THE IMPLICATIONS OF RECENT ECONOMIC AND POLICY CHANGES ON RETAIL AND FARM LEVEL DEMAND FOR FOOD COMMODITIES

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ABSTRACT

THE IMPLICATIONS OF RECENT ECONOMIC AND POLICY CHANGES ON RETAIL AND FARM LEVEL DEMAND FOR FOOD COMMODITIES

by

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The major objectives of this work are to analyze some specific United States farm commodities and isolate and estimate the relevant variables affecting their consumption. The purpose is to evaluate the substitutes and complements for the particular retail products as well as the effect of income and specific marketing costs. The effect of income dependent transfer payments and food stamps on demand is also analyzed.

Econometric analysis is used to determine the relationship among the variables. Unlike previous retail analysis covering many retail commodities, no attempt is made to account for all foods using the usual assumptions about elasticities. Instead, a system was developed for each farm commodity. Retail and farm-level data are used; the retail level data being considered especially relevant for analysis involving consumer choices.

All data used is annual data published by the U. S. Department of Agriculture and the Bureau of Labor Statistics.

Marketing margins are not estimated directly, rather farm-retail price differentials emerge from the estimates of the price at both the farm and retail levels.

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In general farm-retail price differentials have declined or stayed the same over the period in question, 1952-1972, except for bread, flour packaged for retail sale and fluid milk. The percentage of the retail price going to the farmer declined in all cases. The wage of food manufacturing employees and the price of fuel has little impact on these price differentials.

Food stamps and income dependent transfer payments have differential effects on the various commodities and thus on the various producers, processors, retailers, and consumers of those commodities. Income-dependent transfer payments have an effect on commodities in the following order: fed-beef, non-fed beef, flour, broilers, eggs, cookies, cheese, fluid milk, ham and butter; the largest impact being on beef. Ham and butter receive a negative impact.

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Shirley Ann Pryor

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Dedicated to my mother and father

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All the credit for any accomplishments and none of the blame for any failures goes to my friends and most of all to my mother and father. My father showed me the path. My mother widened it for me and pushed me along it. "You don't have to help me with the dishes tonight, dear, do your homework." I am still doing my homework.

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CHAPTER I

INTRODUCTION AND OBJECTIVES

The Role of Demand

An economic system is composed of an infinite number and variety of interdependent components. The problem in analyzing the system is to define possible variables in the system and postulate on their interactions. Various components of the economic system must be defined and isolated to gain an understanding of the whole. This dissertation attempts to isolate, describe and analyze the internal domestic demand for a specific set of U. S. farm commodities.

The demand for any particular product is hypothetically a function of individual tastes and preferences as well as the prices of competing and complementary goods and income. On a national scale, variables such as age, income and geographic distribution are important as are inflation, average income and total population. Public policies affecting these variables are also important. Programs which have a direct effect on the consumers and thus on demand are the income and in-kind transfer (i.e. food stamps) programs.

There have been some large shifts in the use of some major U. S. commodities between 1951 and 1971. The quantity of wheat used for food per capita in the U. S. has declined by about 17 percent over this period. There has been a shift in use from bread to cookies and flour packaged for retail sale. The quantity of milk used has also decreased by about 22 percent. Use of fluid milk and butter declined considerably whereas

the use of cheese increased. Per capita consumption of fed-beef, non-fed beef, hogs and broilers also increased, but egg usage decreased by 10 percent.

Objectives

Using traditional elementary demand theory and econometric analysis, this work attempts to isolate the variables affecting demand for some major food commodities. Particular emphasis is on food stamps and income transfer programs. Variables considered most important due to their possible implication on food demand are substitutes and complements for various food commodities, income, income distribution, and, therefore, policies to redistribute income. Only other food items are tested for their complementarity or substitutability. No attempt was made to analyze the interactions and trade offs between demand for food and demand for non-food items.

The objectives of this study are to describe and analyze changes taking place in the consumption of the major food commodities.[1] Within that framework are the following objectives: 1) to investigate retail product consumption; 2) to analyze the effect of income distribution and income redistribution programs on food consumption; and 3) describe and analyze the role of marketing costs and their effect on retail products.

Method of Analysis

A system of equations is developed for each commodity. They are assumed to be independent except where one commodity is a substitute or complement for another.

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[1] Milk, wheat, beef, pork, broilers and eggs.

Demand for farm commodities is a result of consumer perception of various retail products, not farm products. The retail product is a combination of farm commodities and marketing services. Demand for marketing services and farm commodities is, therefore, expressed for the retail product. Prices and quantities of major retail products are represented herein in a system of equations.

To analyze demand for farm commodities and retail commodities, some concept of marketing margins and costs is essential. Marketing margins are not estimated directly in this analysis but a farm-retail price differential is obtained from price analysis at the farm and retail levels. Factors proxying marketing costs are included in the farm and retail-level equations.

Organization of Thesis

Chapter 2 contains the analysis which underlies the work to follow. The first section presents the basic demand function and defines relationships between farm and retail demand. The second section includes the theory and empirical evidence concerning relationships between income distribution, income redistribution policies and food demand.

The empirical results and analysis of the results form the major bulk of Chapter 3. (Empirical results are presented commodity by commodity). The final pages of the chapter contain an analysis of the results across the commodities for farm-retail price differentials and transfer payments. A summary is presented in Chapter 4 along with some questions raised by the analysis.

CHAPTER II

FRAMEWORK FOR ANALYSIS

Demand Theory

The demand schedule represents the maximum commodity quantities taken by consumers at each price level in a given time period. For a given demand schedule, everything else is assumed constant. For the individual consumer demand function, income, consumer tastes and preferences and consumer investments in consumer durables and disinvestment in wives as factors in home production as well as prices of food substitutes and complements are among the relevant variables assumed constant. In the aggregate, the above factors, as well as income distribution and demographic factors (such as total population size and age distribution) are assumed constant. A shift in any of these factors will cause a shift in the aggregate demand schedule. A shift in the demand schedule will yield a different simultaneous solution of the demand and supply functions, i.e., different values for market clearing prices and quantities.

Whether price and quantity are determined simultaneously is a hypothesis which can be tested. If single demand functions are used for each commodity, either own price or quantity must be assumed exogenous. If quantity is exogenous, the supply function is assumed vertical and predetermined in the time period at which we are looking at demand. If prices are exogenous, the buyer is assumed a price taker. The quantity bought has no effect on price. At the micro level for the individual

consumer, the function can best be expressed as quantity dependent, as the individual has little effect on price. The more aggregated, the more likely the amount bought will effect price. With agricultural products, given the relatively fixed nature of supply, once crops are planted and breeding herds established, price dependent demand equations are generally used. If supply is not assumed fixed in the given time period, parameters can be estimated simultaneously.

The elementary traditional demand equation which is far from ideal would include the commodity's own price and quantity as well as prices of other possible substitutes and complements. The number of parameters to be estimated must be less than the number of observations. Given the limited number of years for which data are available, the number of variables must be severely limited.

Also, the number of years of data used must be limited because the longer the time span, the more likely it is that some variables assumed constant have actually shifted. (Tastes and preferences are two examples).

One way to deal with the problem of degrees of freedom is to divide all food into categories and use concepts suggested by economic theory to find some of the parameters, thereby reducing the number which must be directly estimated. There are costs to this procedure as well as benefits.

This method is used by Brandow as well as George and King.[1] George and King's division of food into groups is less aggregated than

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[1] G. E. Brandow, Interrelations Among Demands for Farm Products and Implications of Market Supply, Pennsylvania Agricultural Experiment Station Bulletin 680, (University Park, 1961); P. S. George and G. A. King, Consumer Demand for Food Commodities in the United States with Projections for 1980, Giannini Foundation Monograph No. 26 (Davis, March 1971).

that of Brandow because they made further assumptions about the utility of goods. However, use of these concepts requires an accounting of total income. There must be information about non-food use as well as disaggregated food use of income.

It is difficult to explain differences existing between retail and farm level demands for food. Usually, the product bought at the retail level is quite different from that sold at the farm level. For example, milk at the farm level becomes ice cream, cheese, yogurt, whipped cream, etc., at the retail level. Though some eggs undergo no essential transformation in form they make a transformation in place and time. Thus, there is a difference in the product whether it be form, time or place.

The difference in product price at the retail and farm level reflects supply and demand for services which change the product in time, form and place. Waldorf[1] attempts to measure demand for these marketing services. He believes a total consumer demand exists for marketing services, including those services which will be bought and those provided at home. Those services which will be bought, i.e. demand for marketing services, are, according to Waldorf, consumer demand for these services minus the household supply of these services.

Finding a proxy for a quantity and price of marketing services is difficult. Waldorf substitutes Bureau of Census data for "value added by manufacturers" adjusted for price changes. The quantity of marketing services consumed is the difference between value of gross output deflated by an index of wholesale food prices and costs of materials and

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[1]William Waldorf, "The Demand and Supply for Marketing Services," Journal of Farm Economics, XV, 42-60.

supplies deflated by an index of materials and supplies. The price of food manufacturing services is value added in current prices divided by value added in constant prices.

When estimating farm level demand, the effect of marketing services on farm demand must be considered. Farm level demand without the demand for marketing services cannot be theoretically justified; it derives from the retail demand and must be analyzed as such.

Demand for the retail product includes demands for marketing services and for farm products that are inputs into the retail product. Neither George and King nor Brandow attempt to handle the question of marketing services within the supply and demand framework. Instead, they link up farm and retail prices by hypothesizing about marketing firm pricing policies. Brandow, for example, assumes a constant markup plus a percentage markup.[1] Thus, only retail price and commodity quantities will affect farm prices. George and King investigate various pricing policies and combinations of pricing policies and, as with Brandow, derive farm level demand from the estimated retail demand functions.

To obtain derived demand Friedman[2] assumes inputs into the retail good are in fixed proportions (Figure 2.1). The demand for one of the joint inputs is derived from the difference between the supply curve for the other and the demand for the total product. Thus, the derived demand for farm goods (inputs into a retail product) is the vertical

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[1]Brandow, Interrelationships Among Demands, p. 44.

[2]Milton Friedman, Price Theory (Chicago: University of Chicago Press, 1962).

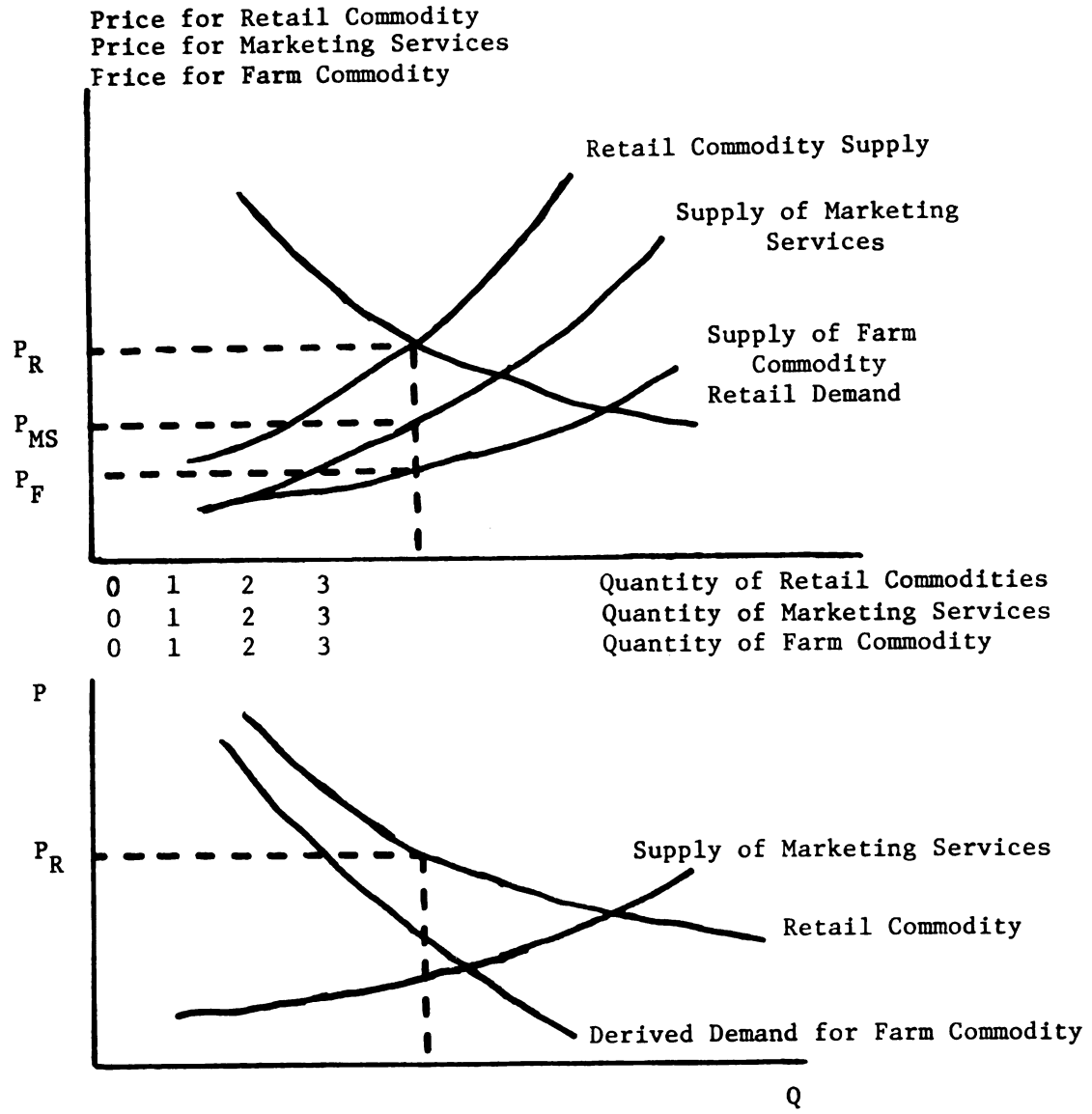

Figure 2.1

Derived demand

difference between the demand for retail products and supply of marketing services.

The maximum amount paid for a retail good is shown by the demand curve for the retail good. The minimum price for marketing services is given by the supply curve for those services. Since the retail product is produced with fixed proportions of inputs, according to the assumptions of the analysis, the demand for farm products is a residual, or the difference between the two curves.

Assumptions of the static model include: 1) a fixed relationship between farm foods and marketing services as inputs into the retail good, and 2) demands for marketing services and farm goods are not simultaneous (except at the original equilibrium point) since each is derived from the other's supply curve.[1]

Richard Foote[2] presents the following model of derived demand consisting of relationships for consumer demand, marketing group supply and demand, and producer's supply.

Q_c = quantity consumed

Q_p = quantity produced

P_r = retail price

P_w = price paid to producer

D = disposable income

Z_1 = other factors affecting consumer demand

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[1] Ibid., p. 151.

[2] Richard Foote, Analytical Tools for Studying Demand and Price Structure, U. S. Department of Agriculture Agricultural Handbook No. 146 (Washington, D. C., August 1958).

Z_2 = other factors affecting marketing groups demand and supply

Z_3 = other factors affecting producer supply

1. $F(Q_c, P_r, D, Z_1) = 0$ consumer demand
2. $g(Q_c, P_r, P_w, Z_2) = 0$ marketing group's supply
3. $h(Q_p, P_r, P_w, Z_2) = 0$ marketing group's demand
4. $i(Q_p, P_w, Z_3) = 0$ producer's supply

Assuming certain equilibrium conditions, the number of equations to be estimated is limited. If $Q_c = Q_p$ the marketing supply and demand equations become one.

5. $j(Q_c, P_r, P_w, Z_2) = 0$ marketing group's behavior

The system then consists of functions for marketing group's behavior, producer supply, and consumer demand (1, 4, 5).

If Q supplied by the marketing group equals the quantity demanded by the consumer group, retail price can be eliminated from 5 and 1 to give the following derived demand for the producer's product.

6. $k(Q_c, P_w, Z_2, D, Z_1) = 0$

Notice that Z_2 or factors affecting the marketing group's behavior must be included in the estimation.

Foote's original four equation framework is useful. Z_2 represents factors affecting both the marketing group's supply and demand. A case can be made for a differentiation of these factors affecting supply and demand. Also, the assumption that $Q_c = Q_p$ will not hold except when the farm product becomes only one retail product. When there are several retail products the system of equations becomes bigger. As with previous methods, assumptions were made to eliminate variables and thus produce a derived demand. This is a "partially reduced form equation derived

from a structural equation by the elimination of a price through the use of equilibrium condition."[1]

Framework

Because of the interest in livestock and food grains only, the schema by Brandow and George and King of accounting for all income is not appropriate for this analysis. Rather than consider each food item a substitute or complement for another one, each commodity will be scrutinized along with its most likely substitutes.

The general schema for commodity estimation is the same as that of Foote except exogenous factors affecting retail supply, Z_2, and farm demand, Z_3 differ. In Foote's schema they are the same.

Retail demand: $Q_R = F(P_R, \bar{Z}_1)$

Retail supply: $Q_R = F(P_R, P_F, \bar{Z}_{2)}$

Farm demand: $Q_F = F(P_F, P_R, \bar{Z}_{3)}$

Farm supply: $Q_F = F(P_F, \bar{Z}_4)$

Q_R = quantity of retail good

P_R = price of retail good

P_F = price of farm commodity

Q_F = quantity of farm commodity

Z_1 = exogenous variables affecting retail demand

Z_2 = exogenous variables affecting retail supply

Z_3 = exogenous variables affecting farm demand

Z_4 = exogenous variables affecting farm supply

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[1] Ibid., p. 102.

Because of the adjustment period for some agricultural commodities, supply and demand at the farm level may not be simultaneous. The quantity of the commodity supplied may be determined by the price of the previous year. This hypothesis is testable. Q_F is then an exogenous variable in the farm demand equations.

The schema changes to:

1. Farm supply: $Q_F = F(\bar{P}_{F\ t-1}, \bar{Z}_4)$
2. Farm demand: $P_F = F(\bar{Q}_F, P_R, \bar{Z}_3)$
3. Retail supply: $Q_R = F(P_R, P_F, \bar{Z}_2)$
4. Retail demand: $Q_R = F(P_R, \bar{Z}_1)$

Functions 2, 3, and 4 can be estimated simultaneously or P_R can be excluded from 2 and the farm demand equation estimated independently of retail supply and demand. If the latter approach is taken, farm demand must be estimated as a derived demand and the effects of Z_1 and Z_2 included in the estimation.

The marketing margin or difference between price at retail and price at the farm emerges from this relationship and supply and demand for marketing services are accounted for, although not specifically tested for. It is not assumed that Q_F and Q_R are the same as in many instances, they are not. Q_F may become many different products at the retail level. Thus, the system of equations needed to explain farm level demand becomes larger as more retail products are produced from the raw product. The system for each commodity expands to several equations of type 3 and 4, two for each retail product as well as 1 and 2 (farm supply and demand).

The new system becomes

1. Retail demand: $R = 1,\ldots,n \quad Q_R = F(P_{R_1}\ \bar{Z}_1)$

2. Retail supply: $R = 1,\ldots,n \quad Q_R = F(P_R, P_F, \bar{Z}_2)$

3. Farm demand: $R = 1,..,n \quad P_F = F(\bar{Q}_F, P_R, \bar{Z}_{3)}$

4. Farm supply: $Q_F = F(\bar{P}_{F_{t-1}}, \bar{Z}_4)$

Q_F, P_F, Q_R, P_R are self-explanatory equation variables. Z_1 variables are the substitutes and complements that retail customers would be choosing among. These would also include more general variables such as average income, population, income transfer programs, and the number of bonus food stamps or total transfers made to low income consumers.

Z_2 variables in the retail supply equation represent inputs into retail product production. This includes changes in the farm product at the wholesale, processing and retail level. Important inputs are: labor, transportation and fuel costs, substitutable and complementary farm commodities. Commodities labeled substitutes at the farm level are those which the processor or wholesaler considers substitutes. In processing, for example, soybean protein may be considered a partial substitute for beef, especially in longer runs; at the retail level, pork and chicken would be substitutes.

Z_3 variables in the farm demand equation resemble those in the retail supply equation except they must include substitutes and complements for all retail production processes and the variables applicable to all, such as labor. The price or the quantity of substitutes and complements can be used. When quantities are used, it is assumed that they are predetermined in the given time period. If prices are used, it is assumed that the buyers are price takers and the prices of the various goods are not determined simultaneously.

Z_4 variables are the inputs into the production process and other exogenous variables affecting farm supply such as policy prices. If it is hypothesized that supply is predetermined, then Z_4 variables do not need to be included in the estimation.

The Interrelationships Among Income Distribution Income Redistribution Policy and Demand for Food

Income distribution has an affect on the demand for food; hence the implication is that income redistribution programs also affect food demand. The connections among these three variables must be established, at least partially and approximately.

Transfer Payments and Income Redistribution

The purpose of government transfer payments and taxation is to redistribute income to designated target groups. There are three aspects to the redistribution. One is taxation; another is deficit financing and the third is transfer. No attempt is made to take into account all aspects of the former two processes.

Much taxation and subsequent transferral of income, goods and services occurs among groups of people whose particular characteristics would be difficult to isolate. Payments are made to groups, e.g., veterans and the aged, based on their particular characteristics.

Low income groups also obtain special consideration. Programs catering to them specifically are called income-tested programs.

It is important to distinguish between programs which transfer income directly and in-kind programs which provide services or a particular good instead of cash. Most relevant to this analysis are income-tested, direct income transfers and food stamp programs.

Tables 2.1 and 2.2 give some perspective on the particular programs as related to other transfer programs and to social welfare payments in the United States. Table 2.1 lists the total social welfare programs and more specifically the public aid programs. Public aid programs increased from 10.6 percent of all social welfare programs in 1950 to 11.2 percent in 1970.

The three income transfer payments used in this analysis are also listed. Aid to families with dependent children (AFDC) has had the largest increase in spending. A brief description of these programs appears in Appendix A.

Table 2.2 compares income dependent programs with other transfer programs sponsored by various government levels. Table 2.3 outlines the historical data along with the most current data on participation numbers and total value of food stamps issued.

In 1970, the program was liberalized greatly increasing the number of participants and government expenditures. If April 1976 is indicative of the rest of 1976, federal contributions to the program for the year would amount to $5,466 million--twice the 1974 amount and ten times the 1970 amount.

Looking briefly at income distribution in the United States reveals two major trends.[1] First, the percent of aggregate income received by each fifth of the families has not changed significantly since 1947. Second, the difference between the lowest fifth and highest fifth

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[1]Sylvia Lane, "Effectiveness of Public Income Redistributive Policies and Programs on the Redistribution of Income to Low-Income Groups" (paper presented at the meeting of the American Agricultural Economics Association, Columbus, Ohio, August 12, 1975), p. 1.

TABLE 2.1

U. S.: TRANSFER PROGRAMS (1950-1974)[a]

	1950	1960	1970	1974	1974/1950
TOTAL SOCIAL WELFARE PROGRAMS Federal, state and local. Includes social insurance, public aid, health and medical programs, veterans programs, education, housing and other social welfare.					
(million dollars)	23,508	52,293	145,962	242,386	10.3
TOTAL PUBLIC AID PROGRAMS AFDC, OAA, GA, Aid to permanently and totally disabled, Aid to blind, Medical Asst. for aged[b]					
(million dollars)	2,496	4,101	16,488	33,628	13.4
TOTAL PUBLIC AID AS PERCENT OF TOTAL SOCIAL WELFARE PROGRAMS	10.6%	7.8%	11.2%	13.8%	
SPECIFIC PUBLIC AID PROGRAMS					
AFDC million dollars	556	1,055	4,857	7,991	14.3
thousand recipients	2,234	3,073	9,659	11,006	4.9
OAA million dollars	1,469	1,922	1,866		
thousand recipients	2,786	2,305	2,082		
GA million dollars	353	422	731	1,131	3.2
thousand recipients	413	431	547	585	1.4

[a]Includes administrative costs.

[b]AFDC=Aid to Families with Dependent Children; OAA=Old Age Assistance; GA=General Assistance

Source: U. S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States, 1975 (Washington, D. C.: Government Printing Office, 1975), p. 284.

TABLE 2.2

U. S.: BENEFIT OUTLAYS UNDER PUBLIC INCOME TRANSFER PROGRAMS, FISCAL YEAR 1972 (in billions of dollars)

Program	Benefit outlays, fiscal year 1972		
	Total	Federal	State and Local
INCOME-TESTED PROGRAMS:[1]			
Aid to families with dependent children	6.7	3.7	3.0
Old age assistance	2.5	1.7	.8
Aid to the blind	.1	.06	.04
Aid to the permanently and totally disabled	1.5	.8	.7
General assistance	.7		.7
Veterans' pensions	2.5	2.5	
National school lunch program (free or reduced-price lunches)	.5	.5	
Food stamps	2.0	2.0	
Food distribution (to individuals and families)	.3	.3	
Public housing	.8	.8	
Medicaid	7.0	3.9	3.1
Total, income-tested programs	24.6	16.3	8.3
OTHER INCOME TRANSFER PROGRAMS:			
Old age and survivors insurance	34.5	34.5	
Disability insurance	4.0	4.0	
Railroad retirement	2.1	2.1	
Civil service retirement	3.4	3.4	
Other federal employee retirement	4.0	4.0	
State and local retirement	3.3		3.3
Unemployment insurance	6.4	6.4	
Workmen's compensation	3.0	.2	2.8
Veterans' medical care	2.2	2.2	
Veterans' compensation	3.6	3.6	
Medicare	8.5	8.5	
Total, other programs	75.0	68.9	6.1
Total, all programs	99.6	85.2	14.4

[1]These programs base benefits on current needs of recipients.

Source: U. S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States, 1975 (Washington, D. C.: Government Printing Office, 1975) p. 281.

TABLE 2.3

U.S.: FEDERAL FOOD STAMP PROGRAM (1961-1976)

	Participants (1,000)	Value of stamps issued: Total retail value (million dollars)	Value of stamps issued: Cost to participant (million dollars)	Bonus stamps: Total (mil. $)	Bonus stamps: Percent of total retail value	Per participant (dollars)
1961	6	1	(a)	(a)	(46.1)	8
1962	8	35	22	13	37.4	92
1963	42	50	31	19	37.4	82
1964	43	73	45	29	39.0	78
1965	110	85	53	33	38.0	76
1966	324	174	109	65	37.2	75
1967	838	296	191	106	35.6	73
1968	1027	452	279	173	38.3	78
1969	1489	603	374	229	37.9	80
1970	1747	1090	540	550	50.4	127
1971	1991	2713	1191	1523	56.1	163
1972	2132	3309	1511	1797	54.3	155
1973	2228	3884	1753	2131	54.9	176
1974 est.	2818	4727	2008	2719	57.5	202
1975 est.	19300	8316	3253	5062	60.8	262
1976 (projected)	18900	8960	3494	5466	61.0	294

[a]Less than $500,000.

Source: U. S. Dept. of Agriculture, Agricultural Statistics 1975 (Washington, D. C.: Government Printing Office, 1975) p. 567.

of the families has widened considerably. One measure of the difference is obtained by dividing all families into five income groups and examining the top income in each income group. In constant dollars the difference between the highest income in the fourth income group and in the first income group was $7,384 in 1947 and $13,945 in 1974.[1]

According to a study by Reynolds and Smolensky,[2] the trend without transfer payments would have been towards more inequality. Transfer payments considerably slowed the rate of increase in income inequality in 1961 and 1970.

Income Distribution and Demand for Food

Income level is a major determinant of the value of food bought. Income distribution should affect the amount of money spent on food as well as the basket of commodities bought.

Theoretically, money received from a transfer payment should not be spent any differently than money from any other income source. Cash transfers, unlike food stamps, for example, do not lock spending into any particular good. Thus, with knowledge of income elasticities for income groups and knowledge of income distribution one should be able to project food consumption with and without transfer payments.

Food Stamps and Demand for Food

Food stamps have a more direct effect on food demand. Theoretically, they should lock some of the money spent on them to food buying.

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[1] U. S. Department of Commerce, Statistical Abstracts, 1975, p. 392.

[2] M. Reynolds and E. Smolensky, "Post-Fisc Distribution of Income: 1950, 1961 and 1970" (paper presented at the meetings of the Western Economic Association, June 27, 1975).

Stamp issuance depends on income. The participant pays a sum for a certain amount of stamps. The difference between the total amount of food stamps and their cost is the amount of "bonus" stamps. The increase in demand for food can at the maximum be equivalent to the bonus food stamps or at the minimum zero.

If the family chooses to spend the same amount of cash as previously spent on food on food stamps, all bonus stamps will represent a demand expansion for food. However, if they choose to spend less cash on food and purchase the number of food stamps that will buy them the same amount of food as previously, there is no demand expansion at all. The average is somewhere in between and depends on income and household size.[1] The lower the income, the larger the family size and the lower the nutritional level of the family, the more effective the food stamps are in increasing food demand.

The U. S. Department of Agriculture (USDA) estimates that with a cash supplement of $1.00, demand for food is expanded by $.20 to $.30 and with $1.00 of bonus food stamps, demand is expanded by $.50. Individual food items were also singled out, using data from the Household Food and Consumption Surveys (HFCS) of 1955 and 1965 to estimate total increase in demand for these various foods due to food stamps. Food stamps have a particularly large impact on red meat.

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[1]U. S. Department of Agriculture, Economic Research Service, Bonus Food Stamps and Cash Income Supplements: Their Effectiveness in Expanding Demand for Food, Marketing Research Report No. 1034 (Washington, D. C.: Government Printing Office 1974), p. iv.

Mittelhammer and West[1] set up a theoretical framework for comparing the impact of food stamps on the recipients with that of a cash transfer on demand for food. Theoretically, demand for food would depend on the indifference curves but generally expenditure on food is expected to be more with food stamps than with a cash subsidy. By studying the number of people spending more for food than their food stamp allotment, they could estimate the numbers that would tend to spend the same amount on food with food stamps as with a cash transfer. Or, conversely, they could estimate the numbers of households where the food stamp programs increase demand for food above that which would be present with a direct cash subsidy. Thirty-eight percent of the families in the 1965 Household Survey used less food than would have been allocated to them under the food stamp program. This represents an estimate of those families for which the food stamp program would increase the food bought above that for a cash subsidy of value equal to the bonus amount in the food stamp program.

Analysis of Transfer Payments

Little work has been done on inclusion of policy variables in food demand equations. One problem is the dearth of relevant data linking retail demand to food stamps. The ideal data for food stamps would be a detailed study of consumer purchases of relevant food categories, income, various socio-economic criteria and whether or not food stamps were used.

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[1]Ron Mittelhammer and Donald A. West, "Impact of the Food Stamp Program on the Demand for Food, Some Theoretical Considerations," (paper presented at the 1974 American Agricultural Economics Association meetings in College Station, Texas, August 1974).

Most data collected cannot be used for this type of analysis. Because of the interest in nutrition of food stamp users, much of the data collected outline differences in food eaten by food stamp users and non-food stamp users rather than food bought.[1]

Transfer payments as well as food stamps affect the consumer's expenditure pattern. In this study food stamps and transfer payments are analyzed for their effect on consumption. The two different programs are summed and a variable representing the two is used to estimate the effect of these variables on food demand.

Commodity Specific Structures

Retail and farm demand for each commodity is estimated using a different set of equations and variables. The equations vary according to hypothesized simultaneity among the supply and demand curves and the number of retail products considered in the analysis of a particular farm product. Retail products considered in the analysis are determined partly by the importance of the retail product that the farm commodity is used in, and by availability of data.

Variables in the equations at the retail level depend on the substitutes and complements for the retail product. All retail equations include a food stamp or transfer variable as well as an income variable. To account for the effect of aggregate population change and inflation,

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[1]Dae Sung Lee and Gus T. Ridgel, Income and Food Expenditure Patterns for a Selected Group of Families in Frankfort-Franklin County, Kentucky State University, Cooperative State Research Service (Frankfort, May 1974); J. Patrick Madden and Marion D. Yoder, Program Evaluation: Food Stamps and Commodity Distribution in Rural Areas of Central Pennsylvania, Pennsylvania State University Agricultural Experiment Station Bulletin 780 (University Park, June 1972).

all quantities are per capita and all prices are deflated by the Consumer Price Index (CPI).

Variables in retail supply equations include inputs into the processing of the farm product and its retailing. In all retail supply equations, wages of food manufacturing employees and the fuel price index were used to proxy these inputs into retail products. The wage used here is only that of food manufacturing employees. It excludes wages in other areas such as transportation, where the wages might be higher. The trends are similar. The simple correlation between the wage of food manufacturing employees and wages of employees in the private non-agricultural sector is .73. There is no proxy for labor-saving capital and new technology. In cases where a possible substitute or complement exists for the farm input into the retail product, it was included as a variable.

Equations representing demand for a farm commodity include variables from all retail supply equations for that particular farm commodity. Thus, aside from wage and fuel, other variables included are substitutes or complements used to produce any of the retail products from that commodity.

Estimation Procedure

The two-stage least squares estimation is used in an attempt to capture the simultaneity in allocating the quantity of farm commodities among the various retail products. This procedure requires that all but one endogenous variable be estimated in the first stage of the process using ordinary least squares (OLS). All exogenous variables in the whole system of equations are the independent variables in this first stage of estimation. In the second stage, the estimated values of the endogenous variables in the first stage are used to estimate the one remaining

endogenous variable.

Each equation in the system is estimated separately. Thus, more than one equation may be used to predict a particular variable. For example, both retail supply and demand equations can be used to predict prices and quantities at the retail level by using included and excluded exogenous variables to project all endogenous variables. Alternatively, the supply and demand equations can be solved simultaneously and used for prediction.

CHAPTER III

STATISTICAL ANALYSIS

Outline for Presenting the Statistical Analysis

The results are presented commodity by commodity. A model is presented for each specific farm commodity along with a discussion of the model. Data problems for the specific commodities and a simple correlation matrix for each set of data are presented.

A measure of the multi-collinearity between variables is provided by a simple correlation between the variables. Because three separate sets of data were used, three simple correlation matrices are presented. There is a listing and analysis of regression results.

The analysis emphasizes: 1) price and quantity relationships; 2) production of a variety of retail products from the farm products; 3) price differentials between farm and retail products and 4) the effect of income and transfer payments on the various retail commodities. Excluded exogenous variables for each equation, i.e., the exogenous variables for the other equations in the system are listed along with the results for each equation. The results include the coefficients for each variable, the standard error for each coefficient, and the R^2 and Durbin-Watson statistic for each equation.

The first stage of the two-stage process is used for estimating some variables. Equations used for that purpose are listed along with the other regression results. Because they are not structural equations their estimated parameters are not included in the analysis of the

regression results.

Wheat

Modeling the Wheat Sector

To model and estimate the wheat sector, it is necessary to find data for not only a relevant category of retail products, i.e. those products which are the major retail products from the farm commodity, but also a matching retail price for a sufficient time span. Bread, flour and cookies meet those criteria best.

The major use of wheat for domestic food consumption is bread. According to the Census of Manufacturers,[1] 71 percent of the wheat flour in 1972 went into making commercial breads and cakes. In 1954, 74 percent of it was used for those products. This represents 40 percent of the total wheat used for food in the United States in 1954 and 1972.

Other major uses of wheat are flour packaged for retail sale, cookies, crackers, cereals and pastas. Retail flour, and cookies and crackers changed from two percent and seven percent of the quantity of wheat used for food in the United States in 1951 to four percent and 10 percent in 1972. There is some specialization in use of various types of wheat for retail products. A more accurate picture of the retail wheat market might be obtained if wheat were disaggregated according to these specializations for estimating purposes.

Wheat is not only used for domestic food consumption, but also for feed, seed and alcohol. Larger proportions of the United States crop are exported every year. In 1950, 20 percent of the United States crop

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[1]This categorization excludes small-scale bakery production where goods are sold directly to the consumer.

was exported. The percentages have continued to increase from 40 percent in 1960 to 52 percent in 1970 and 56 percent in 1975.

Data: Correlation Matrix, Sources of Data and Adequacy of Proxies

There are several problems with the available retail data. Many retail prices from the Bureau of Labor Statistics, for example, have no equivalent retail quantities which can be used for analysis. Thus, many variables must be proxied. How each particular commodity is proxied is explained in the section dealing with the data problems of that commodity.

Retail data for wheat products are no exception. First, the data on quantities of the relevant retail products are taken from the Census of Manufacturers. These data are collected only every 5 years. A linear trend is used between points to estimate the quantities of wheat used in the various retail products for the years in between.

Second, the category used in this analysis to represent bread quantities includes not only bread but also "cakes and related products." Also the cooky variable is represented by data for cookies and crackers. Third, the amount of cookies, bread and wheat flour used are proxied by the amount of wheat that goes into these products as inputs rather than the amount of the retail products produced. Fourth, the retail product prices used are very product specific. The price of bread, for example, is the price of white bread and the price of cookies is sandwich cookies. A more thorough analysis would require finding better matches for the quantities and prices used.

The variables affecting the quantity of wheat used for other than domestic consumption (QWHOTHER), i.e., export and feed demand, are proxied here by lagged quantities of wheat produced and exported. In

TABLE 3.1

THE WHEAT MODEL

System of equations for wheat

Retail demand:	$QBREAD = f(PBWHR, \bar{Z})$
Retail supply:	$QBREAD = f(PBWHR, PWHF, \bar{Z})$
Retail demand:	$QFLOUR = f(PFLR, \bar{Z})$
Retail supply:	$QFLOUR = f(PFLR, PWHF, \bar{Z})$
Retail demand:	$QCOOKIE = f(PCKR, \bar{Z})$
Retail supply:	$QCOOKIE = (PCKR, PWHF, \bar{Z})$
Farm demand:	$QWFOOD = f(PWF, PBWHR, PCKR, PFLR, \bar{Z})$
	$QWOTHER = f(PWF, \bar{Z})$
	$QFOOD + QWOTHER = \overline{QWHPROD}$
Farm supply:	$QWHPROD = f(PWF_{t-1}, \bar{Z})$

Endogenous variables

QBREAD	quantity of bread
PBWHR	price of bread
PWHF	price of wheat at farm
QFLOUR	quantity of retail flour
PFLR	price of retail flour
QCOOKIE	quantity of cookies
PCKR	price of cookies
QWFOOD	quantity of wheat used for food
QWOTHER	quantity of wheat used for other than domestic food
QWHPROD	quantity of wheat produced in U. S.

Exogenous variables $\bar{Z}$

PBWHR	price of bread
PSUGAR	price of sugar
FUEL	price of fuel, power and light bought by manufacturing firms
STAMPS	federal contribution to food stamps
QWHPRODLAG	quantity of wheat produced in the U. S. in time t-1
QWHXLAG	quantity of wheat exported from the U. S. in time t-1
WAGEFME	wage of food manufacturing employees
Y	disposable personal income
PFLR	price of retail flour

further analysis, they might be proxied by foreign production of wheat and the number of cattle on United States farms. (These are more specific indicators of export demand and feed demands). The number of cattle on farms indicates the amount of food needed and the overseas production of wheat indicates the amount of competition for United States suppliers.

Table 3.2 lists the simple correlation matrix for variables in the wheat equations. However, many variables are highly correlated with time (YEAR). Thus, in many equations, the coefficients could be biased because of the correlation of an included variable with a variable which has been excluded from the system, but is also highly correlated with time. Also, transfer payments (TRANS) and disposable personal income (Y), which are included in most retail equations, are highly correlated (.80). This particular problem is discussed later in the chapter.

Analysis of Regression Results

Quantity and Price

As evident from Figure 3.1, the amount of wheat used for food per capita in the United States has dropped significantly. This represents the decline in wheat used for making bread (see Figure 3.3), and the more recent decline in wheat used for cookies and retail flour between 1967 and 1972 (Figures 3.4 and 3.5). From 1951 to 1972, (the time period used for analysis), the total amount of wheat used for food increased but the amount declined. Over the same time period, there was a perceptible decline in price of cookies and retail flour, and an increase followed by a decrease in the price of bread (see Figures 3.6, 3.7 and 3.8).

TABLE 3.2

SIMPLE CORRELATION MATRIX FOR VARIABLES USED IN THE WHEAT EQUATIONS[a]

	FUEL	PBLOHR	PCKR	PFLR	PSUGAR	PWF	QBREAD	QCOOKIES	QFLOUR	QWFOOD	QWHPRODLAG	QWXLAG	STAMPS	TRANS	WAGEFME	YEAR	Y
FUEL	1																
PBWHR	.35	1															
PCKR	.89	.32	1														
PFLR	.77	.44	.95	1													
PSUGAR	.71	.53	.78	.80	1												
PWF	.81	.11	.92	.84	.68	1											
QBREAD	.65	.31	.90	.96	.70	.81	1										
QCOOKIES	-.55	.41	-.69	-.57	-.29	-.80	-.63	1									
QFLOUR	-.66	.17	-.71	-.53	-.27	-.73	-.56	.85	1								
QWFOOD	.65	-.13	.86	.80	.56	.89	.86	-.91	-.76	1							
QWHPRODLAG	-.42	-.38	-.35	-.33	-.39	-.20	-.22	.01	.13	-.08	1						
QWXLAG	-.41	.27	-.60	-.49	-.25	-.69	-.54	.86	.84	-.77	-.04	1					
STAMPS	-.46	-.66	-.70	-.84	-.72	-.54	-.84	.19	.22	-.52	.97	.25	1				
TRANS	-.61	-.65	-.82	-.92	-.79	-.65	-.90	.30	.32	-.61	.32	.30	.97	1			
WAGEFME	-.80	-.16	-.93	-.89	-.72	-.93	-.87	.76	.65	-.90	.28	.60	.62	.73	1		
YEAR	-.78	-.11	-.96	-.91	-.70	-.94	-.92	.83	.77	-.96	.21	.73	.66	.75	.95	1	
Y	-.83	-.25	-.97	-.91	-.78	-.93	-.89	.72	.72	-.89	.25	.66	.70	.80	.95	.97	1

[a]All quantities are per capita and all variables expressed in dollars have been deflated by the CPI (1967=100). TRANS, STAMPS and Y are deflated per capita. Further explanation and data sources for all variables can be found in Appendix B.

Before 1967 the decline in bread consumption could be explained by a response to price changes.[1] After 1967 this was no longer possible as both prices and consumption declined (Figure 3.9). Statistical analysis verifies that price is not the most explanatory variable although it has an effect. The coefficient on the price of bread in Equation 1.5, Table 3.3, is very significant but the price elasticity is small. My results indicate a price elasticity of -.33. The analysis of King and George for comparison produced a price elasticity of -.15.

Consumption of both flour purchased for retail consumption and cookies is unresponsive to price according to the statistical analysis (Equations 1.1 and 1.3). Price coefficients for both cookies and flour are insignificant. A search for possible substitutes and complements for retail products made from wheat was unsuccessful. The only statistically significant substitute for wheat flour is bread and for bread the only substitute is wheat (Equations 1.1 and 1.5).

The idea that there is a substitute for an item which takes such a small portion of the budget is difficult to accept. Therefore, further research is in order. What is labor in the house worth? At what income level, for example, would the consumer make bread instead of buy it?

Equations 1.6 and 1.7 indicate that marketing costs may have an effect on consumption. The price of fuel is significant in both bread and total wheat consumption because bread is the major component of wheat used for food in the United States. Data show that fuel costs decreased relative to other goods between 1951 and 1971 and thus would have a

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[1]U. S. Department of Agriculture, Economic Research Service, Food Consumption, Prices and Expenditures, Agricultural Report No. 138 (Washington, D. C., Government Printing Office, 1968).

TABLE 3.3

REGRESSION RESULTS FOR WHEAT[a]

Equation	Title	Results	Excluded exogenous	R^2	DW
1.1	Retail demand for flour	QFLOUR = - 92.18 + .25 PFLR + 2.06 $\overline{\text{PBWHR}}$ (1.39) (2.41) + 33.24 $\bar{Y}$ - 1.93 $\overline{\text{STAMPS}}$ (14.91) (2.13)	PSUGAR WAGEFME FUEL QWHPRODLAG QWXLAG	.72	.35
1.2	Retail supply of flour	QFLOUR = -50.81 + .33 PFLR - 50.81 PWF (1.09) (21.66) - 68.72 $\overline{\text{WAGEFME}}$ + .07 $\overline{\text{FUEL}}$ (49.85) (.70)	PBWHR PSUGAR Y QWHPRODLAG STAMPS QWXLAG	.24	1.37
1.3	Retail demand for cookies	QCOOKIES = 70.53 + .07 PCKR + 17.87 $\bar{Y}$ (.49) (8.16) - 1.70 $\overline{\text{STAMPS}}$ (.47)	PBWHR PFLR PSUGAR WAGEFME FUEL QWHPRODLAG QWXLAG	.73	.28
1.4	Retail supply of cookies	QCOOKIES = 88.19 + .29 PCKR - 17.63 PWF (.60) (7.19) +.49 $\overline{\text{PSUGAR}}$ - 1.80 $\overline{\text{WAGE}}$ + .17 $\overline{\text{FUEL}}$ (.28) (12.33) (.25)	PBWHR PFLR Y QWHPRODLAG STAMPS QWXLAG	.70	1.55

TABLE 3.3 (cont'd)

Equation	Title	Results	Excluded exogenous	R^2	DW
1.5	Retail demand for bread	QBREAD = 482.81 − 8.15 PBWHR + 3.50 PFLR (1.95) (.60) + 2.95 $\bar{Y}$ − 5.06 $\overline{STAMPS}$ (7.26) (1.28)	WAGEFME FUEL QWPRODLAG	.97	1.14
1.6	Retail supply of bread	QBREAD = 390.35 + 15.09 PBWHR + 65.81 PWF (5.62) (34.30) − 9.00 $\overline{WAGEFME}$ − 2.83 $\overline{FUEL}$ (63.24) (1.27)	PFLR PSUGAR Y QWHPRODLAG STAMPS QWXLAG	.65	1.43
1.7	Farm demand for wheat	QWFOOD = 4.08 − .08 PBWHR + .0003 PFLR (.02) (.01) + .04 PCKR − .13 $\overline{WAGEFMG}$ − .05 $\overline{PWFLAG}$ − .01 $\overline{FUEL}$ (.01) (.11) (.06) (.00)	PSUGAR Y QWHPRODLAG STAMPS QWXLAG	.98	1.81
1.8	Farm demand for wheat	PWF = −8.03 + 2.12 QWFOOD − .03 PBWHR (3.81) (.44) + .02 PFLR − .02 PCKR + .22 $\overline{WAGEFME}$ + .03 $\overline{FUEL}$ (.13) (.16) (1.7) (.06)	PSUGAR Y QWHPRODLAG STAMPS QWXLAG	.87	1.68

TABLE 3.3 (cont'd)

Equation	Title	Results	Excluded exogenous	R^2	DW
1.9	Price of flour	$PFLR = 53.77 - 12.14\ \overline{WAGEFME} + .24\ \overline{FUEL} + 4.69\ \overline{Y}$ (25.94) (5.58) (.13) (6.27) $-1.60\ \overline{STAMPS} - .06\ \overline{QWHPRODLAG} - .003\ \overline{QWXLAG}$ (.36) (.49) (.003) $+ .04\ \overline{PSUGAR}$ (.16)	OLS from equation 1.8	.94	1.29
1.10	Price of cookies	$PCKR = 49.53 - 4.10\ \overline{WAGE} + .33\ \overline{FUEL} - .02\ \overline{PSUGAR}$ (17.71) (3.81) (.09) (.10) $-5.45\ \overline{Y} - .60\ \overline{STAMPS} - .28\ \overline{QWHPRODLAG} - .003\ \overline{QWXLAG}$ (4.28) (.25) (.33) (.002)	OLS from equation 1.8	.98	1.66
1.11	Price of bread	$PBWHR = .68 + 2.09\ \overline{WAGE} + .10\ \overline{FUEL} + 1.45\ \overline{Y}$ (7.08) (1.52) (.03) (1.71) $-.46\ \overline{STAMPS} - .05\ \overline{QWHPRODLAG} + .0008\ \overline{QWXLAG}$ (.10) (.13) (.001) $+.02\ \overline{PSUGAR}$ (.04)	OLS from equation 1.8	.85	1.27

[a]A complete description and source of all data can be found in Appendix B. All quantity variables are per capita and all price variables have been deflated by the CPI (1967=100). Parenthesis under the coefficients enclose the standard errors. Bars over the variables indicate the exogenous variables.

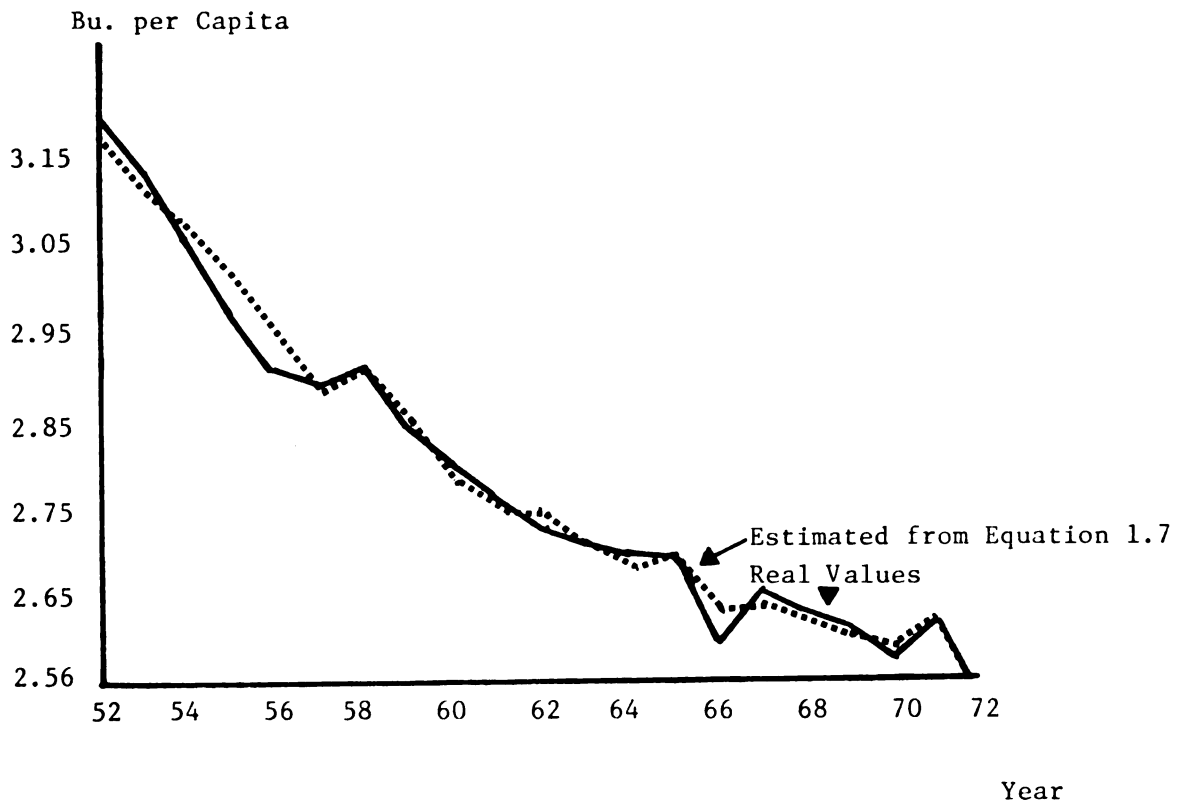

Figure 3.1

U. S.: Quantity of wheat used for food per capita (1952-1972)

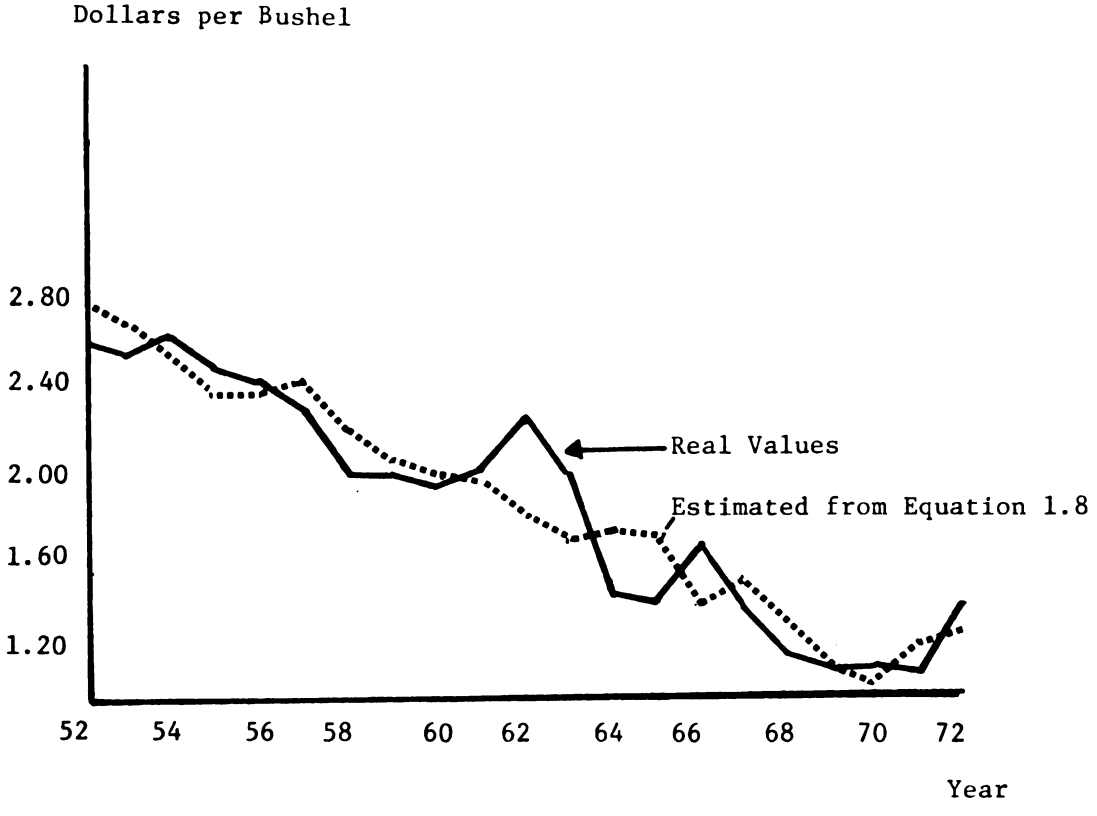

Figure 3.2

U. S.: Farm price of wheat deflated by the CPI (1952-1972)

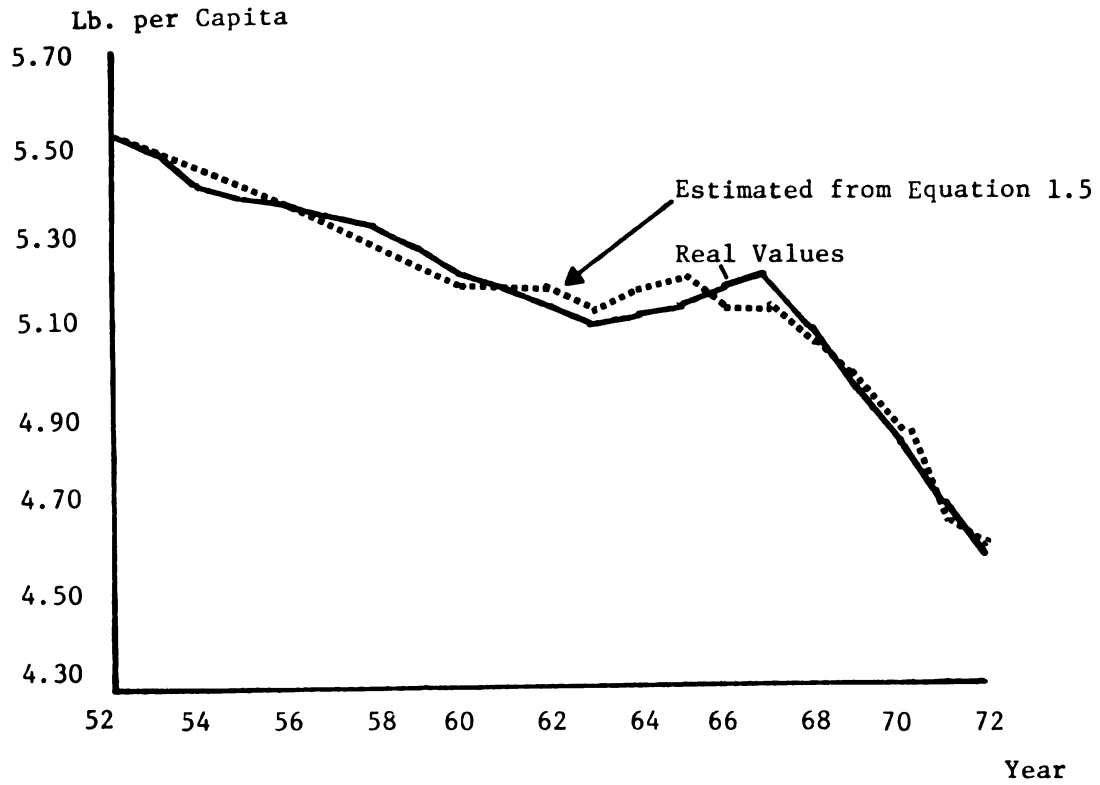

Figure 3.3

U. S.: Quantity of wheat flour used in making bread per capita (1952-1972)

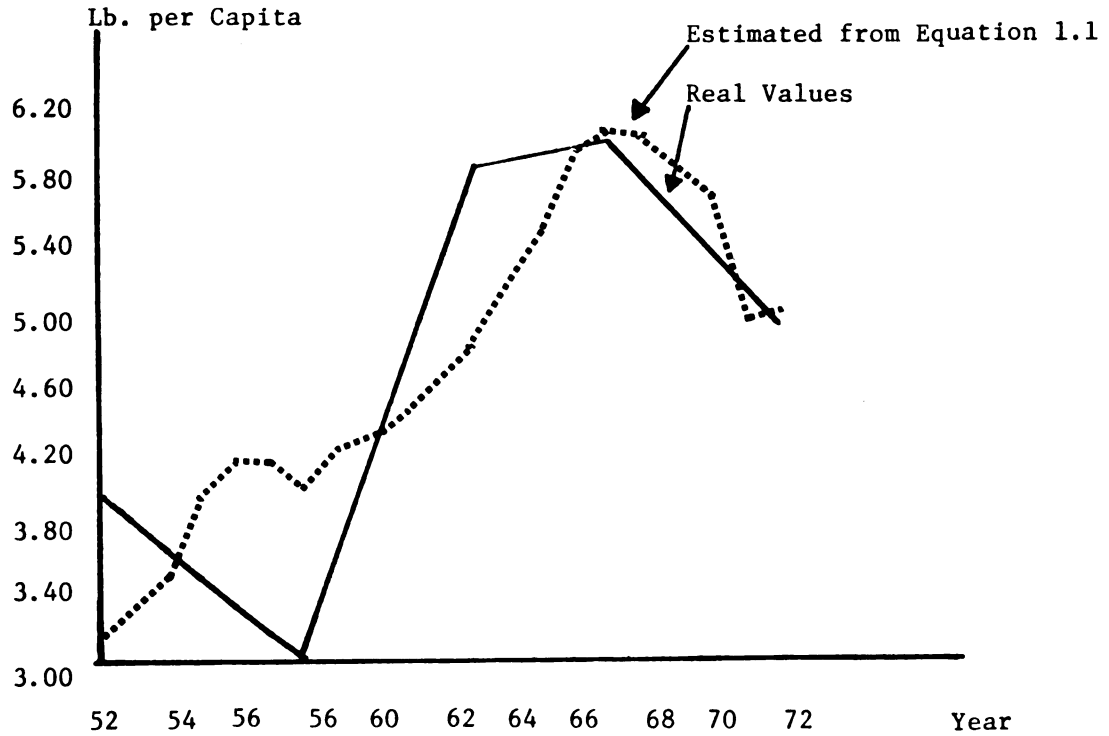

Figure 3.4

U. S.: Quantity of wheat flour used in making flour packaged for retail sale per capita (1952-1972)

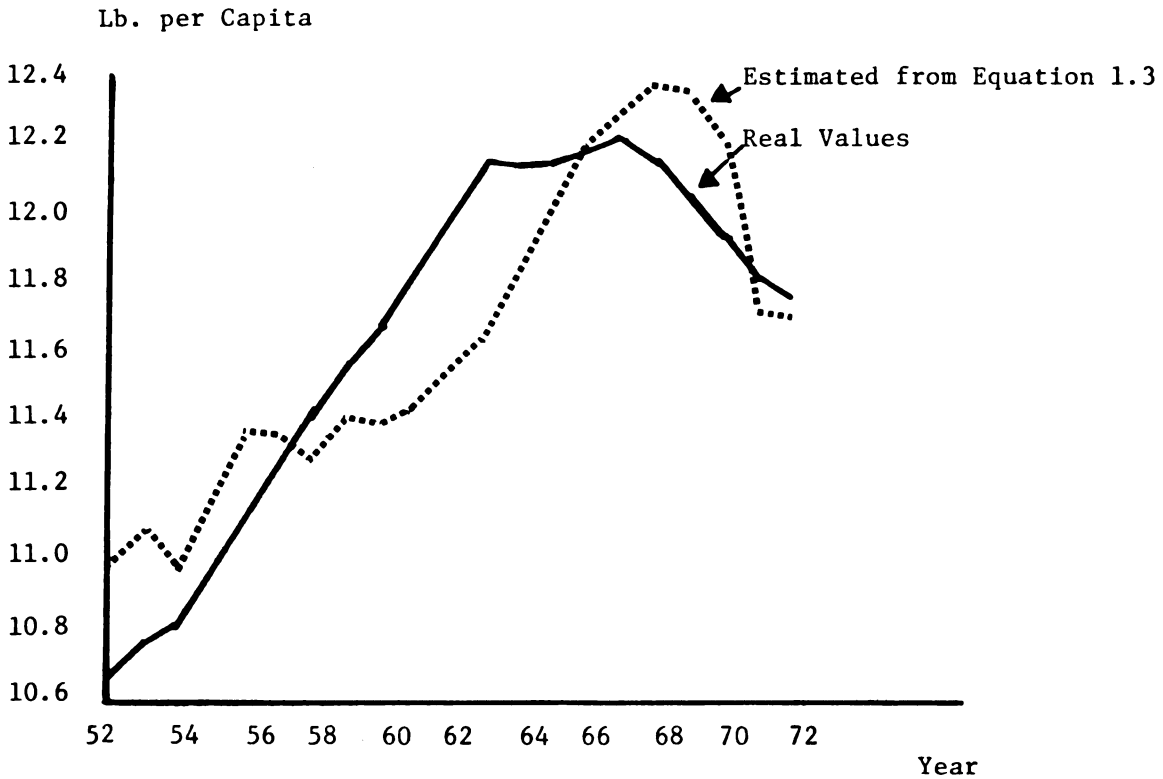

Figure 3.5

U. S.: Quantity of wheat flour used in making cookies and crackers per capita (1952-1972)

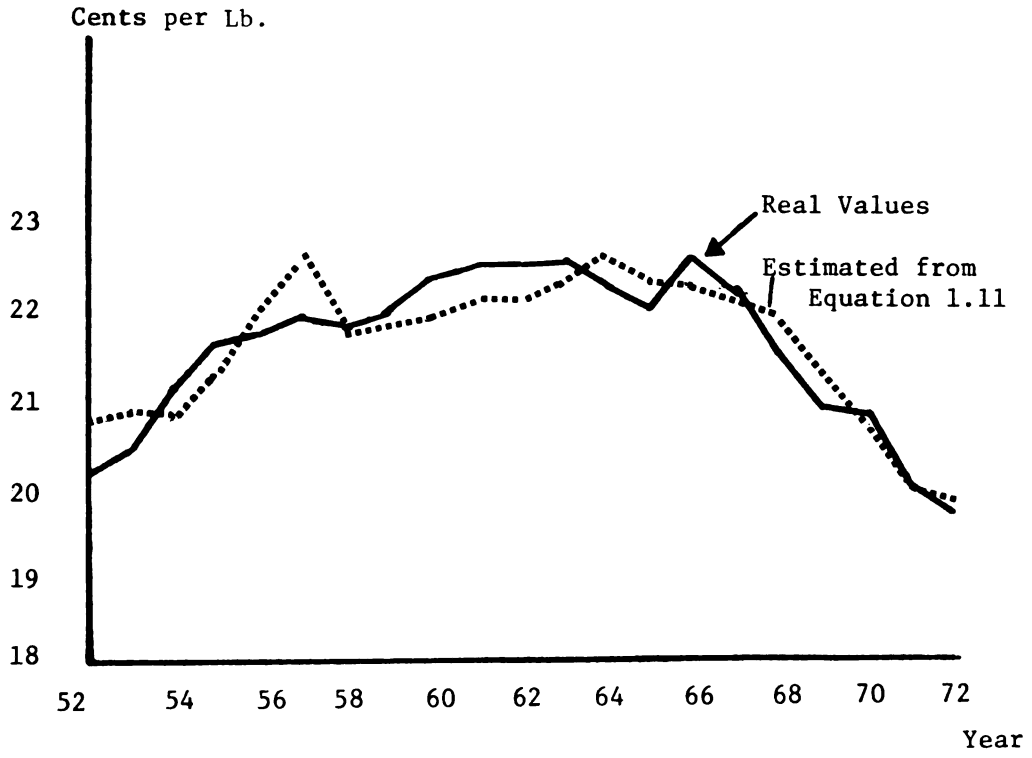

Figure 3.6

U. S.: Retail price of bread deflated by the CPI (1952-1972)

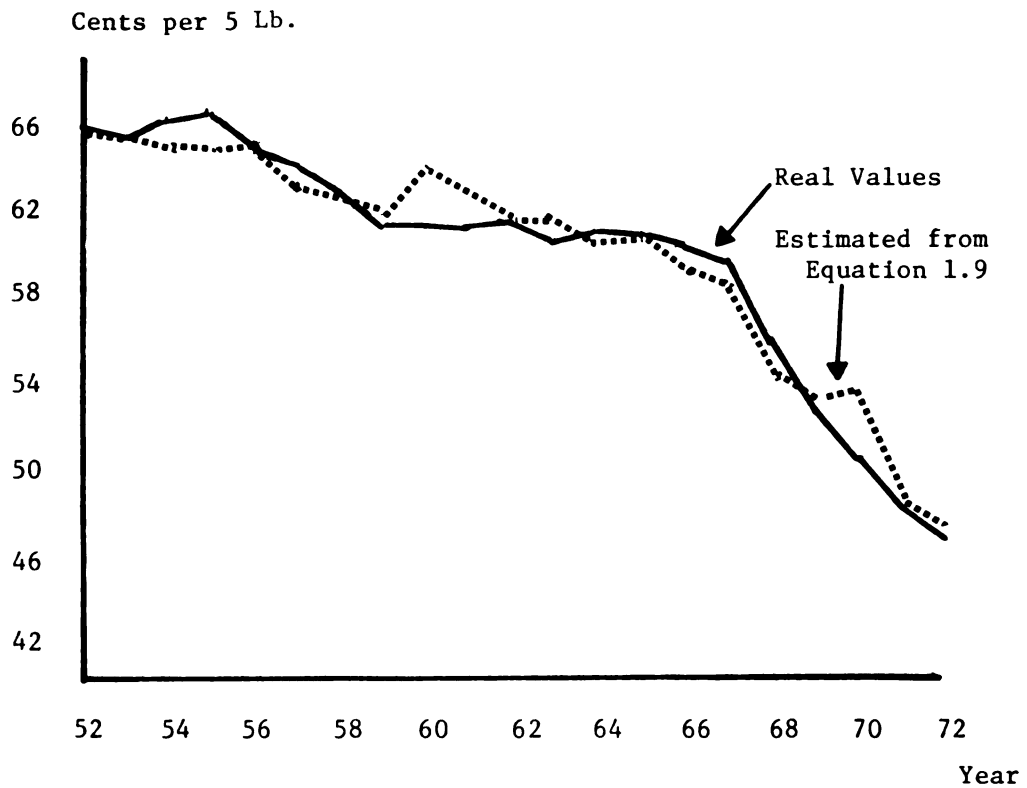

Figure 3.7

U. S.: Price of flour packaged for retail sale deflated by the CPI (1952-1972)

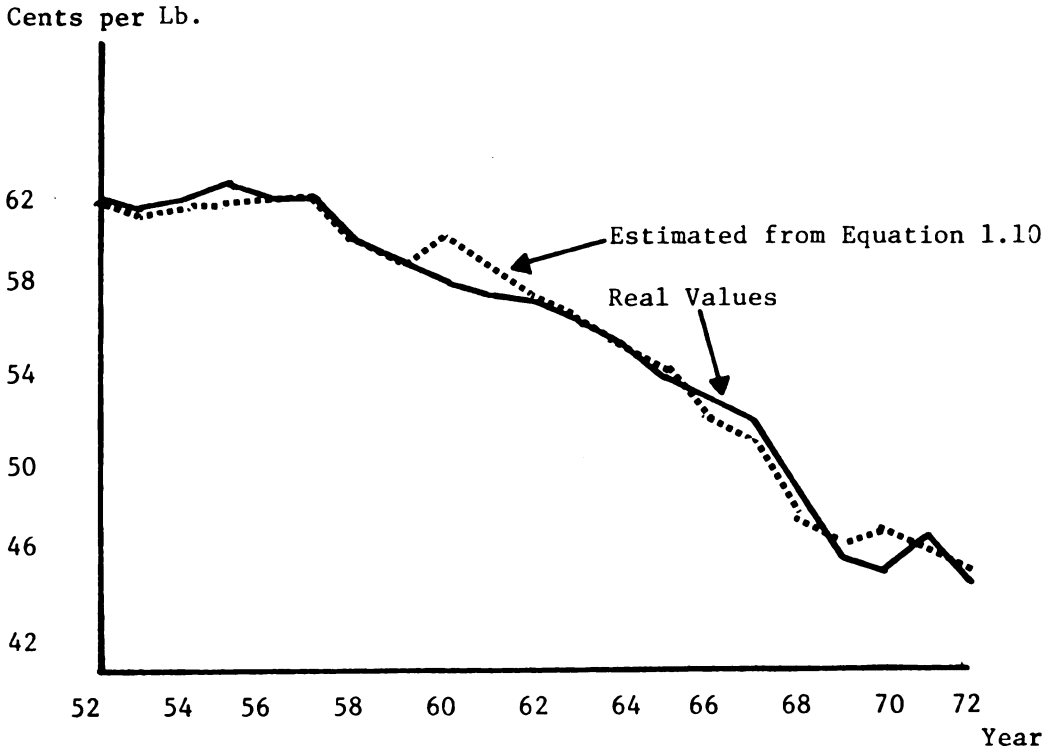

Figure 3.8

U. S.: Price of cookies deflated by the CPI (1952-1972)

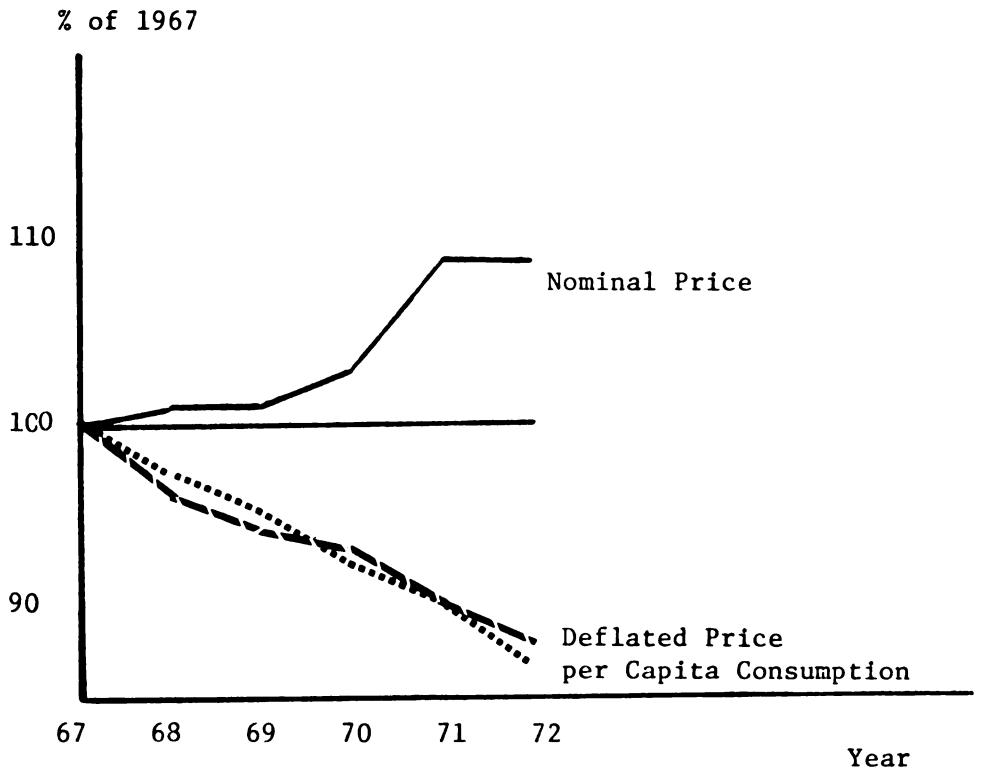

Figure 3.9

U. S.: Bread: price and consumption indexes (1967-1972)

positive influence on consumption. However, it would be interesting to see the effects of this for the period after 1971 when fuel costs rose rapidly.

Income and Transfer Payments: Questions on Analysis

Multicollinearity. Income and transfer payments are included in the analysis although there is a high correlation between them. The correlation between food stamps and income is .70 and between transfer payments and income is .80. Also, all these variables are highly correlated with time (YEAR), stamps (STAMPS), .66; transfer payments (TRANS), .77; and income (Y) .97. These high correlations present some problems in deciphering the relationship between the exogenous variables. Time is excluded from most equations because it provides little insight into the structural relationships involved in the system. Yet, it is likely correlated with some relevant factors excluded from the analysis either because of inability to proxy them such as tastes and preferences or technology, or because of lack of knowledge about their existence.

This analysis accepts the fact of somewhat high correlation between the variables. The implications are that they are fine for prediction purposes but of little use in isolating the affect of either variable on the endogenous variables. The results are checked against theory and against the results of Purcell and Raunikar's study conducted in Georgia.[1]

Income distribution. Both income and transfer payments or food stamps have been included in an attempt to capture the food consumption

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[1] J. C. Purcell and Robert Raunikar, "Quantity-Income Elasticities for Foods by Level of Income," Journal of Farm Economics, XLIX (1967), 1410-1414.

of low and higher income groups. The transfer payments (TRANS) or food stamps (STAMPS) variable proxies income to low income groups, and average income (Y) captures that to higher income groups. Purcell and Raunikar use cross-sectional data to measure income elasticities for various income groups. Theoretically, there should be consistency between transfer and food stamps elasticities and Purcell and Raunikar's low income elasticities, and between my income elasticities and Purcell and Raunikar's income elasticities for higher incomes.

The problem of the excluded variable is now apparent. High correlation may exist between transfer payments, a variable included in the statistical analysis, and personal taxes, a variable not included in the statistical analysis. If this is true, the estimated coefficient for the transfer payment variable represents not only the increase in income to low income people but also the decrease in income of the higher income people or the taxpayers. This biases the coefficient.

There is some correlation between transfer payments and taxes, but the transfer payments here are only income dependent transfers and, therefore, are only a portion of the total transfers. As noted earlier, in 1972, for example, these income-tested programs represented only 24.6 percent of the social welfare transfers. Other types of transfers, such as transfers through the farm programs, are not included under social welfare income-tested transfers. A more exhaustive analysis is needed to analyze the possible relationships between the income-tested transfers presented here and taxes.

Doublecounting. Doublecounting becomes a problem when both income and transfer payments are considered. Income is defined as personal disposable income (income after taxes and transfer payments, but

before payments in kind). Therefore, transfers are actually included twice, in the average income and as a separate variable. In this analysis average income is used as a proxy for the income to those not receiving transfer payments.

Income and transfer elasticities. The expectation for income elasticities aggregated over all income groups is that they will be positive with a few exceptions for low preference products. In the King and George's analysis, for example, only lard has a negative income elasticity. For disaggregated income groups, we might expect large differences in elasticities among the various income groups.

At very low incomes, elasticities would tend to be positive, indicating that a high percentage of each additional dollar is spent on food. There would be little substitutability between food items and additional dollars would be spent on inexpensive generally low preference foods.

As incomes increase and there is more substitutability among foods, the elasticities for some foods might be negative. The higher the income, the more substitutions there are for any product, because the absolute price is less of a constraint, and response to income change is likely to decrease. This decrease is less likely to occur if the good is highly preferred. Beef is a good example.

Analysis of Income and Transfer Payments in the Wheat Equation

For all commodities, both the transfer payment variable (TRANS) and the food stamp variable (STAMP) are tested. In the wheat equations the food stamp variable produces better statistical results.

Results of the analysis of food stamps and income are presented in Table 3.4. For flour, the income elasticity is rather high. A decrease in elasticity is expected as income rises. An increase in desire for home-baked products is a possible explanation for increased elasticity among high income groups. Again, a more thorough analysis of demand for marketing services is needed.

The results for cookies are somewhat unbelievable. There is no ready explanation for the decreasing elasticity from low income to high. The elasticities for bread are quite consistent with other analyses and suggest a constant income elasticity for bread in all income categories.

Questions on Analysis of Farm-Retail Price Differentials:
Farm-Retail Price Differentials versus Marketing Margins

The farm-retail price differentials here are not equivalent to the "marketing-margins" or "farm-retail spreads" used by the U. S. Department of Agriculture. Figure 3.10 below illustrates the U. S. Department of Agriculture's concept. First, an equivalency is established between the retail product and the average amount of farm product that goes into the retail product.[1] Because one unit of a particular farm commodity may not be used for only one retail product, other uses of the farm product must also be considered. For example, a by-product of butter is dry skimmed milk powder. Therefore, the contribution of skimmed milk powder must be subtracted from the gross farm value to obtain a net farm value for butter. The net farm value for the particular retail product is then subtracted from the retail price per pound of that product to arrive

[1] U. S. Department of Agriculture, Economic Research Service, Conversion Factors and Weights and Measures for Agricultural Commodities and their Products, Statistical Bulletin No. 362 (Washington, D. C.: Government Printing Office, 1965).

TABLE 3.4

INCOME AND FOOD STAMP ELASTICITIES
FOR WHEAT PRODUCTS

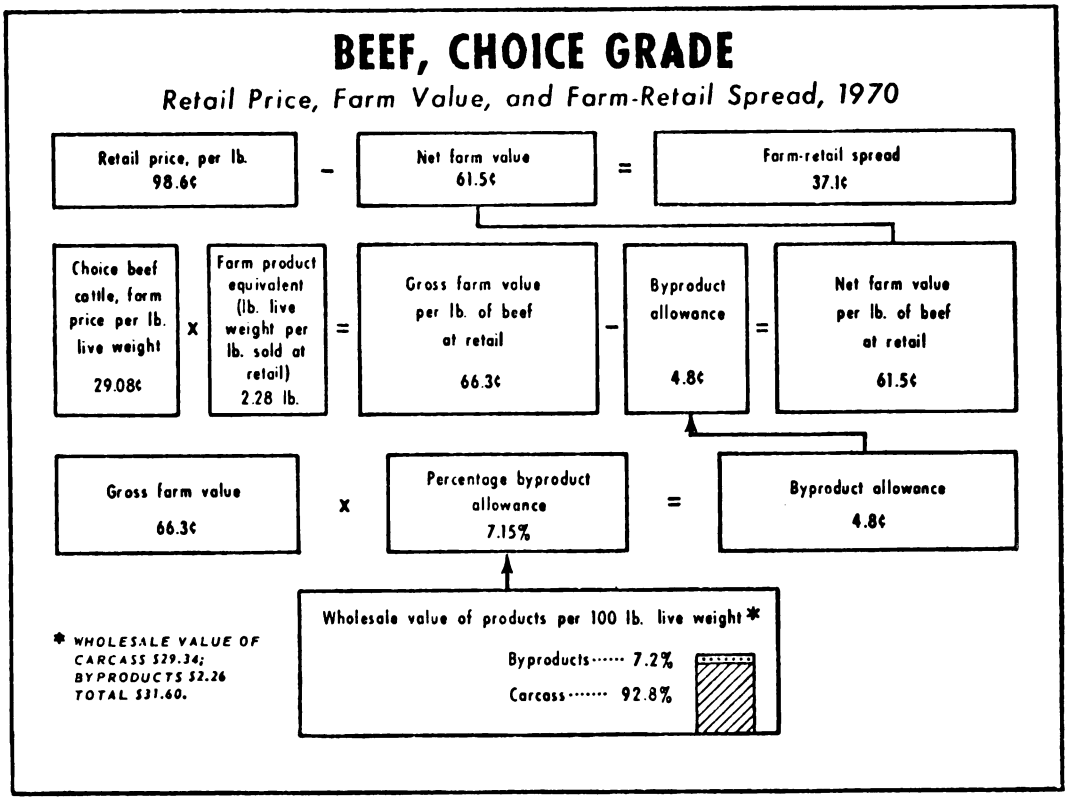
	Packaged Flour	Cookies	Bread
Income elasticity	1.72	.37	.013
t-test for income coefficient	2.22	2.18	.40
Food stamps elasticity	-.036	-.013	.008
t-test for food stamp coefficient	.90	3.61	3.95
High income elasticity[a]	-3.35[d]	b	-.04
Low income elasticity[a]	-.30[d]	b	.19
Aggregate income elasticity[c]	.08	b	.00

[a]Source: J. C. Purcell and Robert Raunikar, "Quantity-Income Elasticities for Foods by Level of Income," Journal of Farm Economics, XLIX (1967), 1410-1414.

[b]No Analysis made of demand for cookies.

[c]Source: P. S. George and G. A. King, Consumer Demand for Food Commodities in The United States with Projections for 1980, Giannini Foundation Monograph No. 26, (Davis: March, 1971), p. 51.

[d]Includes cornmeal as well as white flour.



Source: U. S. Department of Agriculture, ERS, Farm Retail Spreads for Food Products, Miscellaneous Publication No. 741 (Washington, D. C.: Government Printing Office, 1971) p. 66.

Figure 3.10

Determination of U. S. Department of Agriculture's farm-retail spreads: an example

at the marketing margin or farm retail spread. If other ingredients are used to prepare the retail product, the costs of those ingredients must be subtracted from the retail price to arrive at the marketing costs.

In this analysis the marketing margins are not estimated directly but emerge from the estimations of the price at both the retail and farm level. By estimating the by-product allowance and delineating other ingredients into the retail product, the marketing margin can be determined.

The farm-retail price differential, not the spread or the margin, is estimated here. The differential is merely the difference between the farm and retail prices of the farm product per retail quantity, after the farm price has been converted by determining the amount of the farm commodity that is an input into the retail product. The farm-retail price differentials measure the amount of the retail price that goes to marketers.

Farm-Retail Price Differentials for Wheat

The farm-retail price differential has decreased for flour and cookies. This means an absolute decrease in deflated dollars to inputs other than wheat. The farm-retail spread, as calculated by the U. S. Department of Agriculture, has also decreased. For bread, the retail price differential and the farm-retail spread have increased. At the same time, the percent of the retail product going to the farmer for all three wheat products has decreased (Table 3.5). Thus, whether the farm-retail price differential and retail price increase or decrease, the percent going to the farmer tends to decrease relative to the suppliers of other inputs into the retail process.

TABLE 3.5

WHEAT: FARM-RETAIL SPREADS AND PERCENT OF RETAIL PRICE GOING TO FARMER (1950-1970)[a]

	White bread	Cookies	Flour
Percent of retail price going to farmer			
1950	39	4.2	39
1960	35	3.4	35
1970	35	3.2	35
Farm-retail spread[b]			
1950	15.6	c	41.4
1960	19.0	51.8	39.6
1970	17.8	39.6	32.8

[a]Source: U. S. Department of Agriculture, ERS, Farm-Retail Spreads for Food Products, Miscellaneous publication No. 741 (Washington, D. C.: Government Printing Office, January 1972).

[b]Farm-retail spread as defined by U. S. Department of Agriculture and deflated by CPI (1967=100).

[c]Data not available.

Farm Level Demand

At the farm level, the price of bread, cookies and fuel are especially important in determining how much wheat goes into food (Equation 1.7). The price of bread, as expected, is the most important factor. It has a strong negative impact, but the price of cookies has a positive impact. This is difficult to justify theoretically.

Labor costs do not have an impact on the quantity of wheat used for food. Fuel prices have a very small impact (Equation 1.7).

There is no simultaneity in determining the price or quantity of wheat that goes into food. Farmers respond to the price of the previous year.

Milk

Modeling the Dairy Sector

The dairy industry in the United States is heavily regulated. Milk is graded for manufacturing and fluid use and prices are regulated by both federal and state governments. The grade of milk is determined by the sanitary conditions under which it is produced. There has been a large shift in production from manufactured grade to higher standard fluid grade. Presently, only about one-fourth of the milk sold by farmers is sold as manufacturing milk. Regulation of prices by federal and state governments has increased from the late 1940s when 50 percent of the fluid grade milk was regulated to presently when 96 percent is regulated.[1]

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[1]U. S. Department of Agriculture, Economic Research Service, Milk Pricing, by Alden Manchester, Agricultural Economics Report No. 315 (Washington, D. C.: Government Printing Office, 1975), pp. 9-10.

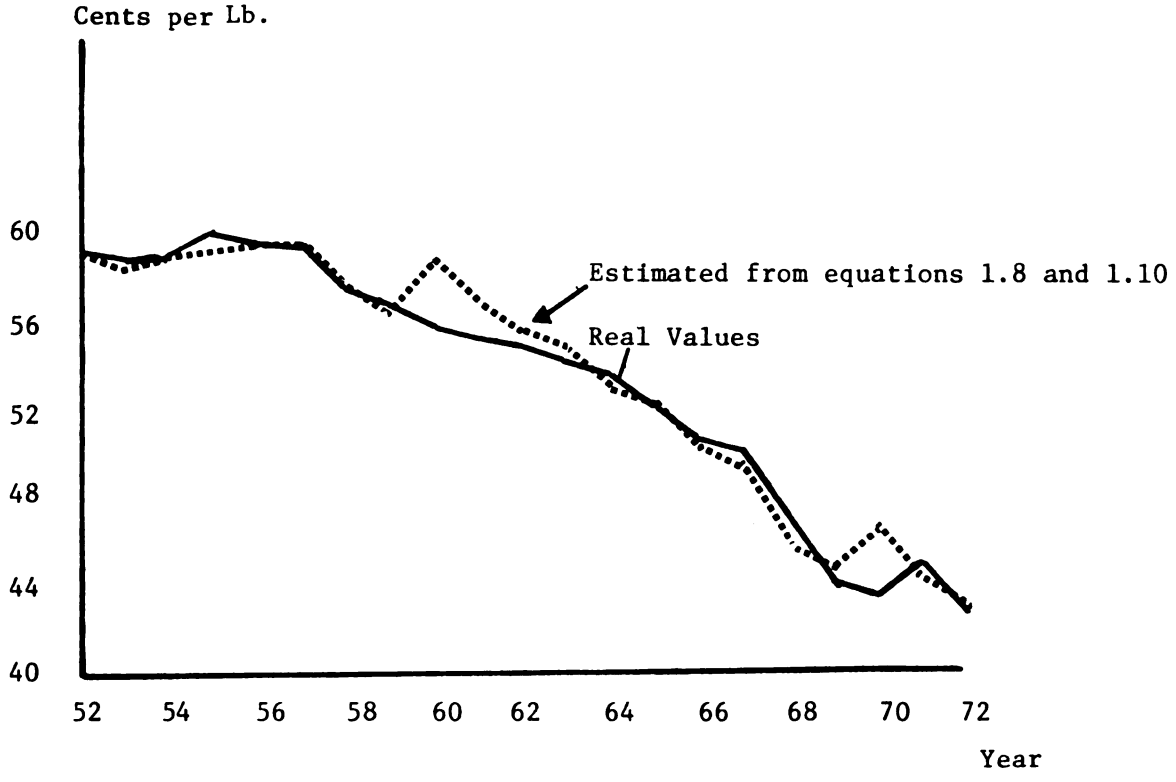

Figure 3.11

U. S.: Farm-retail price differential for cookies deflated by the CPI (1952-1972)

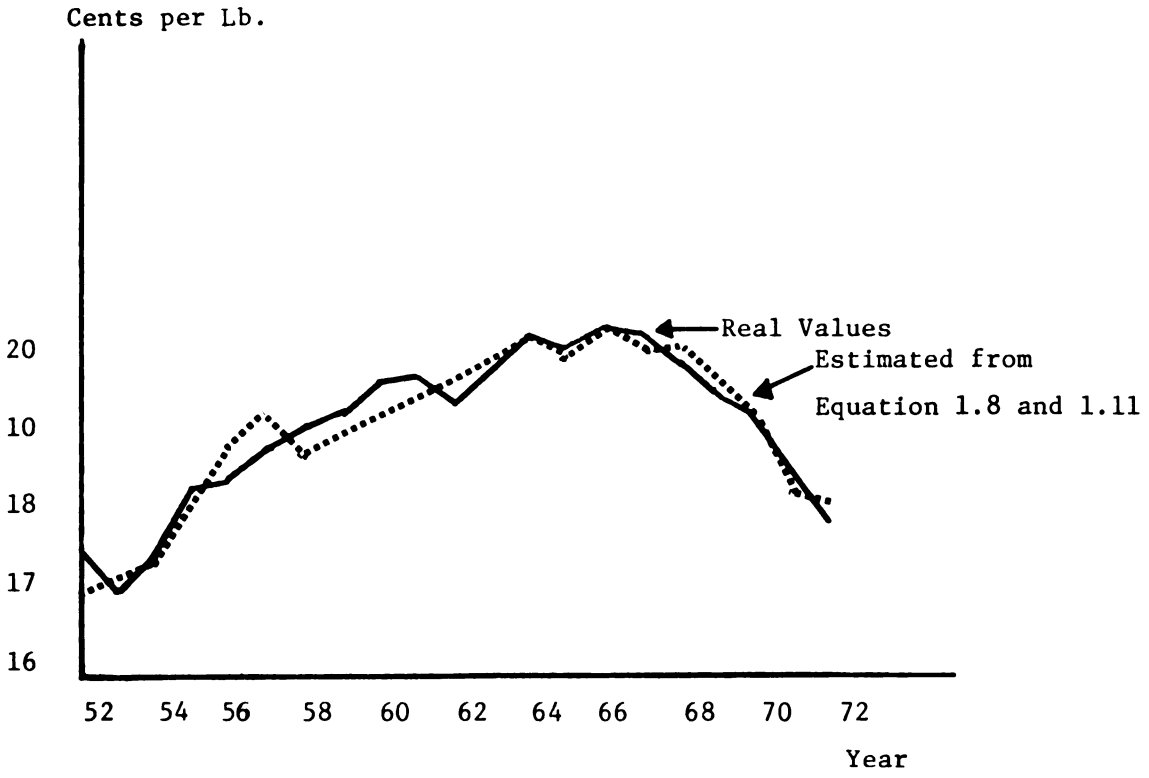

Figure 3.12

U. S.: Farm-retail price differentials for bread deflated by the CPI (1952-1972)

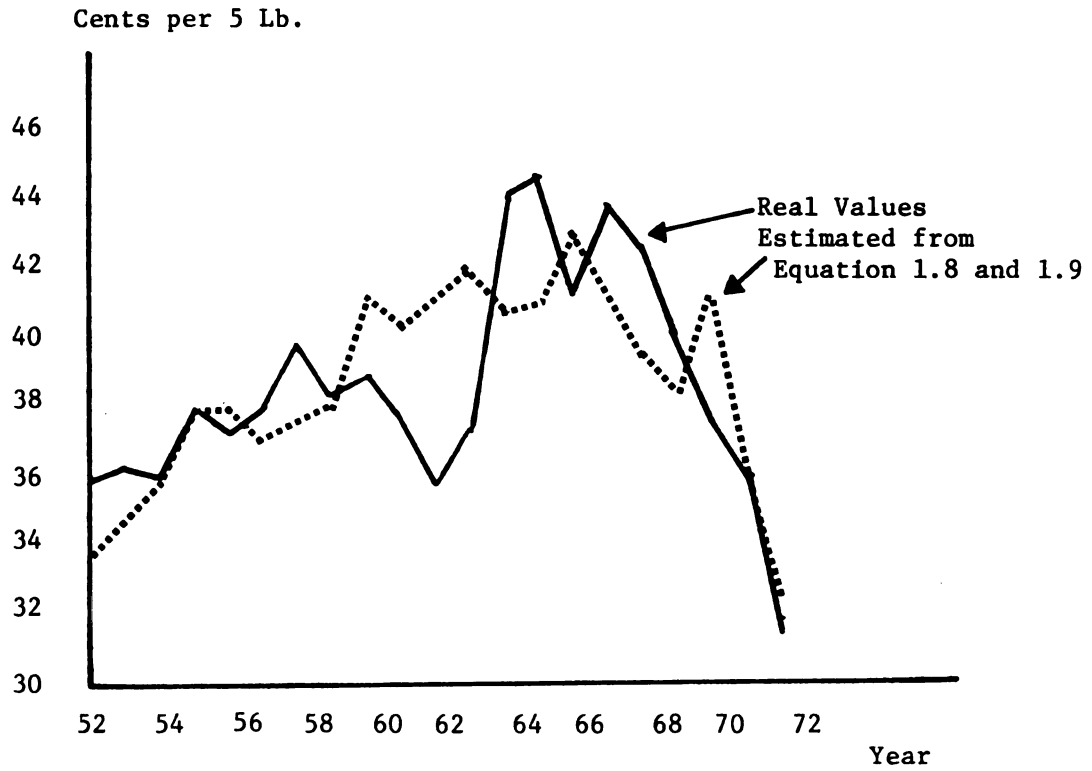

Figure 3.13

U. S.: Farm-retail price differentials for flour packaged for retail sale deflated by the CPI (1952-1972)

As with wheat, the major retail products are used in the estimation. Table 3.6 illustrates major uses of milk. About 50 percent is used for fluid milk production and 40 percent for manufactured products such as butter and cheese. These products are considered the major retail products to be used in analysis. As evident from Item 2 in Table 3.6 virtually all the milk consumed in the United States was produced in the United States that year; little is stored, exported or imported.

It is difficult to determine what price to use in the estimation procedure which proxies the price set by government policy. First, it is supposedly exogenously determined. But this is not completely true because the price is set to represent what would be a longer-run market price, i.e., an endogenously determined variable.

Second, milk prices are regionally determined. Therefore an analysis of the milk market by state or region may present a more precise picture of the dairy sector. In this model a lagged price on the farm and lagged quantity of milk produced are used to proxy the government policy price. Farm price is tested for simultaneous determination with quantity because policy price and farm price are not always the same. The policy price only determines the lower limit.

Supply was tested for simultaneous determination with demand by including the most significant variables from previous independent estimations of the farm supply equation. Those variables were corn, price of non-fed beef and private wage.

Data: Correlation Matrix, Sources of Data and Adequacy of Proxies

The quantities of cheese, butter and fluid milk used were milk equivalents of the quantities. The estimates of the products can be

TABLE 3.6

U. S. CONSUMPTION OF MILK AND DAIRY PRODUCTS (1950-1970)

	1950	1960	1970
1. Milk[a] used for domestic consumption (millions of pounds)	117,358	123,102	117,493
(per capita pounds)	663	691	582
2. Percent of milk[b] used for domestic consumption that was produced in the U. S. that year.	99.35	100.005	99.54
3. Percent of milk[b] used for:			
manufacturing	47	48	51
fluid	36	43	44
farm use	15	7	3
residual	2	2	2
	100	100	100
4. Percent of milk[b] used in various manufactured products as percentages of total consumption in U. S.:			
butter	23	23	20
cheese	10	11	17
canned milk	5	4	2
dry whole milk	.8	.5	.4
ice cream	5	7	9
other manufactured products	3.2	2.5	2.6
milk used for manufacturing	47	48	51

[a]Source: U. S. Department of Agriculture, Agricultural Statistics, (Washington, D. C.: Government Printing Office, 1972).

[b]Computed from above source.

improved by using actual product quantities.

The retail price used for cheese is the price of American cheese. However, there has been a shift in demand for more specialty cheeses and the price of American cheese may not represent this trend.

The price of milk at the farm used in the model is an aggregate price (the price of milk sold to plants and dealers). A disaggregated price series is also available for fluid milk and milk used for manufacturing. The manufacturing grade can be disaggregated further to milk used for butter, cheese, and other manufactured products. Because 50 percent of the milk is used for fluid, this blend price may reflect milk price fluctuations for the fluid milk more than the price of milk for other uses.

Fluid milk costs more than manufactured milk; thus, the aggregate price of milk sold to plants and dealers used in this model is higher than that used for manufacturing. In 1973, for example, the price in dollars per 100 pound of various grades of milk was as follows:

Eligible for fluid milk	$ 7.42
Of manufacturing grade	6.20
Milk for butter	6.10
Milk for all cheese	6.35
Milk for evaporated milk	5.64
All milk wholesale[1]	7.14

Further disaggregation is needed to determine marketing margins. The differential between the price of all milk for wholesale and the price of manufactured grade is large enough so that if the price of all milk is used as a proxy for manufactured milk, the wholesale price of the milk used in making butter is higher than the retail price of the butter--an

[1]This blend price is used in the estimation.

TABLE 3.7

THE DAIRY MODEL

System of equations for milk

Retail demand:	$(QFLUID, PFLUID, \bar{Z}) = 0$
Retail supply:	$(QFLUID, PFLUID, PMILKF, \bar{Z}) = 0$
Retail demand:	$(QCHEESE, PCHEESE, \bar{Z}) = 0$
Retail supply:	$(QCHEESE, PCHEESE, PMILKF, \bar{Z}) = 0$
Retail demand:	$(QBUTTER, PBUTTER, \bar{Z}) = 0$
Retail supply:	$(QBUTTER, PBUTTER, PMILKF, \bar{Z}) = 0$
Farm demand:	$(PMILKF, PBUTTER, PFLUID, PCHEESE, QMILKF, \bar{Z}) = 0$
Farm supply:	$(QMILKF, \overline{POLICYPRICE}, \bar{Z}) = 0$

Endogenous variables

QFLUID	quantity of fluid milk at retail level
PFLUID	price of fluid milk at retail level
PMILKF	price of milk received by farmers
QCHEESE	quantity of cheese at retail level
PCHEESE	price of cheese at retail level
QBUTTER	quantity of butter at retail level
PBUTTER	price of butter at retail level
POLICYPRICE	policy price for farm level milk

Exogenous variables $\bar{Z}$

TRANS	transfer payments
Y	disposable personal income
PBURGER	price of hamburger meat
PMARG	price of margarine
PBREAD	price of bread
WAGEFME	wage of food manufacturing employees
PFUEL	price of fuel
QMILKFMLAG	quantity of milk produced in time t-1
QMILKFARM	quantity of milk produced in time t

unlikely conclusion.

Simple correlations for all variables used in the dairy equations are presented in Table 3.8. As with the wheat equations, there is high correlation between transfer payments (TRANS) and average income (Y). In addition, the index price of fuel is highly correlated with many of the relevant milk variables. This causes difficulty in analysis.

Analysis of Regression Results

Quantity and Price

There have been some major changes in dairy product usage in the United States. Milk use both for fluid milk and manufactured products has decreased from 663 pound per capita in 1950 to 582 pound in 1970. Figures 3.14, 3.15 and 3.16 illustrate some of the per capita changes in consumption trends. Use of fluid milk and cream per capita as well as butter has decreased considerably while that of cheese has increased (Table 3.6). The total amount of milk consumed has declined by 135 million pound or by .11 percent. This represents a per capita consumption decline of 12 percent (see Figure 3.17).

Deflated prices of butter, cheese and fluid milk are illustrated in Figure 3.22, 3.23 and 3.24. All prices declined steadily except that of cheese which begins to increase after 1963. Figure 3.14, 3.15 and 3.16 compare prices both deflated and undeflated with quantities of the various retail products consumed. As illustrated in Table 3.8, there is a positive correlation between deflated prices and quantities consumed. With cheese the correlation is .42; with butter .48; and with fluid milk .73. This is, of course, the opposite of what is expected. A negative correlation is obtained only when undeflated prices are used (except for cheese). Again there is a positive correlation of .82 with cheese, but

TABLE 3.8

SIMPLE CORRELATIONS MATRIX FOR VARIABLES USED IN THE DAIRY EQUATIONS[a]

	FUEL	PBREAD	PBUTTER	PCHEESE	PMGROC	PMILKFARM	PHAMBURG	PMARG	QBUTTER	QCHEESE	QFLUID	QMILKFARM	QMILKFARMLAG	TRANS	WAGE	Y	YEAR
FUEL	1																
PBREAD	.39	1															
PBUTTER	.62	-.28	1														
PCHEESE	-.32	-.51	.37	1													
PMGROC	.80	.08	.83	.03	1												
PMILKFARM	.11	-.58	.77	.78	.53	1											
PHAMBURG	-.04	-.17	.35	.24	.32	.45	1										
PMARG	.80	-.10	.88	.06	.86	.51	.10	1									
QBUTTER	.82	.24	.48	-.48	.64	-.10	-.13	.72	1								
QCHEESE	-.67	-.18	-.57	.42	-.69	-.11	-.46	-.63	-.66	1							
QFLUID	.91	.27	.59	-.44	.73	.05	-.08	.82	.83	-.78	1						
QMILKFARM	.84	-.03	.76	-.19	.79	.28	-.03	.94	.88	-.67	.89	1					
QMILKFARMLAG	.85	.02	.74	-.24	.78	.25	-.01	.94	.85	-.73	.93	.98	1				
TRANS	-.80	-.31	-.57	.40	-.59	.01	.07	-.70	-.79	.77	-.91	-.79	-.83	1			
WAGEFME	-.73	.06	-.74	.15	-.68	-.27	-.14	-.84	-.79	.70	-.79	-.90	-.89	.77	1		
Y	-.79	-.01	-.70	.32	-.76	-.18	-.11	-.86	-.89	.80	-.87	-.95	-.95	.82	.94	1	
YEAR	-.79	.14	-.85	.06	-.84	-.44	-.11	-.96	-.80	.71	-.84	-.97	-.96	.75	.91	.94	1

[a]All quantities are per capita and all variables expressed in dollars have been deflated by the CPI (1967=100). TRANS and Y are deflated and per capita. Further explanation and data sources for all variables can be found in Appendix B.

TABLE 3.9

REGRESSION RESULTS FOR DAIRY EQUATIONS[a]

Equation	Title	Results	Excluded exogenous	R^2	DW
2.1	Retail demand for cheese	QCHEESE = 74.75 + .68 PCHEESE + 5.74 $\overline{\text{TRANS}}$ (.17) (.89) + 5.35 $\overline{\text{Y}}$ - .56 $\overline{\text{PHAMBURG}}$ (1.54) (1.54)	PBREAD PMARG WAGEFME FUEL QMILKFMLAG	.96	2.20
2.2	Price of cheese	PCHEESE = 65.77 - .06 $\overline{\text{QMILKFMLAG}}$ - .07 $\overline{\text{WAGEFME}}$ (21.25) (.02) (.03) - .07 $\overline{\text{FUEL}}$ - .40 $\overline{\text{PBREAD}}$ - .01 $\overline{\text{PBURGER}}$ (.09) (.44) (.05) + 1.20 $\overline{\text{PMARG}}$ + 7.77 $\overline{\text{Y}}$ - .61 $\overline{\text{TRANS}}$ (.21) (3.64) (.72)	OLS from equation 2.1	.91	2.69
2.3	Retail supply of cheese	QCHEESE = 14.93 + 3.46 PCHEESE - 1.66 PMFARM (1.04) (.57) + .06 $\overline{\text{WAGEFME}}$ - .02 $\overline{\text{FUEL}}$ (.06) (.21)	PBREAD PHAMBURG PMARG Y QMILKFMLAG TRANS	.73	1.22
2.4	Retail demand for butter	QBUTTER = 264.97 - 1.80 PBUTTER - 56.91 $\overline{\text{Y}}$ (.92) (18.12) + 1.46 $\overline{\text{PMARG}}$ - 3.13 $\overline{\text{TRANS}}$ + 3.38 $\overline{\text{PBREAD}}$ (1.96) (8.19) (3.87)	WAGEFME FUEL QMILKFMLAG PHAMBURG	.86	2.39

TABLE 3.9 (cont'd)

Equation	Title	Results	Excluded exogenous	R^2	DW
2.5	Price of butter	PBUTTER = 151.43 − .15 $\overline{\text{QMILKFMLAG}}$ − .10 $\overline{\text{WAGEFME}}$ (40.28) (.05) (.05) + .31 $\overline{\text{FUEL}}$ − 2.83 $\overline{\text{PBREAD}}$ .13 $\overline{\text{PBURGER}}$ (.17) (.85) (.09) + 2.45 $\overline{\text{PMARG}}$ + 3.77 $\overline{\text{Y}}$ − 5.29 $\overline{\text{TRANS}}$ (.41) (6.91) (1.37)	OLS from equation 2.4	.96	3.28
2.6	Retail supply of butter	QBUTTER = 159.28 + 1.80 PBUTTER − 3.70 PMFARM (1.66) (2.07) − .33 $\overline{\text{WAGEFME}}$ + .98 $\overline{\text{FUEL}}$ (.24) (.67)	PBREAD PHAMBURG PMARG Y QMILKFARM TRANS	.86	1.26
2.7	Retail demand for fluid milk	QFLUID = 297.10 + .67 PMGROC − 16.40 $\overline{\text{Y}}$ (.81) (7.48) − 11.81 $\overline{\text{TRANS}}$ (3.35)	PBREAD PHAMBURG PMARG WAGEFME FUEL QMILKFMLAG	.88	.73
2.8	Price of fluid milk	PMGROC = 43.29 − .05 $\overline{\text{QMILKFMLAG}}$ + .08 $\overline{\text{WAGEFME}}$ (23.18) (.02) (.03) + .23 $\overline{\text{FUEL}}$ − .16 $\overline{\text{PBREAD}}$ + .07 $\overline{\text{PBURGER}}$ (.10) (.48) (.05) + .71 $\overline{\text{PMARG}}$ − 8.77 $\overline{\text{Y}}$ + .09 $\overline{\text{TRANS}}$ (.23) (3.97) (.79)	OLS from equation 2.7	.92	2.22

TABLE 3.9 (cont'd)

Equation	Title	Results	Excluded exogenous	R^2	DW
2.9	Retail supply of fluid milk	QFLUID = 209.50 + .37 PMGROC − .54 PMFARM (1.49) (.54) − .19 $\overline{\text{WAGEFME}}$ + 1.26 $\overline{\text{FUEL}}$ (.09) (.50)	PBREAD PHAMBURG PMARG Y QMILKFMLAG TRANS	.87	1.45
2.10	Farm demand for milk	PMFARM = −22.38 + .58 PMGROC + .41 PBUTTER (.44) (.21) + .62 PCHEESE − .005 $\overline{\text{QMILKFARM}}$ (.37) (.01) + .01 $\overline{\text{WAGEFME}}$ − .21 $\overline{\text{FUEL}}$ (.04) (.12)	PBREAD PHAMBURG PMARG Y TRANS	.92	1.44
2.11	Quantity of milk	QMILKFM = 777.87 + .07 $\overline{\text{QMILKFMLAG}}$ + .18 $\overline{\text{WAGEFME}}$ (191.72) (.23) (.28) + 1.97 $\overline{\text{FUEL}}$ − 9.07 $\overline{\text{PBREAD}}$ − 1.49 $\overline{\text{PBURGER}}$ (.83) (4.04) (.45) + 4.33 $\overline{\text{PMARG}}$ − 107.09 $\overline{\text{Y}}$ + 1.10 $\overline{\text{TRANS}}$ (1.97) (32.89) (6.54)	OLS	.99	2.75

[a]A complete description and source of all data can be found in Appendix B. All quantity variables are per capita and all price variables have been deflated by the CPI (1967 = 1000). Parenthesis under the coefficients encloses the standard errors. Bars over the variables indicate the exogenous variables.

TABLE 3.10

PRICE, INCOME AND TRANSFER ELASTICITIES
FOR DAIRY PRODUCTS

	Fluid milk	Cheese	Butter
Price elasticity	.12	.32	-.82
t value on price coefficient	.82	4.00	1.95
King and George's price elasticity[a]	-.34	-.46	-.62
Income elasticity	-.13	.14	-.87
t value on income coefficient	2.19	3.47	3.10
Transfer elasticity	-.79	1.28	-.87
t value on transfer coefficient	3.52	6.44	.38
Low income elasticity[c]	.35	b	b
High income elasticity	.35	b	b
Aggregate income elasticity[a]	.203	.24	.318

[a]Source: P. S. George and G. A. King, Consumer Demand for Food Commodities in the U. S. with Projection for 1980, Giannini Foundation Monograph No. 26 (Davis: March, 1971).

[b]Data not available.

[c]Source: J. C. Purcell and Robert Raunikar, "Quantity Income Elasticities for Foods by Level of Income," Journal of Farm Economics, XLIX (1967), 1410-1414.

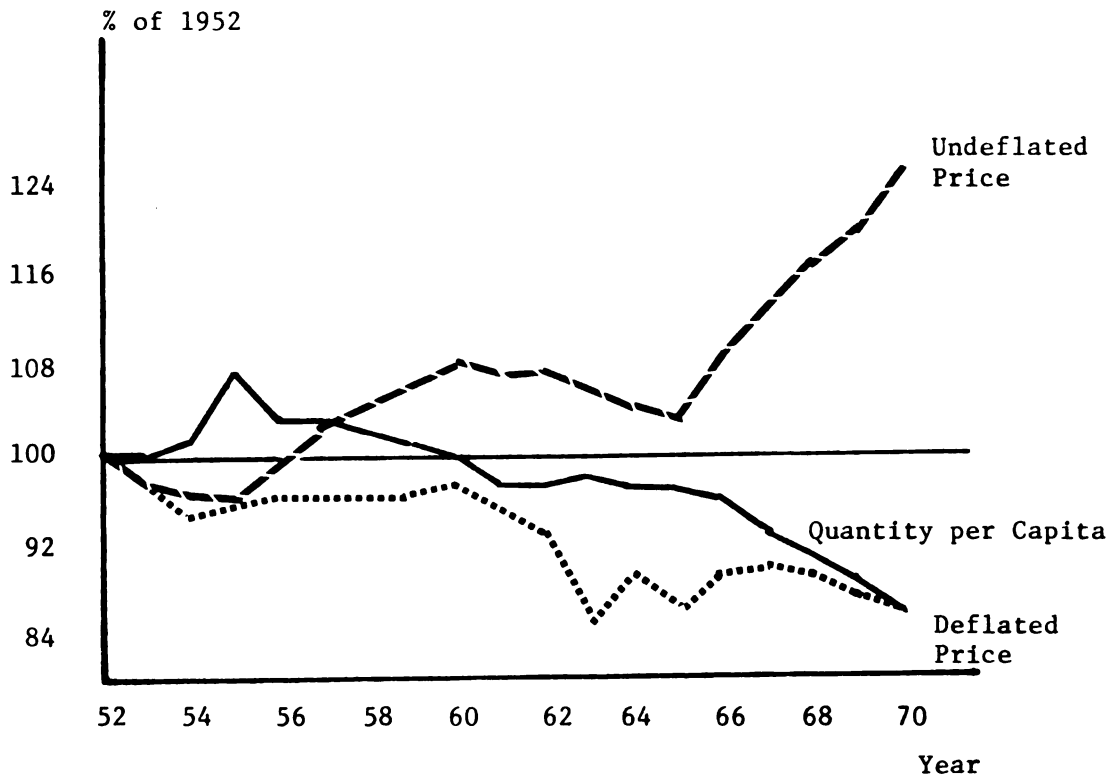

Figure 3.14

U. S.: Fluid milk: price and consumption indexes (1952-1970)

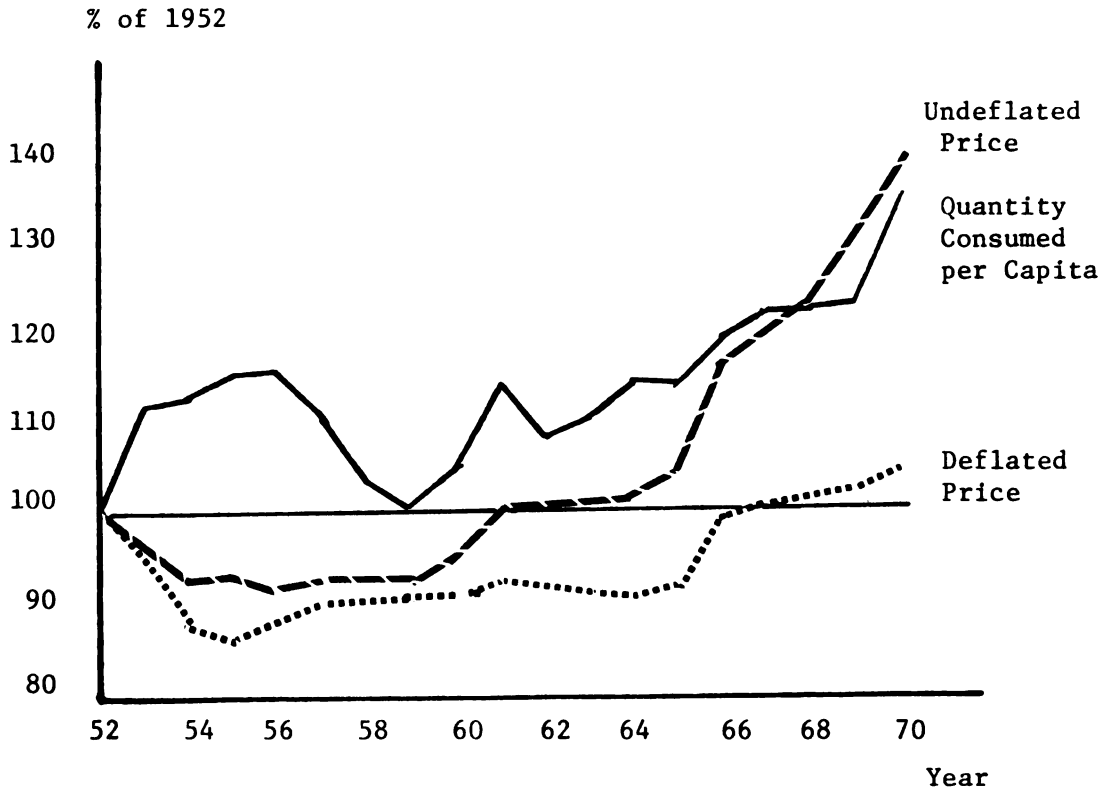

Figure 3.15

U. S.: Cheese price and consumption indexes (1952-1970)

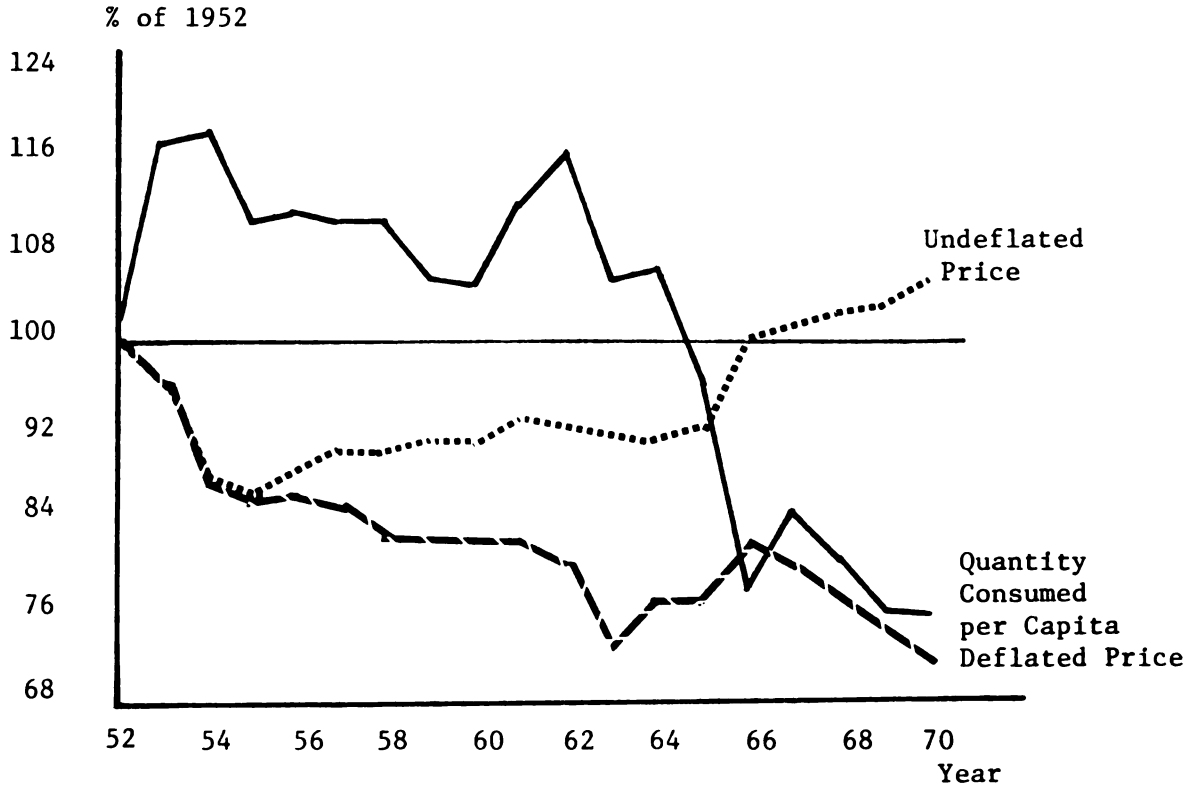

Figure 3.16

U. S.: Butter: Price and Consumption Indexes (1952-1970)

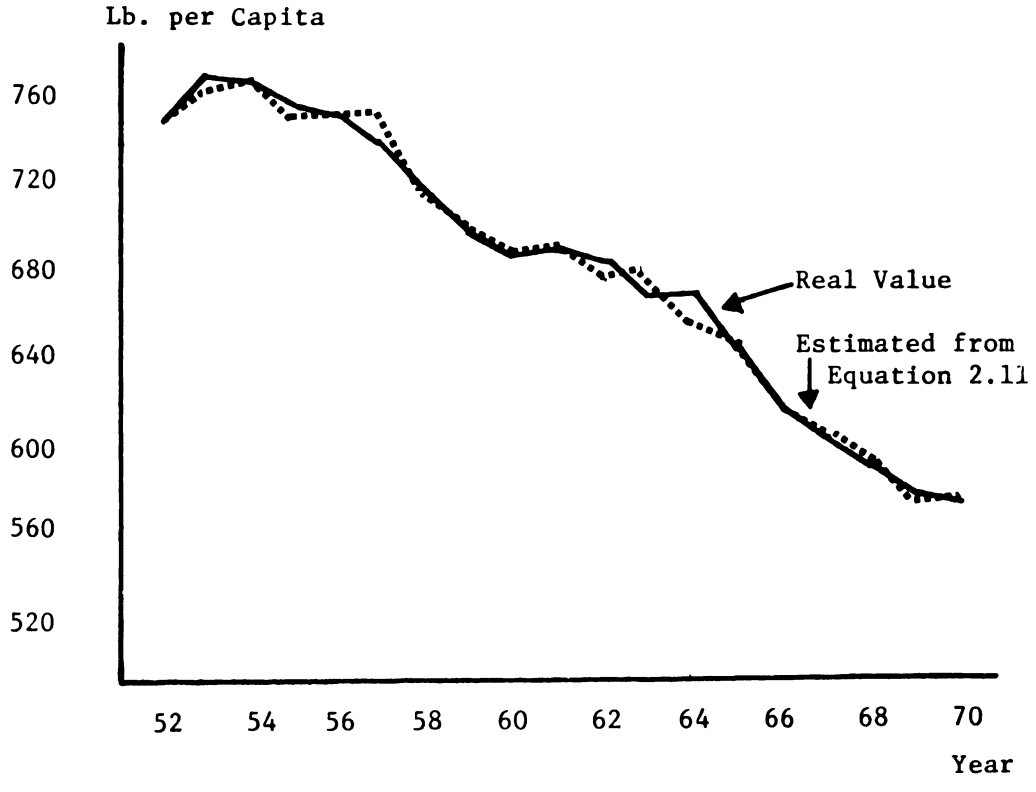

Figure 3.17

U. S.: Quantity of milk produced per capita (1952-1970)

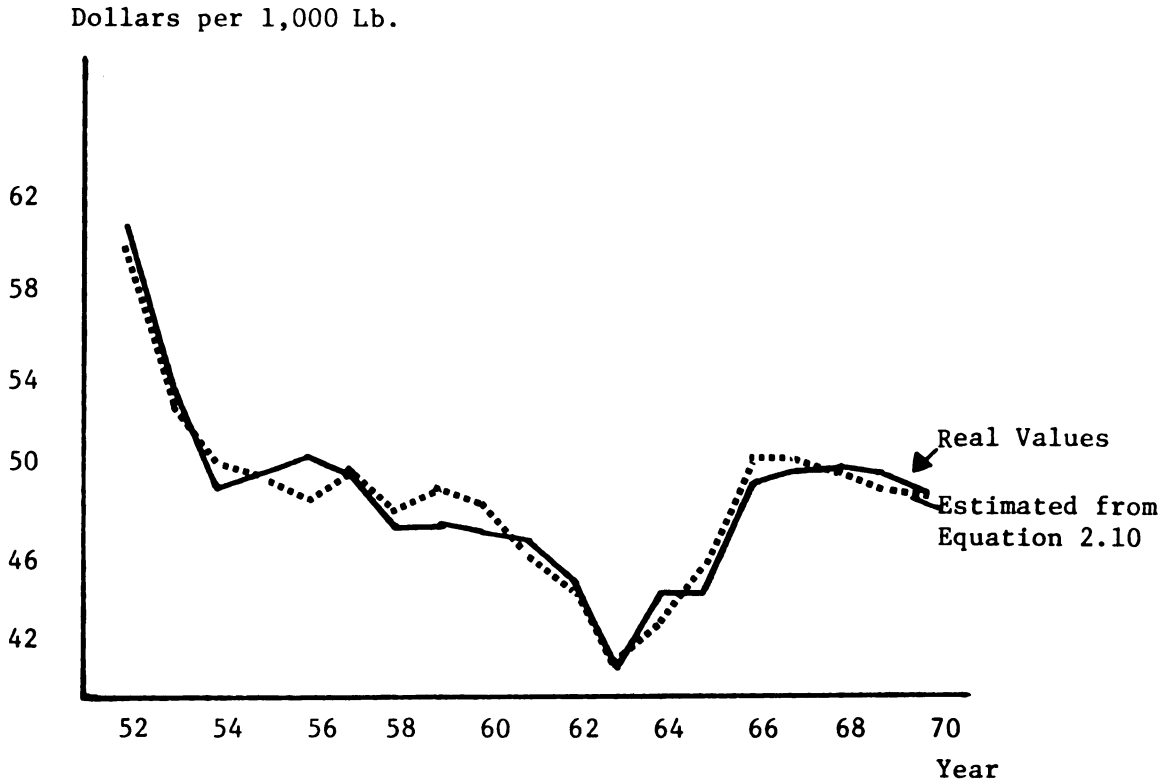

Figure 3.18

U. S.: Farm price of milk deflated by the CPI (1952-1970)

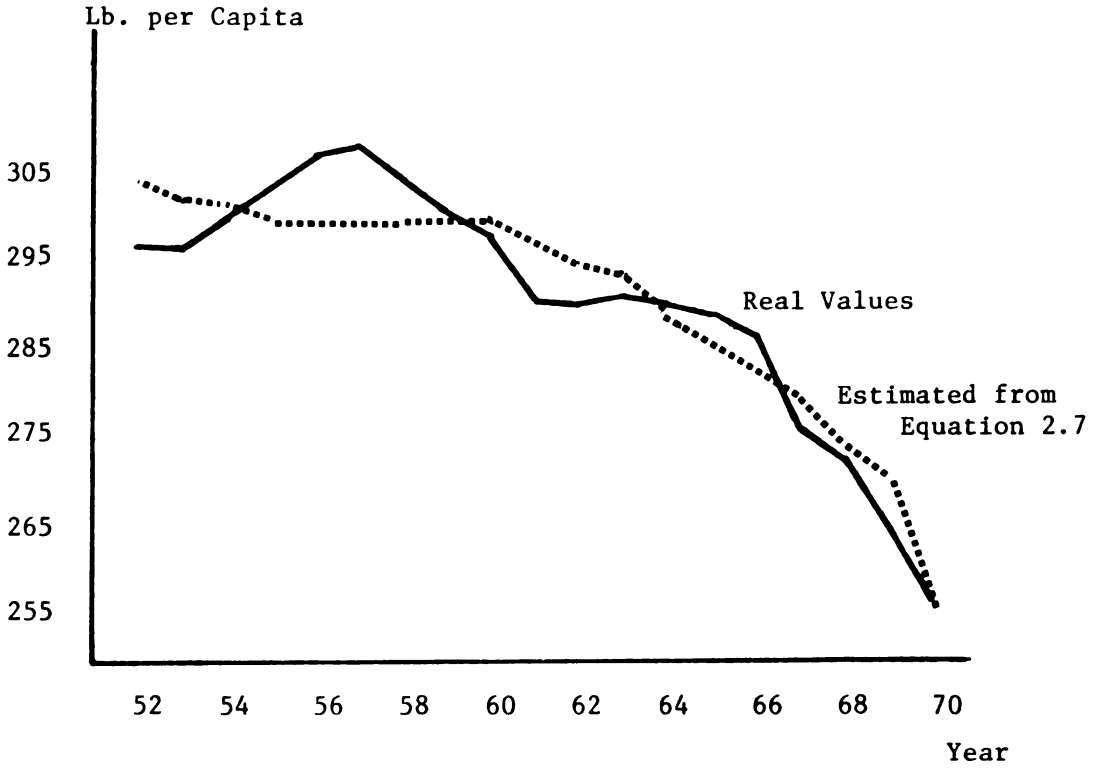

Figure 3.19

U. S.: Quantity of milk used for making fluid milk per capita (1952-1970)

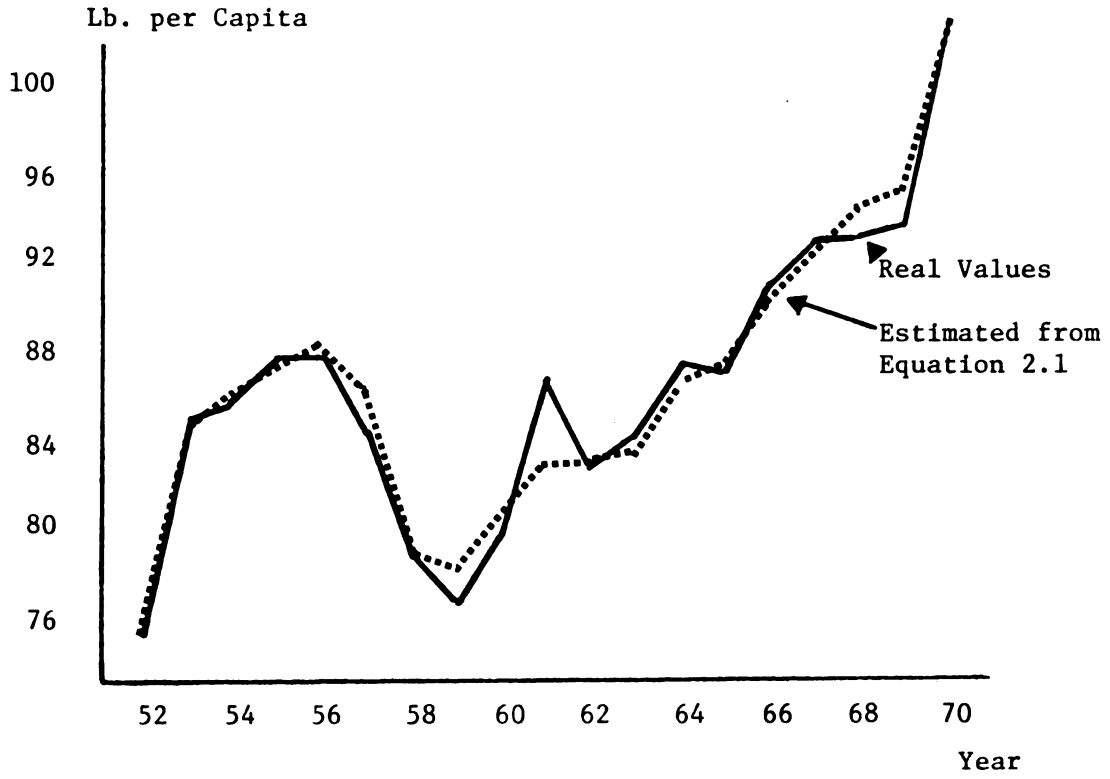

Figure 3.20

U. S.: Quantity of milk used for making cheese per capita (1952-1970)

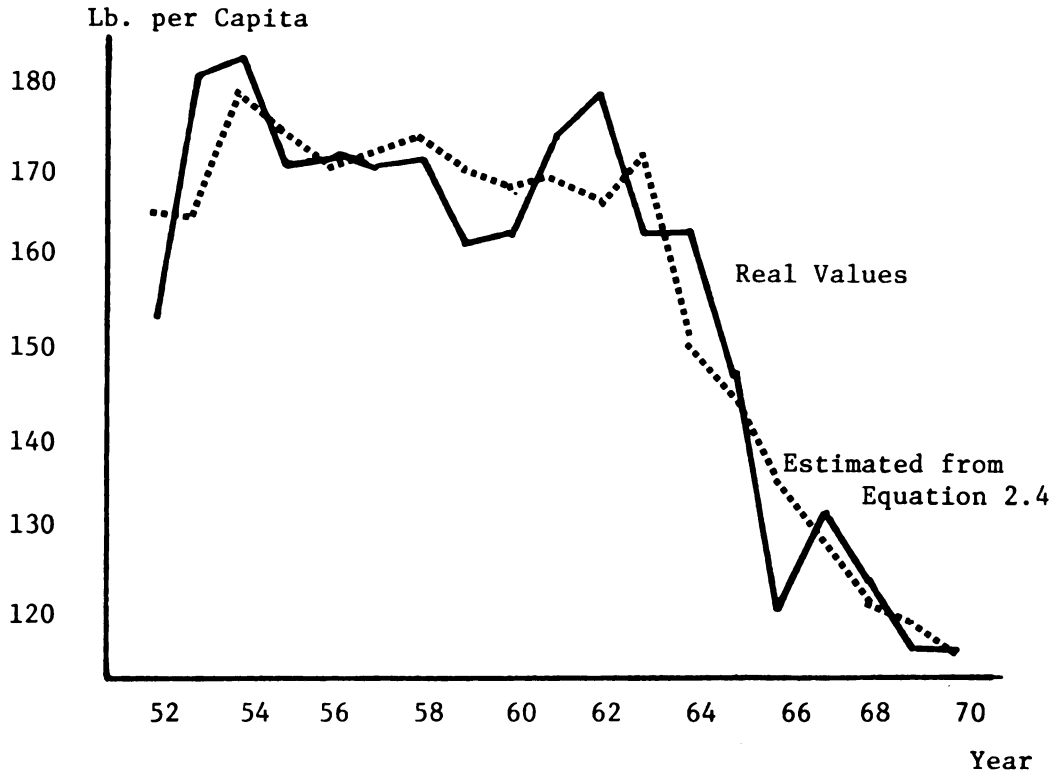

Figure 3.21

U. S.: Quantity of milk used for making butter per capita (1952-1970)

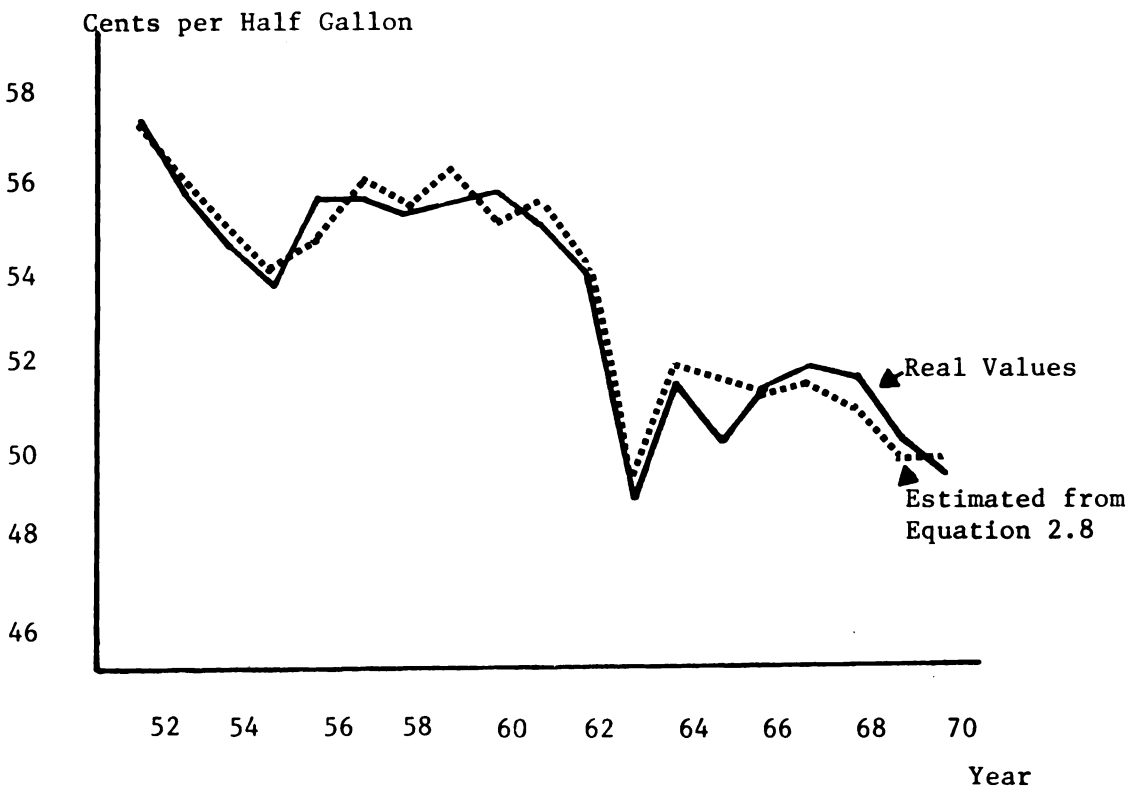

Figure 3.22

U. S.: Retail price of fluid milk deflated
by the CPI (1952-1970)

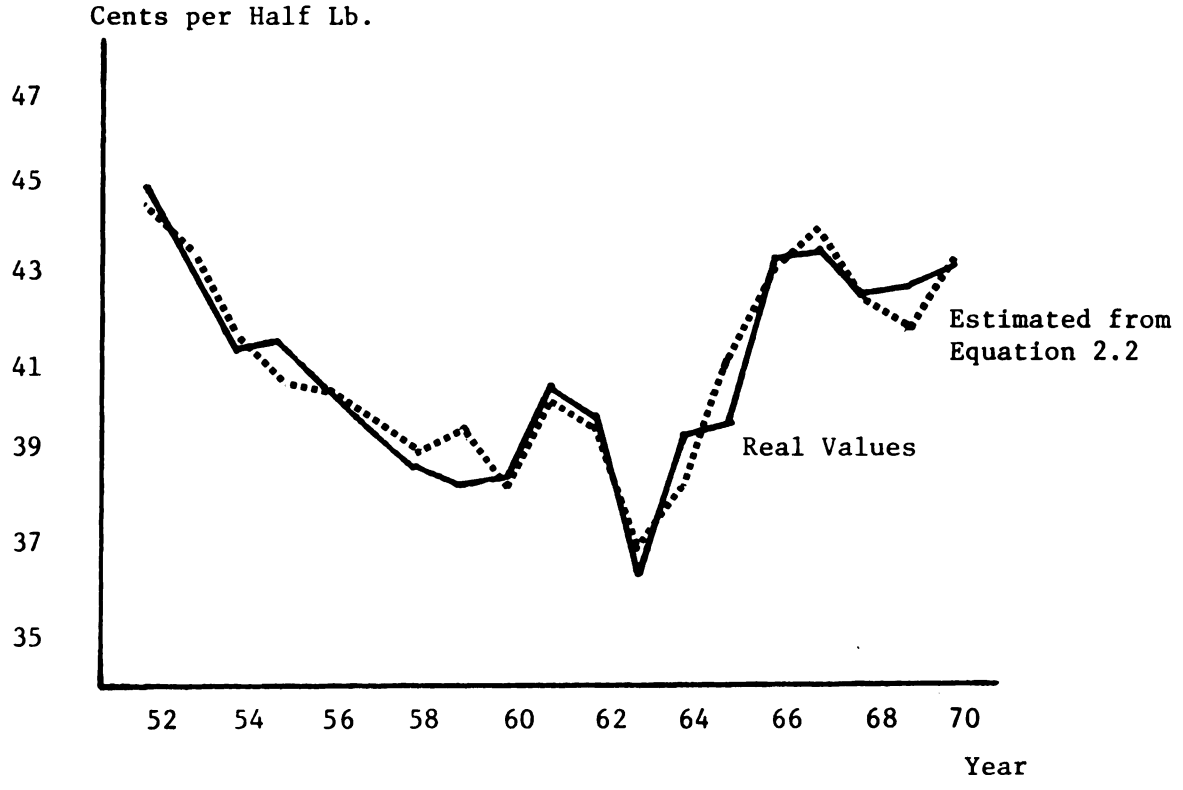

Figure 3.23

U. S.: Price of cheese deflated by the CPI (1952-1970)

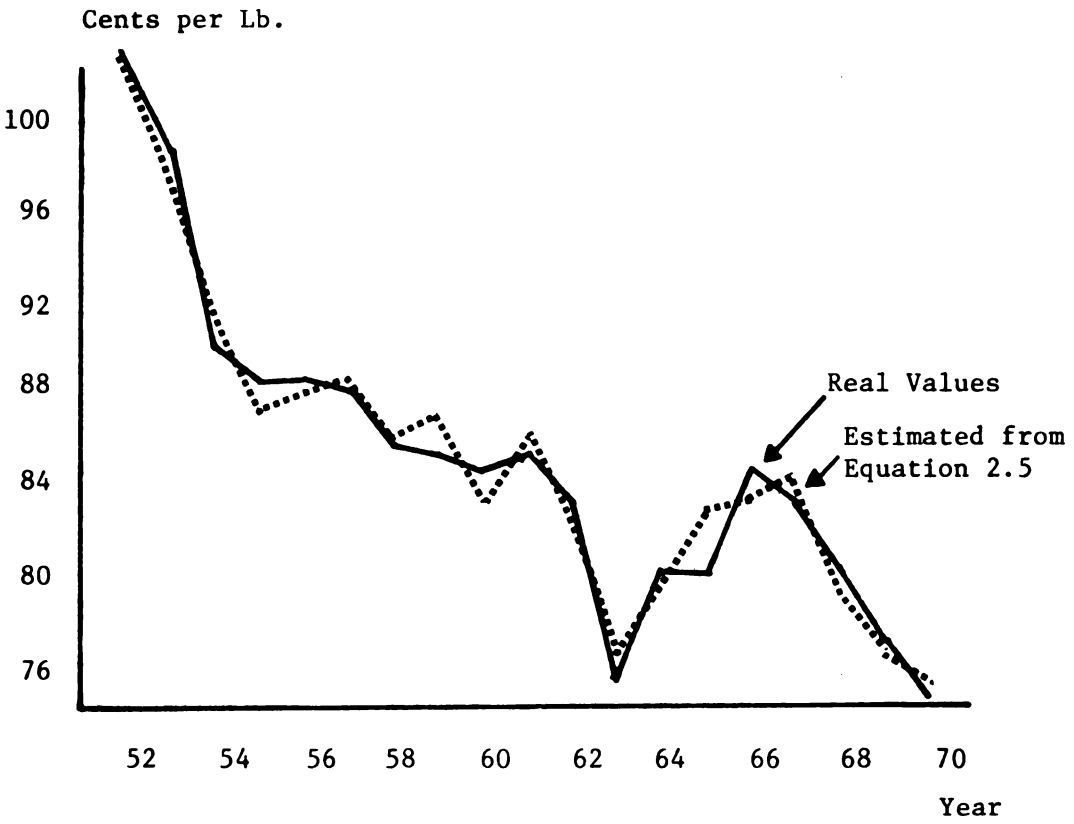

Figure 3.24

U. S.: Price of butter deflated by the CPI (1952-1970)

it is -.85 and -.90 with butter and fluid milk, respectively.

Statistical analysis should ferret out the effect of the other variables as well as own price on consumption. Equations 2.1, 2.4 and 2.7 in Table 3.9 are the retail demand equations for fluid milk, cheese and butter. In Table 3.10 my own computed income and price elasticities are compared with those of others.

Own price coefficients for cheese and butter are significant. The coefficient for milk is not. Price has a large impact on the amount of butter consumed and a much smaller impact on quantities of fluid milk and cheese consumed.

Price elasticity signs for fluid milk and cheese are positive, indicating an increase in consumption with an increase in price, a result not justified by the theory. The coefficient for fluid milk is insignificant and thus can be excused. The insignificance of the sign argues for the lack of responsiveness of milk to its own price. This is a justifiable conclusion. However, the coefficient for cheese is highly significant with a t value of 4 (see Table 3.9). The price of cheese must be highly correlated with another possible explanatory but excluded variable to suggest that variable is actually the cause of this unusual result. A change in tastes and preferences is unlikely the reason for the positive price elasticity because the price of cheese is not highly correlated with time (YEAR); in fact, the correlation is very low, .06.

The results suggest two possibilities: 1) consumers will increase their consumption of cheese if the price increases; and 2) the data used could be the source of the problem. The price of cheese more than likely is relatively accurate. The prices of cheese, butter, fluid milk and milk at the farm are highly correlated (Table 3.8) indicating there are

no real absurdities in those particular data sets. But the price of cheese does represent only one variety of cheese, American cheese, whereas the quantity used represents all cheese varieties.

If American cheese substitutes well for other varieties, its price is probably a good proxy because the price of all cheese varieties should rise and fall together. But if they are not substitutes, the price of American cheese is not a good proxy and could upset the analysis. Further work must be done in order to clarify whether or not the varieties of cheese are highly substitutable for each other.

No statistically significant substitutes or complements were found for any milk products. Even margarine as a substitute for butter has a t value of only .74. This suggests it is not the price of margarine which makes it such a good substitute but a change in tastes and preferences as indicated by the high t value for income (Y), 3.30.

Income and Transfer Payments

From Table 3.10 we can see that both fluid milk and butter have negative income and transfer payment elasticities. The elasticities for cheese are what might be expected. The elasticity is high at low income and decreases rather abruptly at higher incomes. This suggests cheese is a luxury food at low income levels, but relatively unresponsive to income changes at higher incomes.

The elasticities are negative and constant for butter. The large negative income elasticity is likely a result of changing tastes and preferences, since margarine and butter are by common sense highly substitutable for each other, yet this is not indicated in the analysis.

The elasticity for milk is negative and increasing for higher incomes, i.e., there is less of a negative impact on consumption with

income change. This result, too, could be explained away by suggesting a change in tastes and preferences but there is nothing to indicate that in the analysis.

Farm-Retail Price Differentials

Farm-retail price differentials can be estimated only for fluid milk. The reasons were explained thoroughly in the section on data but the main thrust is that the farm level price estimated is an aggregate and of all retail products from milk; only fluid milk has a per unit retail price higher than the per unit farm level price. But even the results for milk are unsatisfactory due to the wide divergence of estimate farm-retail price differentials from the actual price (Figure 3.25).

Table 3.11 shows that the share of the retail price going to the farmer has declined. At the same time the farm-retail spreads have fluctuated for the various retail products. From 1950-1960 the percentage of the retail price for fluid milk going to the farmer decreased while the farm-retail spread increased. The percentage going to the farmer increased from 1960-1970, but the farm-retail spread decreased.

Analysis suggests the price of fuel has affected the quantity of fluid milk supplied at the retail level (Equation 2.9, Table 3.9). The high correlation between retail price of fluid milk (PMGROC) and price of fuel (FUEL), .80, suggests multicollinearity and inability to separate the effect of either variable. It is likely that the price of milk rather than fuel (because fuel should theoretically have a negative sign and it has a positive one) is responsible for the high correlation. Wage has some impact on the amount of fluid milk supplied and thus on margins. In addition, price of fuel also affects the price of milk at the farm (PMFARM).

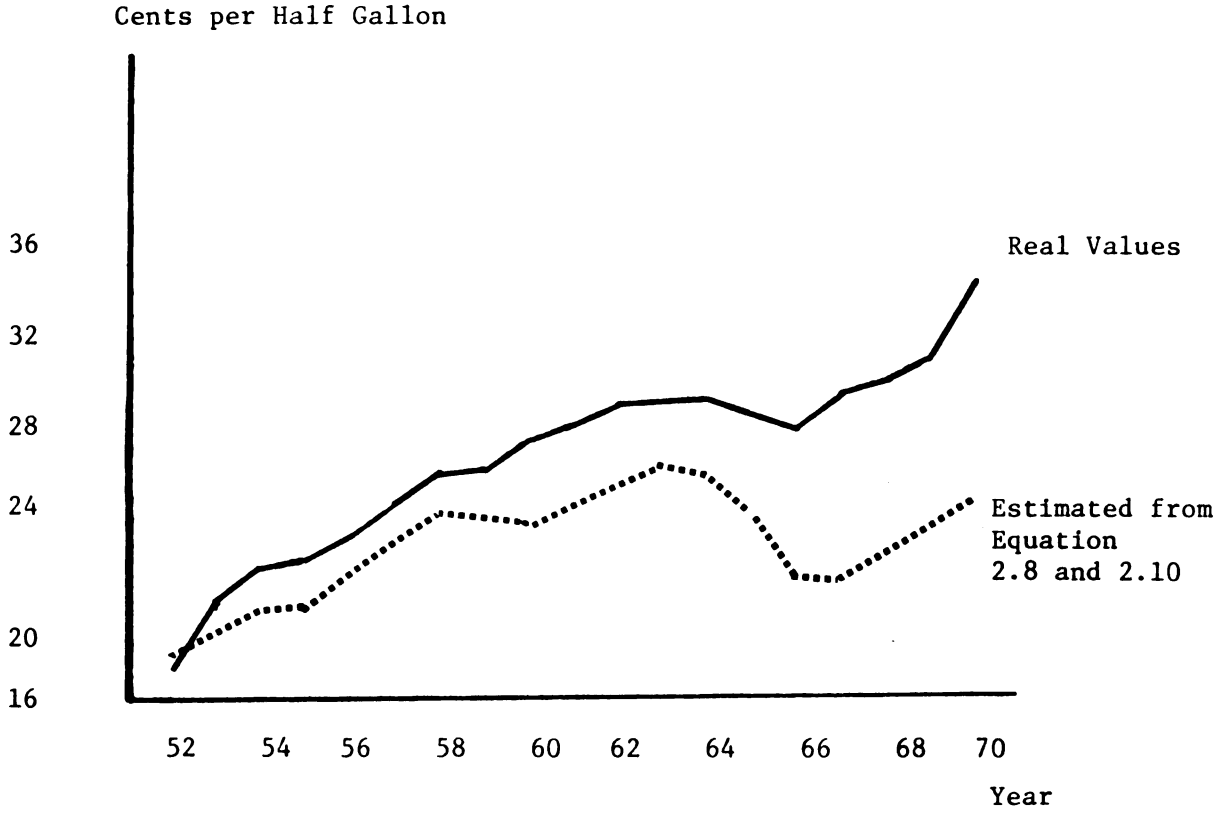

Figure 3.25

U. S.: Farm-retail price differential for fluid milk deflated by the CPI (1952-1970)

TABLE 3.11

DAIRY PRODUCTS: FARM-RETAIL SPREADS AND PERCENT OF RETAIL PRICE GOING TO FARMER (1950-1970)[a]

	Fluid milk	Cheese	Butter
Farm-retail spreads[b]			
1950	21.9[c]	21.0	22.9
1960	28.3	21.3	23.0
1970	24.5	24.1	21.0
Percent of retail price going to farmer			
1950	55	47	77
1960	47	44	77
1970	50	44	71

[a]Source: U. S. Department of Agriculture, ERS, Farm-Retail Spread for Food Products, Miscellaneous Publication No. 741 (Washington, D. C.: Government Printing Office, 1971).

[b]Deflated by CPI (1967=100).

[c]Per half gallon.

With cheese, however, the amount as well as the percentage going to the marketers have increased. At the same time the cheese consumption has increased greatly and cheese prices have risen despite the corresponding decline in milk prices at the farm.

As with fluid milk, the farm-retail spread for butter increased in 1960 and decreased in 1970. At the same time, percent of the retail price going to the farmer decreased (Table 3.11). The postulated shift in tastes and preferences away from butter, especially after 1960, and the subsequent shift in demand for butter caused its decline in retail price. Thus, the percentage going to the farmer has also declined. The farmer seems to have absorbed the impact more than the intermediaries.

Farm Level Demand

Cheese has the highest coefficient in the farm level demand equation, Equation 2.10 and may explain changes in milk price at the farm more than any other retail product made from milk. The price of fuel (FUEL) and the retail price of milk (PNGROC) are highly correlated. Fuel is perhaps picking up some of the effect of fluid milk at the farm level explaining why fluid milk seems to have a smaller impact on the farm level demand for milk.

The amount of milk produced does not effect its price nor are the two simultaneously determined (Equation 2.10). Neither fuel nor labor costs have any impact on the price of milk.

Fed and Non-Fed Beef

Modeling the Beef Sectors

Fed and non-fed beef were treated as separate commodities and, therefore analyzed separately. Both fed and non-fed were tested for

TABLE 3.12

THE FED BEEF MODEL

System of equations for fed beef

Retail demand:	(QSTEAK, PSTEAK, $\bar{Z}$) = 0
Retail supply:	(QSTEAK, PSTEAK, PFEDBF, $\bar{Z}$) = 0
Retail demand:	(QHAMBURG, PHAMBURG, $\bar{Z}$) = 0
Retail supply:	(QHAMBURG, PHAMBURG, PFEDBF, $\bar{Z}$) = 0
Retail demand:	(QCHUCK, PCHUCK, $\bar{Z}$) = 0
Retail supply:	(QCHUCK, PCHUCK, PFEDBF, $\bar{Z}$) = 0
Farm demand:	(QFEDBFPR, PFEDBF, PCHUCK, PHAMBURG, PSTEAK, $\bar{Z}$) = 0
Farm supply:	(QFEDBFPR, PFEDBF, $\bar{Z}$) = 0

Endogenous variables

QFEDBFPR	quantity of steers and heifers slaughtered
PFEDBF	price of fed-beef received by farmers
PCHUCK	price of chuck meat
PHAMBURG	price of hamburger meat
QSTEAK	quantity of steaks, roasts and chops
BURGPLUS	quantity of hamburger and ground beef

Exogenous variables $\bar{Z}$

WAGEFME	wage per hour of food manufacturing employees
PHOGS	price of hogs received by farmers
PBROIL	price of broilers received by farmers
QFEDBFPR	quantity of steers and heifers slaughtered
QNONFED	quantity of beef slaughtered other than steers and heifers
QHOGSPR	quantity of hogs slaughtered
QBROILERPR	quantity of broilers produced
Y	disposable personal income
TRANS	income dependent transfer programs
PFRYING	price of frying chickens
PHAM	price of ham

TABLE 3.13

THE NON-FED BEEF MODEL

System of equations for non-fed beef

Retail demand:	(QHAMBURG, PHAMBURG, $\bar{Z}$) = 0
Retail supply:	(QHAMBURG, PHAMBURG, PNONFED, $\bar{Z}$) = 0
Retail demand:	(QCHUCK, PCHUCK, $\bar{Z}$) =)
Retail supply:	(QCHUCK, PCHUCK, PNONFED, $\bar{Z}$) = 0
Farm demand:	(QNONFED, PNONFED, PHAMBURG, PCHUCK, $\bar{Z}$) = 0
Farm supply:	(QNONFED, PNONFED, $\bar{Z}$) = 0

Endogenous variables

PNONFED	price received by farmers for other than steers and heifers
PHAMBURG	price of hamburger
PROUND	price of round steak
QNONFED	quantity of beef other than steers and heifers slaughtered
BURGPLUS	quantity of hamburger and ground beef sold
PCHUCK	price of chuck

Exogenous variables, $\bar{Z}$

QNONFED	quantity of beef other than steers and heifers slaughtered
PFUEL	price of fuel
QFEDBEEF	quantity of steers and heifers slaughtered
QHOGSPR	quantity of hogs slaughtered
QBROILPR	quantity of broilers produced
WAGEFME	wage of food manufacturing employees
PBROIL	price of broilers received by farmers
PHAM	price of ham
PFRYING	price of fryers
Y	disposable personal income
TRANS	income dependent transfer payments

lagged response to price. If farm supply is determined by expected price, let us say the price of the previous year, the model changes so that the farm demand equation becomes:

$$P_{\text{fed beef}} = F\ (P_{\text{chuck}},\ P_{\text{roast}},\ \bar{Q}_{\text{fed beef}},\ \bar{Z})$$

For this model the quantities of other possible substitutes produced are used instead of prices.

As with other products it is difficult to obtain retail data for the various cuts; consequently, only one retail product was used as the retail equivalent for the farm product.

Data: Correlation Matrix, Sources of Data and Adequacy of Proxies

The data used to represent fed-beef includes the number of steers and heifers slaughtered. Non-fed is a residual or the difference between total slaughter and steer and heifer slaughter.

There is little information on retail level beef products. The Bureau of Labor has collected a series of prices of retail beef cuts. The U. S. Department of Agriculture publishes a series of uncanned meat products. From these series the quantity of steaks, roasts and chops produced is used to represent one of the retail products from fed-beef. A combination of hamburger and ground beef is used to represent one of the major retail products of non-fed beef. Two problems are encountered when these data are used.

First, the category steak does not include only fed-beef. There is a growing trend towards steaks from non-fed beef. Fast food chains are the major procurers of these steaks and an industry has grown around the processing of meat for these chains. It would have been more appropriate to account for the various cuts of fed-beef but the data on

quantities are not available. Much of the cutting is done at the butchers and there is little way of measuring what happens to the carcasses at that retail level.

Second, in the data series on retail cuts no information on the amount of the various types of meat going into each category of cut is available. For example, hamburger meat is usually a combination of pork and beef, but there are no data on the amount of actual beef in hamburgers.

The correlation matrix for livestock and poultry is presented in Table 3.14. A difficulty in the analysis arises because the quantity of fed-beef produced (QFEDBFPR) is so highly correlated with time (YEAR) and thus with income (Y), .98.

Analysis of Regression Results

Quantity and Price

Over the time period studied, 1953 to 1971, the quantity of fed-beef produced increased by 83 percent while the quantity of non-fed beef decreased by 25 percent (Figure 3.26). Data from the Livestock and Meat Statistics[1] show that the amount of hamburger and ground beef has increased by 390 percent and the amount of steaks, chops and roasts has increased by 726 percent over the same time period.

Over the same period, the price of fed-beef increased by 9 percent and that of non-fed increased by 25 percent. The price of hamburger and round declined over the same period--hamburger by one percent and round by two percent.

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[1] U. S. Department of Agriculture, Economic Research Service, Livestock and Meat Statistics, Statistical Bulletin No. 522 (Washington, D. C.: Government Printing Office, 1973).

TABLE 3.14

SIMPLE CORRELATION MATRIX FOR VARIABLES[a] USED IN THE LIVESTOCK AND POULTRY EQUATIONS

	BURGPLUS	FUEL	HAMBAC	PBROIL	PCHUCK	PEGGSF	PEGGSR	PFBF	PFBFLAG	PFRYING	PHAM	PHAMBURG	PHOGS	PHOGSLAG	PNONFED	PROUND	QBROILPR	QEGGSPR	QEGGSPRLAG	QFEDBFPR	QHOGS	QNFBLAG	QNONFED	QSTEAK	STAMPS	TRANS	WAGEFME	Y	YEAR
BURGPLUS	1																												
FUEL	-.86	1																											
HAMBAC	.67	-.41	1																										
PBROIL	-.67	.59	-.29	1																									
PCHUCK	-.38	.25	.29	.09	1																								
PEGGSF	-.67	.56	-.41	.92	.14	1																							
PEGGSR	-.76	.66	-.39	.92	.28	.96	1																						
PFBF	.09	-.14	.04	-.27	.83	-.27	-.14	1																					
PFBFLAG	-.09	.04	.00	.26	.40	.33	.35	.20	1																				
PFRYING	-.68	.63	-.26	.99	.07	.92	.93	-.28	.22	1																			
PHAM	-.64	.45	-.52	.82	.24	.80	.84	-.05	.21	.82	1																		
PHAMBURG	.13	-.22	-.05	-.37	.80	-.28	-.19	.86	.48	-.41	-.15	1																	
PHOGS	-.30	.08	-.61	.56	.06	.61	.54	-.10	.06	.52	.79	-.14	1																
PHOGSLAG	-.19	.02	-.00	.54	.01	.34	.37	.05	.09	.53	.60	-.15	.42	1															
PNONFED	.40	-.45	.16	-.59	.75	-.51	-.44	.86	.14	-.60	-.30	.85	-.20	-.12	1														
PROUND	-.30	.18	-.31	-.01	.94	.04	.16	.80	.33	-.30	.09	.80	.00	-.09	.54	1													
QBROILPR	.83	-.78	.36	-.94	-.19	-.86	-.92	.23	-.20	-.95	-.78	.34	-.43	-.41	.59	-.08	1												
QEGGSPR	-.64	.64	-.13	.90	.09	.76	.83	-.16	.10	.92	.80	-.38	.43	.59	-.48	-.07	-.91	1											
QEGGSPRLAG	-.68	.70	-.12	.88	.20	.78	.85	-.10	.11	.90	-.71	-.33	.34	.42	-.43	.03	-.92	.94	1										
QFEDBFPR	.90	-.86	.44	-.85	-.39	-.80	-.89	.02	-.16	-.87	-.75	.18	-.39	-.34	.42	-.28	.96	-.86	-.89	1									
QHOGS	-.42	.45	-.17	.26	.13	.15	.21	-.03	.00	.26	.06	-.11	-.17	-.00	-.22	.12	-.37	.27	.30	-.38	1								
QNFBLAG	-.20	.20	.02	.51	-.26	.43	.42	-.20	-.42	.55	.56	-.54	.44	.54	-.26	-.39	-.43	.67	.61	-.39	-.03	1							
QNONFED	-.19	.19	-.05	.67	-.51	.57	.48	-.58	-.29	.68	.55	-.78	.54	.44	-.67	-.56	-.53	.64	-.89	-.38	.08	.78	1						
QSTEAK	.94	-.75	.76	-.49	-.30	-.52	-.58	.13	-.03	-.50	-.53	.12	-.25	-.09	.35	-.23	.66	-.45	-.48	.73	-.48	-.10	-.11	1					
STAMPS	.83	-.49	.72	-.45	-.28	-.57	-.60	.13	-.03	-.46	-.55	.11	-.35	-.05	.29	-.22	.57	-.38	-.44	.62	-.20	-.14	-.12	.86	1				
TRANS	.96	-.77	.74	-.61	-.26	-.66	-.71	.20	-.01	-.63	-.63	.22	-.35	-.12	.45	-.19	.76	-.56	-.60	.81	-.43	-.22	-.25	.97	.90	1			
WAGEFME	.87	-.86	.50	-.83	-.27	-.81	-.86	.18	-.28	-.84	-.72	.21	-.41	-.31	.52	-.20	.92	-.77	-.77	.93	-.25	-.25	-.34	.72	.57	.78	1		
Y	.91	-.87	.47	-.81	-.41	-.78	-.87	.05	-.23	-.82	-.70	.13	-.33	-.25	.43	-.31	.94	-.79	-.83	.98	-.36	-.25	-.26	.75	.65	.82	.94	1	
YEAR	.87	-.82	.41	-.91	-.28	-.86	-.93	.15	-.21	-.93	-.79	.26	-.43	-.38	.51	-.15	.99	-.90	-.91	.98	-.34	-.42	-.46	.70	.62	.79	.93	.97	1

[a]All quantities are per capita and all variables expressed in dollars have been deflated by the CPI (1967=100). TRANS, STAMPS and Y are per capita and deflated. Further explanation and data sources for all variables can be found in Appendix B.

TABLE 3.15

REGRESSION RESULTS FOR BEEF[a]

Equation	Title	Results	Excluded exogenous	R^2	DW
3.1	Retail demand for steak	QSTEAK = -6896.13 + 6.07 PCHUCK + 242.04 $\overline{Y}$ (36.64) (788.86) + 2965.62 $\overline{TRANS}$ (363.20)	PFBFLAG WAGEFME	.96	1.80
3.2	Farm demand for fed-beef	QFEDBFPR = 10.15 - .11 PFEDBF - .46 PCHUCK (.22) (.12) + .41 PHAMBURG + .04 $\overline{WAGEFME}$ (.08) (.01) + .02 $\overline{PHOGS}$ - .06 $\overline{PBROIL}$ (.03) (.03)	PFBFLAG PHAM PFRYING Y TRANS	.97	2.66
3.3	Price of fed-beef	PFEDBF = 15.97 + .09 $\overline{WAGEFME}$ - .12 $\overline{PHOG}$ (14.06) (.06) (.25) + .31 $\overline{PBROIL}$ + .05 $\overline{PFBLAG}$ + .24 $\overline{PHAM}$ (.56) (.16) (.15) - .35 $\overline{PFRYING}$ - 11.10 $\overline{Y}$ + 4.02 $\overline{TRANS}$ (.30) (4.25) (2.07)	OLS from equation 3.2	.61	2.25

TABLE 3.15 (cont'd)

Equation	Title	Results	Excluded exogenous	R^2	DW
3.4	Retail demand for hamburger	BURGPLUS = -804.8 - 2.47 PHAMBURG (6.75) + .98 PCHUCK + .48 $\overline{\text{PHAM}}$ + .81 $\overline{\text{PFRYING}}$ (6.62) (1.42) (1.40) + 198.42 $\overline{\text{Y}}$ + 270.77 $\overline{\text{TRANS}}$ (51.30) (31.25)	QNFBFLAG WAGEFME	.98	2.17
3.5	Farm demand for non-fed beef	PNONFED = 66.80 + .81 PHAMBURG - .64 PROUND (.24) (.19) + .71 $\overline{\text{QNONFED}}$ - .15 $\overline{\text{FUEL}}$ - 2.97 $\overline{\text{QFEDBFPR}}$ (.90) (.10) (.80) + .10 $\overline{\text{QHOGSPR}}$ + .005 $\overline{\text{QBROILPR}}$ (.08) (.001)	Y TRANS QNFBFLAG	.94	2.06
3.6	Price of hamburger	PHAMBURG = 116.94 - 4.50 $\overline{\text{QNONFED}}$ - .39 $\overline{\text{FUEL}}$ (28.11) (2.38) (.17) - 5.50 $\overline{\text{QFEDBFPR}}$ - .12 $\overline{\text{QHOGS}}$ (1.92) (.29) +.002 $\overline{\text{QBROILPR}}$ + 1.74 $\overline{\text{TRANS}}$ (.003) (2.79) - 1.60 $\overline{\text{QNFBLAG}}$ + 16.67 $\overline{\text{Y}}$ (1.49) (16.98)	OLS from equation 3.5	.84	1.50

TABLE 3.15 (cont'd)

Equation	Title	Results	Excluded exogenous	R^2	DW
3.7	Price of round	PROUND = 200.29 + .48 $\overline{\text{QNONFED}}$ - .46 $\overline{\text{PFUEL}}$ (1.50) (.10) - 6.63 $\overline{\text{QFEDBFPR}}$ + .09 $\overline{\text{QHOGS}}$ (1.21) (.18) + .009 $\overline{\text{QBROILPR}}$ + 2.25 $\overline{\text{TRANS}}$ (.002) (1.76) - 3.18 $\overline{\text{QNFBLAG}}$ - 1.58 $\overline{\text{Y}}$ (.94) (10.72)	OLS from equation 3.5	.92	2.22
3.8	Quantity of non-fed beef	QNONFED = 7.08 + .10 PNONFED - .11 PHAMBURG (.17) (.09) - .05 PROUND + .01 $\overline{\text{WAGEFME}}$ + .01 $\overline{\text{FUEL}}$ (.06) (.01) (.03) + .07 $\overline{\text{PBROIL}}$ + .05 $\overline{\text{PHOGS}}$ (.02) (.03)	PHAM PFRYING Y TRANS PNFBFLAG	.90	2.07

[a]A complete description and source of all data can be found in Appendix B. All quantity variables are per capita and all price variables have been deflated by the CPI (1967=100). Parentheses under the coefficients enclose the standard errors. Bars over the variables indicate the exogenous variables.

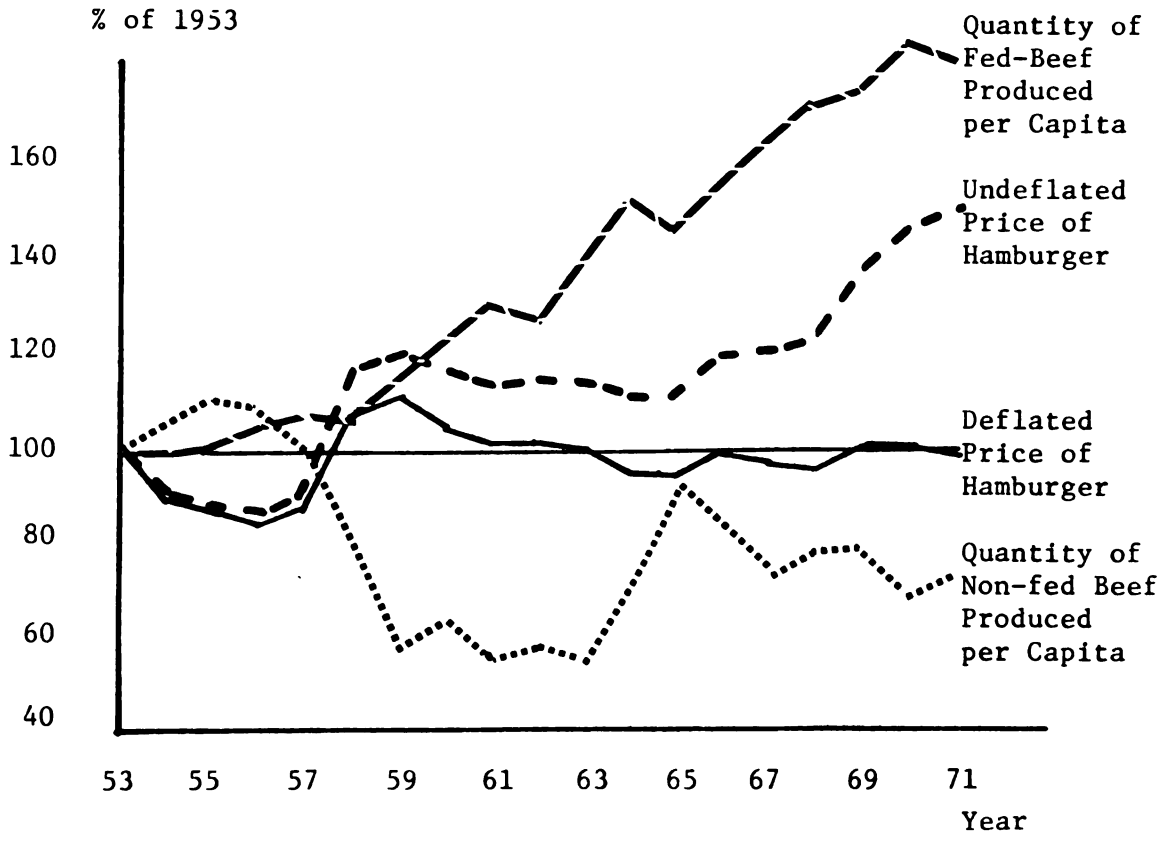

Figure 3.26

U. S.: Beef: Price and consumption indexes (1953-1971)

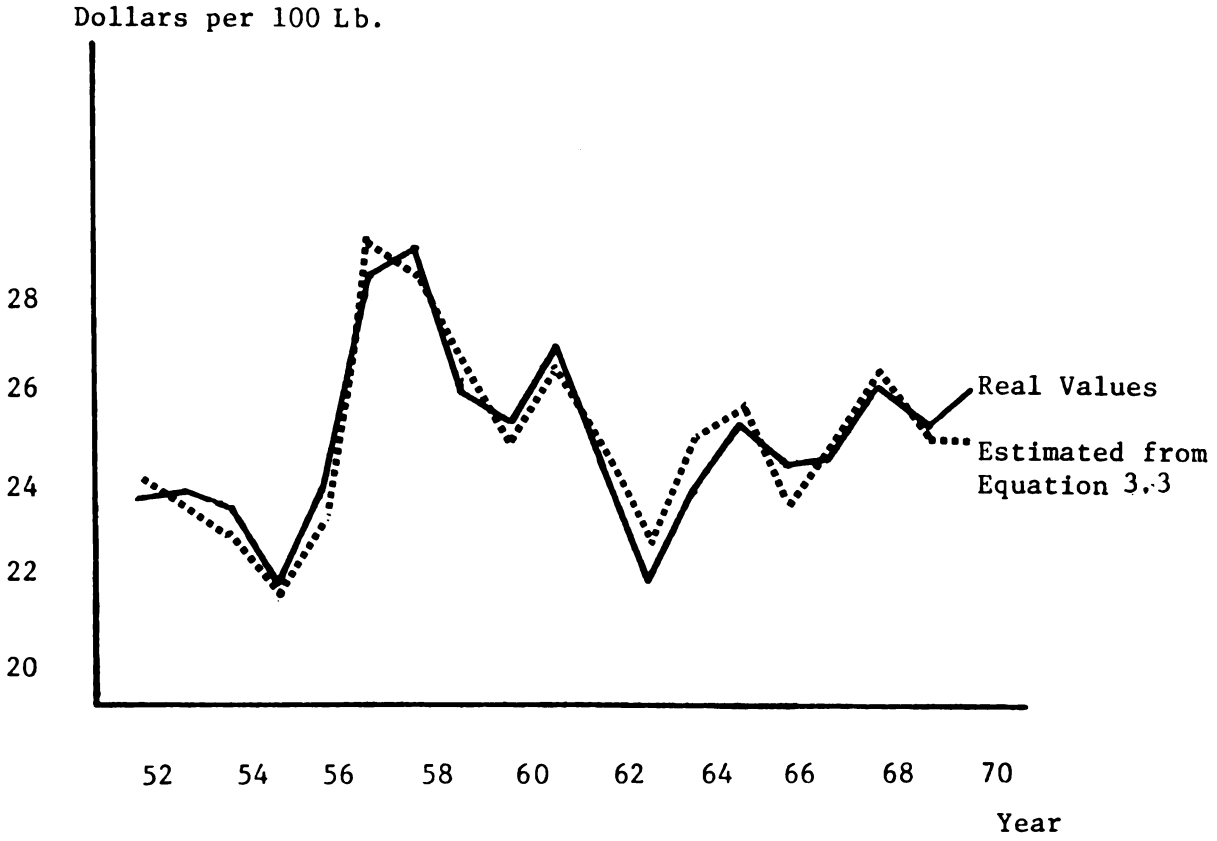

Figure 3.27

U. S.: Price of fed-beef deflated by the CPI (1953-1971)

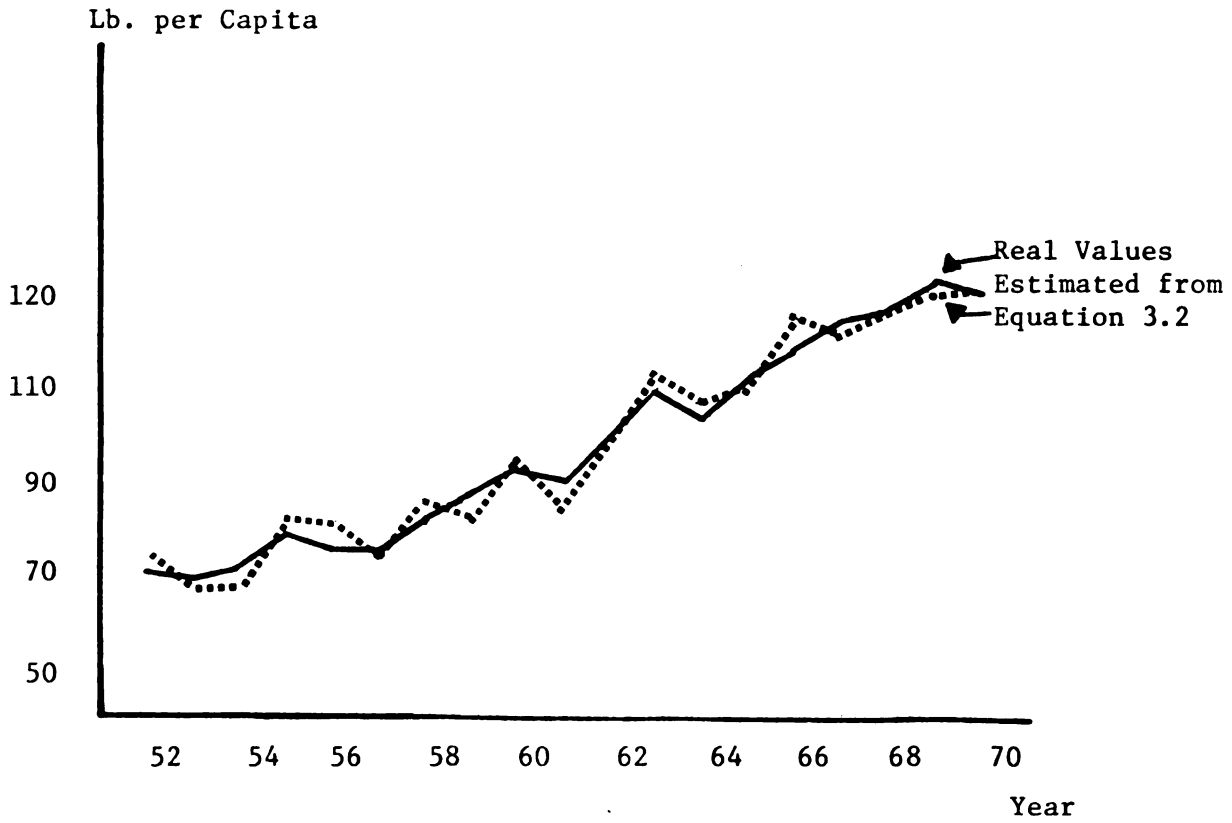

Figure 3.28

U. S.: Quantity of fed-beef produced per capita (1953-1971)

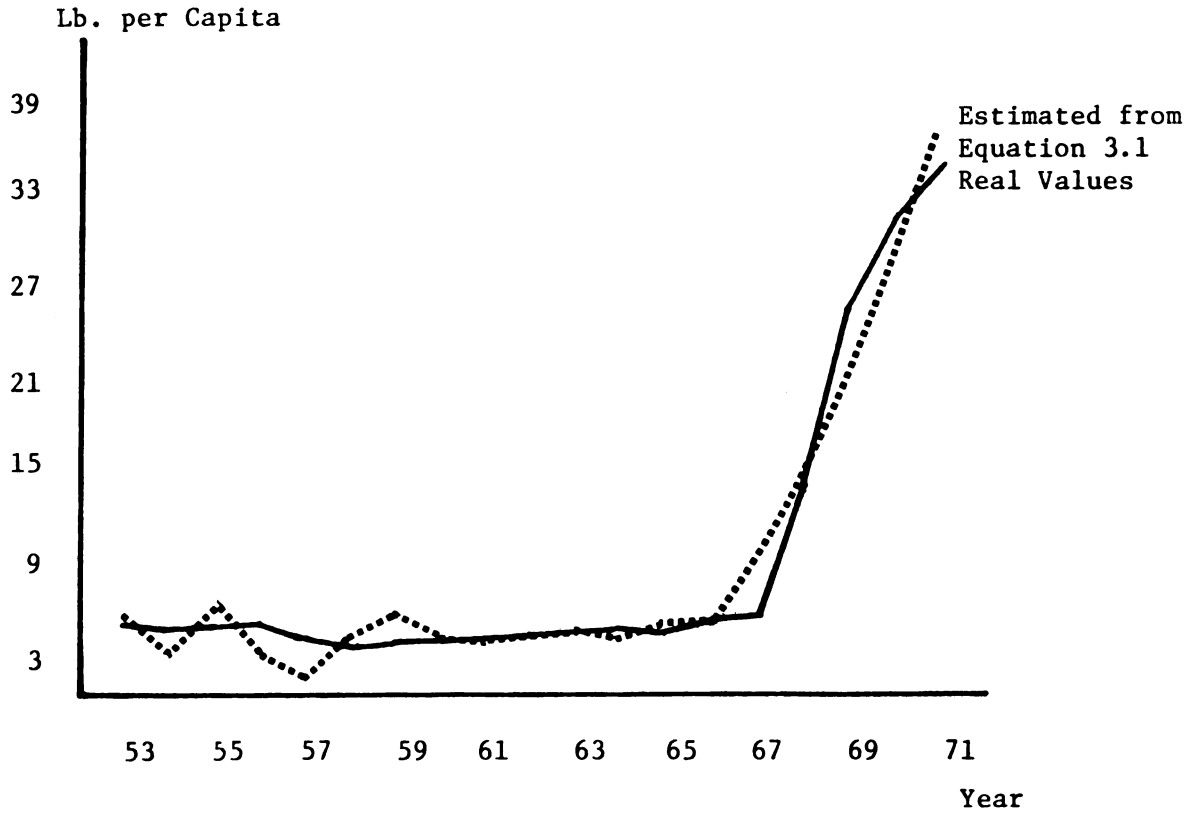

Figure 3.29

U. S.: Quantity of steak consumed per capita (1953-1971)

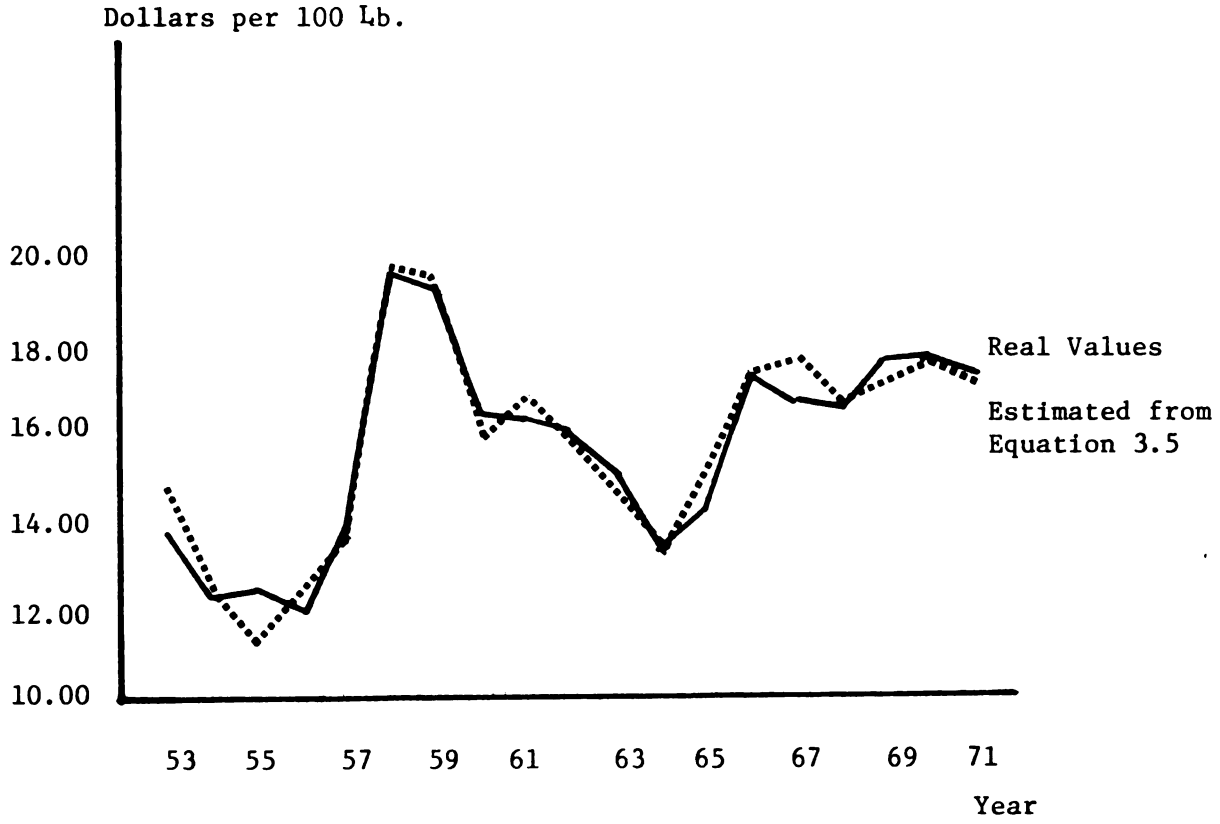

Figure 3.30

U. S.: Price of non-fed beef deflated by the CPI (1953-1971)

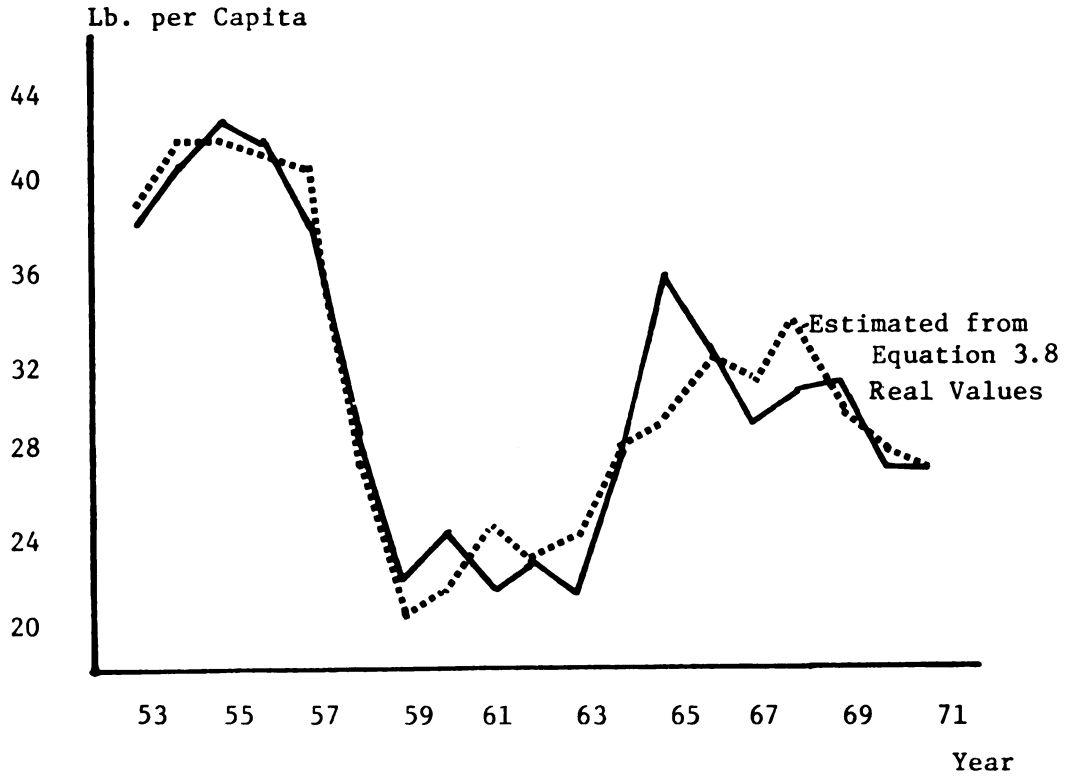

Figure 3.31

U. S.: Quantity of non-fed beef produced
per capita (1953-1971)

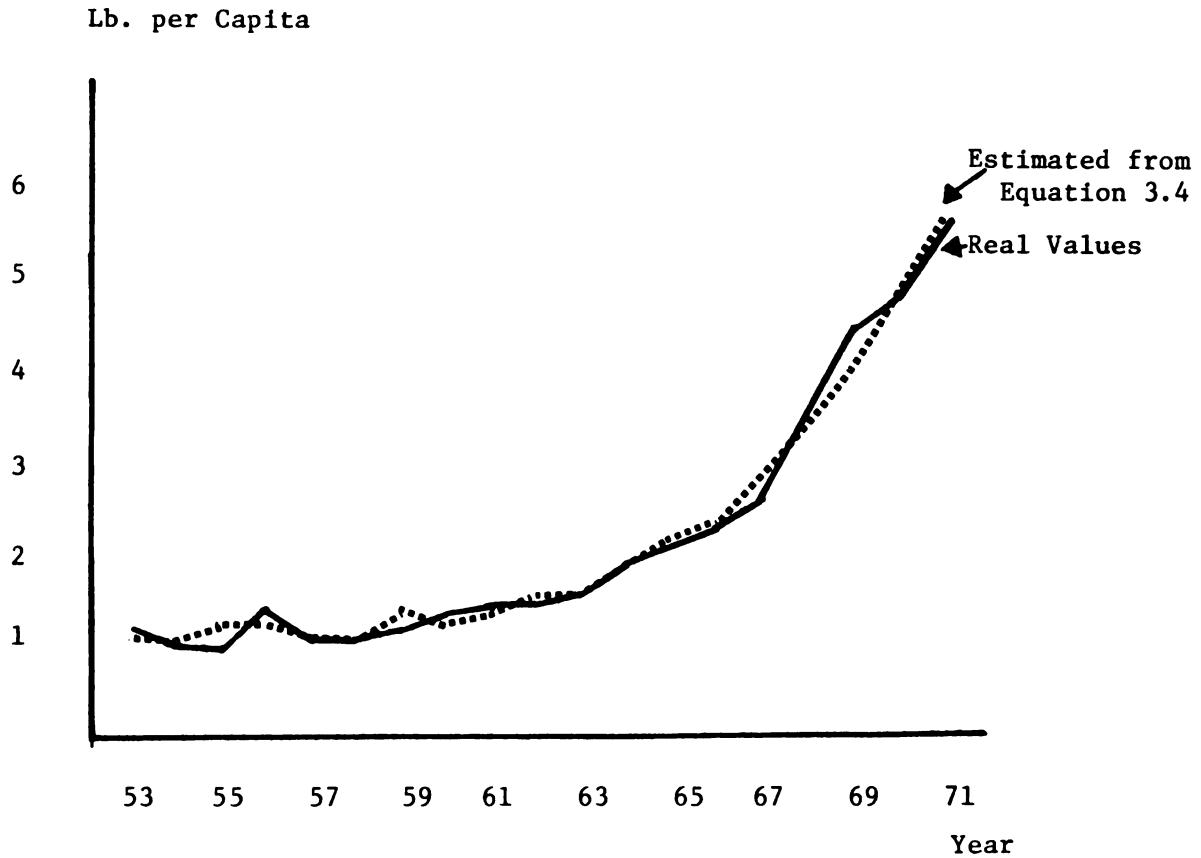

Figure 3.32

U. S.: Quantity of hamburger and ground beef consumed per capita (1953-1971)

According to the statistical analysis at the retail level, the most substitutable product for steak is chicken. At no level does fed-beef have a significant price coefficient, indicating no significant response to price change.

Chicken, pork and fed-beef all appear as substitutes for non-fed beef (Table 3.15). Consumption of non-fed beef is also unresponsive to price change.

Results of the analysis might be more significant using aggregated beef rather than fed and non-fed beef categories. The prices of non-fed and fed-beef are highly correlated, .86, and the quantities are relatively correlated, -.38, both indicating substitutability. At the same time, Equation 3.5 indicates high substitutability of fed-beef for non-fed beef although the opposite does not appear to be true (Equation 3.1 and 3.2).

Income and Transfer Payments

The most interesting results are the effects of income (Y) and transfer payments (TRANS) on consumption of fed-beef and non-fed beef (Equation 3.1 and 3.4, Table 3.15). The income and transfer elasticities have been computed and compared with other elasticities for beef from other sources (Table 3.16). Although the data for steak and hamburg are highly questionable, it is interesting that the retail level equations should have such good statistical results and that it is transfer payments and income that are so significant.

The income elasticity for fed-beef is inaccurate but the t value for the income coefficient is small, verifying the inaccuracy of the income elasticity. Transfer payments had a strong impact on beef quantities consumed, both fed and non-fed. These elasticities are consistent

with expectations. Transfer payments, for example, have a bigger elasticity for fed-beef than non-fed, and have a higher elasticity than income.

Farm-Retail Price Differentials

Farm-retail differentials for fed-and non-fed beef when adjusted for inflation remain quite constant over the period 1953 to 1971 (Figure 3.33). Table 3.17 verifies that this is also true for farm-retail spreads, as defined by the U. S. Department of Agriculture for choice beef. Over this same period the percentage going to the farmer has declined from 66 percent of the retail price to 63 percent.

Farm Level Demand

The quantity and price of fed-beef are simultaneously determined according to the farm demand regression result (Equation 3.2). With non-fed beef the quantity is determined exogenously to the price in time t. For fed-beef both chuck and hamburger appear to be major retail products but the high multicollinearity between the prices of retail products made from beef makes it impossible to tell which one is most important in determining the quantity of fed-beef produced.

Retail prices are a major determinant of the quantity of fed-beef sold. Wages have an important effect on fed-beef production; fuel prices do not. Hogs and broilers are the only other products which appear to be substitutes and complements to fed-beef. Broilers are the most significant but appear as a complement--an unlikely result.

Fed-beef is a substitute for non-fed beef (Equation 3.5). No other commodity substitutes according to the regression results. The substitution goes one way. The amount of fed-beef produced affects the

price of non-fed but the reverse is not true. Neither fuel nor labor costs have a definite impact on non-fed beef (Equation 3.5).

Hogs

Modeling the Hog Sector

As with beef, the hog model is tested for simultaneity in price and quantity and lagged response to price changes. Ham and bacon combined are used as the retail product. As with beef there are limitations to the data available for retail products. Thus, ham and bacon are combined to form some measure of retail pork use. The price of ham (from the Bureau of Labor Statistics) is a proxy for the prices of the various types of ham and bacon.

Analysis of Regression Results

Figure 3.34 illustrates changes in the hog market between 1953 and 1971. The retail and farm price has declined considerably, whereas the quantity of hogs produced, although it has fluctuated, has on the average remained about the same. However, the use of hogs for ham and bacon has increased although there are no data to indicate which product the shift is from.

No possible substitutes are significant in the regression results. As with beef, the main variable affecting hog quantities is transfer payments (TRANS). The elasticity is quite high (.42) and significant. The results are consistent with those expected because the elasticity for high income or the average income (Y) is lower than that for the lower income group or the transfer payments.

The farm level demand analysis indicates the quantity of hogs produced by farmers is not determined simultaneously with the price of the same year. Fed-beef is possibly a substitute for hogs (Equation 4.2). Broilers and non-fed beef appear to be possible complements.

TABLE 3.16

INCOME AND TRANSFER ELASTICITIES FOR BEEF

	Fed beef	Non-fed beef	Total beef
Income elasticity	511619	2.22	c
t value on income coefficient	.30	3.86	
Transfer elasticity	6.83	2.48	c
t value on transfer coefficient	7.54	8.66	
Low income elasticity[a]	c	c	.37
High income elasticity	c	c	.37
Aggregate income elasticity[b]	c	c	.28

[a]Source: J. C. Purcell and Robert Raunikar, "Quantity-Income Elasticities by Level of Income," Journal of Farm Economics, XLIX (1967) 1410-1414.

[b]Source: P. S. George and G. A. King, Consumer Demand for Food Commodities in the United States with Projections for 1980, Giannini Foundation Monograph No. 26 (Davis: March, 1971).

[c]Not available.

TABLE 3.17

BEEF, PORK AND POULTRY:
FARM RETAIL SPREADS AND PERCENT OF RETAIL PRICE
GOING TO FARMER (1953-1970)[a]

	Choice beef	Pork	Frying chickens	Eggs grade A large
Farm-retail spreads[b]				
1953	28.8	25.7	25.7	26.0
1960	31.6	30.6	19.9	22.2
1970	31.9	33.0	19.0	19.6
Percent of regail price going to farmer				
1953	66	67	65	70
1960	65	51	57	65
1970	62	51	46	63

[a]Source: U. S. Department of Agriculture, ERS, Farm-Retail Spread for Food Products, Miscellaneous Publication No. 741 (Washington, D. C.: Government Printing Office, 1971).

[b]Deflated by CPI (1967=100).

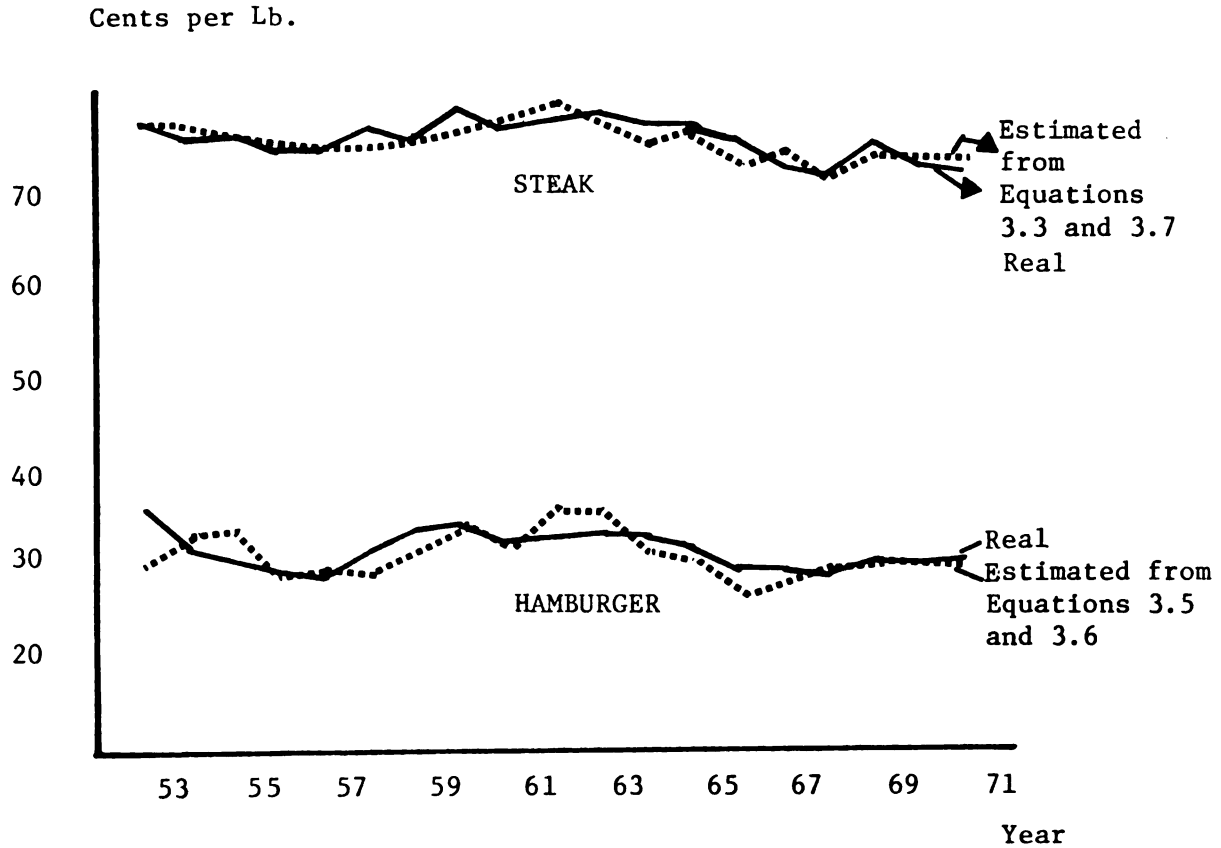

Figure 3.33

U. S.: Farm retail price differentials for beef deflated by the CPI (1953-1971)

TABLE 3.18

THE HOG MODEL

System of equations for hogs

Retail demand:	$(QHAM, PHAM, \bar{Z}) = 0$
Retail supply:	$(QHAM, PHAM, PHOGS, \bar{Z}) = 0$
Farm demand:	$(QHOGS, PHOGS, PHAM, \bar{Z}) = 0$
Farm supply:	$(QHOGS, PHOGS, \bar{Z}) = 0$

Endogenous variables

PHAM	price of ham
PHOGS	price of hogs received by farmers
QHAM	quantity of ham
QHOGS	quantity of hogs produced

Exogenous variables $\bar{Z}$

PFRYING	price of chicken at the retail level
FUEL	indexed price of fuel
PHAMBURG	price of hamburger meat sold at retail
PHOGSLAG	price of hogs received by farmers in t-1
QBROIL	quantity of broilers produced
QFED	quantity of fed beef produced
QNONFED	quantity of non-fed beef produced
TRANS	transfer payments
WAGEFME	wage of food manufacturing employees
Y	personal disposable income

TABLE 3.19

REGRESSION RESULTS FOR HOGS[a]

Equation	Title	Results	Excluded exogenous	R^2	DW
4.1	Retail demand for ham and bacon	HAMBAC = 2056.92 − 14.09 PHAM − 78.49 $\overline{Y}$ (15.24) (285.99) + 431.25 $\overline{TRANS}$ + 9.20 $\overline{PFRUING}$ (194.80) (11.47) − 2.05 $\overline{PHAMBURG}$ (12.58)	PHOGSLAG WAGEFME FUEL	.76	1.69
4.2	Farm demand for hogs	PHOGS = 114.15 + .10 PHAM + .06 $\overline{QHOGSPR}$ (.34) (.31) + .005 $\overline{QBROILPR}$ − 2.28 $\overline{QFEDBFPR}$ (.003) (2.08) + 2.87 $\overline{QNONFED}$ + .21 $\overline{WAGEFME}$ − .55 $\overline{FUEL}$ (1.61) (.12) (.36)	Y TRANS PHOGSLAG	.76	1.78
4.3	Price of ham	PHAM = 191.39 − .46 $\overline{QHOGSPR}$ + .001 $\overline{QBROILPR}$ (79.58) (.64) (.008) − 3.92 $\overline{QFEDBFPR}$ + 1.96 $\overline{QNONFED}$ (3.71) (4.30) − .13 $\overline{WAGEFME}$ − .65 $\overline{FUEL}$ − 6.75 $\overline{TRANS}$ (.20) (.43) (5.49) + 6.86 $\overline{Y}$ + .39 $\overline{PHOGSLAG}$ (38.63) (.48)	OLS from equation 4.2	.84	2.16

[a]A complete description and source of all data can be found in Appendix B. All quantity variables are per capita and all price variables have been deflated by the CPI (1967=100). Parentheses under the coefficients enclose the standard errors. Bars over the variables indicate the exogenous variables.

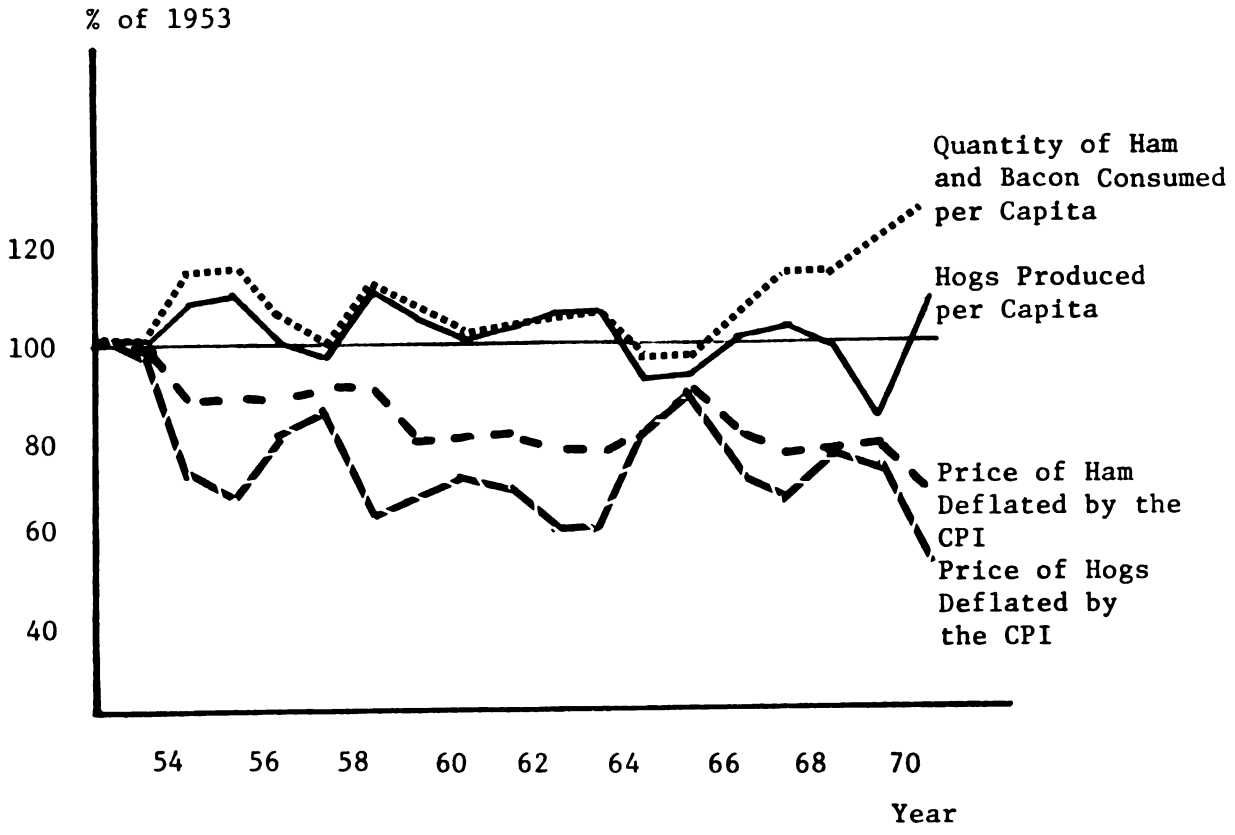

Figure 3.34

U. S.: Hogs: price and consumption indexes (1953-1971)

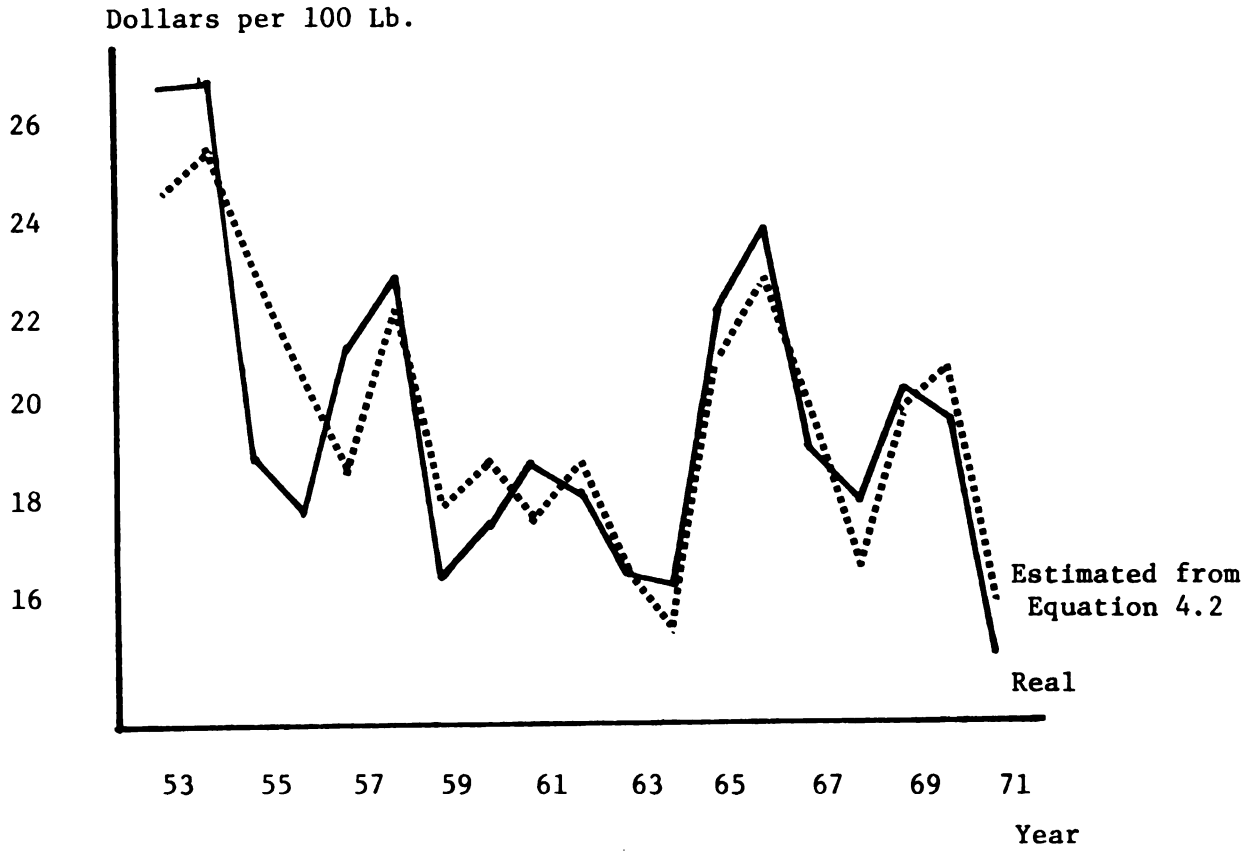

Figure 3.35

U. S.: Price of hogs deflated by the CPI (1953-1971)

Figure 3.36

U. S.: Price of ham deflated by the CPI (1953-1971)

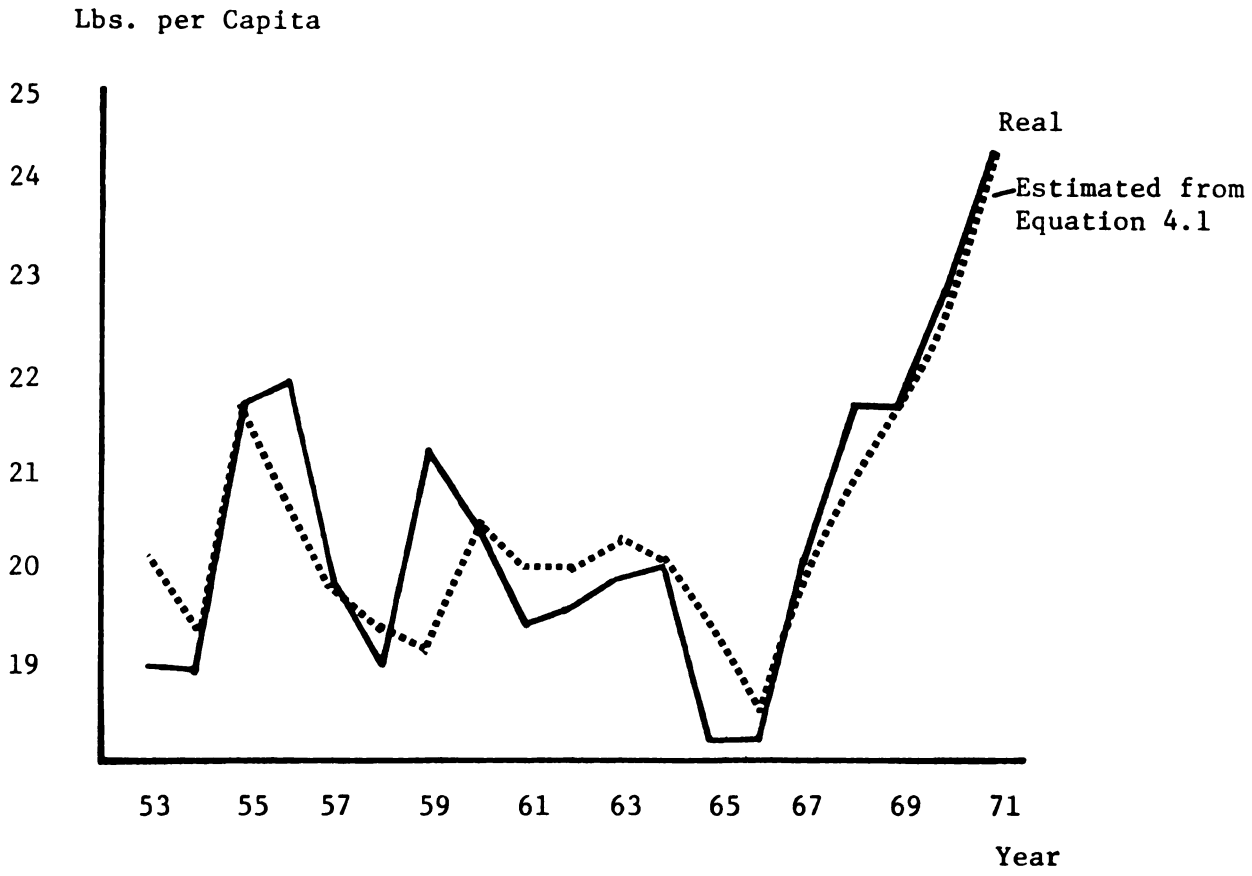

Figure 3.37

U. S.: Quantity of ham and bacon consumed per capita (1953-1971)

Figure 3.38

U. S.: Farm-retail price differentials for ham deflated by the CPI (1953-1971)

TABLE 3.20

INCOME AND TRANSFER ELASTICITIES FOR HOGS AND POULTRY

	Ham and Bacon	Broilers	Eggs
Income elasticity	-.09	1.23	.76
t value for income coefficient	.27	7.94	2.43
Transfer elasticity	.42	-.002	0
t value for transfer coefficient	2.2	.43	.11
Low income elasticity[a]	.31[c]	.13[d]	.16
High Income elasticity	-.26[c]	.13[d]	-.22
Aggregate income elasticity[b]	.13[c]	.17	.05

[a]Source: J. C. Purcell and Robert Raunikar, "Quantity and Income Elasticities by Level of Income," Journal of Farm Economics, XLIX (1967), 1410-1414.

[b]Source: P. S. George and G. A. King, Consumer Demand for Food Commodities in the U. S. with Projections for 1980, Giannini Foundation Monograph No. 26, (Davis: March, 1971).

[c]Elasticity for pork.

[d]Elasticity for poultry.

None have t values larger than two, although they do approach it. Again, wages and price of fuel do not appear to have a significant effect on the price of hogs although the t values are close enough to two to suggest that they might have an effect.

The percent of the retail price going to farmers has decreased over the period of analysis. At the same time the farm-retail spreads have increased according to the U. S. Department of Agriculture for the aggregate, pork (Table 3.20).

Figure 3.38 illustrates the declining farm-retail price differential for ham only. The differences between the spreads and the differentials can be explained in two ways. First, the definitions between the farm-retail price differential and price spread differ. Second, the United States Department of Agriculture figures represent an average price for all cuts of hogs including ham and pigtails. In other words, we might be looking at spreads between the various cuts of pork indicating a declining spread for more expensive cuts and an increasing spread for less expensive cuts.

Chicken

Modeling the Broiler Sector

Broiler production was used as a proxy for retail consumption because there are no data on consumption of various types of chicken. Also, chicken consumption per capita and broiler production are highly correlated (.98). Table 3.14 shows that broiler production per capita (QBROILPR) is highly correlated with time (YEAR) which could result in misinterpretation of results.

TABLE 3.21

THE BROILER MODEL

System of equations for broilers

Retail demand:	(QCHICKEN, PCHICKEN, $\bar{Z}$)
Retail supply:	(QCHICKEN, PCHICKEN, PBROILERS, $\bar{Z}$)
Farm demand:	(QBROILERS, PBROILERS, PCHICKEN, $\bar{Z}$)
Farm supply:	(QBROILERS, PBROILERS, $\bar{Z}$)

Endogenous variables

PBROILERS	price of broilers at farm level
PCHICKEN	price of chicken at retail level
QBROILERS	quantity of broilers produced
QCHICKEN	quantity of chicken consumed

Exogenous variables $\bar{Z}$

FUEL	price of fuel
PFEDBF	price of fed beef (steers and heifers) received by farmers
PHAM	price of retail ham
PHAMBURG	price of hamburger meat at retail
PHOGS	price of hogs received by farmers
PNONFEDBEEF	price of non-fed beef (cows) received by farmers
QBRPRLAG	quantity of broilers produced in year t-1
STAMPS	quantity of bonus food stamps
WAGEFME	wage of food manufacturing employees
Y	disposable personal income

TABLE 3.22

REGRESSION RESULTS FOR BROILERS[a]

Equation	Title	Results	Excluded exogenous	R^2	DW
5.1	Retail demand for broilers	QBROILPR = .074 − .02 PFRYING − .002 $\overline{\text{PHAM}}$ (.006) (.006) + 1.35 $\overline{\text{Y}}$ − .10 $\overline{\text{STAMPS}}$ + .01 $\overline{\text{PHAMBURG}}$ (.17) (.23) (.007)	QBRPRLAG WAGEFME FUEL	.99	2.20
5.2	Farm demand for broilers	QBROILPR = 6.52 + .12 PBROIL − .10 PFRYING (.46) (.21) + .007 $\overline{\text{WAGEFME}}$ − .11 $\overline{\text{PFEDBF}}$ (.01) (.14) + .11 $\overline{\text{PNONFED}}$ − .01 $\overline{\text{PHOGS}}$ − .01 $\overline{\text{FUEL}}$ (.15) (.04) (.04)	Y STAMPS QBRPRLAG	.95	1.85
5.3	Price of broilers	PBROIL = 78.44 − .15 $\overline{\text{WAGEFME}}$ + .85 $\overline{\text{PFEDBF}}$ (37.69) (.08) (.78) − .70 $\overline{\text{PNONFED}}$ − .04 $\overline{\text{PHOGS}}$ − .33 $\overline{\text{FUEL}}$ (.67) (.19) (.16) 12.60 $\overline{\text{Y}}$ + 3.47 $\overline{\text{STAMPS}}$ − 10.68 $\overline{\text{QBRPRLAG}}$ (9.55) (4.75) (2.38)	OLS from equation 5.2	.96	3.01

TABLE 3.22 (cont'd)

Equation	Title	Results	Excluded exogenous	R^2	DW
5.4	Price of frying chicken	PFRYING = 138.60 - .27 $\overline{\text{WAGEFME}}$ + 1.44 $\overline{\text{PFEDBF}}$ (47.25) (.10) (.98) - 1.01 $\overline{\text{PNONFED}}$ - .33 $\overline{\text{PHOGS}}$ - .50 $\overline{\text{FUEL}}$ (.84) (.24) (.20) + 30.22 $\overline{Y}$ + 4.82 $\overline{\text{STAMPS}}$ - 23.50 $\overline{\text{QBRPRLAG}}$ (11.97) (5.96) (2.99)	OLS from equation 5.2	.98	2.60

[a]A complete description and source of all data can be found in Appendix B. All quantity variables are per capita and all price variables have been deflated by the CPI (1967=100). Parentheses under the coefficients enclose the standard errors. Bars over the variables indicate the exogenous variables.

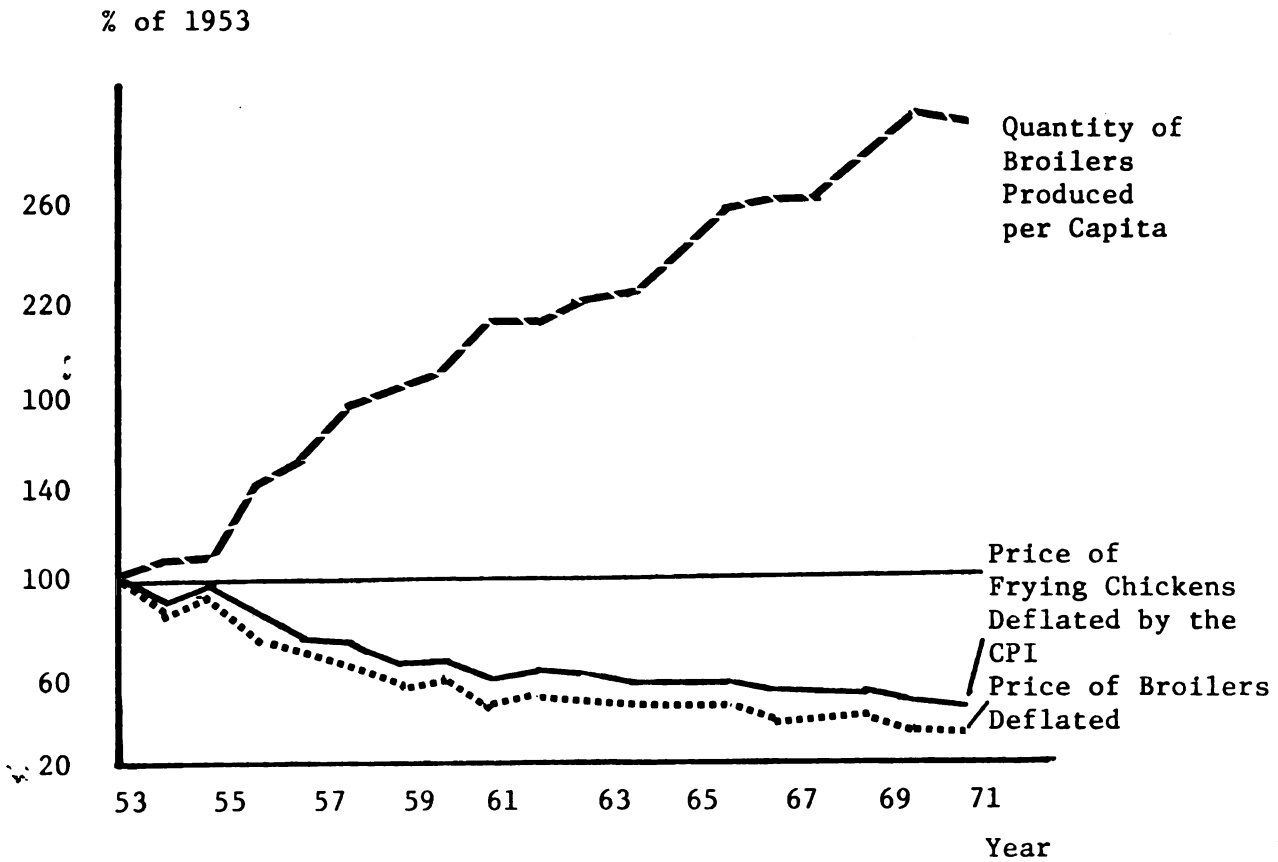

Figure 3.39

U. S.: Broilers: Price and consumption indexes (1953-1971)

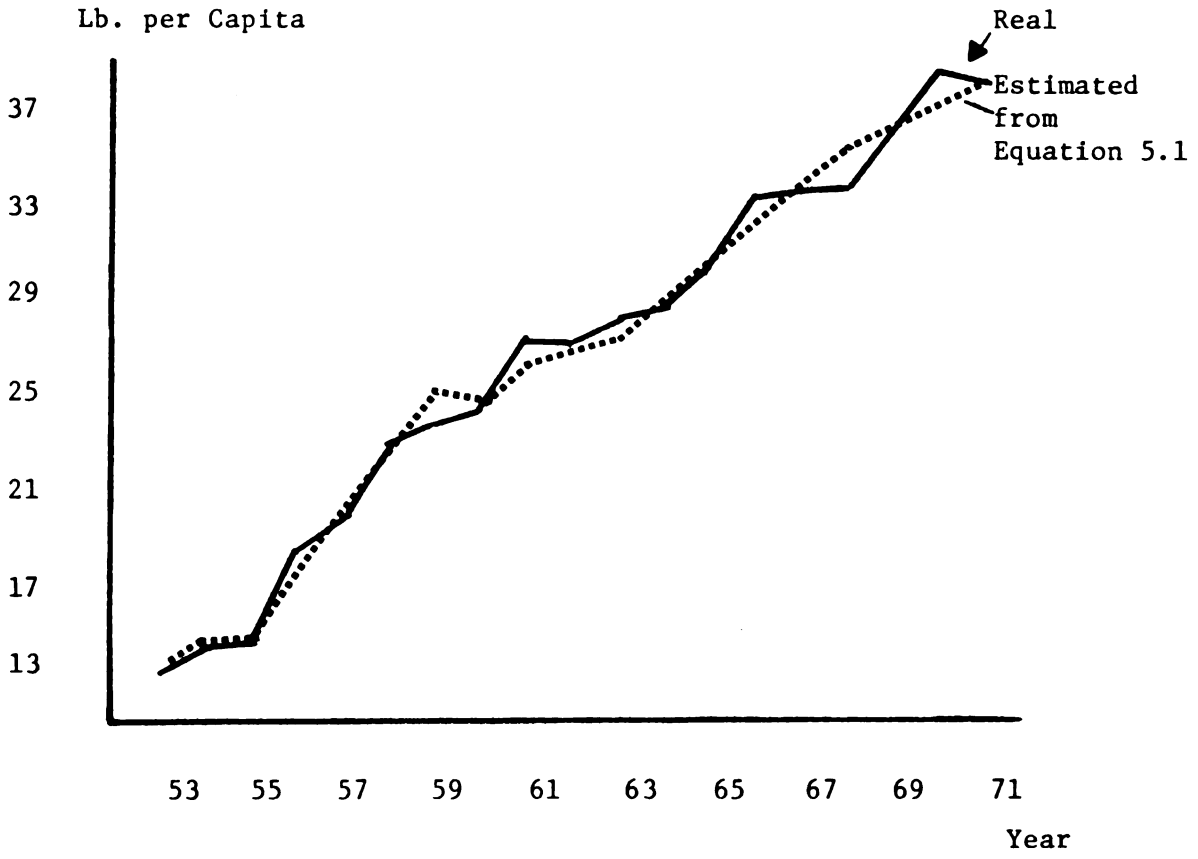

Figure 3.40

U. S.: Quantity of broilers produced per capita (1953-1971)

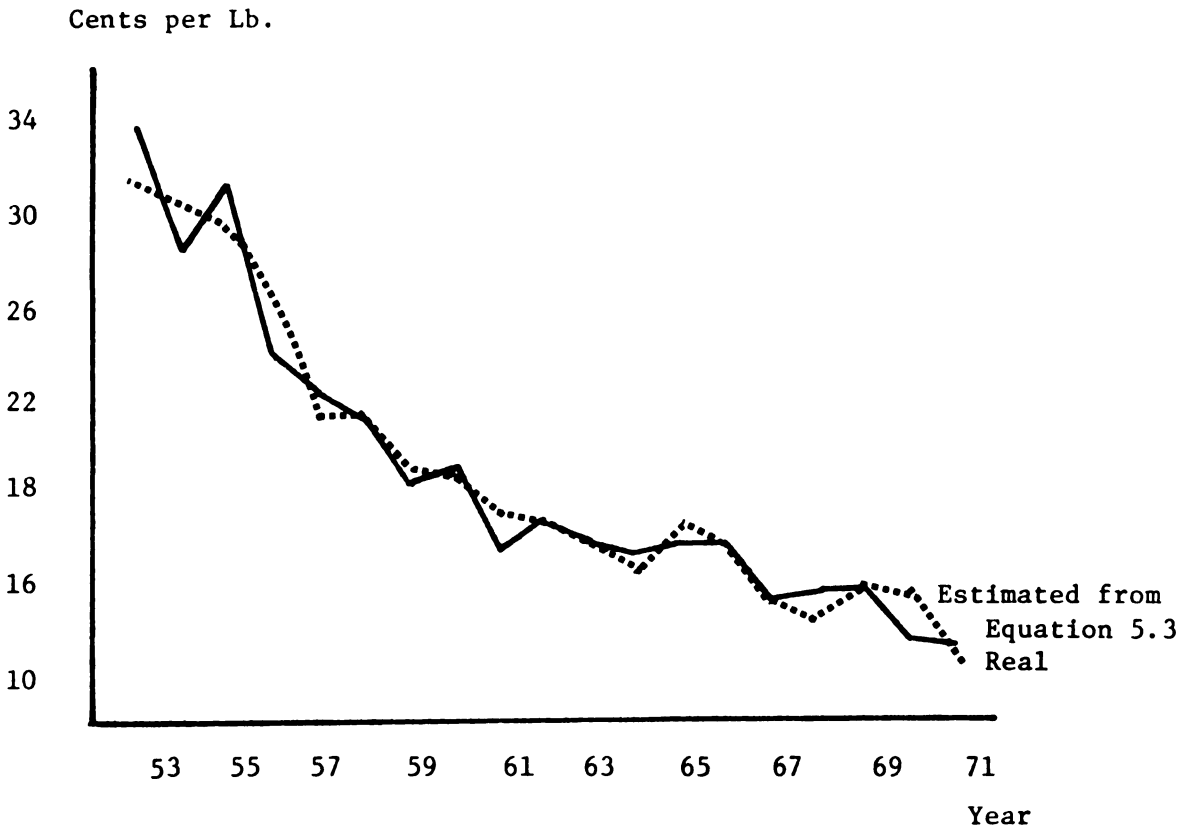

Figure 3.41

U. S.: Price of broilers deflated by the CPI (1953-1971)

Figure 3.42

U. S.: Price of fryers deflated by the CPI (1953-1971)

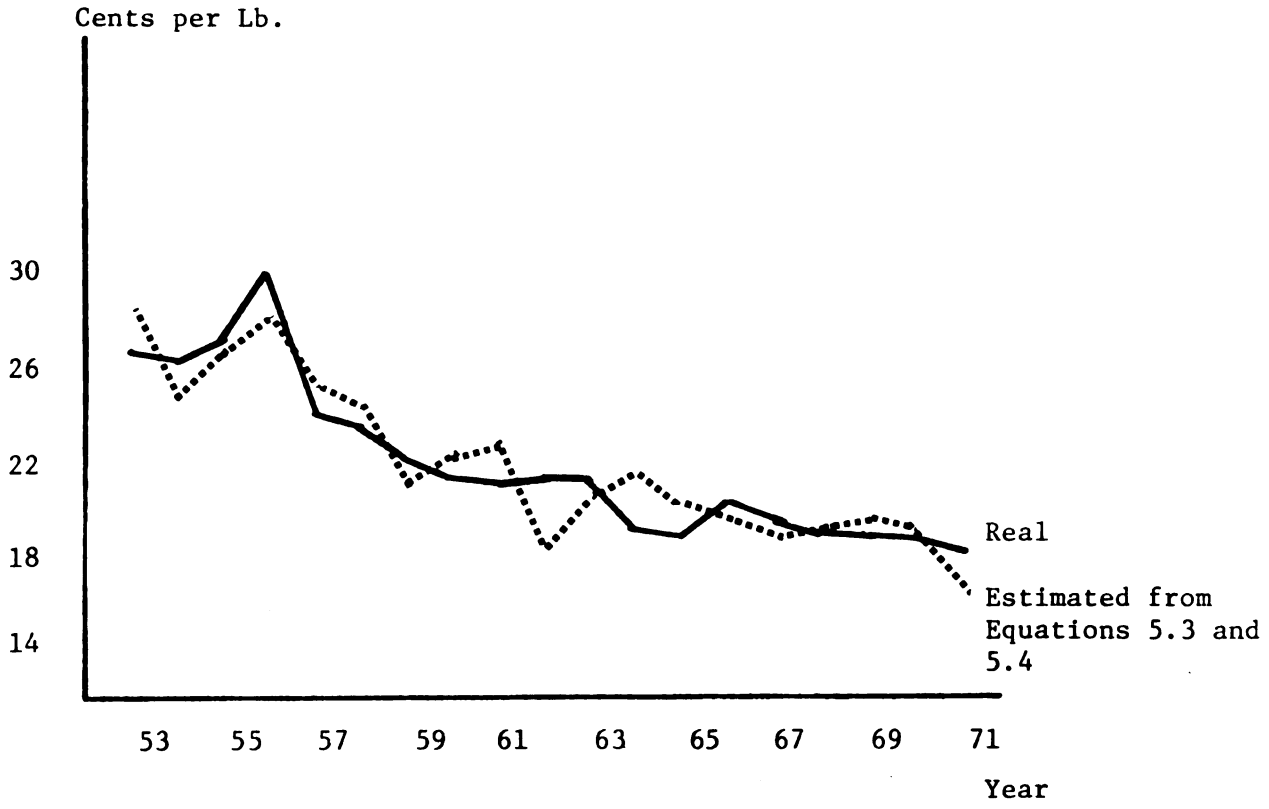

Figure 3.43

U. S.: Farm-retail price differentials for broilers deflated by the CPI (1953-1971)

Analysis of Regression Results

Since 1953 there has been a constant decrease in farm and retail prices of chicken (Figure 3.39). Concurrently, production and consumption of chicken has rapidly expanded. Chicken production has increased by 190 percent while the 1971 prices of broilers and retail fryers are 33 percent and 45 percent, respectively, of their 1953 price when adjusted for inflation. Prices at both the retail and farm level are highly correlated, .99.

From the regression analysis, we see that the amount of chicken consumed definitely responds to price change (Table 3.22). The price coefficient is significant with a t value of 3.33 with our own price elasticity of -.36. According to the results, hamburger is a substitute for chicken.

However, since all the retail prices for beef are so highly correlated, there is no certainty that hamburger is actually a substitute but rather some or all retail beef cuts may act as substitutes.

The coefficient for food stamps (STAMPS) is negative and insignificant, but for income it is very high and significant (Table 3.20). One problem with elasticity interpretation is that personal disposable income (Y) is highly correlated with time (YEAR), .97, and there is no certainty that the large response with respect to increased income is not a result of the huge technological changes in the industry over the last 20 years.

Figure 3.43 and Table 3.17 illustrate the decrease in the farm-retail price differentials and spreads for broilers. According to the U. S. Department of Agriculture statistics the farm-retail spread declined by 26 percent from 1953 to 1971. At the same time the percentage

of the retail price going to the farmer also declined. Those data are indicative of the huge decline in retail price. Again, the decline is explained by technological advances in the marketing sector.

In the analysis of farm level demand no variable has a t value of two or more although the R^2 (.95) and Durbin-Watson statistics (1.85) are within reasonable range (Equation 5.2). Thus, according to the farm level demand regression results, there are no definite substitutes or complements for broilers. Wage rate, price of fuel, and own price are not significant in determining broiler quantity demand at the farm level.

Since two-stage least squares was used it is likely that in the first stage results, the overwhelming importance of technological change was manifested through the income variable (Y). This variable is highly correlated with time and thus highly correlated with the technological change in the industry within the 20 year time span of the analysis. This explains the high R^2.

As is evident from the correlation matrix in Table 3.14, income (Y) explains .94 percent of the variation in quantity of broilers produced. This quantity (QBROILERS) would have to be run against time to see if the system used here has provided a better understanding of the structure of the system than simple use of time. Indeed it has because when this particular analysis was done, although the R^2 is high, .98, the Durbin-Watson is low 1.16, indicating poor structural analysis when only time is used.

Eggs

Modeling the Egg Sector

The quantity of eggs produced and eggs consumed is so highly correlated (.99) that egg production was used as a proxy for consumption.

TABLE 3.23

THE EGG MODEL

System of equations for eggs

Retail demand:	(QEGGS, PEGGS, $\bar{Z}$)
Retail supply:	(QEGGS, PEGGSF, PEGGS, $\bar{Z}$)
Farm demand:	(QEGGS, PEGGSF, PEGGS, $\bar{Z}$)
Farm Supply:	(QEGGS, PEGGSF, $\bar{Z}$)

Endogenous variables

PEGGS	price of eggs at retail
PEGGSF	price of eggs received by farmers
QEGGS	quantity of eggs

Exogenous variables $\bar{Z}$

FUEL	price of fuel indexed
PFRYING	price of retail chicken
PHAM	price of ham
PHAMBURGER	price of hamburger
QBROILPR	quantity of broilers produced
QEGGSPR	quantity of eggs produced
QEGGSPRLAG	quantity of eggs produced in year t-1
QFEDBRPR	quantity of steers and heifers slaughtered
QNONFED	quantity of cows slaughtered
TRANSFER	dollar value of income dependent transfer payment
WAGEFME	wage of food manufacturing employees
Y	disposable personal income
YEAR	trend

TABLE 3.24

REGRESSION RESULTS FOR EGGS[a]

Equation	Title	Results	Excluded exogenous	R^2	DW
6.1	Retail demand for eggs	QEGGSPR = 245.53 − .01 PEGGSR − .0004 $\overline{\text{PFRYING}}$ (.02) (.02) + .002 $\overline{\text{PHAM}}$ + .004 $\overline{\text{PHAMBURG}}$ + .95 $\overline{\text{Y}}$ (.005) (.014) (.39) + .00007 $\overline{\text{TRANS}}$ − .12 $\overline{\text{YEAR}}$ (.0006) (.03)	QEGGSPRLAG WAGEFME FUEL	.97	1.90
6.2	Price of eggs at retail	PEGGSR = −448.89 + .78 PFRYING + .14 $\overline{\text{PHAM}}$ (7123.14) (.54) (.38) + .49 $\overline{\text{PHAMBURG}}$ − 7.88 $\overline{\text{Y}}$ + .06 $\overline{\text{WAGEFME}}$ (.36) (35.01) (.20) + .05 $\overline{\text{FUEL}}$ − 6.47 $\overline{\text{QEGPRLAG}}$ − .001 $\overline{\text{TRANS}}$ (.45) (17.76) (.002) + .23 $\overline{\text{YEAR}}$ (3.62)	OLS from equation 6.1	.94	2.30
6.3	Farm demand for eggs	PEGGSF = 10.34 + .85 PEGGSR − 11.18 $\overline{\text{QEGGSPR}}$ (.57) (5.71) + 2.07 $\overline{\text{QNONFED}}$ + .71 $\overline{\text{QFEDBFPR}}$ (.87) (.75) − .0009 $\overline{\text{QBROILPR}}$ (.005)	Y TRANS QEGGSPRLAG	.97	2.57

[a]A complete description and source of all data can be found in Appendix B. All quantity variables are per capita and all price variables have been deflated by the CPI (1967=100). Parentheses under the coefficients enclose the standard errors. Bars over the variables indicate the exogenous variables.

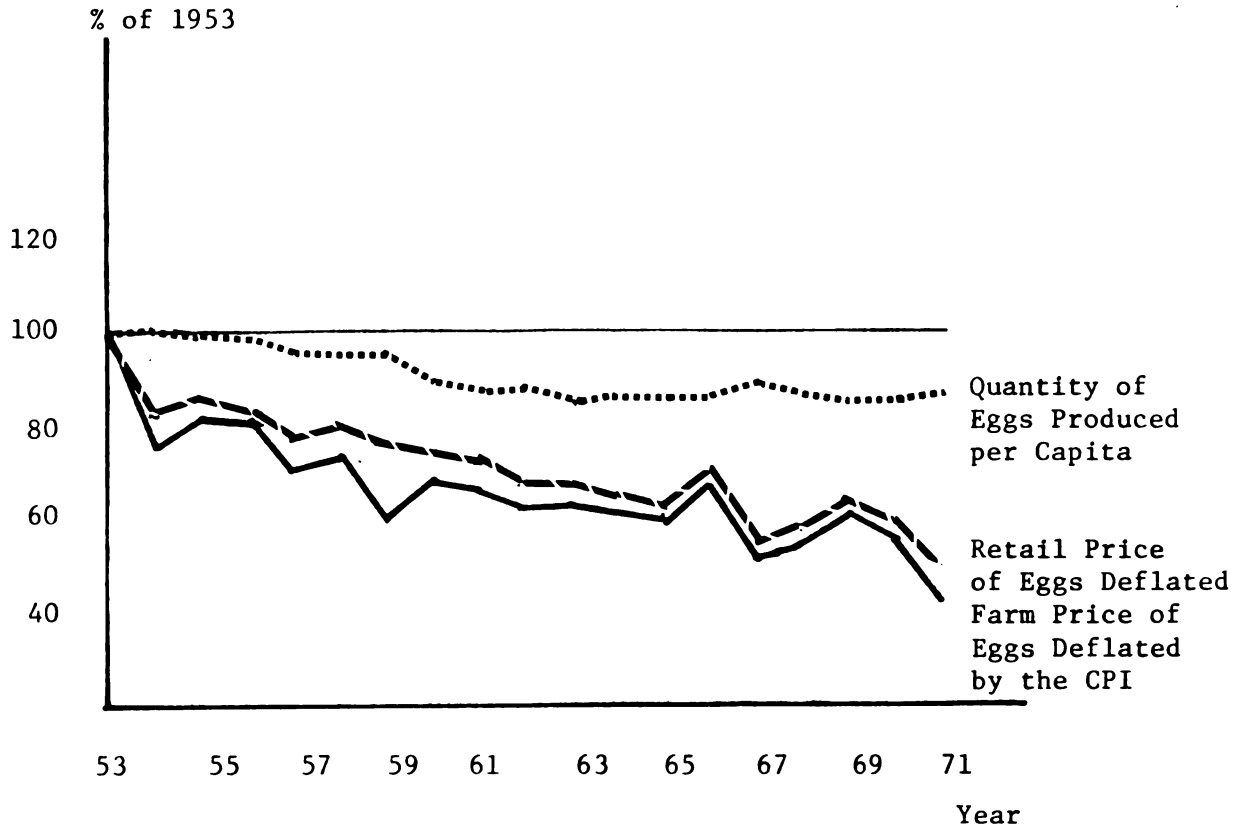

Figure 3.44

U. S.: Eggs: price and consumption indexes (1953-1971)

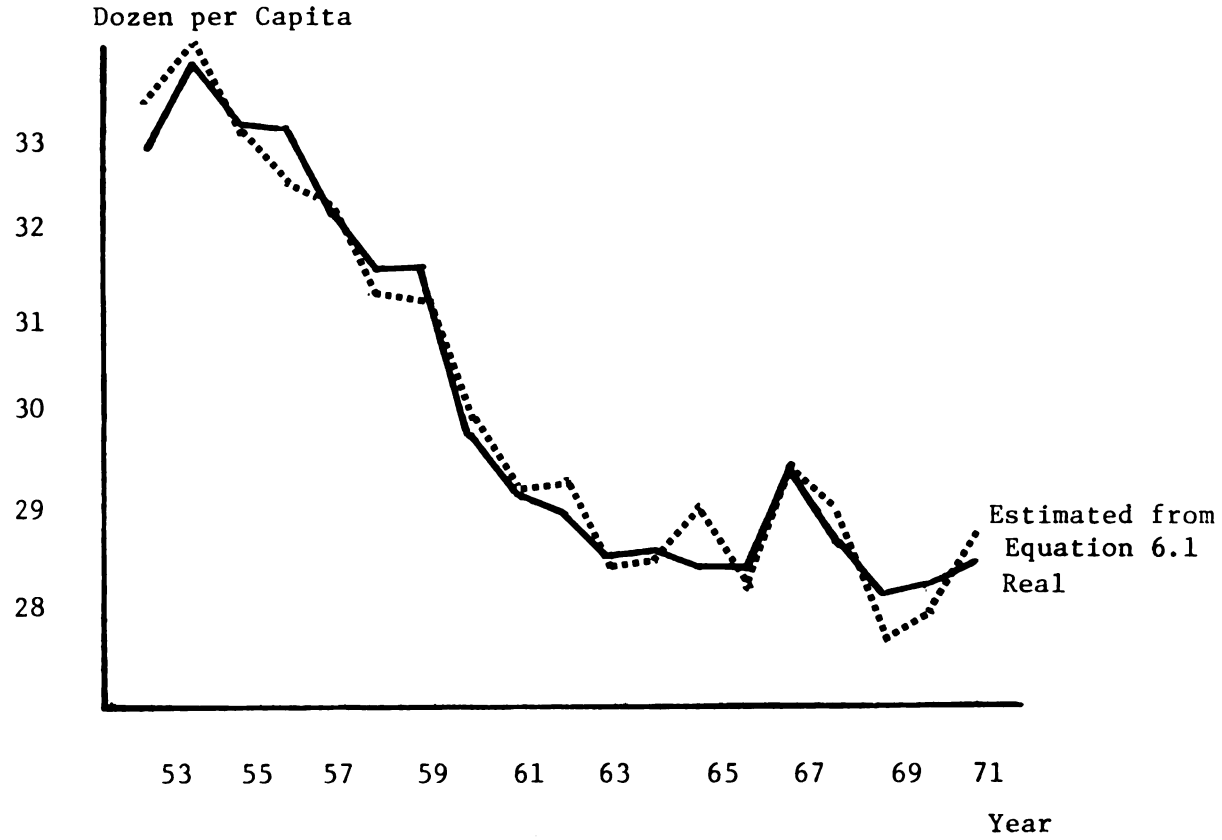

Figure 3.45

U. S.: Quantity of eggs produced per capita (1953-1971)

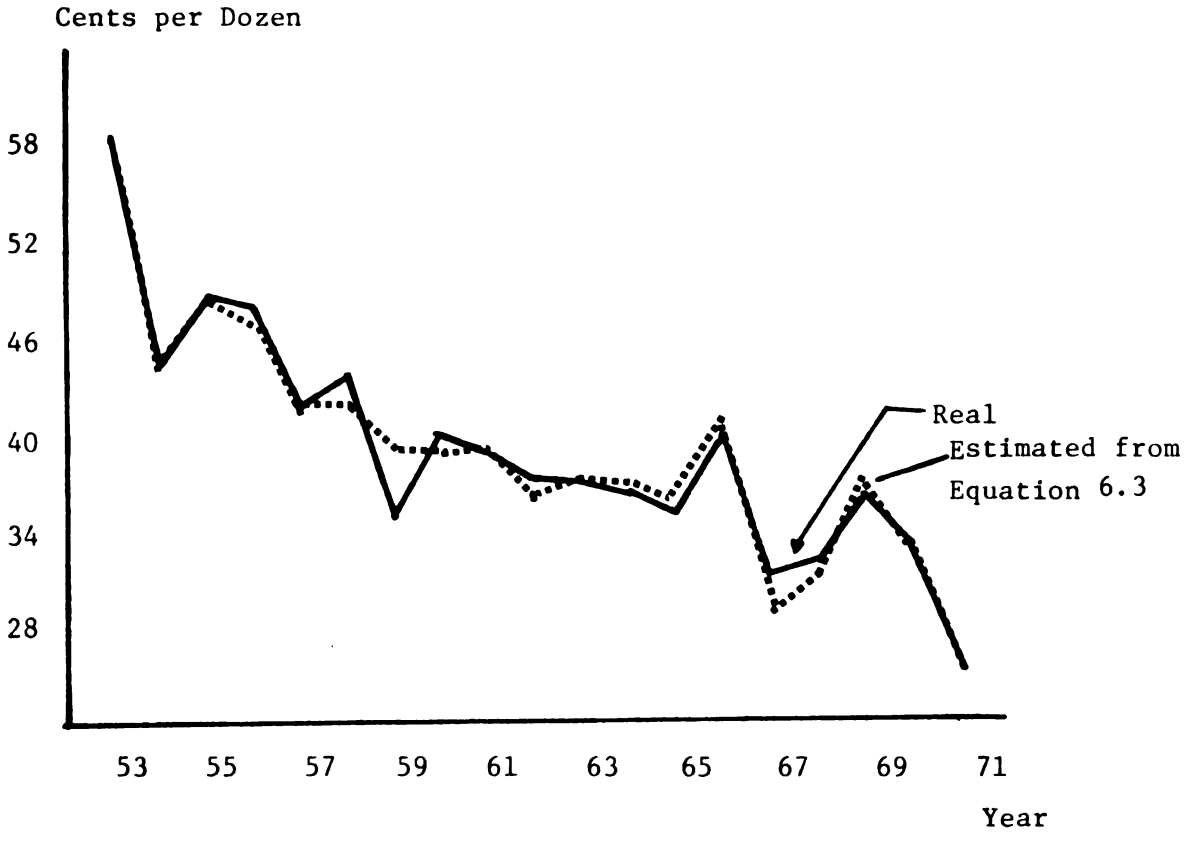

Figure 3.46

U. S.: Farm price of eggs deflated by the CPI (1953-1971)

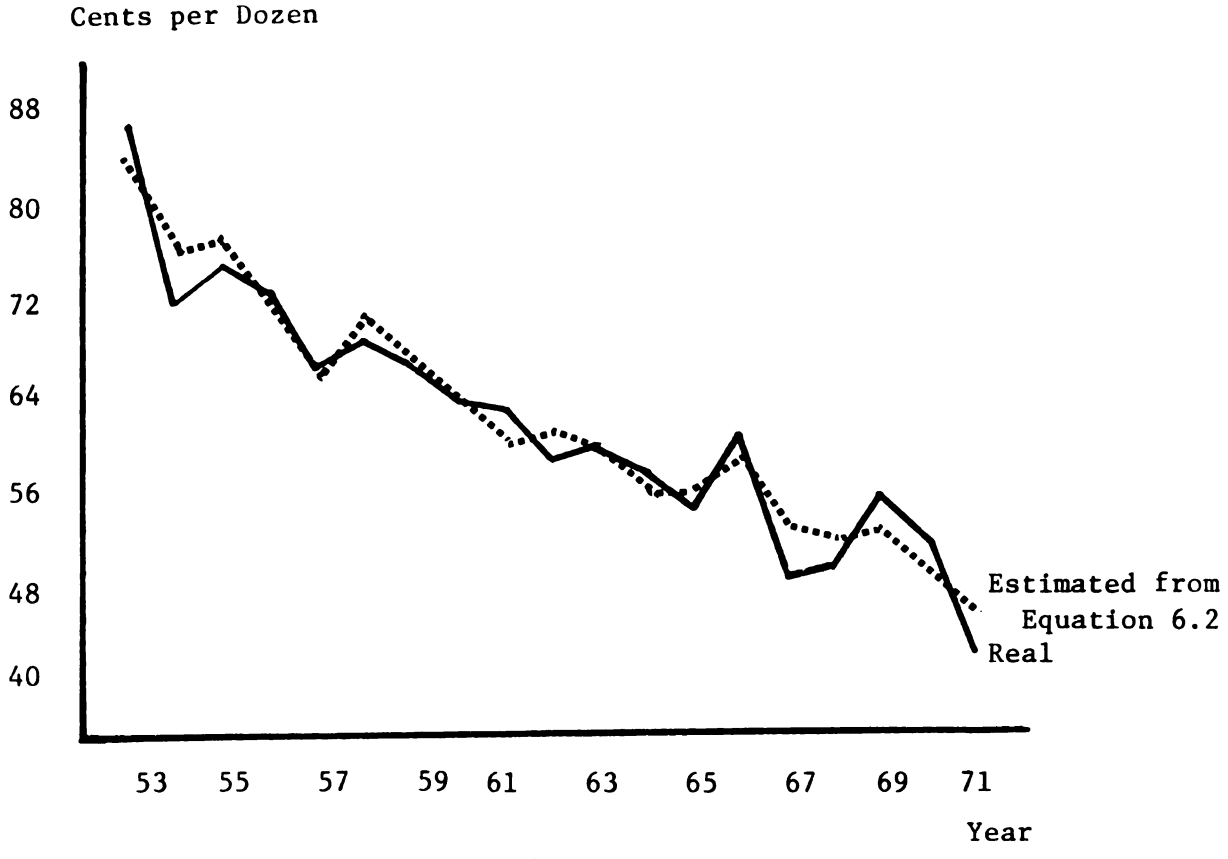

Figure 3.47

U. S.: Retail price of eggs deflated by the CPI (1953-1971)

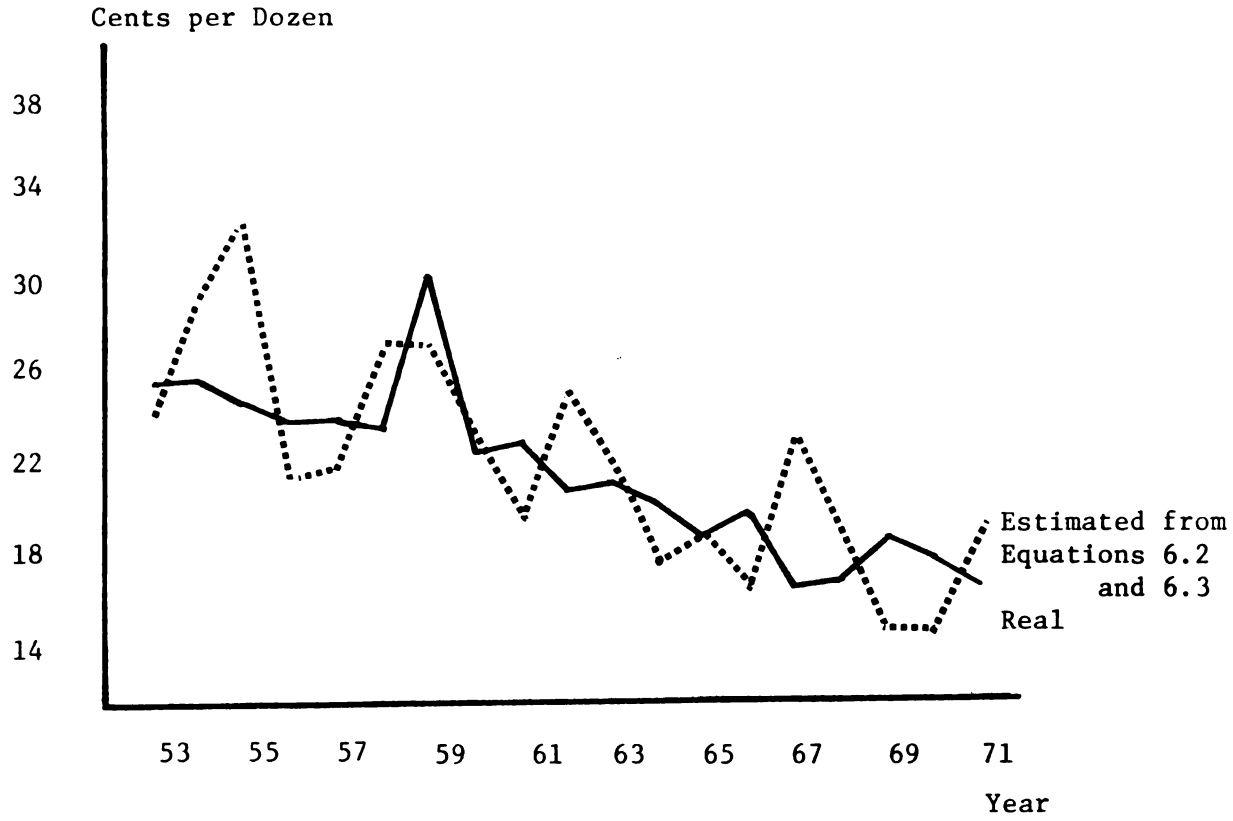

Figure 3.48

U. S.: Farm-retail price differentials for eggs deflated by the CPI (1953-1971)

Analysis of Regression Results

Per capita egg consumption has declined considerably since 1953. Per capita production, which is highly correlated (.99) with per capita egg consumption, has declined by 13 percent since 1953. From 1951 to 1969 the amount of eggs used for breaking has increased by 52 percent. This represents an increase in percentage of total egg production from 6.6 to 8.5.[1] Various parts or the whole part of the liquid egg is extracted for use in the manufacture of baked goods, mayonnaise, noodles, baby food and many other products. On the whole, per capita consumption of processed eggs has increased but processed eggs still comprise only about 10 percent of total per capita egg consumption.

Statistical analysis shows there is a significant and negative relationship between price of eggs at the farm and the quantity of eggs produced (Equation 6.3, Table 3.24). The quantity of eggs produced according to this model is exogenous to the present price.

Non-fed beef according to the farm level equation (6.3) is a complement for eggs and has a high t value (2.37). Fed-beef also appears as a complement but the t value is smaller (.94). In the retail level (Equation 6.1), the coefficient price of hamburg has a very low t value and, therefore, contradicts the results above. It may be that beef is acting as a proxy for an excluded variable or that the multicollinearity between the retail price of eggs (PEGGSR) and the quantity of non-fed beef produced (QNONFED) is interfering with the accuracy of the coefficients.

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[1] U. S. Department of Agriculture, Economic Research Service, The Egg Products Industry, Marketing Research Report No. 917 (Washington, D. C.: Government Printing Office, 1971) p. 4.

Time (YEAR) was included as a variable in the retail demand equations to test for the possibility that changes in tastes and preferences have caused the decline in per capita egg consumption. The t value for the coefficient is four, indicating the possibility of a change in tastes and preferences away from eggs over this period. Recommendations by doctors and subsequent advertising on the relationship between eggs, cholesterol and heart disease may have affected the preference for eggs.

U. S. Department of Agriculture data for farm-retail spreads appear in Table 3.17; Figure 3.48 illustrates the decline in farm-retail price differentials between 1953 and 1971. Recent technological advances in egg production and marketing have led to the sharp decline in price. But the swing away from egg consumption despite the retail drop in price has caused an even larger drop in price. The amount going to the marketers has decreased but at the same time the percentage as well as amount going to the farmer has declined.

CHAPTER IV

SUMMARY AND CONCLUSIONS

The major objectives of this work are to analyze some specific United States farm commodities and isolate and estimate the relevant variables affecting their consumption. The purpose is to evaluate the substitutes and complements for the particular retail products as well as the effect of income and specific marketing costs. The effect of transfer payments and food stamps on demand is also analyzed. Many variables cannot be studied because they are either assumed to be insignificant or their effects cannot be measured by this analysis. Some variables which could be isolated in further analysis were mentioned previously.

Econometric analysis of the demand function is used to determine the relationships among the variables. Unlike previous retail analysis covering many retail commodities, no attempt is made to account for all foods using the usual assumptions about elasticities. Instead, a system was developed for each farm commodity. Retail and farm-level data are used; the retail level data being considered especially relevant for analysis involving consumer choices.

The major results for each commodity are given in Chapter 3. But there are also some general observations about the farm-retail price differentials and the transfer payments and food stamps that can be made.

In this analysis, marketing margins are not estimated directly; rather farm-retail price differentials emerge from the estimations of the price at both the retail and farm level. Thus, to determine the

marketing margins (as defined by the U. S. Department of Agriculture) a by-product allowance must be estimated. This is omitted in our analysis. Also there is no allowance for the other ingredients in the retail commodity.

Instead, conversion factors[1] specified by the U. S. Department of Agriculture are used to determine the amount of the farm commodity used in the relevant amount of the retail product. The farm price for the retail equivalent amount of the product is subtracted from the retail price to ascertain the marketing margin.

Farm-retail price differential estimates are more successful in some cases than others. Because two separate estimates of two different prices are used to estimate the farm-retail price differential, errors in the separate equations may counteract each other or build on each other so that the real and estimated differentials tend to diverge. Estimates for bread and cookies were generally more accurate. Fluid milk, however, is a good example of the actual diverging from the estimate. Cheese and butter are not estimated because the aggregated price of milk at the farm used in this analysis is higher than the retail price of the equivalent quantities of butter and cheese. Other commodities tend to follow the appropriate trends, but do not provide accurate year to year estimates.

A major problem in analyzing the marketing costs is finding appropriate data to proxy these costs. Fuel prices and wages of food manufacturing employees are used here for that purpose. Fuel costs play a role in the amount of wheat and fluid milk consumed and the quantity of

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[1]U. S. Department of Agriculture, Economic Research Service, Conversion Factors and Weights and Measures for Agricultural Commodities and their Products, Statistical Bulletin No. 362 (Washington, D. C.: Government Printing Office, 1965).

milk demanded at the farm level. Labor costs at the retail level affect the supply of fluid milk. A more direct analysis of marketing margins is needed to better understand the various components of the margins.

This analysis indicates only fluid milk has experienced any increase in the percent of the retail price going to the farmer. The percentage going to the farmer has declined whether or not the retail price and/or the farm-retail spread has increased or decreased. Between 1960 and 1970 the deflated farm-retail price spread increased for cheese, beef and pork. Only for these products, then, has the actual amount going to marketing costs increased.

From 1950 to 1960 there was also an increase in spread for milk and bread. Consumption of beef and cheese increased, too. (Chicken is not included here because the technological changes have greatly lowered the costs of marketing broilers). Consumption of high quality pork cuts has increased also although pork slaughter per capita has not. Thus, a possible correlation exists between increases in consumption per capita and increases in farm-retail spreads.

As shown earlier, chosen proxies for marketing costs have not proved significant in determining quantities consumed of the various products. The correlation between quantities consumed and farm-retail spreads might give some hint as to why some spreads have increased. If they cannot be explained by costs, they can perhaps be explained by other costs not included in this analysis or profits gained by marketing firms from increased demand of these products. Structural analysis of the industries involved would help answer this question.

The general decline in marketing margins remains unexplained. One assumes they would remain rather steady, but technological changes

may be responsible for their continuing decline. This hypothesis requires further investigation.

Income-dependent transfer payments in 1971 are 3.37 times larger than their 1953 value. After adjustment for inflation and population increase, the deflated per capita figure is 1.75 times the 1953 value. Similarly, disposable personal income adjusted for inflation and population change increased by only 50 percent.

In order to believe the statistical results from the analysis of income and transfer payments we expect some kind of coincidence between the transfer elasticities derived in this study and low income elasticities derived from other sources. Table 4.1 compares the transfer elasticities with the low income elasticities presented in Raunikar and Purcell's study. Where comparisons are available, except for fluid milk and chicken, the signs are coincidental. The coefficient for transfer payments for chicken was not significant and, therefore, does not contradict the low income elasticity found by Purcell and Raunikar. However, the statistical results of the milk analysis contradict the results from other sources.

This study contributes to the information about food stamps and transfer payments combined over time. It does not single out food stamps and analyze the effect of this particular policy alone. This has been done by the U. S. Department of Agriculture in a study entitled, Bonus Food Stamps and Cash Income Supplements: Their Effectiveness is Expanding Demand for Food.[1]

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[1]U. S. Department of Agriculture, Economic Research Service, Bonus Food Stamps and Cash Income Supplements: Their Effectiveness in Expanding Demand for Food, Marketing Research Report No. 1034 (Washington, D. C.: Government Printing Office, 1974).

TABLE 4.1

COMPARISON OF TRANSFER ELASTICITIES AND LOW INCOME ELASTICITIES

	Transfer elasticity	t value of transfer coefficient in retail equation	Low income elasticity[a]
Flour	-.036	.90	-.30
Cookies	-.013	3.61	b
Bread	.008	3.95	.19
Cheese	1.28	6.44	b
Butter	-.87	.38	b
Fluid Milk	-.79	3.52	.35
Steak	6.83	7.54	.37
Hamburger	2.48	8.66	
Ham and bacon	.42	2.52	.31
Chicken	-.002	.43[c]	.13
Eggs	.43	1.16	.16

[a]Source: J. C. Purcell and Robert Raunikar, "Quantity Income Elasticities for Foods by Level of Income," Journal of Farm Economics XLIX (1967), 1410-1414.

[b]Not available.

[c]Elasticity for poultry.

Only with better micro-level cross-sectional data specifying consumption with and without food stamps can a more complete analysis be undertaken. This particular analysis could be improved if the results found here were compared with those of a study, similar to that done by the U. S. Department of Agriculture study mentioned above, analyzing food stamps and transfer payments together rather than food stamps alone.

Results from this study indicate transfer payments and the food stamp program have had a significant impact on food consumption in the United States. These impacts have been felt by the farmers, wholesalers and retailers of farm commodities as well as the whole economy. This implies that any policy analysis of these programs must consider carefully not only the effects on the recipients but also the effects on others in the economy.

Studying the effects on the various factors in the economy, the transfer and food stamp programs as an aggregate seem to shift diets away from grains and toward more expensive sources of protein and calcium. The effect on the producers is to shift demand to beef producers and to producers of feed for beef and away from producers of wheat.

The effect on the marketers is somewhat obscure. Data imply that where there is a strong increase in demand there is an increase in marketing margins. But this may mean profits rather than marketing services. A more direct analysis should yield some information on the effect of transfer payments and food stamps on demand for these services.

The analysis sheds some light on the adequacy of the food stamp program. The two stated objectives of the food stamp programs are to 1) increase the nutritional standards of the low income population; and 2) increase demand for food. This study highlights the fact that there

are distribution impacts regarding both of these objectives. Various income groups use their new income differently and, as a result of these programs, demand is increased from some farm products and decreased for others.

APPENDICES

APPENDIX A

DESCRIPTION OF TRANSFER PROGRAMS

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DESCRIPTION OF TRANSFER PROGRAMS

Aid to Families with Dependent Children (AFDC). Assistance is provided to needy families with dependent children where the father is absent, incapacitated, or in 25 states, unemployed. Benefit amounts vary by family size, and are decreased as the family's other income rises. The program is administered and partially funded by State and/or local governments. Non-Federal costs are matched with Federal funds, the Federal percentage ranging from 50 percent of total costs in New York to 83 percent in Mississippi. AFDC programs operate in 54 jurisdictions (all 50 states, the District of Columbia, Guam, Puerto Rico, and the Virgin Islands).

Food Stamps. The Department of Agriculture, through local welfare agencies, provides food coupons for needy families and individuals in the 2,027 counties electing to operate the program. A county cannot operate both the food stamp and food distribution programs except in emergency situations. Eligible persons may purchase the coupons; the purchase price increases as other income increases. Coupon allotments vary with family size. The coupons are redeemed at face value by grocery stores for food items purchased by recipients. State and local governments bear most of the administrative costs.

General Assistance (GA). Welfare payments made in cash or in kind by states and localities to low-income persons ineligible for

assistance under one of the four Federal categories (families with dependent children, the aged, the blind, and the disabled) are termed general assistance. These programs are authorized, administered, and financed solely by state and local governments. Rules of eligibility and benefit levels vary widely from place to place, with some localities having virtually no general assistance at all.

Old Age Assistance (OAA). Assistance is provided to needy individuals who are age 65 or over. Benefits decrease for increases in other income. (For administration, financing and jurisdictions covered, see "aid to families with dependent children").

Source: U. S. Congress, Joint Economic Committee, Public Income Transfer Programs: The Incidence of Multiple Benefits and the Issues Raised by their Receipt, by James Storey, Joint Economic Committee Print, Paper No. 1 (Washington, D. C.: Government Printing Office, 1972).

APPENDIX B

VARIABLES USED IN STATISTICAL ANALYSIS

APPENDIX B

VARIABLES USED IN STATISTICAL ANALYSIS

Variable name	Description	Units	Source[a]		
			Publication	Date	Page
BURGPLUS	Hamburger and ground beef prepared and processed under federal inspection	1,000 lb.	LMS	1973	301
CPI	Consumer price index	1967=100	AS	1972	503
FUEL	fuel, power and light bought by manufacturing firms	1967=100	MTS	May, 1974	24
HAMBAC	Bacon regular, sliced; ham regular, water added, boneless; picnics regular, water added and boneless; pork butts, pork other; bu prepared and processed under federal inspection.	1,000 lb.	LMS	1973	301
PBREAD	price of white bread retail level	cents/lb.	BLS	1950-1972	
PBROIL	price for broilers received by farmers	cents/lb.	AS	1972	
PBUTTER	retail price of butter	$/lb.	BLS	1950-1972	
PBWHR	price of white bread at retail	$/lb.	BLS	1950-1972	
PCHEESE	retail price of American cheese	$/1/2 lb.	BLS	1950-1972	
PCHUCK	retail price of chuck	cents/lb.	BLS	1950-1972	
PCKR	retail price for sandwich cookies	$/lb.	BLS	1950-1972	
PFBFLAG	price of fed-beef (steers and heifers) received by farmers in year t-1	$/100 lb.	AS	1972	365
PFEDBF	price of fed-beef (steers and heifers) received by farmers	$/100 lb.	AS	1972	365
PFLR	price of flour at retail level	$/5 lb.	BLS	1950-1972	
PFRYING	retail price for frying chicken	cents/lb.	BLS	1950-1972	

APPENDIX B (cont'd)

Variable name	Description	Units	Source[a]		
			Publication	Date	Page
PHAM	retail price for whole smoked ham	cents/lb.	BLS	1950-1972	
PHAMBURG	price for hamburger meat at retail level	cents/lb.	BLS	1950-1972	
PHOGS	price for hogs received by farmers	$/100 lb.	AS	1972	379
PHOGSLAG	price for hogs received by farmers in t-1	$/100 lb.	AS	1972	379
PMARG	price of margarine at retail level	cents.lb.	BLS	1950-1972	
PMFARM	price of all milk wholesale received by farmers	$/100 lb.	AS	1972	445
PMGROC	retail price of fluid milk sold in grocery stores	$/1/2 gal.	BLS	1950-1972	
PNFBFLAG	price for non-fed beef (cows) received by farmers in year t-1	$/100 lb.	AS	1972	365
PNONFED	price for non-fed beef (cows) received by farmers	$/100 lb.	AS	1972	365
POP	U. S. civilian population eating out of domestic food supplies on July 1	1,000,000	AS	1972	682
PROUND	retail price of U. S. choice meat	cents/lb.	BLS	1950-1972	
PSUGAR	retail price of sugar	$/5 lb.	BLS	1950-1972	
PWHFMLAG	price of wheat received by farmers in year t-1	$/bu.	AS	1972	1,2
PWF	price of wheat received by farmers	$/bu.	AS	1972	1,2
QBREAD	quantity of wheat flour used in selected industries to produce bread, cake and related products	1,000 cwt.	CM	1954, 58, 63, 67, 72	
QBROIL	commercial broiler production, ready-to-eat weight	1,000,000 lb.	AS	1972	481, 482

APPENDIX B (cont'd)

Variable name	Description	Units	Source[a]		
			Publication	Date	Page
QBUTTER	quantity of milk used in making creamery butter	1,000,000 lb.	AS	1972	440,441
QCHEESE	quantity of milk used in making American, cottage cheese and other	1,000,000 lb.	AS	1972	440,441
QCOOKIES	quantity of wheat flour consumed by selected industries for making cookies and crackers	1,000 cwt.	CM	1954,58, 63, 67, 72	
QFEDBFPR	quantity of fed beef (steers and heifers) slaughtered	1,000,000 lb.	AS	1972	373
QFLOUR	quantity of wheat flour consumed by selected industries for making blended and prepared flour	1,000 cwt	CM	1954, 58. 63, 67, 72	
QFLUID	quantity of milk used in fluid milk production	1,000,000 lb.	AS	1972	440,441
QHOGSPR	quantity of hogs slaughtered	1,000,000 lb.	AS	1972	381
QMILKFMLAG	quantity of milk produced on the farm in year t-1	1,000,000 lb.	AS	1972	440,441
QNFBFLAG	quantity of non-fed beef (cows) slaughtered in year t-1	1,000,000 lb.	AS	1972	373
QNONFED	quantity of non-fed beef (cows) slaughtered (total slaughter minus steer and heifer slaughter)	1,000,000 lb.	AS	1972	373
QSTEAK	quantity of steaks, chops, roasts and boneless cuts prepared and processed under Federal inspection	1,000 lb.	LMS	1973	301

APPENDIX B (cont'd)

Variable name	Description	Units	Source[a]		
			Publication	Date	Page
QFOOD	quantity of wheat used for food in U.S.	1,000,000 bu.	AS	1972	12
QWHPRODLAG	quantity of wheat produced in the U.S. in year t-1	1,000,000 bu.	AS	1972	12
QWXLAG	quantity of wheat exported in year t-1	1,000,000 bu.	AS	1972	12
STAMPS	federal contribution to food stamps (bonus food stamps)	$1,000,000	AS	1972	92
TRANS	income tested transfer programs: food stamps, AFDC, OAA, general assistance	$1,000,000	SA	1972, 69 66, 63, 60	
WAGEFME	wage of food manufacturing employees	$/hour	MTS	1950-1972	2
Y	disposable personal income	Bil.Dol.	AS	1972	503
YEAR	trend variable	beginning 1950			

[a]AS: Agricultural Statistics; BLS: Bureau of Labor Statistics; CM: Census of Manufacturers; LMS: Livestock and Meat Statistics; MTS: Marketing and Transportation Situation; SA: Statistical Abstracts.

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