1982a) shows that per capita consumption has decreased for beans, peanuts and soy products, dry beans and dry peas with dry beans leading the decline (Table I). Peanuts account for much of the decline in the first category. A study of the food service industry indicated a 20% drop in the quantity of peanuts served in bars and restaurants between 1969 and 1979, while there was a 530% increase in other snacks (Van Dress, 1982). In 1980 alone, expenditures on snack foods increased 12% to over $10 billion which is about 3 percent of all food expenditures (Scales, 1982). Crackers, a subgroup of snack foods, is reported to be the fastest growing segment of the cereal industry (Faubion, et al., 1982). With respect to major categories of cereals and legumes listed on Table I, corn is the clear winner with a 154% increase in pounds per capita. This is attributed primarily to the recent innovation and quick industry adoption of high fructose corn sweeteners. Corn sweeteners have been relatively successful because they are competitive on price and have a reputation for having health advantages.

Recent studies of consumer food preferences in the U.S. (Chou, 1982) and in Europe (Cereal Foods World, 1982) show that consumers prefer foods that are healthy, natural, and safe and they are willing to pay more for such foods. How consumers define healthy, natural and safe is not always obvious. In Europe, "healthy" meant foods that were associated with high protein, high fiber and low calories. It also implied an absence of excessive amounts of refined white sugar and preservatives or artificial coloring. Europeans considered healthy foods to include yogurt, protein fortified snacks and pasta, low calorie salad dressings, bran and brown bread. The retail price differential between white and multigrained bread in England reflects a willingness to pay over 13 cents more for the same size loaf of a so-called healthy bread (Cereal Foods World, 1982). In the U.S., "natural" foods are identified as those which have minimum additives and are minimally processed. Confidence in processed foods has diminished partly, it is thought, because of extensive advertising promoting "natural" foods which leaves the impression that processed foods are unnatural and, therefore, inferior (Chow, 1982). On both continents consumers were vitally concerned with avoiding excess calories, harmful ingredients and hazardous substances. The latter are universal issues whereas only in highly developed countries are excess calories likely to be a problem. Useful technological innovation in food stuffs for post-industrial consumers might lie in finding ways to provide food with more bulk as well as more nutrients per calorie.

Studies of consumer food preferences in developing countries are less readily available but experience has shown that they, like us, prefer to eat their traditional foods. Educating individual households to use new foods is tedious but it may be the only way to influence the adoption of new food technology. The American Soybean Association is trying this approach in Mexico in an attempt to introduce high protein soy flour into home baked tortillas. Mexican families reported liking the soy flour tortillas (Wall Street Journal, 1983). A study of Columbian consumers showed, however, that a favorable price ratio was not enough to induce large numbers of Columbians to purchase combination soy-meat products even though basic meat requirements were not being met by their normal diet (de Buckle, 1981). Traditional foods are terribly important to people's sense of security and identity. One of the major concerns with high technology food research is that it will <u>not</u> be applied to improving crop yields and nutritional content of foods that people actually want to eat but will be applied only to crops with high dollar value for commercial agriculture and international trade (Hardin, 1979; Ward, 1979).

B. Innovation and Consumers' Welfare

1. Economic Welfare

One goal of plant breeding and more recently of genetic manipulation is to engineer edible plants with more desirable characteristics. Biotechnology applied to food and agriculture holds promises of increased crop yields by making plants resistant to drought, herbicides, salt water, viruses, heat and cold. Plants may also be designed to have multiple flowers, stems and seeds and may be adapted to new environments such as tropics and seacoasts. Building in nitrogen fixing mechanisms can decrease fertilizer costs while insect resistance reduces costs of pesticides. Engineering for specific characteristics of the final food product is also underway. Tomatoes, for instance, appear to be the "white mice" of agricultural biotechnology as they are subjected to genes that make them pulpy for catsup, hard for shipping, resistant to cold temperatures for northern climates, and uniformly ripe for harvesting (Hughey, 1983). Many consumers would argue that tomatoes seem to have genes that specialize in everything except flavor. Increasing the protein quality in rice and corn are examples of improving nutritional characteristics of food crops which could be of great benefit to worldwide consumers. Other examples of things made possible through this research are fast rising yeasts, amino acid sweeteners, increased gluten strength, hard kerneled corn and edible protein from tobacco leaves.

Will consumers benefit from this type of research? Will they face new risks? The answer to both questions is yes. Menz and Neumeyer (1981) argue that "the consequences of genetic engineering for commercial maize production are likely to be less in the direction of yield enhancement and more in the direction of cost reduction". To the extent that new plant characteristics decrease the costs of production, food prices should decrease over the long run. Declining food prices releases part of consumers' budgets for other goods and services and improves their well-being. The economics of this is illustrated in Figure 1 with the supply and demand curves for a genetically improved crop. Before improvement, consumers paid price P_o for quantity Q_o. After improvement, decreased production costs shift the supply curve to S_2 (more can be produced at the same cost) and consumers now pay a lower price P_1 for a larger quantity Q_1. The area above the price line and below the demand curve is called consumer surplus; it approximates the utility consumers receive from purchasing a given quantity in excess of what they actually spent. At the old price, P_o, consumer surplus was equal to area a and at the new lower price, P_1, consumer surplus is area a+b+c+d. When consumer surplus increases, consumers are better off (ceteris paribus).

Increased yields of agricultural products have served consumers well over time by making greater quantities of foods available at lower prices. This not only tends to improve health and nutrition, but

Figure 2

increases consumer surplus. This can also be seen on Figure 2 where consumers originally pay price P_o for quantity Q_o, the price and quantity where supply equals demand. Technological advances in agricultural crops have the effect of lowering the market clearing price to P_M for quantity Q_M and consumer surplus increases by the area designated $b+b'+c+d+d'+e+f$. Unfortunately, in many cases, price P_M is not high enough for farming to be a profitable business given the number of resources devoted to agriculture, in particular the number of farmers. For a variety of social and political reasons, the government often wishes to slow the rate of out-migration from rural and farm sectors. Subsidizing farm production is one way to slow that out-migration. Suppose the government raises the price farmers receive to P_T. This induces them to stay in agriculture and increases their output along supply curve S_2 up to quantity Q_T. At price P_T consumers will purchase quantity Q_D and relative to their position at price P_M they will have lost consumer surplus equal to area $d+d'+e+f$. They pay $d+d'+e$ more for quantity Q_D; area f is an allocative loss because P_T is above the market clearing price, P_M. The difference between the quantity purchased by consumers, Q_D, and quantity supplied, Q_T, is subsidized by a government transfer of the difference between P_T and P_M and is equal to the darkened areas f+g+h. Assuming, first, that the surplus quantity sells in the export market, the net social cost of this subsidy is equal to area f. Area f is the result of subtracting the loss in consumer surplus plus the subsidy payment equal to areas $d+d'+e+2f+g+h$ from the gain in producer surplus which is area $d+d'+e+f+g$ plus a cash payment equal to area h.

Now, assume that the surplus does not sell on the export market, but is bought by the government. In that case the government transfer equals the entire darkened area plus whatever must be spent for administration, storage and distribution of excess food. All taxpayers share in these transfer payments and subsidy costs.

In the absence of the subsidy, the supply curve S_2 would drift back towards S_1 as resources, including farmers, migrated out of agriculture. Assume S_2 settled at S_2', P_T would now be the price where supply equalled demand at Q_D. Consumers would still lose the same consumer surplus area ($d+d'+e+f$) and producer surplus would increase by $d+d'+\frac{1}{2}e$ for a net social loss of $f+\frac{1}{2}e$. This presumes that the resources leaving agriculture found more profitable employment elsewhere.

The good news is that increasing crop yields increases the supply of food, should improve the general level of nutrition, lower consumer's direct cost of food and increases their welfare. The bad news is that U.S. consumers will not purchase all the available supply at the government supported price. For U.S. agricultural commodities to be exported, they must be able to compete with the prevailing world market price. If exports are not sufficient, U.S. consumers may spend billions of tax dollars for agricultural subsidies and enormous surpluses of agricultural products may develop without other programs to restrict output. In the absence of greatly expanded exports, further improved crop yields in the U.S. implies that fewer resources, including farmers, will be used to produce our food or the social costs of food production will increase. On the other hand, if prime agricultural land is being destroyed by erosion or urban sprawl or too intensive use, high yielding crop seeds may become necessary just to meet the demand of domestic consumers and current levels of export trade. Under any circumstances the benefits that consumers might realize from most of the current genetic research are at least a decade ahead of us.

2. Technical and Personal Risks

If the quality of food is improved by biotechnology and by more conventional food research techniques, and prices do not increase disproportionately, consumers will be better off, assuming they adopt the food with the new characteristics. There is a tendency for consumers to think that any new food is not as good as old and familiar, natural foods. Furthermore, they are suspicious of unknown hazards lurking in laboratory concocted ingredients. This fear is not entirely irrational for one of the great unknowns about newly engineered foods is the human health hazards they may pose. Many of these hazards cannot be foreseen during food development stages and many will not be discovered until years after humans ingest them. We cannot be too careful about checking and double-checking for potentially disasterous ramifications. We cannot assume new discoveries do not bring new health hazards.

Other risks posed by genetic engineering, especially with respect to seeds, is that the world's supply of germ plasm is being diminished and monopolized. Germ plasm is the material in every seed that determines the personality of the plant and by selecting personality traits that are commercially desirable, the existing variety of plants is diminishing. Unique varieties, perfect for isolated growing areas, may cease to exist while fewer widely used seed varieties run the risk of exposure to an unknown blight or insect, which they have not been engineered to resist. Under these circumstances a major portion of the world supply of a new superior crop could be wiped out, causing financial disaster for farmers and drastically increasing food prices for consumers. In addition, lacking a wide variety of available germ plasm for further research, engineering new seed varieties to meet new requirements will become more difficult.

The total supply of germ plasm is also endangered by the monopolization of the seed industry (Schapiro, 1983). Allowing scientific knowledge to be patented diminishes its usefulness to the larger community and allows the patent owners to extract economic rent from all consumers of products eminating from that patent. Government funded and operated depositories for germ plasm have provided a partial answer to this long run problem (Comacho, 1981), but divorcing incentives for basic research from commercial profits is a challenge that must be met if society as a whole is to realize long run payoffs from biotechnology in agriculture.

3. Food Innovation: Soy Protein

Technological advances in food processing also expand food choice, improve foods' convenience and, in some cases, improve nutritional quality and lower costs. The development of textured vegetable proteins, particularly soy protein, is a good example of innovation that may expand food choice. Soy can be separated from soybean oil in the form of flour, grits, textured protein, protein concentrates or isolates. Soy proteins are substituted for other ingredients in familiar foods because they impart superior characteristics such as improved protein quality, increased shelf life or better quantity and quality control. The wholesale price of soy protein varies with its form from about $.20 per lb. for flour to

$.35 for textured soy protein, to $1.00 for soy isolates (Langsdorf, 1981). When it replaces ingredients which cost more, food production costs decrease and consumers could benefit not only from high quality, low fat protein but from a lower price.

The 1977-78 National Food Consumption Survey found that individuals in the U.S. ate an average of 75.5 gm. of protein per day which is 165% of the recommended daily allowance (USDA, 1980, p. 75, 84). About 22% of their proteins came from vegetable sources and 47% from meat (USDA, 1980, p. 61). Americans are not short on protein but they consume it in expensive forms. Prices per pound of protein in June 1980 were approximately $12.40 from beef (round), $3.25 from chicken and $1.03 from soy protein concentrate (Langsdorf, 1981, p. 340). If consumers obtained all their protein from just one of these sources each day it would cost them $2.11 for beef protein, $.55 for chicken protein and $.17 for soy protein. Except for tofu, American consumers rarely eat soy protein identified as itself. It is not a familiar food but its versatility has allowed it to simulate or imitate familiar foods, such as bacon bits, and it can be blended with processed meats on a one for one basis with virtually no obvious change in flavor or character. It has been used most extensively as a meat extender or substitute in institutional cooking. In 1971, the U.S. Department of Agriculture allowed the addition of 25% to 30% textured vegetable protein (TVP) to hamburger used in the school lunch program producing a cost savings of $36 to $39 per 100 pounds of meat used (Langsdorf, 1981).

There are several reasons why Americans are not consuming more soy protein. For one thing, they are consuming more than adequate protein already and the form in which they consume it is familiar, tasty and affordable. If they are to consume more soy protein it will likely be as a substitute for meat or milk products. If soy protein was to be substituted for some portion of meat protein on a one for one weight basis, and consumers purchased the combined products, they could realize a savings in food expenditures with no loss in protein quality. Potential cost savings on meat expenditures by U.S. consumers resulting from a 10% and 25% soy protein substitution for the 1981 total meat consumption are reported on Table II. Savings for the total population from a 25% substitution for the total amount of meat, fish, and poultry consumed would be $12,254.4 million or 18.8% less than expenditures for pure meat. This represents a savings of $53.32 per capita for one year. The ratio of the price of a pound of soy protein to a pound of meat varies with the type of meat and the form of soy protein but most calculations result in a ratio between .13 and .30. Prices used for the calculations on Table II have a ratio of .25 for all meat but a ratio of .50 for edible offals. Edible offals were chosen because they are used in processed meat products like sausages and lunch meats; products to which soy protein can be easily added. The cost savings in these meat products is less because the soy protein-meat price differential is smaller and many fewer pounds of these types of meats are consumed. With a 25% substitution, however, a 12.5% savings could be realized but this amounts to only $.70 per person per year.

Table II

In order for soy protein to be consumed in quantities that will impart substantial savings, American consumers must first be convinced of their benefits and assured of their safety. Second, a substantial

Figure 3

cost savings must appear. These two conditions are illustrated in Figure 3 which depicts, initially, two meat products, a and b. Vector oa represents a hypothetical, technical ratio of protein to calories in all meat and ob represents the same technical ratio for a meat-soy protein combination. Both meat products are the same price. Line ab represents the least cost frontier along which a rational consumer will choose product a or b or some combination depending on where the indifference curve U_1 is tangent to ab (Lancaster, 1966). Consumer's indifference curve U_1 is drawn tangent to b, implying the consumer will purchase product b. Product c represented by vector oc then enters the market at the same price (length of oc=length of ob and oa). Product c has more soy protein than product b but it will not be purchased by the consumer unless it is offered at a substantially lower price. Extending oc to oc' represents lowering the price of product c by about one-third. Line c'a becomes the new least cost frontier and consumers move to a higher indifference curve (U_2) at point d where (s)he still purchases some of product a but mostly product c. In this example, the price of a soy-meat mixture had to be considerably lower to attract consumption. Gallimore (1979) found the sale of soy-beef combinations to be very sensitive to the price of close substitutes. A 10% increase in the price of hamburger led to an 11-16% increase in the sale of a soy-beef product. The soy-beef blend was also sensitive to its own price as a 10% decrease in the price of soy-beef blends led to a 16-18% increase in their sales.

One other way to entice consumers to purchase product c in Figure 3 is to change their relative preferences for protein versus calories by providing them with new information and experience. If, for instance, consumers learned that calories were bad for their health and proteins prevented aging, a new indifference curve like U_n might appear. Before product c appeared on the market, consumers with preferences represented by U_n would purchase product b on U_{n1} and after c appeared on the market they would purchase product c on U_{n2}. In this case the price of c would not need to be lower than the price of a or b for consumers to purchase it. Changing consumer preferences for basic food attributes is not easy and generally not desirable unless some new health related information is discovered. But new information about the health benefits or hazards of foods and food additives has served to change consumer's preferences over the years.

Figure 4

Providing accurate information about the true attributes of different food products is always in the consumers' interest and improves their well-being. This is illustrated in Figure 4. Suppose oa again represents pure meat and ob represents consumer's beliefs about the ratio of flavor to "naturalness" in product b which shall be designated a soy-meat combination. The consumer believes that for f units of flavor, product b is half as "natural" as product a. Given the indifference curve U_1, all meat is purchased on the least cost line at point a. Suppose further that the true ratio of flavor to "naturalness" in product b is represented by ob'. With true information, the consumer would purchase b' on a higher indifference curve U_2 and be better off.

II. Consumer Information and Labeling Regulations

The question of consumer information and regulations regarding food labeling is a safety issue and an economic issue. The economics of product safety dictates that the party in the best position to know the characteristics of a product and to take action which will avoid accidents be designated the "best cost avoider". U.S. manufacturers of food and drink in sealed containers were deemed the "best cost avoiders" and held strictly liable for the safety of their products under implied warranty law as early as 1913-1914 (Leigh-Jones, 1969, p. 4). An implied warranty on food and drink is that the product is safe for human consumption and will nourish not diminish one's health. To the extent that any food ingredient, additive, processing residue or container may be hazardous to someone's health or safety, they are at least entitled to know about its existence. The top line on product safety is to eliminate the hazard; the middle line is to inform when elimination is not feasible; and the bottom line is to hold the manufacturer liable for damages caused by foods consumed.

Determining the feasibility of eliminating hazards is mostly an economic issue, not a technical question. Product hazards can always be eliminated by removing the products from the market. We have seen products recalled when they were found to contain deadly poisons such as botulin, ptomaine, or cyanide. In addition, we've seen consumers who have purchased contaminated products be warned not to consume them. Consumers are able to react rationally to this type of information because: (1) they are informed specifically about its existence in a particular product, (2) it is easy to assess the consequences of consuming that product, and (3) they have alternative products to consume which are safer. These three conditions are necessary for consumers to make rational choices and act in the market to screen out those products they consider too risky.

Some substances in food products are harmful to only a few individuals with specific health problems such as allergies or high blood pressure. They generally meet the second and third criteria for rational market selection; the first criteria can be met by informative labeling. One criteria for mandating that a particular type of information appear on food labels is to require the information when the present value of the cost of providing information is less than the present value of the probability of harm times the cost of injury or death summed over all individuals.[1/] The importance of this approach is that it accounts for the probability of harm and for the costs incurred by the injured. It also allows consumers to make informed choices; it does not automatically ban a substance because it was found harmful in isolated cases.

Although mandatory labeling seems to be an anathema to manufacturers, it can yield many social benefits. Usefulness of labels cannot be judged by the number of people who read them or by how often they are read in any one time period. Information is semi-durable and consumers do not need to read all labels on every shopping trip. Furthermore, the non-use benefits of mandatory information are distributed over all consumers (Padberg, 1977). These benefits accrue in the form of generally safer and more predictable quality products because compliance with mandatory labeling imposes a discipline on the industry. Labeling the presence of sodium, for instance, requires testing for its quantity and a monitoring of that quantity over time. Even minimal enforcement of ingredient labeling would make most manufacturers hesitate to use TVP when their labels say "all beef." Besides industry discipline, mandatory labeling raises the conscientiousness level of both buyers and sellers and carries great potential for long-run improvement in nutrition and health.

Two areas where food labeling laws and demands for information are especially lax are for snack foods and food served away from home. As long as consumers associate food with recreation as much as nourishment, they seem to abandon their concerns for precise information. Ironically, snack foods and food away from home are two of the fastest growing segments of the food industry and will undoubtedly be asked for more precise information in the future.

Economic theory indicates that when consumers make purchases on the basis of incorrect information they cannot maximize their utility. An allocative efficiency loss occurs whether the product turns out to be better or worse than they expected (Kinsey, et al., 1980 and Sexton, 1981). igure 5 This is illustrated in Figure 5 for a product that turned out worse than expected. Originally consumers purchased quantity Q_o at price P_o along demand curve D_o. Experiencing inferior product performance, this demand curve shifts to D_1. Consumers would have been willing to buy only quantity Q_1 at price P_o if they had known its true characteristics. They have already paid an amount equal to areas a+b+c for quantity Q_o and expected consumer surplus equal to area d+e. Under their new demand curve, D_1, they received consumer surplus equal to d and are willing to pay areas a+b for Q_o. Area e represents consumer surplus not received. Area c represents dollars spent for which no utility was received. This is sometimes referred to as a deadweight loss since this expenditure cannot be transferred to other persons or products in the economy; it is simply lost.

The question of how much consumers are willing to pay for information is often asked. Theoretically they would be willing to pay an amount equal to the deadweight loss (area c) to avoid losing utility on that expenditure. In fact, consumers pay for information in many ways: (1) increased cost of well labeled products, (2) purchase of newspapers or magazines or other informative literature, (3) use of their time (and direct costs of transportation) for comparison shopping and time to read the literature and the labels and talk to experienced users, and (4) experiment with the product and see how well it performs. When all of these search costs begin to outweigh the expected benefits in terms of decreased utility and disappointment, consumers stop gathering information. Minimizing consumers' search costs is one of the purposes of food labeling and standardization. Accurate food labels provide a relatively inexpensive way for consumers to be informed about their food choices. An even less expensive way for consumers to be informed about the characteristics of a food product is to create "standardized" foods, with standard identities and recipes or ingredient mixes. We have many standardized foods in the U.S.; peanut butter, mayonnaise, starch based salad dressing, and margarine are a few. Some have suggested that vegetable protein products should somehow be made a "standardized" product that could be marketed under its own identity rather than as "imitation" this or "simulated" that (Lamberg, 1979). The advantage of this approach lies not only in inexpensive consumer information but improved ability to promote consumption of an identifiable product. For example, both margarine and salad dressing now sell under their own names and not as imitation butter or imitation mayonnaise. Others have suggested that a standard be set for the percent of the original food, such as meat, that can be replaced by vegetable protein (Ward, 1979). This is analogous to the standard for peanut butter, 10% of which can be something other than ground peanuts.

Designing labels that serve the informational needs of consumers and also promote research and development of new food products is a tricky business. It has received international attention with respect to vegetable proteins. The Food and Agriculture Organization and the World Health Organization of the United Nations has a joint program on food standards which is operating chiefly through the Codex Alimentaris Commission. This commission is an international governmental body whose purpose is to protect consumers against health hazards in food and against fraud. The commission has 116 member governments and a special committee working on definitions and worldwide standards for vegetable protein products derived from soybeans, cottonseed, groundnuts, and cereals (Hutchinson, 1979). With increased international trade and travel, international standards of safety and identity for food products is a concept whose time has come.

III. Summary

We have looked at trends in consumption of cereals and legumes by U.S. consumers and examined their stated preferences for natural, healthier foods free from potential hazards. The economic benefits of technological change in basic agriculture and the food processing industry were examined in terms of how they might impact consumer's welfare. Benefits from new innovation can easily be exaggerated if not examined in the cold light of consumer demand. For example, promoters of soy protein argue that it can provide low income American households with less expensive and adequate protein. It turns out that individuals in low income households (<$6,000 per year) in the 1977-78 National Food Consumption Survey were already eating 154 percent of the recommended daily allowance of protein (USDA, 1980, p. 85). Improving the quantity or quality of protein in American diets is not a large problem looking for a solution. Basic research need not and should not concern itself with commercial profitability, but scientists and marketers alike need to ask what foods consumers of the world need and want lest we find ourselves with a set of solutions looking for a set of problems.

New technology, especially in the consumer market, brings with it the inevitable problems of identity, adaptation and information. The economics of consumer information tells us that better informed consumers are better able to maximize their welfare. Since information is not free, consumers will bear the costs of search until the last unit of search costs more than the expected benefit from more information. Lowering search costs is one of the purposes of food labeling along with promoting health and safety and industry discipline. The benefits of accurate labeling are available to all food consumers. They are not diminished by someone else's use and they are paid for by both private and public dollars. They are both a private and a public good implying that accurate labeling is not only in the consumer's best interest but in the best interest of the public at large.

FOOTNOTE

$$\underline{1}/ \quad \frac{C_i}{(1+r)^i} \leq \sum_{i=1}^{T} \frac{\sum_{j=1}^{N} (P_j \cdot E_j)_i}{(1+r)^i}$$

C_i = cost of providing information on a label in year i,

P_j = probability of the j^{th} person being harmed,

E_j = expenses incurred if the j^{th} person is injured or if killed, the value of their earnings in year i,

r = discount rate,

T = total number of years that expenses occurred,

N = total number of individuals harmed.

Table I. Percentage Change in Per Capita Consumption of Cereals and Legumes, 1960-1981, for U.S.

Food Type	Percent Change in Pounds per Capita	Pounds per Capita in 1981
Beans, Peanuts, Soy Products	-9	15.0
Edible Dry Beans	-44	4.1
Dry Peas	-30	0.4
Cereal and Flour	+3	151.3
Fats and Oils - Vegetable	+67	48.4
Sugars and Sweeteners	+24	134.9
Corn Syrup	+439	55.0
Dry Corn Sweeteners	+284	44.6
Rice	+80	11.0
Corn	+154	120.5

SOURCE: USDA, ERS, Food Consumption, Prices, and Expenditures, 1960-1981, Washington, D.C., Statistical Bulletin 694, November 1982.

Table II. Potential Savings on Meat Expenditures by U.S. Consumers with Soy Protein Substitutes of 10 and 25 Percent ($ million).

	1981 Pounds per Capita[a/]	Total Cost - No Soy Protein[b/]	Cost with 10% Soy Protein Substitute[c/]	Cost with 25% Soy Protein Substitute	Total Savings (Dollars per Capita)	Percent Saved
All Meat, Fish Poultry	237	$65,357.1	$60,372.6		$ 4,985.5 ($21.70)	7.6
	237	$65,357.1		$53,102.6	$12,254.4 ($53.32)	18.8
Edible Offals[d/]	9.4	$ 1,296.1	$ 1,231.3		$ 64.8 ($.28)	4.9
	9.4	$ 1,296.1		$ 1,134.1	$162.0 ($.70)	12.5

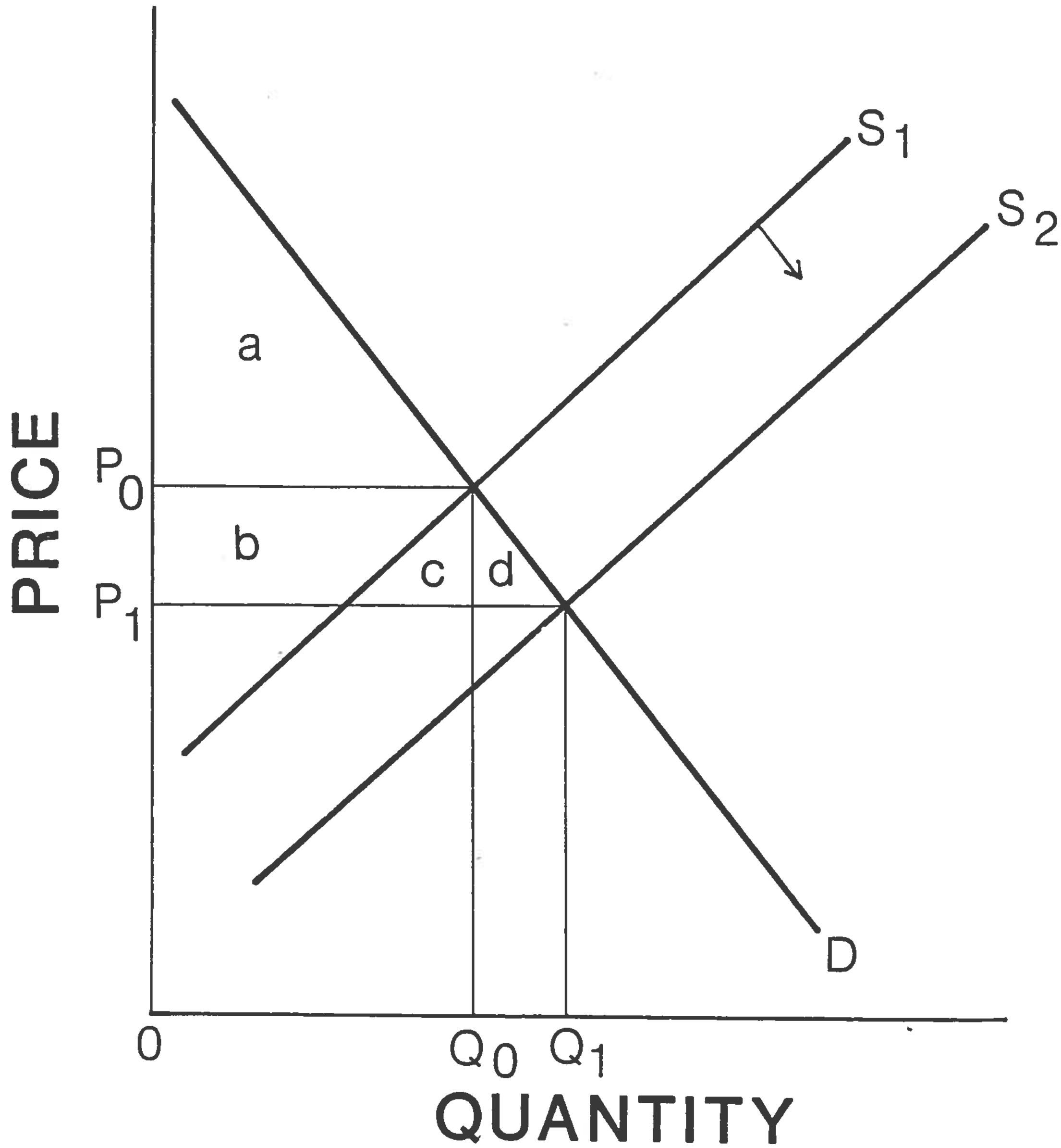
a/ USDA, 1982a, p. 2 and p. 33.

b/ Assumes meat costs average $1.20/1b. and edible offals cost average $.60/1b. (Langsdorf, 1981, p. 340).

c/ Assumes soy protein cost of $.30/1b. and soy protein substitutes one for one in pounds of meat (Langsdorf, 1981, p. 340).

d/ All meat includes edible offals.

FIGURE 1. Supply of Genetically Improved Crop and Changes in Consumer Surplus



S1
S2
a
PRICE
P0
b
c
d
P1
D
0
Q0
Q1
QUANTITY

FIGURE 2. Social Costs of Surplus Agricultural Products

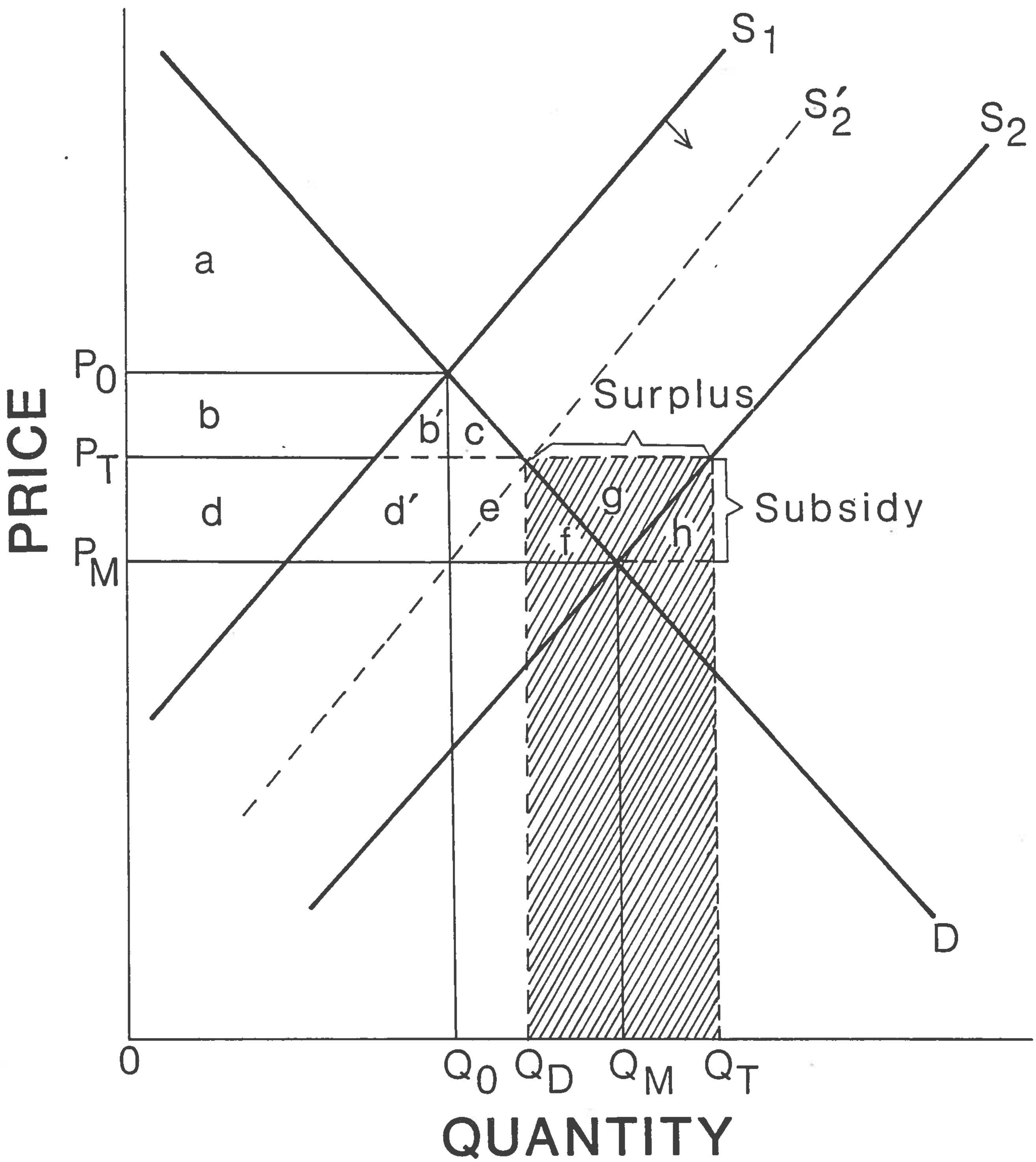
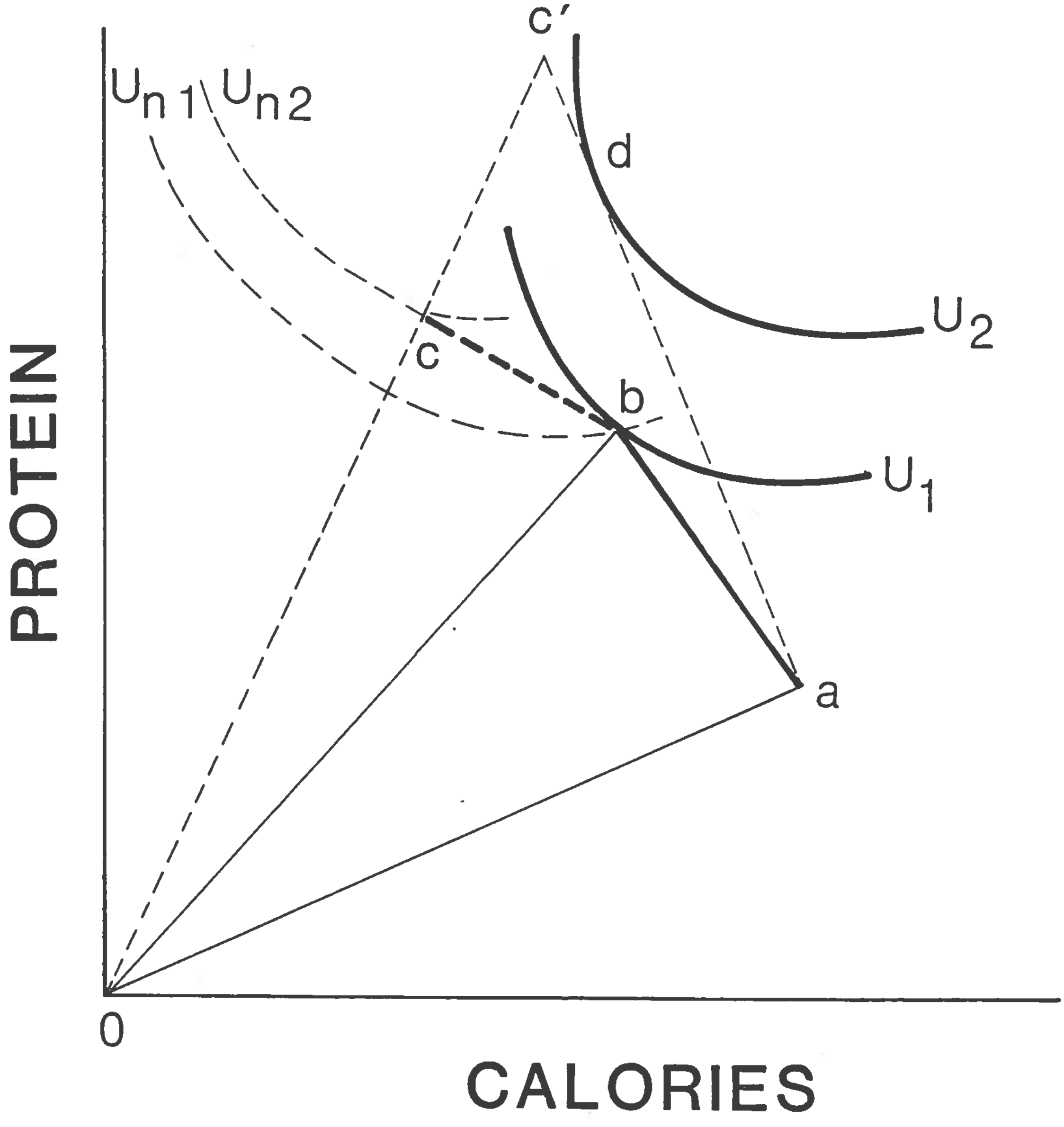

S1
S2'
S2
a
P0
Surplus
b
b'
c
PT
d
d'
e
g
Subsidy
f
h
PM
PRICE
D
0
Q0
QD
QM
QT
QUANTITY

FIGURE 3. Adoption of a New Product by Decreasing Price or Changing Preferences



c′
U_{n1}
U_{n2}
d
c
b
U_2
U_1
a
0
PROTEIN
CALORIES

FIGURE 4. Accurate Information Improves Consumer Welfare

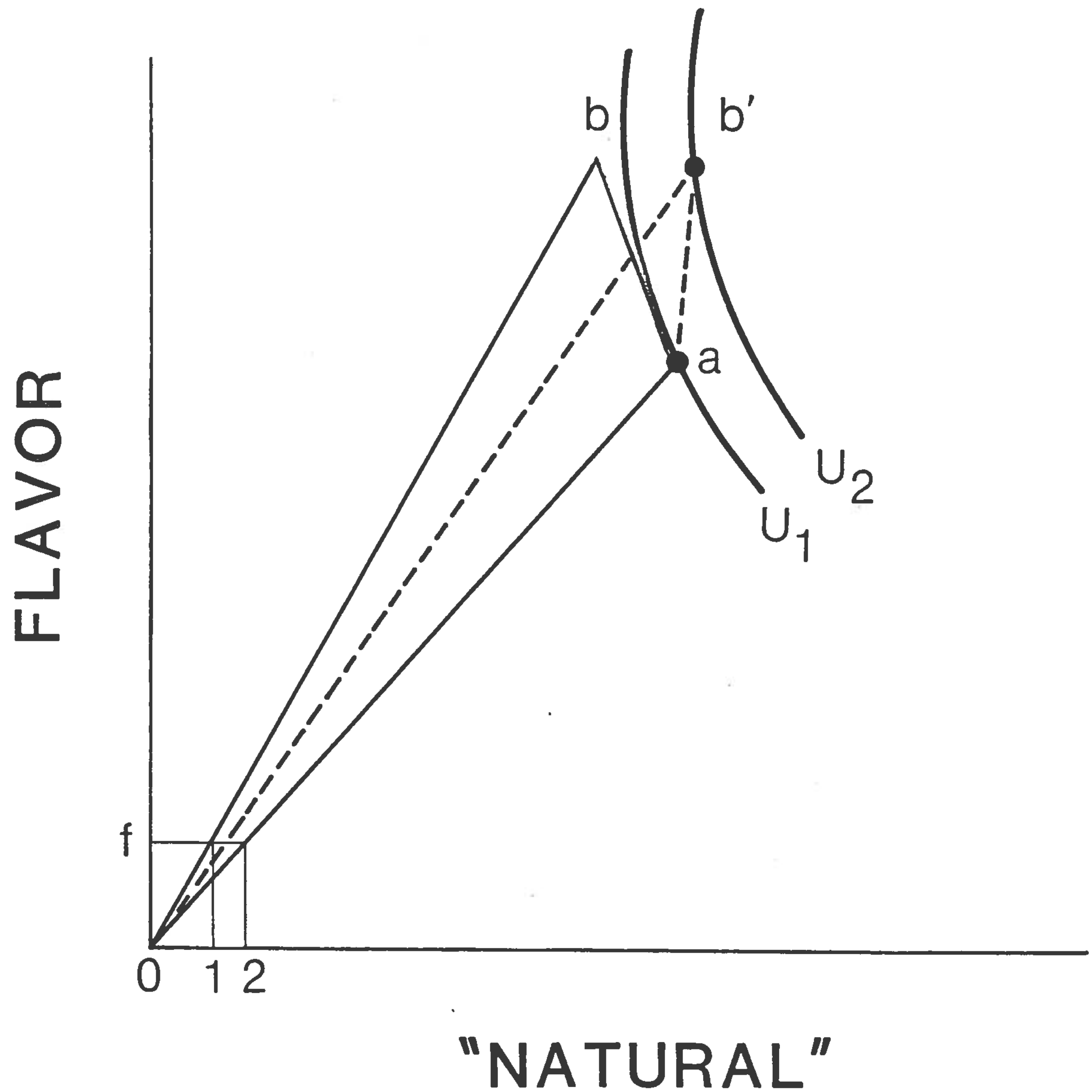
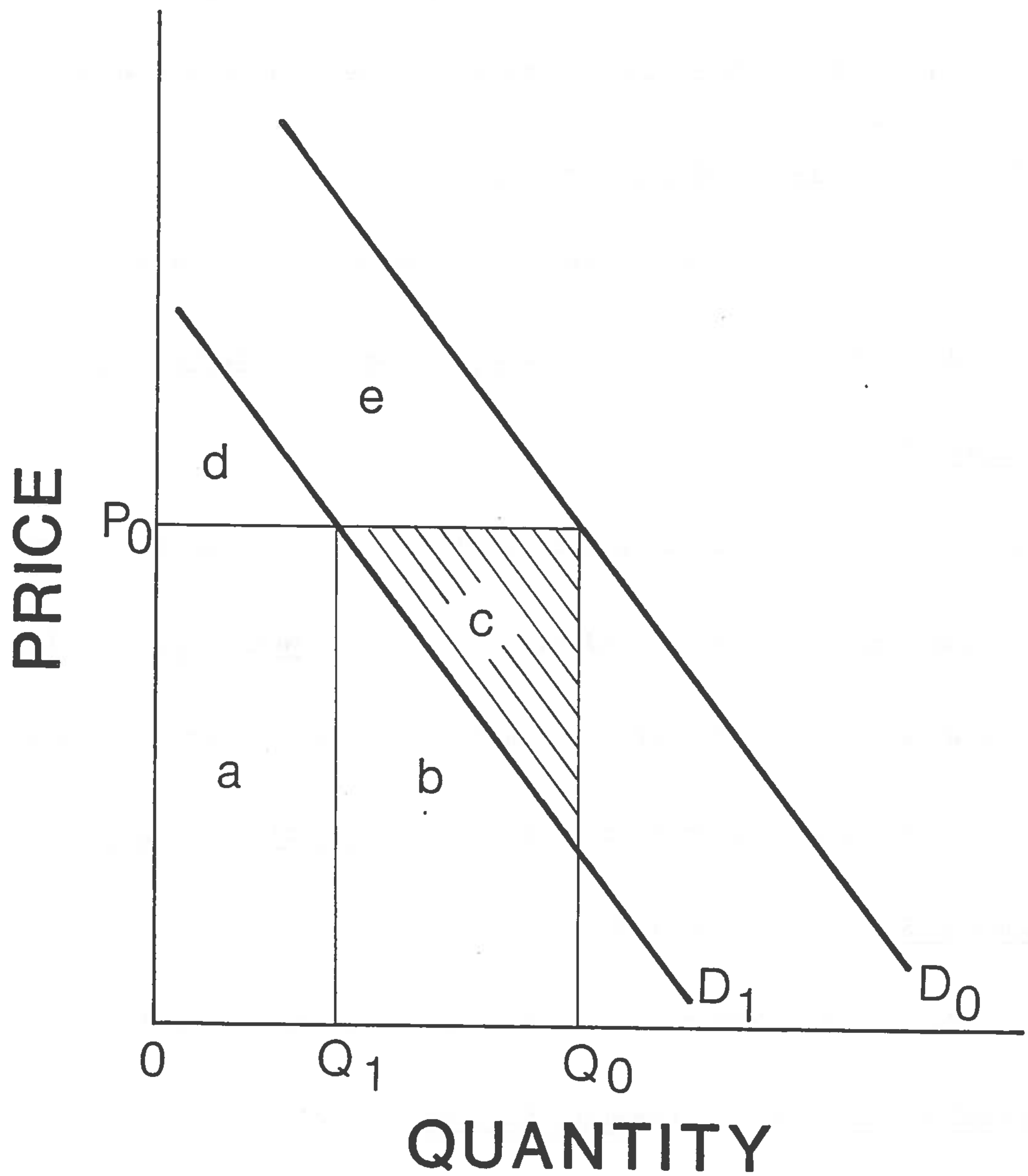

FLAVOR
b
b′
a
U_2
U_1
f
0
1
2
"NATURAL"

FIGURE 5. Loss in Consumption Efficiency Due to Inaccurate Information


PRICE
P0
d
e
c
a
b
D1
D0
0
Q1
Q0
QUANTITY

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