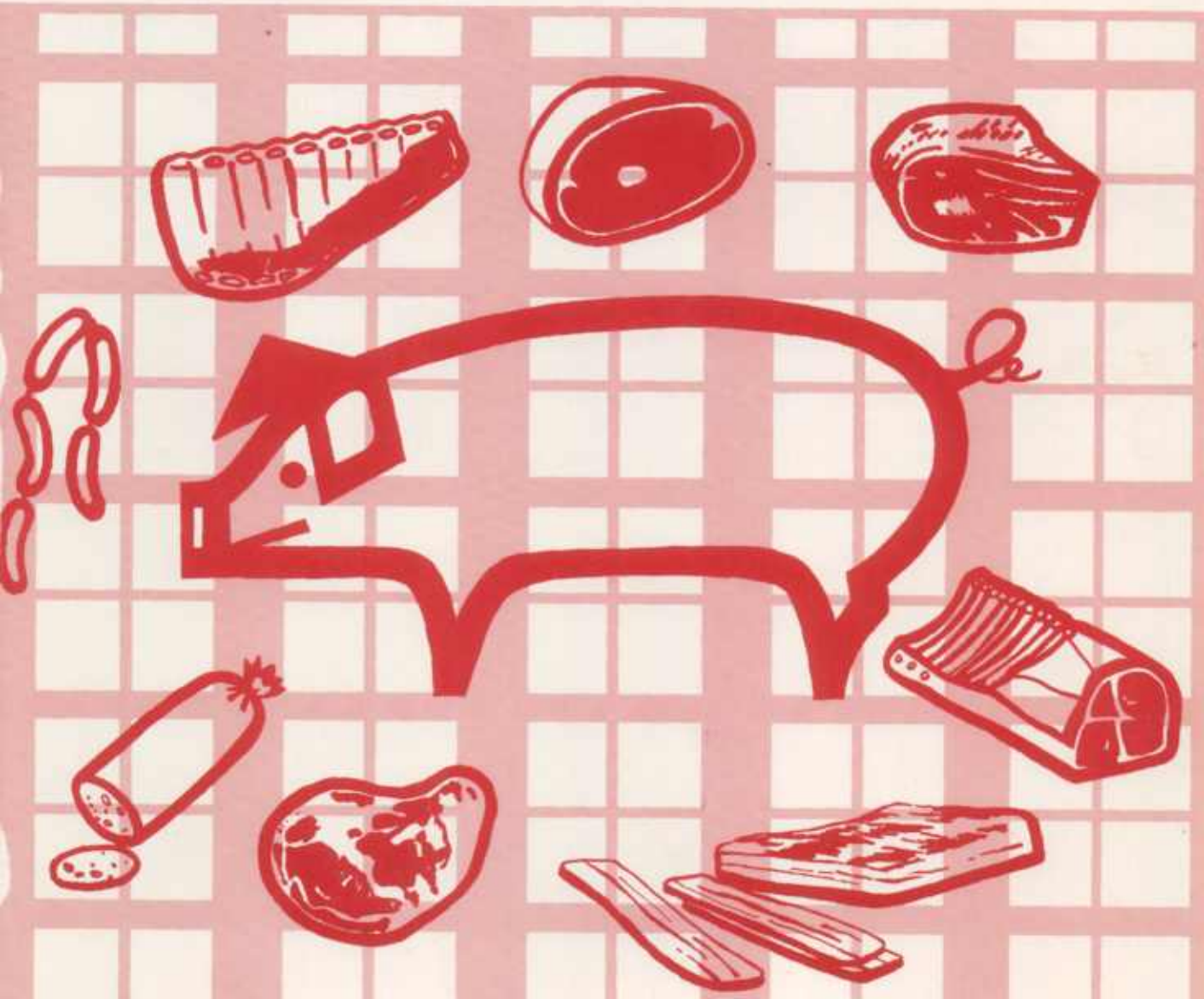
PRICE-QUANTITY RELATIONSHIPS FOR SELECTED RETAIL CUTS OF PORK



NOMIC RESEARCH SERVICE • U.S. DEPARTMENT OF AGRICULTURE • AGRICULTURAL ECONOMIC REPORT NO. 245 - 24
1973-74

ABSTRACT

In examining price-quantity relationships of eight cuts of pork (loins, hams, butts, spareribs, sausage, picnics, bacon, and lunch meat); and three types of outlets (chain, independent, and convenience), equation results of a specific cut were found not to differ greatly by retail outlet. Equations of retail price predictions for each of the 24 combinations are presented, and various data series, not generally available are included in the study. Appendixes to the main text provide more complete examination of derivation of data, a brief look at the theory involved, and estimates of elasticity. Data derivations include quantities by cut as they flow through nonretail consumer outlets (hotel restaurants, institutions, and other away-from-home eating places). A shift in pork demand between 1965 and 1966 was noted, and the fact that poultry was a closer competitor of pork than was beef. The study also showed differences in demand among pork cuts, and examined other areas such as sales trends by types of retail outlet.

Keywords: Pork products, Supply and demand, Price predictions, Retail, T-regression analysis, Price-quantity relationships, Elasticity.

PREFACE

This publication is one of a series reporting findings of a hog-pork subsector research project undertaken by the U.S. Department of Agriculture, Purdue University, and Michigan State University. This joint effort utilizes a systems analysis approach to examine the production and marketing system for hogs and pork. Although one of the major objectives of the project is to explore a possible trend toward vertical coordination, the project also includes a number of related studies encompassing all segments of the hog-pork industry.

CONTENTS

TABLES

FIGURES

SUMMARY

Results of regression equations indicate that prices of eight specific pork cuts studied--loins, hams, butts, spareribs, sausage, picnics, bacon, and lunch meat--can be predicted with the explained variation averaging about 0.90. Monthly dummies (utilizing 11 variables having "zero" and "one" values, based on January), income, poultry price, poultry production, and red meat production are significant in most equations. Beef price is used in a few equations.

The eight pork cuts studied were examined in relation to the prices obtained and quantities sold through three types of retail outlets--chain, independent, and convenience grocers. The dependent variable in each equation of the regression analysis was the price by cut and retail outlet. And, one of the independent variables used was the quantity of the cut analyzed moving through the outlet studied during the month.

Although beef price was used in some equations, poultry price better explained price changes of pork cuts. Per capita disposable income was significant for all cuts except lunch meat. Income served as a trend term as well as a reflector of income changes because it was not deflated and increased rather steadily throughout 1965-69, the study period. Although differences in price-quantity relationships were found between cuts, variation by outlet for a cut was small.

The procedure used in breaking the aggregate data on quantity available into quantity by cut and outlet is discussed in both text and appendix A. Appendix B looks briefly at the demand theory as it relates to pork cuts, discusses some alternative procedures for studying price-quantity relationships, and provides the elasticity estimates obtained in this study.

PRICE-QUANTITY RELATIONSHIPS FOR SELECTED RETAIL CUTS OF PORK

By Lawrence A. Duewer, Agricultural Economist
Commodity Economics Division,
Economic Research Service

INTRODUCTION

Most studies of the demand for pork consider only pork in the aggregate But consumers buy individual cuts--a canned ham, a package of pork chops, or a pound of bacon--from at least three retail grocery categories and several types of away-from-home markets. An adequate analysis of the demand for pork must examine the price-quantity relationships for retail cuts bought from the various sources. Summarizing cut data by purchasing source then can provide a means of determining demand for total pork and the derived demand for slaughter hogs.

Major objective of this report is to develop 24 equations that will predict prices for the eight retail pork cuts--loin, ham, butts, spareribs, sausage, picnic, bacon, and lunch meat--and the three types of retail outlets studied--chain, independent, and convenience stores (treated as all other retail outlets).

These equations will be used in an industry model of the hog-pork subsector that includes all stages from production through retail sale. This recursive-simulation model internally produces the supply quantities of each cut available for sale in each outlet. Historical supply quantity data had to be developed, as explained briefly in the text and detailed in appendix A. Although data for movement of pork cuts through nonretail consumer outlets also were developed, the price-quantity relationships were not examined.

Among the eight pork cuts used in the industry model and in this study, lunch meat is mostly delicatessen products, partly or entirely pork, such as bologna, salami, frankfurters, etc. These products could not be classified within one of the other categories of cuts in this study. For the eight cuts and the three types of outlets studied, the industry model also specified the use of monthly data for 1965-69.

Much effort went into relating demand theory to approaches for examining specific cut demands. (See appendix B.)

REGRESSION EQUATIONS

Conventional demand theory provided the primary basis for specifying the equations. While all variables are not used in each equation, the general form of the 24 equations is:

$$Y^{jK} = a^{jK} + b_i^{jK} BP + b_i^{jK} PPI + b_i^{jK} PRM + b_i^{jK} PPO + b_i^{jK} D65 + b_i^{jK} OQ^{jK} + b_i^{jK} IC + \sum_{i=8}^{18} b_i^{jK} MD_i$$

when the variables are

j = 8 cuts--loins, butts, ham, ribs, sausage, picnic, bacon, lunch meat.
K = 3 outlets--chain, independent, convenience stores.
Y^{jK} = price of cut by retail outlet (dependent variable).
BP = beef price, composite retail.
PPI = poultry price, retail.
PRM = production of all red meat.
PPO = poultry production.
D65 = 0-1 variable representing demand shift after 1965.
OQ^{jK} = quantity of this cut (Y^{jK}) available for sale by this outlet this month.
IC = per capita income.
MD_i = monthly dummies for February through December.
a^{jK} = intercept term.
b_i^{jK} = coefficients where i = 1, 18.

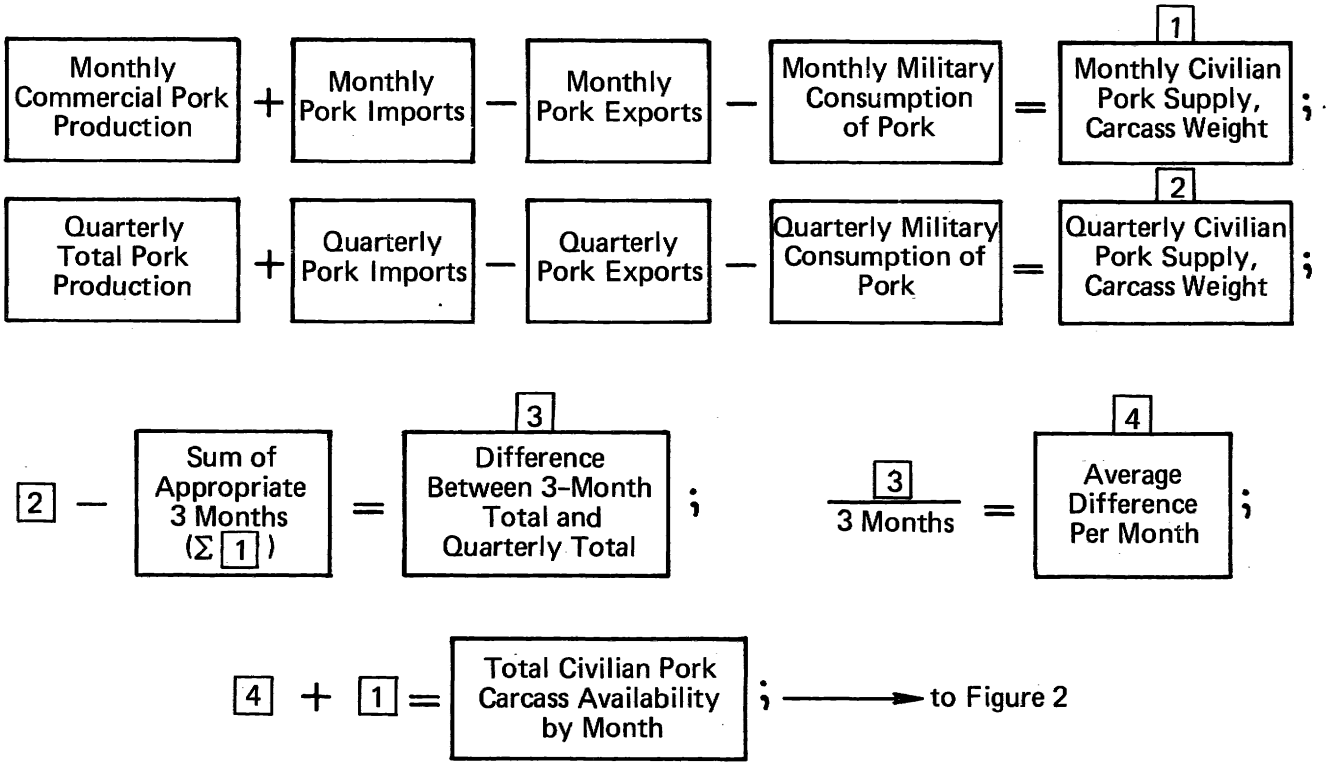
More specific descriptions of these variables appear later. This set of equations was estimated by least squares.

DERIVATION OF HISTORICAL DATA

Quantity data is not available from secondary sources in the necessary form. Although from among the eight selected pork cuts, some cuts such as ham could be broken down into several more specific cuts, the scarcity of data and lack of need for further refinement precluded further breakdown.

A detailed description of the derivation of the quantity data appears in appendix A. A summary of the methods used in deriving the data is presented here for readers not interested in further detail.

PROCEDURE FOR OBTAINING TOTAL PORK AVAILABLE FOR CIVILIAN USE*



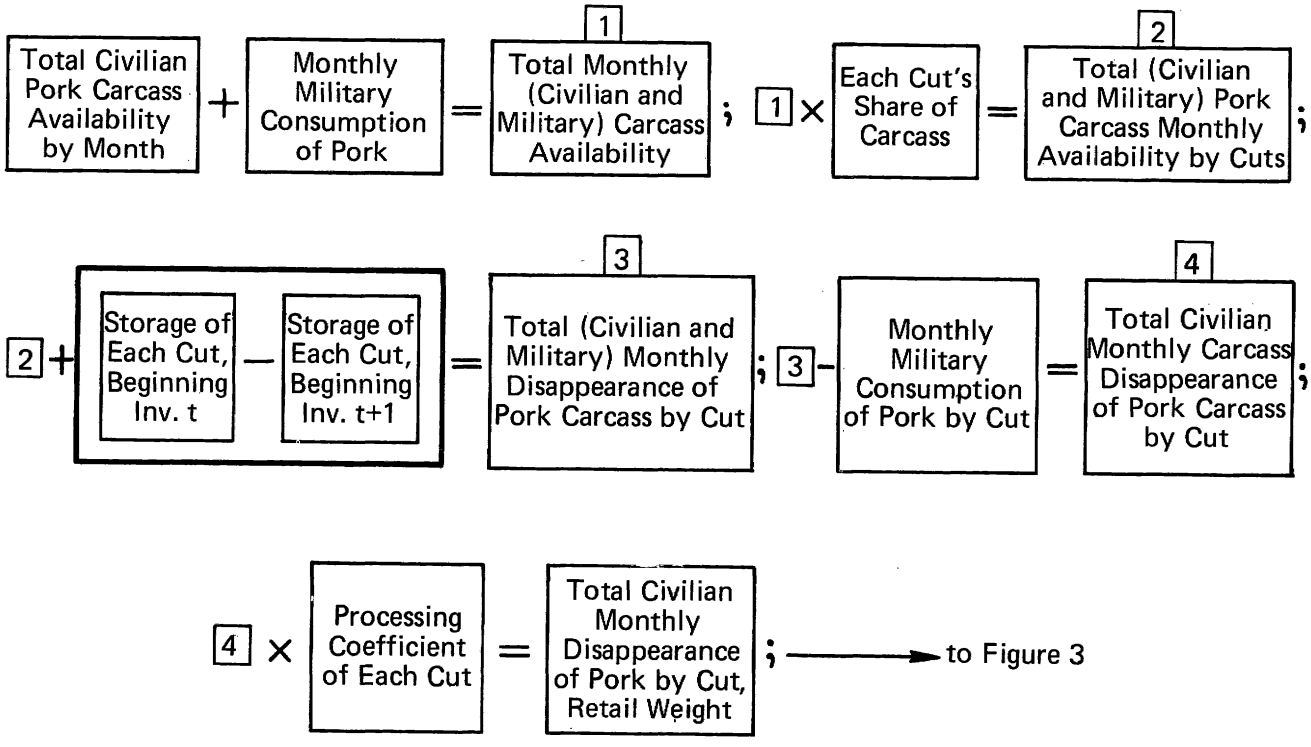
*(References and Data Sources are in Appendix A.)

Figure 1

Total Pork Consumed Monthly

The first step involved obtaining an estimate of total pork available for civilian use monthly, as outlined in figure 1. It allowed the use of quarterly data including farm slaughter, to adjust monthly data that excluded farm slaughter.

HOW PORK (CARCASS) BREAKS DOWN INTO 8 CUTS FOR CIVILIAN USE*



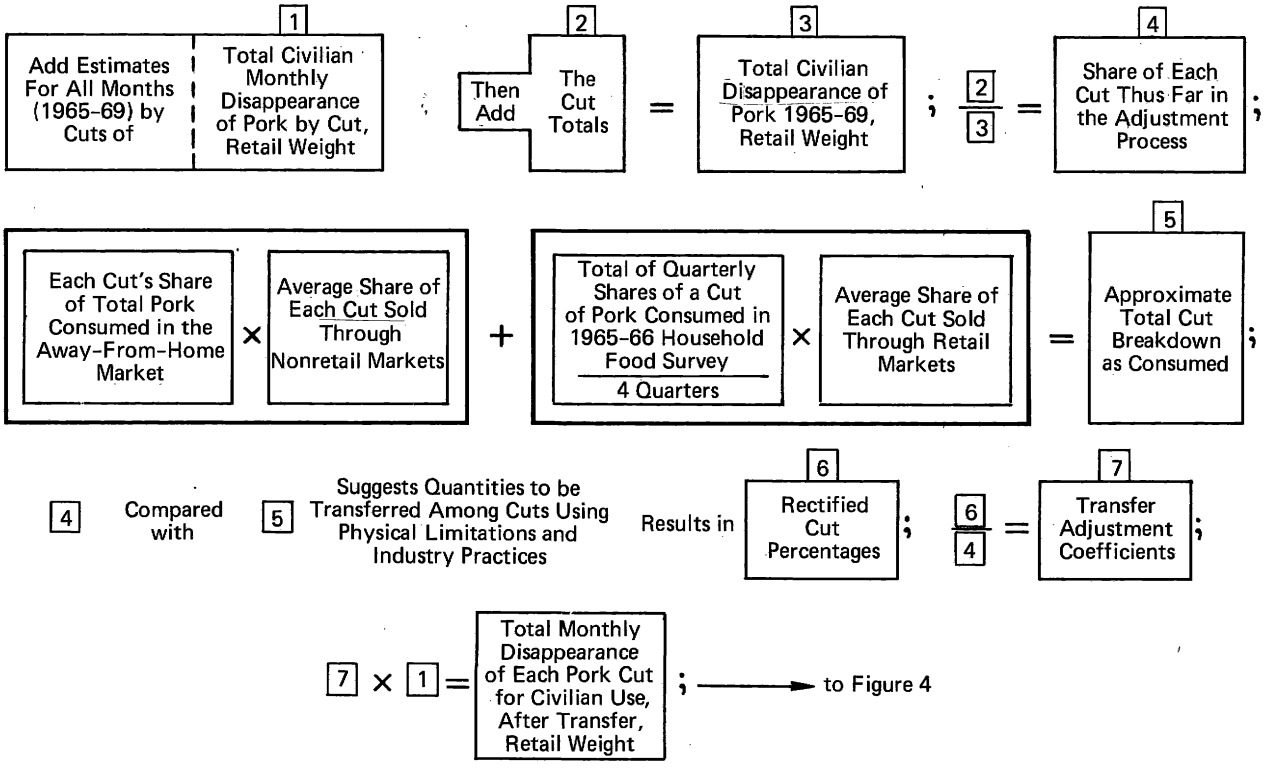
*(References and Data Sources are in Appendix A.)

Figure 2

Individual Cuts Consumed Monthly

Figure 2 indicates that total pork availability is divided into quantities of each of the eight cuts by applying carcass proportions. The change in the storage level for each cut is then taken into account. Military consumption by cut is then removed. Conversion from carcass to retail weight basis is indicated at the bottom of figure 2.

RECTIFYING PRODUCTION AND CONSUMPTION OF PORK CUT PROPORTIONS*



*(References and Data Sources are in Appendix A.)

Figure 3

Conversion of Primal Cuts to Other Retail Cuts

Some conversion among cuts is possible. For example, picnics can be used in making lunch meat. Several steps are required to adjust the quantities of each cut to actual consumption.

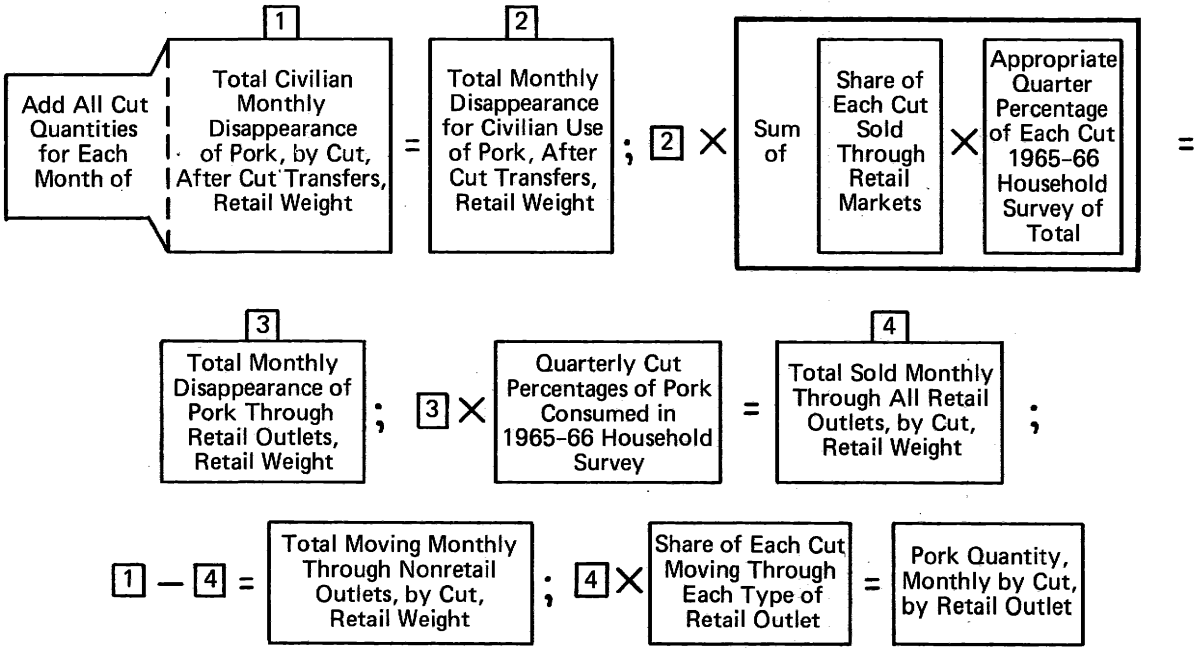
The top of figure 3 shows each cut's share of total pork given all previous calculations. The breakdown of cuts as consumed is then estimated using the away-from-home survey1/, and 1965-66 household food survey data.2/ The proportions of each cut sold through retail and nonretail consumer outlets also are utilized.

These two sets of cut percentages, derived for the adjustment process (box 4 of fig. 3) and from consumption data (box 5 of fig. 3) are then rectified as indicated in the third row on figure 3. The ratio of rectified cut shares to the percentages at this point in the adjustment process (box 4 of fig. 3) provides transfer adjustment coefficients. The application of these transfer coefficients provides the estimates of total civilian monthly disappearance of pork by cut after transfers on a retail weight basis.

1/ Van Dress, Michael G. The Foodservice Industry: Type, Quantity, and Value of Foods Used. Stat. Bul. No. 476, U.S. Dept. Agr., Econ. Res. Serv., Washington, D.C., Nov. 1971.

2/ Food Consumption of Households in the United States, Seasons and Year, 1965-66. Rpt. No. 12, U.S. Dept. Agri., Agr. Res. Serv., Washington, D.C., Mar. 1972.

HOW SHARES OF PORK CUTS MOVE THROUGH RETAIL OUTLETS



*(References and Data Sources are in Appendix A.)

Figure 4

Breakdown by Type of Market Outlet

Figure 4 diagrams the last steps of the procedure for calculating monthly quantities by cut and type of outlet.

First, all cut quantities are added for each month. The total pork moving through all retail outlets is obtained by multiplying the monthly pork totals by the weighted average percentage of cuts moving quarterly through retail outlets. This total monthly pork disappearance through retail outlets is then multiplied by the cut percentages of total pork consumed for the appropriate quarter to obtain the total quantity by cut moving monthly through all retail outlets.

Subtracting the monthly quantities by cut moving through retail outlets from the quantities obtained in the previous figure results in nonretail outlet quantities. The final step divides the quantity moving through all retail outlets into chain, independent, and convenience categories. These monthly quantities by cut and by outlet appear in table 1.

Table 1--Estimated quantities of 8 pork cuts sold monthly by 3 types of retail outlets, 1965-69

Year and month	Loin			Ham			Butts			Spareribs		
	Chain	Indep.	Conv.	Chain	Indep.	Conv.	Chain	Indep.	Conv.	Chain	Indep.	Conv.
	Million pounds											
1965:												
Jan.	58.3	76.3	1.36	56.1	72.5	1.30	18.3	23.9	0.43	7.9	10.3	0.18
Feb.	51.9	67.8	1.21	49.9	64.4	1.15	16.3	21.3	.38	6.9	9.1	.16
Mar.	62.4	81.6	1.45	60.0	77.5	1.39	19.6	25.6	.46	8.4	11.0	.20
Apr.	50.8	66.5	1.18	70.1	90.5	1.62	16.0	21.0	.37	6.7	8.8	.16
May	44.2	57.8	1.03	60.9	78.7	1.41	14.0	18.3	.33	5.8	7.6	.14
June	46.3	60.5	1.08	63.8	82.4	1.48	14.6	19.1	.34	6.1	8.0	.14
July	39.6	51.7	.92	52.1	67.3	1.21	12.8	16.7	.30	5.5	7.2	.13
Aug.	42.5	55.6	.99	56.0	72.3	1.30	13.7	18.0	.32	5.9	7.7	.14
Sept.	46.1	60.3	1.07	60.7	78.4	1.40	14.9	19.5	.35	6.4	8.4	.15
Oct.	56.0	73.2	1.30	53.4	68.9	1.24	16.9	22.2	.40	6.6	8.6	.15
Nov.	57.0	74.5	1.33	54.3	70.2	1.26	17.2	22.6	.40	6.7	8.8	.16
Dec.	53.3	69.7	1.24	50.8	65.7	1.18	16.1	21.1	.38	6.3	8.2	.15
1966:												
Jan.	49.0	62.8	1.13	47.3	59.6	1.08	15.4	19.7	.35	6.6	8.5	.15
Feb.	47.1	60.4	1.09	45.4	57.2	1.04	14.8	18.9	.34	6.3	8.1	.15
Mar.	57.9	74.2	1.33	55.8	70.3	1.27	18.1	23.2	.42	7.8	10.0	.18
Apr.	45.8	58.7	1.06	63.2	79.7	1.44	14.5	18.5	.33	6.0	7.7	.14
May	46.3	59.3	1.07	63.9	80.5	1.46	14.6	18.7	.34	6.1	7.8	.14
June	47.5	60.9	1.10	65.7	82.7	1.50	15.0	19.2	.35	6.2	8.0	.14
July	40.8	52.2	.94	53.7	67.7	1.23	13.2	16.8	.30	5.6	7.2	.13
Aug.	47.1	60.4	1.09	62.2	78.4	1.42	15.2	19.5	.35	6.5	8.3	.15
Sept.	44.8	57.4	1.03	59.1	74.5	1.35	14.5	18.5	.33	6.2	8.0	.14
Oct.	61.8	79.2	1.42	59.0	74.4	1.35	18.7	24.0	.43	7.3	9.3	.17
Nov.	65.9	84.5	1.52	63.0	79.4	1.44	19.9	25.5	.46	7.8	10.0	.18
Dec.	66.7	85.4	1.54	63.7	80.3	1.45	20.1	25.8	.46	7.9	10.1	.18
1967:												
Jan.	64.8	80.6	1.47	62.4	76.5	1.40	20.3	25.3	.46	8.7	10.9	.20
Feb.	57.2	71.2	1.30	55.1	67.5	1.24	17.9	22.3	.41	7.7	9.6	.17
Mar.	65.0	80.9	1.47	62.7	76.7	1.41	20.4	25.4	.46	8.7	10.9	.20
Apr.	51.1	63.6	1.16	70.6	86.4	1.59	16.1	20.1	.37	6.7	8.3	.15
May	53.2	66.2	1.21	73.4	89.9	1.65	16.8	20.9	.38	7.0	8.7	.16
June	52.3	65.2	1.19	72.3	88.5	1.62	16.5	20.6	.38	6.9	8.6	.16
July	45.3	56.4	1.03	59.8	73.2	1.34	14.6	18.2	.33	6.3	7.8	.14
Aug.	53.9	67.1	1.22	71.1	87.0	1.60	17.4	21.7	.40	7.5	9.3	.17
Sept.	52.7	65.6	1.20	69.6	85.2	1.56	17.0	21.2	.39	7.3	9.1	.17
Oct.	69.4	86.4	1.57	66.3	81.3	1.49	21.0	26.1	.48	8.2	10.2	.19
Nov.	69.9	87.1	1.59	66.8	81.9	1.50	21.2	26.4	.48	8.3	10.3	.19
Dec.	69.5	86.5	1.58	66.4	81.4	1.49	21.0	26.2	.48	8.2	10.3	.19
1968:												
Jan.	70.3	84.7	1.56	67.7	80.3	1.50	22.0	26.5	.49	9.4	11.4	.21
Feb.	60.6	73.0	1.35	58.3	69.2	1.29	19.0	22.9	.42	8.1	9.8	.18
Mar.	65.0	78.3	1.45	62.6	74.3	1.38	20.4	24.6	.45	8.8	10.5	.20
Apr.	60.2	72.5	1.34	83.1	98.5	1.83	19.0	22.9	.42	7.9	9.5	.18
May	55.8	67.2	1.24	77.1	91.3	1.70	17.6	21.3	.39	7.3	8.8	.16
June	55.0	66.2	1.22	75.9	89.9	1.68	17.4	20.9	.39	7.2	8.7	.16
July	53.2	64.1	1.18	70.2	83.2	1.55	17.2	20.7	.38	7.4	8.9	.16
Aug.	54.0	65.1	1.20	71.2	84.4	1.57	17.5	21.0	.39	7.5	9.0	.17
Sept.	54.0	65.1	1.20	71.3	84.5	1.57	17.5	21.0	.39	7.5	9.0	.17
Oct.	77.7	93.6	1.73	74.3	88.1	1.64	23.5	28.3	.52	9.2	11.1	.20
Nov.	72.0	86.8	1.60	68.8	81.6	1.52	21.8	26.2	.48	8.5	10.3	.19
Dec.	73.1	88.1	1.63	69.9	82.9	1.54	22.1	26.7	.49	8.7	10.4	.19
1969:												
Jan.	72.7	84.1	1.58	69.2	80.4	1.51	22.8	26.3	.50	9.8	11.3	.21
Feb.	63.9	74.0	1.39	60.9	70.8	1.33	20.0	23.2	.44	8.6	9.9	.19
Mar.	71.1	82.2	1.55	67.7	78.6	1.48	22.3	25.8	.48	9.5	11.0	.21
Apr.	60.8	70.3	1.32	83.0	96.4	1.81	19.2	22.2	.42	8.0	9.2	.17
May	58.5	67.7	1.28	79.9	92.8	1.74	18.5	21.4	.40	7.7	8.9	.17
June	57.1	66.1	1.24	78.0	90.7	1.70	18.1	20.9	.39	7.5	8.7	.16
July	54.6	63.2	1.19	71.3	82.8	1.56	17.7	20.4	.38	7.6	8.8	.16
Aug.	51.2	59.3	1.12	66.9	77.7	1.46	16.6	19.2	.36	7.1	8.2	.16
Sept.	56.6	65.5	1.23	73.9	85.8	1.61	18.3	21.2	.40	7.8	9.1	.17
Oct.	74.9	86.7	1.63	70.8	82.2	1.54	22.7	26.2	.39	8.9	10.2	.19
Nov.	64.7	74.8	1.41	61.1	71.0	1.33	19.6	22.6	.43	7.7	8.9	.17
Dec.	73.8	85.3	1.61	69.7	81.0	1.52	22.3	25.8	.49	8.7	10.1	.19

Table 1--Estimated quantities of 8 pork cuts sold monthly by 3 types of retail outlets, 1965-69--Continued

Year and month	Sausage			Picnics			Bacon			Lunch meat		
	Chain	Indep.	Conv.	Chain	Indep.	Conv.	Chain	Indep.	Conv.	Chain	Indep.	Conv.
	Million pounds											
1965:												
Jan.	36.1	46.2	4.98	22.4	28.0	.41	53.2	65.9	2.68	27.6	34.2	9.16
Feb.	32.1	41.0	4.42	19.9	24.9	.36	47.3	58.5	2.38	24.5	30.4	8.14
Mar.	38.6	49.4	5.32	23.9	29.9	.43	56.9	70.5	2.87	29.6	36.6	9.80
Apr.	26.5	33.8	3.64	17.2	21.5	.31	54.5	67.5	2.74	26.1	32.3	8.64
May	23.0	29.4	3.17	14.9	18.7	.27	47.4	58.6	2.38	22.7	28.1	7.52
June	24.1	30.8	3.32	15.7	19.6	.28	49.6	61.5	2.50	23.8	29.5	7.88
July	23.5	30.0	3.23	15.7	19.6	.28	48.3	59.8	2.43	23.7	29.4	7.87
Aug.	25.3	32.3	3.48	16.8	21.0	.30	52.0	64.4	2.62	25.5	31.6	8.46
Sept.	27.4	35.0	3.77	18.2	22.8	.33	56.3	69.7	2.84	27.7	34.3	9.17
Oct.	29.8	38.1	4.11	18.9	23.6	.34	49.5	61.3	2.49	24.7	30.6	8.19
Nov.	30.4	38.8	4.18	19.3	24.1	.35	50.4	62.4	2.54	25.1	31.1	8.33
Dec.	28.4	36.3	3.92	18.0	22.5	.33	47.2	58.4	2.37	23.5	29.2	7.80
1966:												
Jan.	30.5	37.9	4.13	18.8	23.1	.34	44.6	54.3	2.23	23.2	28.2	7.55
Feb.	29.3	36.5	3.97	18.0	22.2	.32	42.9	52.2	2.14	22.3	27.1	7.26
Mar.	36.0	44.8	4.88	22.2	27.2	.40	52.7	64.1	2.63	27.4	33.3	8.91
Apr.	23.9	29.8	3.24	15.4	19.0	.28	49.0	59.6	2.44	23.5	28.5	7.64
May	24.2	30.1	3.28	15.6	19.1	.28	49.5	60.3	2.47	23.8	28.8	7.72
June	24.8	30.9	3.37	16.0	19.7	.29	50.8	61.9	2.54	24.4	29.6	7.94
July	24.3	30.2	3.29	16.1	19.7	.29	49.7	60.5	2.48	24.5	29.7	7.95
Aug.	28.1	35.0	3.81	18.6	22.9	.33	57.5	70.0	2.87	28.3	34.4	9.20
Sept.	26.7	33.2	3.62	17.7	21.7	.32	54.6	66.5	2.72	26.9	32.6	8.74
Oct.	33.0	41.1	4.48	20.8	25.6	.37	54.5	66.4	2.72	27.3	33.1	8.87
Nov.	35.2	43.9	4.78	22.2	27.3	.40	58.2	70.8	2.90	29.1	35.3	9.46
Dec.	35.6	44.4	4.83	22.5	27.6	.40	58.8	71.6	2.93	29.4	35.7	9.56
1967:												
Jan.	40.2	48.8	5.38	24.7	29.8	.44	58.6	70.1	2.90	30.5	36.5	9.66
Feb.	35.4	43.0	4.74	21.8	26.2	.39	51.7	61.9	2.55	26.9	32.2	8.53
Mar.	40.3	48.9	5.39	24.8	29.8	.44	58.7	70.4	2.90	30.6	36.7	9.70
Apr.	26.6	32.3	3.56	17.1	20.7	.30	54.3	65.0	2.68	26.1	31.2	8.27
May	27.7	33.6	3.70	17.8	21.5	.32	56.5	67.6	2.79	27.1	32.5	8.59
June	27.3	33.1	3.65	17.6	21.1	.31	55.6	66.6	2.75	26.7	31.9	8.45
July	26.9	32.7	3.60	17.8	21.4	.32	54.9	65.7	2.71	27.1	32.4	8.57
Aug.	32.0	38.9	4.29	21.2	25.5	.38	65.2	78.1	3.23	32.2	38.5	10.18
Sept.	31.4	38.1	4.20	20.7	24.9	.37	63.8	76.4	3.15	31.5	37.7	9.97
Oct.	37.1	45.0	4.96	23.3	28.0	.41	60.8	72.9	3.01	30.5	36.5	9.65
Nov.	37.3	45.3	4.99	23.4	28.2	.42	61.3	73.4	3.03	30.7	36.7	9.73
Dec.	37.1	45.0	4.96	23.3	28.1	.41	60.9	73.0	3.01	30.5	36.5	9.66
1968:												
Jan.	43.3	51.4	5.72	26.5	31.4	.47	63.1	74.0	3.08	32.9	38.6	10.21
Feb.	37.3	44.3	4.94	22.9	27.1	.40	54.4	63.8	2.66	28.4	33.3	8.81
Mar.	40.0	47.6	5.30	24.3	28.8	.43	58.4	68.5	2.85	30.5	35.7	9.45
Apr.	31.2	37.0	4.12	20.0	23.7	.35	63.5	74.5	3.10	30.5	35.8	9.48
May	28.9	34.3	3.82	18.6	22.0	.33	58.9	69.1	2.88	28.3	33.2	8.79
June	28.4	33.8	3.76	18.3	21.6	.32	58.0	68.0	2.83	27.9	32.7	8.66
July	31.4	37.3	4.16	20.7	24.5	.36	63.9	75.0	3.13	31.6	37.0	9.80
Aug.	31.9	37.9	4.22	21.0	24.9	.37	64.9	76.2	3.17	32.1	37.6	9.95
Sept.	31.9	37.9	4.22	21.0	24.9	.37	64.9	76.2	3.17	32.1	37.6	9.95
Oct.	41.2	49.0	5.45	25.8	30.6	.46	67.6	79.4	3.31	34.0	39.8	10.54
Nov.	38.2	45.4	5.05	23.9	28.4	.42	62.7	73.6	3.06	31.4	36.8	9.75
Dec.	38.8	46.1	5.13	24.3	28.8	.43	63.6	74.7	3.11	32.0	37.4	9.91
1969:												
Jan.	44.3	51.5	5.79	27.1	31.6	.47	64.2	74.4	3.12	33.7	38.7	10.34
Feb.	39.0	45.3	5.10	23.8	27.8	.42	56.5	65.5	2.75	29.6	34.0	9.09
Mar.	43.3	50.3	5.66	26.2	30.5	.46	62.8	72.8	3.05	32.9	37.8	10.10
Apr.	31.1	36.2	4.07	19.9	23.2	.35	63.1	73.2	3.07	30.5	35.1	9.36
May	30.0	34.9	3.92	19.2	22.4	.34	60.8	70.5	2.95	29.3	33.7	9.01
June	29.3	34.1	3.83	18.7	21.8	.33	59.4	68.8	2.88	28.7	33.0	8.81
July	32.0	37.2	4.18	21.0	24.5	.37	64.7	75.0	3.14	32.1	36.9	9.85
Aug.	30.0	34.8	3.92	19.6	22.9	.34	60.7	70.4	2.95	30.1	34.6	9.24
Sept.	33.1	38.5	4.33	21.7	25.3	.38	67.0	77.7	3.26	33.2	38.2	10.20
Oct.	39.3	45.7	5.14	24.5	28.6	.43	64.2	74.4	3.12	32.3	37.2	9.92
Nov.	33.9	39.4	4.43	21.2	24.7	.37	55.4	64.2	2.69	27.9	32.1	8.58
Dec.	38.7	45.0	5.06	24.2	28.2	.42	63.2	73.2	3.07	31.8	36.3	9.78

Table 2--Additional price, production, and income series used in regression equations

Year and month	Price										Production		Per capita disposable income
	Loin	Ham	Butts	Spare-ribs	Sausage	Picnics	Bacon	Lunch meat	Beef	Poultry	All red meat	Poultry	
	Cents										10 million pounds		Dollars
1965:													
Jan.	72	66	51	55	52	38	68	72	76.9	37.5	269.1	56.0	2,354
Feb.	73	65	49	56	53	38	66	72	76.2	38.8	235.4	46.9	2,354
Mar.	72	65	50	57	54	38	68	72	75.5	38.5	277.8	52.9	2,366
Apr.	73	63	51	58	53	40	68	73	77.5	38.6	252.3	54.1	2,375
May	77	66	54	63	56	40	71	72	79.3	37.7	235.0	56.3	2,393
June	85	71	61	67	60	45	79	75	82.9	40.8	245.8	64.5	2,425
July	88	75	66	70	62	46	85	77	83.8	40.5	240.3	68.3	2,449
Aug.	86	75	67	69	65	49	92	79	82.9	40.0	251.0	77.3	2,468
Sept.	86	75	65	68	67	49	93	79	81.7	40.0	269.0	84.7	2,511
Oct.	85	76	65	67	66	49	90	79	81.2	38.5	266.8	87.7	2,476
Nov.	86	77	64	65	65	50	88	79	81.9	38.6	264.0	81.9	2,515
Dec.	90	85	69	71	68	53	97	80	81.6	38.5	257.1	69.5	2,529
1966:													
Jan.	94	89	72	74	71	55	100	81	81.0	38.9	261.5	58.2	2,533
Feb.	94	87	71	75	75	55	101	82	83.1	42.8	239.1	52.2	2,550
Mar.	91	87	70	74	74	54	95	84	84.1	43.7	275.0	56.2	2,563
Apr.	85	79	67	73	73	52	91	84	84.6	43.6	255.4	60.2	2,571
May	84	76	64	72	70	51	89	84	83.8	41.8	257.8	61.7	2,575
June	88	77	66	76	70	54	90	84	81.7	41.9	266.7	72.4	2,591
July	89	76	68	78	69	53	94	83	81.5	42.5	242.4	71.7	2,602
Aug.	90	78	69	80	70	54	96	84	81.7	42.1	274.9	89.3	2,617
Sept.	89	78	67	78	68	51	96	83	82.2	41.8	283.8	93.1	2,629
Oct.	88	78	65	70	68	51	88	84	81.3	39.8	282.9	95.8	2,645
Nov.	84	78	63	65	66	52	83	84	80.3	38.2	286.6	88.8	2,658
Dec.	82	78	60	67	65	51	79	86	83.6	37.9	286.3	79.0	2,666
1967:													
Jan.	81	78	58	63	65	48	80	86	80.4	36.9	296.4	65.5	2,687
Feb.	80	75	56	65	64	49	78	86	80.9	38.8	263.6	54.4	2,695
Mar.	79	74	57	64	62	47	76	86	80.8	38.6	295.5	62.4	2,710
Apr.	76	70	55	66	62	46	77	85	80.4	38.5	272.1	60.5	2,716
May	83	70	58	68	63	47	80	85	79.6	38.5	280.1	73.3	2,725
June	86	74	62	73	66	48	87	85	81.9	37.2	277.6	79.1	2,738
July	88	74	64	74	66	49	89	82	83.3	38.7	254.9	76.4	2,749
Aug.	87	75	64	74	66	49	83	82	84.0	38.7	286.9	97.8	2,761
Sept.	86	75	62	73	67	49	83	82	85.5	39.1	281.4	91.3	2,770
Oct.	82	75	60	66	65	48	78	83	85.3	37.3	300.5	98.6	2,773
Nov.	81	75	59	65	62	48	79	82	84.4	37.0	287.2	88.4	2,800
Dec.	79	72	58	64	61	46	79	83	85.3	37.4	279.1	74.1	2,827
1968:													
Jan.	81	74	58	64	63	46	76	82	84.3	38.0	306.8	68.7	2,838
Feb.	84	73	59	67	63	47	78	82	85.1	38.0	272.1	56.6	2,870
Mar.	83	74	60	67	64	47	78	83	85.6	41.5	278.3	58.2	2,897
Apr.	82	72	60	69	64	47	79	83	85.6	40.6	285.6	62.0	2,904
May	83	72	60	70	65	46	79	83	85.8	39.7	301.2	69.4	2,925

Table 2--Additional price, production, and income series used in regression equations--Continued

Year and month	Price										Production		Per capita disposable income
	Loin	Ham	Butts	Spare-ribs	Sausage	Picnics	Bacon	Lunch meat	Beef	Poultry	All red meat	Poultry	
	Cents										10 million pounds		Dollars
1968:													
June	85	73	60	72	65	46	80	83	85.8	39.9	263.7	67.1	2,934
July	90	73	64	73	66	48	79	82	87.1	39.9	283.6	80.5	2,941
Aug.	89	74	65	75	67	48	77	84	87.0	40.0	290.2	88.0	2,947
Sept.	87	74	62	75	67	50	80	84	88.4	41.3	289.4	85.8	2,962
Oct.	85	75	62	69	67	49	78	85	87.7	39.9	328.9	98.4	2,977
Nov.	84	75	62	67	65	49	78	84	88.1	39.2	291.0	80.3	2,993
Dec.	83	74	62	68	65	49	78	84	88.5	39.2	291.0	76.4	3,000
1969:													
Jan.	85	75	62	68	66	50	77	84	89.6	39.1	314.3	72.6	3,005
Feb.	87	75	63	69	67	50	77	85	89.7	40.0	277.6	57.9	3,015
Mar.	85	76	62	69	68	48	80	85	91.0	41.1	288.9	63.1	3,037
Apr.	86	74	63	71	68	49	81	86	93.4	42.2	290.8	66.1	3,052
May	90	75	66	76	70	51	83	87	97.9	40.8	280.8	72.4	3,066
June	96	76	68	81	74	53	87	91	102.0	42.7	272.2	78.3	3,092
July	98	78	72	85	78	56	86	93	102.5	44.4	283.1	84.2	3,115
Aug.	98	79	75	85	79	56	91	95	101.2	44.5	277.1	89.7	3,142
Sept.	97	80	74	84	79	56	94	96	99.2	44.7	303.1	94.9	3,152
Oct.	96	82	75	77	78	56	93	96	95.4	42.5	329.4	104.8	3,162
Nov.	96	83	73	79	77	56	91	96	96.6	42.8	273.3	81.2	3,174
Dec.	97	86	72	79	77	57	93	96	97.0	42.1	300.7	84.0	3,183

Data For Other Variables

Detailed discussion of data for the remaining variables used in the regression analysis and their sources are found in appendix A. A brief discussion of these variables follows:

Eleven monthly dummy variables ("zero or one") reflect the seasonal variation in the demand for pork cuts. Although monthly dummy variables and the 1965 dummy variable are not listed, the other independent variable data are presented in table 2.

The 1965 dummy has "ones" in all observations for 1965 but "zeros" for all other observations, and would equal a shift in demand after 1965.

Income used is per capita disposable income, functioning partly as a trend variable and as a reflector of changes in purchasing power. Pork cut prices used as dependent variables appear in table 2.

Retail beef and poultry prices, poultry production, and total red meat production are also used as independent variables. These variables and the income variable are all listed in table 2. They are lagged 1 month in the regressions in order to use data that are known when retailers set the price of pork items for the current month.

An adjustment was made in the data for all quantity variables to eliminate differences among months caused by the changing number of days per month.

RESULTS OF REGRESSION ANALYSIS

Coefficients and statistics indicating the significance of the analysis are presented in tables 3-6. Table 3 lists the variables, their means, and their standard deviations. Coefficients and standard errors of all the variables are presented in table 4 except for the monthly dummies which are presented in table 5. The data in tables 4 and 5 indicate the form of each of the 24 equations because the variables not used have zero coefficients. The intercepts, percentage of explained variation (R^2's), the standard error of the estimate, and the overall F-values are also presented in table 4. The coefficient divided by the standard error provides the value of the "t" statistic. Coefficients significant at the 5 percent and 1 percent levels are identified with asterisks.

As monthly dummies are looked upon as a set, either all or none are included. The set of monthly dummies have very significant F-values for all equations except those estimating lunch meat price. Table 6 presents the results obtained for lunch meat when the monthly dummies are not used. Because much of the variation in lunch meat prices is explained by the beef price, the number of independent variables can be reduced further, as in the last three equations shown in table 6. Lunch meat prices should, of course, be highly correlated with beef prices because large amounts of beef are used in lunch meat.

Table 3--Variables included in the regression equations, their means and standard deviations

Variable	Other explanations	Mean	Standard Deviation
Composite loin price	Chain and independent current month	85.767	6.266
Composite ham price	do.	75.483	5.137
Butts price	do.	63.100	6.055
Spareribs price	do.	70.367	6.641
Sausage price	do.	66.517	6.086
Picnic price	do.	49.200	4.445
Bacon price	do.	83.483	8.278
Lunch meat price	do.	83.467	5.580
February	Monthly dummy	.083	.279
March	do.	.083	.279
April	do.	.083	.279
May	do.	.083	.279
June	do.	.083	.279
July	do.	.083	.279
August	do.	.083	.279
September	do.	.083	.279
October	do.	.083	.279
November	do.	.083	.279
December	do.	.083	.279
Composite beef price	Lagged 1 month	85.308	6.246
Poultry price	do.	39.998	2.053
Commercial total red meat production	Lagged 1 month, monthly adjusted	277.157	24.168
Poultry production	do.	73.707	14.303
1965 dummy		.200	.403
Loin chain quantity	Monthly adjusted	57.422	9.515
Loin indep. quantity	do.	70.883	10.481
Loin conv. quantity	do.	1.296	.200
Ham chain quantity	do.	64.833	8.414
Ham indep. quantity	do.	79.135	8.502
Ham conv. quantity	do.	1.454	.168
Butts chain quantity	do.	17.968	2.694
Butts indep. quantity	do.	22.178	2.884
Butts conv. quantity	do.	.404	.055
Spareribs chain quantity	do.	7.460	1.048
Spareribs indep. quantity	do.	9.212	1.093
Spareribs conv. quantity	do.	.169	.021
Sausage chain quantity	do.	32.396	5.672
Sausage indep. quantity	do.	39.332	6.381
Sausage conv. quantity	do.	4.335	.726
Picnic chain quantity	do.	20.554	3.159
Picnic indep. quantity	do.	24.757	3.538
Picnic conv. quantity	do.	.365	.054
Bacon chain quantity	do.	57.062	5.926
Bacon indep. quantity	do.	68.184	5.966
Bacon conv. quantity	do.	2.817	.267
Lunch meat chain quantity	do.	28.484	3.111
Lunch meat indep. quantity	do.	33.943	3.125
Lunch meat conv. quantity	do.	9.040	.809
Per capita disposable income	Lagged 1 month	2748.500	242.360
Composite loin price	Conv. price current month	90.055	6.580
Composite ham price	do.	79.258	5.394
Butts price	do.	66.255	6.358
Spareribs price	do.	73.885	6.973
Sausage price	do.	69.842	6.390
Picnic price	do.	51.660	4.667
Bacon price	do.	87.658	8.692
Lunch meat price	do.	87.640	5.859

Table 4--Price equations, coefficients, and related information for individual pork cuts[1/ 2/]

Dependent variable	Intercept	Beef price	Poultry price	Commercial production red meat	Poultry production
			0.74400**	-0.21235**	0.24647**
Chain loin price	51.14058		(.19690)	(.03231)	(.09030)
			.72189**	- .21337**	.27794**
Indep. loin price	71.72387		(.19677)	(.03210)	(.08887)
			.76715**	- .22507**	.28531**
Conv. loin price	65.80471		(.20489)	(.03352)	(.09298)
			.52876*	- .19402**	.21012
Chain ham price	81.34860		(.25598)	(.04008)	(.12555)
			.55361*	- .19367**	.21751
Indep. ham price	99.32420		(.24943)	(.03954)	(.12348)
			.55883*	- .20340**	.22001
Conv. ham price	96.55274		(.26587)	(.04178)	(.13082)
			1.10385**	- .18487**	.23624*
Chain butts price	24.39150		(.19866)	(.03241)	(.09063)
			1.00262**	- .17656**	.17843
Indep. butts price	57.49767		(.19634)	(.03173)	(.09941)
			1.00145**	- .19959**	.22130*
Conv. butts price	53.22856		(.21687)	(.03427)	(.10697)
			.93583**	- .14289**	.24349**
Chain spareribs price	25.25590		(.15745)	(.02558)	(.07946)
			.92374**	- .13840**	.22184**
Indep. spareribs price	46.95930		(.15434)	(.02508)	(.07826)
			.95977**	- .15550**	.31600**
Conv. spareribs price	37.37556		(.17102)	(.02744)	(.08421)
		0.31814*	.84558**	- .15382**	.22617*
Chain sausage price	31.16957	(.15714)	(.26164)	(.03491)	(.10666)
		.32731*	.85613**	- .15124**	.21928*
Indep. sausage price	42.70912	(.15604)	(.25961)	(.03471)	(.10617)
		.33534*	.89324**	- .16001**	.23396*
Conv. sausage price	39.30844	(.16359)	(.27212)	(.03636)	(.11112)
			.73471**	- .14471**	.20923*
Chain picnic price	38.59072		(.17558)	(.02857)	(.08900)
			.74880**	- .14384**	.20531*
Indep. picnic price	45.56313		(.17289)	(.02838)	(.08849)
			.81697**	- .15154**	.23016*
Conv. picnic price	41.56295		(.19014)	(.03123)	(.09705)
			.79318*	- .28733**	.26429
Chain bacon price	118.46459		(.36700)	(.05803)	(.18191)
			.84647*	- .28810**	.28329
Indep. bacon price	138.28984		(.36834)	(.05865)	(.18340)
			.87942*	- .30602**	.28875
Conv. bacon price	135.69610		(.38677)	(.06149)	(.19256)
		.36086*	.46707	- .04810	.22384
Chain lunch meat price	24.53679	(.17905)	(.30183)	(.03978)	(.12187)
		.36507*	.48057	- .04780	.22727
Indep. lunch meat price	26.57248	(.18042)	(.30480)	(.04009)	(.12285)
		.38165	.52322	- .05099	.24088
Conv. lunch meat price	27.59514	(.18902)	(.31517)	(.04200)	(.12835)

See footnotes at end of table.

Continued

Table 4--Price equations, coefficients, and related information for individual pork cuts--Continued

Dependent variable	1965 dummy	"Own" quantity 3/	Per capita disposable income	R^2	Standard error of Estimate	Overall F ratio
Chain loin price		-0.74095** (.08968)	0.03346** (.00311)	0.9228	2.0401	32.103
Indep. loin price		- .60001** (.07192)	.02532** (.00244)	.9237	2.0278	32.524
Conv. loin price		-34.78896** (4.13441)	.03045** (.00283)	.9245	2.1180	32.898
Chain ham price	-4.89698** (1.30717)	- .64246** (.10587)	.01951** (.00410)	.8302	2.5088	12.081
Indep. ham price	-5.03694** (1.29159)	- .54193** (.08678)	.01263** (.00327)	.8348	2.4749	12.483
Conv. ham price	-5.24293** (1.36393)	-30.80634** (4.99750)	.01663** (.00380)	.8327	2.6148	12.298
Chain butts price		-2.49412** (.29385)	.02835** (.00317)	.9167	2.0474	29.570
Indep. butts price	-1.91633 (1.03744)	2.08419** (.23091)	.01878** (.00246)	.9243	1.9748	30.161
Conv. butts price	-1.88475 (1.12342)	-104.64281** (12.18792)	.02124** (.00277)	.9192	2.1419	28.112
Chain spareribs price	-3.06762** (.82818)	-4.93187** (.55186)	.02514** (.00253)	.9589	1.5959	57.621
Indep. spareribs price	-3.89180** (.81787)	-4.00719** (.43406)	.01744** (.00194)	.9606	1.5620	60.265
Conv. spareribs price	-3.25332** (.89027)	-225.75115** (26.18981)	.02125** (.00233)	.9569	1.7154	54.877
Chain sausage price	-4.99696** (1.34608)	-.99308** (.14986)	.01430** (.00516)	.9297	1.9360	30.108
Indep. sausage price	-4.99812** (1.33811)	-.82932** (.12372)	.00965 (.00483)	.9305	1.9246	30.495
Conv. sausage price	-5.18851** (1.40179)	-7.90951** (1.17471)	.01259* (.00521)	.9308	2.0161	30.649
Chain picnic price	-4.22353** (.92874)	-1.24994** (.21782)	.01332** (.00258)	.8857	1.7811	19.143
Indep. picnic price	-4.23689** (.92239)	-1.05484** (.18093)	.01071** (.00228)	.8873	1.7686	19.448
Conv. picnic price	-4.43320** (1.01507)	-69.30008** (13.27880)	.01195** (.00264)	.8763	1.9455	17.500
Chain bacon price	-6.85688** (1.89539)	-1.45392** (.17207)	.02755** (.00557)	.8632	3.6291	15.587
Indep. bacon price	-6.84877** (1.91595)	-1.21045** (.14574)	.01876** (.00495)	.8602	3.6684	15.202
Conv. bacon price	-7.20144** (2.00936)	-30.65142** (3.68304)	.02390** (.00550)	.8606	3.8470	15.246
Chain lunch meat price	-4.43745** (1.53517)	-.37165 (.20838)	.00649 (.00598)	.8912	2.2080	18.655
Indep. lunch meat price	-4.45206** (1.54720)	-.27965 (.17683)	.00486 (.00572)	.8895	2.2252	18.333
Conv. lunch meat price	-4.60908** (1.62079)	-1.15030 (.69924)	.00519 (.00597)	.8900	2.3310	18.430

1/ Each independent variable is recorded: Coefficient (standard error)
2/ Monthly dummy variables are also included in all equations. See table 5.
3/ Quantity of selected cut moving through selected outlets.

* Differs significantly at the 5-percent level.
** Differs significantly at the 1-percent level.

Table 5--Coefficients and standard errors for monthly dummies of regression equations reported in table 4 1/ 2/

Dependent variable	Feb.	Mar.	Apr.	May	June
Chain loin price	8.50552**	-1.41359	-5.08259*	-9.72909**	-3.71408*
	(1.88211)	(1.89316)	(2.09580)	(1.99235)	(1.66154)
Indep. loin price	8.73792**	- .51559	-4.25606*	-8.87528**	-2.96780
	(1.86599)	(1.87503)	(2.04361)	(1.92085)	(1.59979)
Conv. loin price	9.22171**	- .84076	-4.76838*	-9.60043**	-3.45173*
	(1.94795)	(1.95994)	(2.14684)	(2.02260)	(1.69109)
Chain ham price	5.58620*	-1.81388	8.23727**	.74516	4.94328*
	(2.32881)	(2.49652)	(2.85966)	(2.26862)	(2.08186)
Indep. ham price	5.66753*	-1.44965	8.84788**	1.29763	5.63629*
	(2.29497)	(2.45681)	(2.86096)	(2.26958)	(2.11009)
Conv. ham price	5.89187*	-1.78485	8.98532**	1.08632	5.64457*
	(2.42626)	(2.59974)	(3.00228)	(2.38168)	(2.20782)
Chain butts price	5.87240**	-1.16135	-5.06093*	-11.03367**	-6.24548**
	(1.88862)	(1.89969)	(2.09445)	(1.99261)	(1.65768)
Indep. butts price	5.58695**	-1.48628	-5.27467*	-11.08387	-5.83987**
	(1.84513)	(1.96055)	(2.08129)	(1.94341)	(1.56199)
Conv. butts price	6.58402**	1.61198	-4.34415	-10.24256**	-4.97314**
	(1.98903)	(2.12720)	(2.21354)	(2.03378)	(1.63346)
Chain spareribs price	6.45223**	1.76979	-1.65467	-5.01340**	-.05838
	(1.49271)	(1.58338)	(1.73792)	(1.66210)	(1.37741)
Indep. spareribs price	6.34223**	1.67129	-1.74989	-4.92581**	.42029
	(1.46260)	(1.55040)	(1.70184)	(1.61439)	(1.31017)
Conv. spareribs price	755439**	3.98308	-.11937	-3.61394**	.72290
	(1.59089)	(1.70102)	(1.79644)	(1.68402)	(1.43175)
Chain sausage price	6.93031**	1.35349	-7.09259**	-11.94688**	-9.02050**
	(1.87667)	(1.92230)	(2.50477)	(2.49450)	(2.16694)
Indep. sausage price	6.89663**	1.48484	-7.14516**	-11.95866**	-8.87721**
	(1.86606)	(1.90905)	(2.48923)	(2.47310)	(2.12946)
Conv. sausage price	7.26187**	1.51358	-7.57225**	-12.65385**	-9.47340**
	(1.95425)	(2.00074)	(2.61198)	(2.59849)	(2.24573)
Chain picnic price	5.75719**	-.64698	-5.12836*	-9.70666**	-6.64232**
	(1.66361)	(1.76966)	(2.17190)	(2.12279)	(1.80990)
Indep. picnic price	5.75563**	-.65039	-5.17590*	-9.77807**	-6.65858**
	(1.65157)	(1.75720)	(2.15479)	(2.10714)	(1.79039)
Conv. picnic price	6.02398**	-.57439	-4.98307*	-9.49566**	-6.52906**
	(1.82120)	(1.93215)	(2.37485)	(2.29144)	(1.97668)
Chain bacon price	9.58786**	-2.05128	5.80749	-5.22970	2.42025
	(3.37387)	(3.61014)	(3.54243)	(3.05113)	(2.42953)
Indep. bacon price	9.79846**	-1.43194	6.32549	-4.66797	3.07192
	(3.40719)	(3.64234)	(3.58245)	(3.07242)	(2.45114)
Conv. bacon price	10.30965**	-1.97673	6.26734	-5.32515	2.83332
	(3.57268)	(3.82493)	(3.75553)	(3.23116)	(2.57302)
Chain lunch meat price	2.89512	3.77345	2.68245	.52170	.89030
	(2.13304)	(2.19568)	(2.20089)	(2.00916)	(1.59089)
Indep. lunch meat price	2.94515	3.85307	2.80711	.73611	1.07216
	(2.14937)	(2.21053)	(2.21282)	(2.01043)	(1.58744)
Conv. lunch meat price	3.12489	4.05123	2.91885	.69723	1.07279
	(2.24843)	(2.31483)	(2.31838)	(2.11213)	(1.66680)

See footnotes at end of table.

Continued

Table 5--Coefficients and standard errors for monthly dummies of regression equations reported in table 4--Continued

Dependent variable	July	Aug.	Sept.	Oct.	Nov.	Dec.
Chain loin price	-11.11957**	-12.39513**	-10.37392**	- 1.41891	1.95168	- 1.65160
	(1.97187)	(1.85241)	(2.07834)	(2.07449)	(2.42950)	(1.63118)
Indep. loin price	-10.41432**	-11.54384**	- 9.88675**	- .79604	2.41554	- .70165
	(1.89770)	(1.78657)	(2.05098)	(2.08984)	(2.43214)	(1.64907)
Conv. loin price	-11.37947**	-12.61234**	-10.84046**	- 1.28433	2.24931	1.13151
	(2.01550)	(1.89412)	(2.15515)	(2.16086)	(2.52817)	(1.70958)
Chain ham price	- 6.01352**	- 4.75848*	- .96254	- 3.13452	1.15629	- .76276
	(1.73375)	(2.11450)	(3.10623)	(2.79398)	(3.35941)	(2.14866)
Indep. ham price	- 5.52610**	- 4.04771	- .20917	- 2.37205	2.02040	.29184
	(1.71873)	(2.12439)	(3.11199)	(2.79479)	(3.35201)	(2.15231)
Conv. ham price	- 5.97665**	- 4.50540*	- .53046	- 2.73794	1.84179	- .19883
	(1.81256)	(2.23075)	(3.26866)	(2.94077)	(3.52955)	(1.25678)
Chain butts price	-12.07962**	-11.38475**	-10.54707**	- 2.90809	.31291	- 2.44233
	(1.91289)	(1.80259)	(2.05646)	(2.01418)	(2.38103)	(1.60431)
Indep. butts price	-11.38044**	- 9.90896**	- 8.29482**	- .26917	3.30036	- .00083
	(1.78419)	(1.70449)	(2.16633)	(2.21196)	(2.65620)	(1.70690)
Conv. butts price	-10.81813**	- 9.61676**	- 8.33441**	- 3.20813	2.36414	- .79097
	(1.86604)	(1.81821)	(2.34649)	(2.30380)	(2.84871)	(1.83530)
Chain spareribs price	- 4.53718**	- 4.49170**	- 4.14768*	- 6.63427**	- 5.28175*	- 4.82220**
	(1.51433)	(1.44718)	(1.77961)	(1.67161)	(2.04534)	(1.38397)
Indep. spareribs price	- 3.96969**	- 3.68373*	- 2.81027	- 5.47178**	- 3.71915	- 3.45926*
	(1.43309)	(1.37187)	(1.71840)	(1.64298)	(2.01022)	(1.32877)
Conv. spareribs price	- 4.36796**	- 3.51479*	- 4.12114*	- 7.18994**	- 5.50134*	- 4.49212**
	(1.60608)	(1.49575)	(1.90849)	(1.79645)	(2.19845)	(1.47485)
Chain sausage price	-12.32679**	-11.92034**	- 9.82153**	- 5.97528*	- 4.12851	- 5.46496**
	(2.15767)	(2.13381)	(2.57345)	(2.38142)	(2.74428)	(1.94384)
Indep. sausage price	-12.12291**	-11.54405**	- 9.31857**	- 5.35213*	- 3.38667	- 4.71807*
	(2.11525)	(2.08420)	(2.53236)	(2.36189)	(2.72271)	(1.90301)
Conv. sausage price	-12.92225**	-12.37026**	-10.09802**	- 5.94817*	- 3.97521	- 5.35974*
	(2.23473)	(2.20322)	(2.66701)	(2.47648)	(2.85450)	(2.00783)
Chain picnic price	- 8.57641**	- 8.47084**	- 7.10158**	- 5.04315*	- 1.63893	- 2.86633
	(1.66750)	(1.59436)	(1.97340)	(1.86796)	(2.28475)	(1.52951)
Indep. picnic price	- 8.54371**	- 8.28410**	- 6.83892**	- 4.71370*	- 1.20249	- 2.46633
	(1.64540)	(1.56530)	(1.95235)	(1.85870)	(2.27319)	(1.50780)
Conv. picnic price	- 8.60329**	- 8.69165**	- 7.29159**	- 5.38581*	- 1.72937	- 2.90432
	(1.81693)	(1.74542)	(2.15381)	(2.03985)	(2.49589)	(1.67015)
Chain bacon price	- 2.10423	1.24269	9.97513*	.05951	4.87815	.27916
	(2.49852)	3.01445)	(4.43760)	(3.99639)	(4.82494)	(3.09150)
Indep. bacon price	- 1.51484	1.97470	10.53593*	.77891	5.60173	1.42209
	(2.52814)	(3.07802)	(4.52226)	(4.06988)	(4.90340)	(3.14571)
Conv. bacon price	- 2.01627	1.56179	10.64392*	.39782	5.51238	.79837
	(2.64915)	(3.20712)	(4.71864)	(4.25131)	(5.12941)	(3.28565)
Chain lunch meat price	- 1.60556	- 1.31283	- 2.82528	- 2.74715	- 2.89624	- .11525
	(1.64297)	(1.95871)	(2.84944)	(2.72891)	(3.14312	(2.12968)
Indep. lunch meat price	- 1.45371	- 1.21186	- 2.82214	- 2.66280	- 2.80816	..08064
	(1.64510)	(1.98119)	(2.89416)	(2.76340)	(3.18039)	(2.14237)
Conv. lunch meat price	- 1.60751	- 1.35479	- 3.01368	- 2.89314	- 3.00069	.03394
	(1.73057)	(2.06974)	(3.01275)	(2.88379)	(3.32478)	(2.24472)

1/ Each variable is recorded: coefficient (standard error)

2/ These monthly dummy variables, with the independent variables listed in table 4, are the complete equations.

* Differs significantly at the 5-percent level.

** Differs significantly at the 1-percent level.

Table 6--Lunch meat price equations, coefficients, and related information, excluding seasonal variation[1/]

Dependent variable	Intercept	Beef price	Poultry price	Commercial production red meat	Poultry production
Chain lunch meat price	31.53118	0.45409** (.13874)	0.27432 (.21693)	-0.00597 (.01661)	0.05908* (.02445)
Indep. lunch meat price	33.39597	.45198** (.14023)	.28825 (.21777)	- .00641 (.01679)	.06134* (.02499)
Conv. lunch meat price	34.66009	.47908** (.14695)	.31394* (.22764)	- .00628 (.01760)	.06420* (.02624)
Chain lunch meat price	25.13337	.46250** (.06769)	.40995 (.18289)		.04867* (.02218)
Indep. lunch meat price	25.13337	.46250** (.06769)	.40995* (.18289)		.04867* (.02218)
Conv. lunch meat price	26.39004	.48562** (.07107)	.43045* (.19204)		.05110* (.02329)

Dependent variable	1965 dummy	"Own" quantity 2/	Per capita disposable income	R^2	Standard error of estimate	Overall of ratio
Chain lunch meat price	-5.58958** (1.12994)	-0.30795* (.15219)	0.00343 (.00440)	0.8650	2.1836	47.609
Indep. lunch meat price	-5.57043** (1.13949)	- .23785 (.12992)	.00234 (.00426)	.8632	2.1982	46.880
Conv. lunch meat price	-5.83086** (1.19845)	- .93535 (.51617)	.00225 (.00443)	.8630	2.3095	46.813
Chain lunch meat price	-5.53267** (.79824)			.8541	2.2074	80.497
Indep. lunch meat price	-5.53267** (.79824)			.8541	2.2074	80.497
Conv. lunch meat price	-5.80930** (.83815)			.8541	2.3178	80.497

1/ Each independent variable is recorded: Coefficient (standard error).
2/ Quantity of selected cut moving through selected outlets.
* Differs significantly at the 5-percent level.
** Differs significantly at the 5-percent level.

INTERPRETATION OF RESULTS

Results obtained for each pork cut are quite similar for each of the three types of retail outlets, most likely due to the similarity of the price series used by outlets for a cut. Additionally, most of the independent variables are the same except for "own" quantity, and these quantities are closely related for a cut. At the same time, the variation among cuts indicated distinct demands for individual cuts. Price elasticities discussed in appendix B also point this out. The different demand curves and elasticities of individual pork cuts had implications for pricing cuts and cutting them from the carcass (see the example in the elasticity section of appendix B). More total revenue could be obtained if a quantity of an inelastic cut were transformed into a price elastic form.

Equations presented for predicting cut prices by retail outlet seemed adequate by statistical tests and economic logic. Almost all signs of the independent variables are consistent with economic theory, except the poultry production variable. This implied that the rapid rise in poultry consumption happened independently, rather than as a direct shift from pork.

Both poultry price and poultry production are included in all the equations, and for both of these lagged variables the sign of the coefficient is always positive. The sign is expected to be positive when associated with the price of a competing good, but the sign of the quantity coefficient should be negative, regardless of the fact that these are lagged variables. Demand for and production of poultry had been increasing at a rather rapid rate, but without a decrease in price (1965-69). This fact indicated that poultry price and quantity are not highly correlated ($r=0.10$). Thus, they function as separate variables in their effect on prices of pork cuts.

The coefficient for the quantity variable was negative in every equation, which is in accord with supply-demand relationships. If the quantity available increases, the price of the cut decreases. The coefficient for total production of all red meat (lagged) was negative as expected. This meant that, as supplies of pork and red meat increased, the selling prices of pork cuts decreased. The quantity of competing meat products affects purchases of pork.

Beef price (lagged) was a significant variable in explaining prices of sausage and lunch meat. The sign of the beef price coefficient was, logically, positive in both cases, because the price of a cut tends to rise if prices of competing products increase. Beef price was not significant for most of the other six pork cuts, but poultry price was. This suggested that poultry more than beef is competitive with pork and is a closer substitute than beef. A price rise in poultry, rather than in beef, is more apt to strengthen the price of pork.

Income was a significant variable for all cuts except lunch meat. The coefficient was positive, indicating that as income rises demand for pork cuts increases. Actual dollars were used for both prices and income. Inflation, therefore, caused part of the related increases. Since there is a strong upward trend in income, the income variable as a substitute for time might reflect changes in consumer tastes, besides reflecting consumer responses to income changes. However, income contributed more to the explanation of the dependent

variable than did a time trend variable. Thus, changes in income, as well as the general level of inflation, affected price.

Differences are marked between the coefficients in the equations for lunch meat and the other cuts using the same variables (tables 4 and 5). Part of this probably resulted from the more stable lunch meat price from month to month, since lunch meat is a highly processed product having a large share of fixed costs. The inelastic demand for lunch meat was also a factor. Appendix B shows the most inelastic demand among the eight cuts is for lunch meat. But, lunch meat is a mixture that includes beef and possibly chicken, mutton, and cereal, whose prices fluctuate differently than pork prices. These fluctuations can change the mix. Income and total red meat production explained very little of the change in lunch meat prices. Even the quantity of lunch meat did not add much to the explained price variation, although the t-value borders on the 5-percent significance level.

The demand curve for pork seems to have shifted between 1965 and 1966. The 1965 dummy used in the equations to reflect this shift was significant except for loin cuts and butts. This variable was left in the equations explaining the price of butts sold by independent and convenience outlets, because it increased the explained variation. However, the t-value (a statistical measure) was not quite significant at the 5-percent level. The 1965 dummy was not used in the equations for loins or for butts sold through chains. Further, examination of the historical data also indicated shifts in 1955 and 1960. This pattern might suggest future shifts in demand every 5 or 6 years.

As a group, monthly dummies improved the "fit" of the equations significantly, except for the three lunch meat equations. The dummy variables were significant even when adjusted to eliminate variations in numbers of days per month. Thus, a pattern of seasonal variation occurs in prices of pork cuts (except lunch meat). January was used as the base month and, for all cuts, price proved higher in February and lower in July. Prices dipped below the base in August, September, and October for all cuts except bacon. And among all cuts in the other 7 months, there was a mix of higher and lower prices. Cuts also may be examined individually. For instance, the price of ham is higher than in January, in February, April, May, June, November, and (for one type of retail outlet) December. The sign of the coefficients suggests the relative demand for cuts among months. If the coefficient is positive, the demand for a particular cut that month could be greater than for a month with a negative coefficient.

A considerable monthly variation in pork prices occurred, implying that the seasonal variation in production and the amount desired by consumers have not been adjusted completely by storage. Because monthly dummies for the fresh cuts were statistically more significant than for the smoked processed cuts, storage likely helps to dampen monthly price fluctuations. All cuts differ slightly in patterns of monthly price variations. For instance, a price surge in April apparently results from sales of Easter hams. The report therefore suggests that the seasonal variation in production should be modified or storage activities increased.

The R^2 value is a measure of the amount of variation in the dependent variable explained by the set of independent variables. The R^2 values for the 24 equations in table 4 varied from 0.83 to 0.96. Although 0.96 is the better indication of fit, the 0.83 value is acceptable. The R^2's for ham were the lowest and those for spareribs, highest.

Predicting equations do not provide perfect estimates. Thus, a measure of the accuracy of the predicted values (related to the original values of the dependent variables) is shown by the standard error of estimate, which varied from 1.56 to 3.85 cents.

As shown in table 4, an overall F-ratio is also reported for each equation measuring the significance of the explanatory variables associated with the equation. These are significant for all equations, because the lowest calculated F is 12.1 and the 1-percent tabular F-value for all equations is less than 2.50.

APPENDIX A

DERIVATION OF DATA

Published data on individual cuts needed for this study are not available. However, several reasonable and logical assumptions can yield the necessary individual data. Both underlying assumptions and the development of these quantity data are shown in this appendix. Sources and use of other data required for the regression analysis also are discussed.

QUANTITY BY CUT BY OUTLET BY MONTH

Besides the quantity data used for the eight cuts, there is a need for the data to be divided among the three sales outlets. Monthly data are required for 1965-69. The decisions on time periods, cuts, and retail outlets were made consistent with requirements of the industry model.

Steps in the Computation Process

Total Pork Consumed by Month

Commercial pork production is reported monthly, and total pork production (including farm slaughter), quarterly, in Livestock and Meat Statistics.[3/] The pork slaughtered and consumed on the farm must be added to the reported monthly commercial pork production. To derive the farm slaughter the first step is to add the level of monthly imports to commercial production and then to subtract levels of exports and military consumption. Quarterly values of total production including farm slaughter are adjusted similarly. The derived monthly data (without farm slaughter) are then totaled for each quarter and subtracted from the derived quarterly value that includes farm slaughter. The difference is divided by 3 and the result (equaling monthly farm slaughter) is added to the monthly values derived from commercial production to obtain total civilian monthly pork consumption (table A-1). Beginning and ending stocks were not adjusted at this point. These data can be adjusted later with available storage data.

Disaggregation to Cuts

Percentages in table A-2 used to divide total pounds of pork into cuts are somewhat arbitrary for lunch meat. The 8 percent used is the amount remaining

3/ Livestock and Meat Statistics. Stat. Bul. No. 333, and the relevant yearly supplements, Agr. Mktg. Serv., Statis. Rptg. Serv., and Econ. Res. Serv., U.S. Dept. Agr., Washington, D. C.

Table A-1--Total civilian pork consumption by months, without adjustment for stock changes, 1965-69

Year	Civilian pork consumption											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	Million pounds											
1965	1,062	932	1,132	988	807	810	767	809	924	974	992	930
1966	871	840	1,047	939	866	843	786	896	921	1,057	1,122	1,135
1967	1,138	1,016	1,163	1,018	920	921	846	1,002	1,045	1,170	1,175	1,136
1968	1,183	1,021	1,090	1,145	1,051	928	933	990	1,058	1,275	1,163	1,186
1969	1,165	1,067	1,176	1,152	1,019	956	979	942	1,070	1,203	1,020	1,144

Source: Livestock and Meat Statistics. (See footnote 3.)

Table A-2--Allocation of total pork to retail cuts using cutting data

Cut	Percent	Cut	Percent
Loin	20.1	Sausage	7.5
Ham	23.0	Picnic	10.8
Butts	8.6	Bacon	17.7
Spareribs	4.3	Lunch meat	8.0

Source: Duewer, Lawrence A. Price Spreads for Beef and Pork Revised Series 1949-69. Misc. Pub. No. 1174, Econ. Res. Serv., U.S. Dept. Agr., Washington, D.C., May 1970, p. 26.

after accounting for the other cuts. The source of table A-2 lists this share as pigsfeet, tails, neckbones, and jowls. Later in the report data are used that adjust the percentages to the actual amounts of the cuts consumed.

Pork consumption could have been divided into a greater number of cuts. For instance, loins could be subdivided into rib chops, loin chops, loin roast, tenderloin, and other more specific cuts. The eight cuts used, however, allow a sufficient breakdown for study without incurring further data work.

Adjustments for Storage

Stocks of individual pork cuts are reported monthly.4/ Monthly changes in stocks show the amount consumption differs from production because of storage. Thus, changes in storage levels rather than absolute storage values are presented in table A-3. Commodity designations in the source differ from the eight original cuts used. Thus, frozen loins are used for loin storage, both frozen and canned hams to obtain changes in ham storage, and frozen butts, spareribs, and picnics to indicate changes in such storage. Frozen trimmings are used for sausage storage and both frozen and salt bellies are used for bacon storage. The category of all other frozen pork is utilized for lunch meat storage.

Monthly changes in storage indicate the magnitude and seasonality of storage levels for the various cuts (table A-3). Largest changes in storage are for ham and bacon. The general pattern indicates cuts are stored in the winter, removed from storage in summer.

Military Consumption

Military consumption is removed from the consumption data by pork cut at this stage of calculations. Consumption by the military depends, of course, on the size of the military force. Their use of various cuts of pork may change greatly from one period to another because packers often make price concessions to the military for cuts in excess supply. The share of total military pork consumption of each cut during 1965-69 was:

	Percent
Loin	20.39
Ham	34.97
Butts	2.92
Spareribs	3.55
Sausage	7.39
Picnic	2.78
Bacon	23.45
Lunch meat	4.57

These are generally in line with carcass cuttings (see table A-2) except that military consumption of ham is considerably above carcass proportions.

4/ Summary of Regional Cold Storage Holdings (for appropriate years). Crop Rptg. Bd., Statis. Rptg. Serv., U.S. Dept. Agr., Washington, D. C.

Table A-3--Storage changes (additions or subtraction to or from consumption availabilities) of pork cuts, by months, 1965-69

	Loin	Ham	Butts	Spareribs	Sausage	Picnics	Bacon	Lunch meat	Total
					Million pounds				
1965:									
Jan.	1.3	-16.9	0.1	-1.4	1.0	-0.1	- 9.3	-2.2	-27.5
Feb.	2.3	-16.9	.8	- .2	.5	1.3	-12.4	3.9	-20.7
Mar.	1.7	7.1	- .5	-1.0	-4.0	-1.2	-16.0	1.0	-12.9
Apr.	- .6	- .2	- .2	.1	3.0	1.7	- 6.8	-5.9	- 8.9
May	.9	3.6	.1	3.2	4.5	4.2	17.7	6.4	40.6
June	1.2	19.4	1.5	5.4	3.7	6.2	29.4	9.8	76.6
July	.4	- 3.2	.7	1.6	2.9	1.4	33.8	3.1	40.7
Aug.	1.9	15.6	.9	2.7	2.2	2.7	18.9	4.5	49.4
Sept.	1.7	- 5.9	.1	.3	2.5	- .3	13.8	- .9	11.3
Oct.	.4	- 4.9	.4	.4	- .2	.6	- .1	3.4	.0
Nov.	-2.0	12.9	- .9	-1.9	-1.6	-1.1	- 8.4	- .7	- 3.7
Dec.	-2.4	12.7	.0	-1.9	-1.2	-2.1	- 9.7	-3.4	- 8.0
1966:									
Jan.	.6	-16.1	.3	.0	1.8	- .1	- 3.4	1.2	-15.7
Feb.	.9	-18.5	- .5	.3	-1.6	1.3	- 8.4	.5	-26.0
Mar.	-2.4	3.6	-1.2	-2.5	-6.0	-1.2	-12.5	-9.9	-32.1
Apr.	-2.1	-24.1	-1.3	-3.8	-3.7	1.7	-14.1	-7.9	-55.3
May	- .1	5.6	- .2	3.1	- .8	4.2	- 2.7	-4.2	5.1
June	2.0	20.0	1.3	3.9	5.1	6.2	18.5	1.5	58.5
July	1.3	3.0	.4	1.3	2.8	1.4	21.5	.4	32.1
Aug.	2.9	19.7	1.3	1.3	3.9	3.7	5.3	1.8	39.9
Sept.	.8	- 3.0	.1	-1.3	- .6	- .3	14.7	-3.6	6.8
Oct.	- .2	-21.2	.0	.3	-2.7	.6	- 2.1	-3.6	-28.9
Nov.	-3.1	2.8	-1.1	-2.9	-4.4	-1.1	-11.5	-5.5	-26.8
Dec.	-1.9	19.3	.0	-3.0	-1.9	-2.1	-24.9	-11.7	-26.2
1967:									
Jan.	.6	-23.1	- .2	-1.6	.1	.7	- 5.7	1.2	-28.0
Feb.	.2	-12.8	.1	-1.5	-3.1	.5	-17.4	- .8	-34.8
Mar.	-3.6	.6	-1.9	-2.6	-4.7	-1.2	-23.5	-6.8	-43.7
Apr.	.9	-33.8	- .7	-2.1	-1.9	.0	-17.5	-7.8	-60.9
May	2.0	22.9	.7	4.0	2.7	1.2	8.0	10.5	52.0
June	.0	12.6	1.1	5.3	5.4	.6	11.1	5.6	41.7
July	2.2	- .9	.8	1.5	4.5	1.3	29.0	6.9	45.3
Aug.	1.1	12.9	.2	2.2	3.8	- .2	28.0	1.5	49.3
Sept.	1.4	- 9.4	- .1	-1.2	-1.0	.0	12.6	-1.6	.7
Oct.	- .7	-21.0	- .5	- .1	-2.7	- .8	-12.1	-7.0	-44.9
Nov.	-3.6	6.9	- .7	-4.3	-5.3	- .7	-17.8	-2.2	-27.7
Dec.	-2.0	32.8	- .2	-3.5	-3.2	- .9	-20.3	-2.8	- .1
1968:									
Jan.	2.6	-13.0	.1	- .7	3.3	.8	2.0	-1.5	- 6.4
Feb.	1.1	- 5.7	.4	.1	.6	1.5	- 9.9	4.5	- 7.4
Mar.	- .5	16.0	- .4	-1.6	-1.1	-2.3	-14.4	-2.4	- 4.7
Apr.	-5.0	-13.9	-2.8	-2.3	-2.4	-1.7	-22.5	-5.9	-56.5
May	-1.7	- 9.7	-2.1	.0	-4.0	.3	-14.3	-3.5	-35.0
June	1.7	9.3	1.6	6.1	4.0	2.7	26.3	6.0	57.7
July	4.5	7.0	3.0	4.4	5.5	1.6	44.1	8.3	78.4
Aug.	- .4	13.0	.8	3.3	1.9	- .1	32.9	1.1	52.5
Sept.	1.9	-10.9	.4	-1.5	- .1	.7	12.9	-2.4	1.0
Oct.	.0	-16.1	- .8	.9	-1.7	-1.0	- 5.5	-2.2	-26.4
Nov.	-3.2	15.2	- .6	-4.1	-1.6	- .5	-13.7	-2.1	-10.6
Dec.	-2.2	22.3	.8	-4.7	-1.4	.0	-15.1	-12.5	-12.8
1969:									
Jan.	2.5	- 5.1	.5	-1.0	4.0	1.5	2.1	7.6	12.1
Feb.	1.3	- 8.1	- .1	- .2	-3.0	.3	- 9.1	.5	-18.4
Mar.	- .8	9.9	- .7	.0	-1.1	- .7	-19.4	4.1	- 8.7
Apr.	-4.0	-26.8	-4.1	-1.5	- .6	.8	-20.8	-7.1	-64.1
May	2.3	1.4	3.7	4.8	3.1	- .1	.0	5.1	20.3
June	2.6	17.0	1.8	4.3	2.5	.2	12.6	13.6	54.6
July	1.9	.1	.2	.9	5.4	- .1	37.8	3.8	50.0
Aug.	.3	1.7	- .6	3.3	-1.2	.1	24.9	.0	28.5
Sept.	- .6	- 2.6	-2.8	-1.0	-3.0	- .2	9.3	2.7	1.8
Oct.	2.1	-15.2	-1.4	.0	-3.4	- .7	- 7.6	-4.5	-30.7
Nov.	-1.9	6.8	- .5	-3.3	-4.8	-1.0	- 6.6	.0	-13.3
Dec.	-1.6	30.6	.4	-2.1	-2.7	.1	-12.7	.5	12.5

Source: Summary of Regional Cold Storage Holdings. (See footnote 4)

Table A-4--Military monthly pork procurement, by cuts, 1965-69, as noted by the Agricultural Marketing Service, U.S. Department of Agriculture

	Loin	Ham	Butts	Spareribs	Sausage	Picnics (other pork)	Bacon	Lunch meat	Total
				1,000 pounds					
1965:									
Jan.	2,989	5,576	659	892	1,568	569	3,376	338	15,967
Feb.	3,610	4,864	668	646	2,553	613	4,582	364	17,900
Mar.	3,923	5,377	535	710	2,847	718	4,630	1,307	20,047
Apr.	2,728	6,531	463	439	1,833	501	3,546	429	16,447
May	3,488	5,611	456	561	1,202	811	4,327	669	17,115
June	4,968	8,753	553	539	1,365	916	3,573	695	21,362
July	3,349	5,966	562	552	1,077	408	3,271	453	15,636
Aug.	4,447	6,790	950	706	2,122	855	6,745	1,363	23,978
Sept.	3,321	9,104	1,011	784	2,295	516	4,015	1,660	22,696
Oct.	5,518	7,205	724	1,292	2,680	517	4,477	5,267	27,678
Nov.	3,089	7,469	582	618	1,326	678	5,621	903	20,286
Dec.	2,787	9,221	581	383	1,818	862	5,203	1,205	22,060
1966:									
Jan.	3,131	6,176	694	720	1,909	440	5,014	410	18,494
Feb.	4,390	8,641	1,252	906	1,713	1,164	5,807	1,064	24,636
Mar.	2,779	5,159	695	732	1,860	611	5,299	1,779	18,914
Apr.	2,191	3,496	231	237	2,303	500	3,442	712	13,112
May	5,504	9,427	418	366	3,521	1,416	5,419	1,468	27,509
June	3,318	6,279	771	564	3,378	560	5,145	1,054	21,069
July	2,154	4,756	597	612	1,211	624	3,710	388	14,042
Aug.	5,729	12,475	821	681	1,735	1,715	4,375	1,231	28,762
Sept.	5,113	6,322	951	652	1,291	635	6,178	1,159	22,271
Oct.	4,407	7,053	851	951	1,913	689	6,710	719	23,293
Nov.	4,160	6,437	766	1,015	1,726	582	6,175	963	21,818
Dec.	4,722	7,044	1,189	795	1,636	531	4,249	580	20,546
1967:									
Jan.	5,280	8,378	608	849	2,265	505	3,951	778	22,614
Feb.	3,873	6,549	926	839	1,521	586	5,342	752	20,388
Mar.	3,477	5,813	841	792	1,182	436	4,663	2,047	19,251
Apr.	4,119	6,343	548	637	1,668	662	7,615	647	22,239
May	6,162	13,045	704	820	1,435	883	8,401	1,214	32,564
June	4,858	8,687	943	933	1,904	731	7,352	1,318	26,726
July	3,418	5,357	394	513	1,191	502	4,560	616	16,551
Aug.	7,495	10,339	1,170	1,054	920	1,101	5,526	1,251	28,836
Sept.	3,468	5,231	608	831	1,168	731	4,814	443	17,294
Oct.	6,894	11,429	869	1,133	1,791	1,039	5,252	1,263	29,670
Nov.	3,777	5,254	300	723	560	616	3,444	302	14,976
Dec.	4,054	5,026	413	708	1,390	608	4,623	435	17,257
1968:									
Jan.	5,863	7,829	685	619	1,513	656	4,950	494	22,859
Feb.	4,759	7,634	542	1,015	992	422	4,559	421	20,344
Mar.	6,013	12,052	484	739	1,615	359	4,357	640	26,256
Apr.	5,933	14,475	197	871	1,162	376	7,902	671	31,587
May	6,814	8,881	192	664	1,372	263	6,224	587	24,997
June	5,892	13,964	567	671	2,342	374	8,558	2,693	35,061
July	8,967	12,781	629	902	1,129	827	6,261	2,080	33,576
Aug.	4,393	6,456	558	817	1,126	391	3,921	1,268	23,960
Sept.	3,769	6,358	700	1,063	1,756	459	6,981	1,312	22,398
Oct.	2,828	5,937	281	560	1,094	284	4,470	364	15,818
Nov.	4,401	6,987	489	492	1,743	352	4,106	542	19,112
Dec.	3,677	5,409	531	684	1,432	395	4,024	1,504	17,656
1969:									
Jan.	7,606	11,011	612	1,033	1,687	679	5,813	2,017	30,458
Feb.	3,049	6,734	503	850	1,188	604	4,815	1,418	19,161
Mar.	4,042	4,342	322	534	994	414	3,114	321	14,081
Apr.	3,949	6,835	463	571	1,136	356	3,860	664	17,834
May	5,358	7,268	626	785	927	359	4,501	796	20,620
June	5,256	9,017	404	847	1,720	115	6,866	644	24,869
July	2,666	6,585	595	960	499	74	5,008	421	16,808
Aug.	2,886	5,784	419	833	1,043	210	4,674	373	16,222
Sept.	4,392	7,741	520	1,442	1,229	168	2,944	763	19,199
Oct.	4,982	6,104	681	861	1,232	262	5,124	771	20,017
Nov.	3,462	6,929	587	834	1,291	384	5,741	464	19,692
Dec.	2,419	4,825	693	845	841	811	2,201	267	12,900

Quantities of pork cuts purchased by the military are listed in table A-4. Specifications of cuts in the data available agree with the cuts used in this study, except when using the category of other pork for picnics.

Weight Loss in Processing

When fresh pork cuts are processed, some cuts lose weight (carcass weight to retail weight), varying according to the final product. For instance, a greater weight loss ensues when loins are sold as boneless chops rather than as roasts.

Processing coefficients used to adjust the consumption figures obtained from previous steps are:

Loin---------0.9878	Ham---------0.9468
Butts-------- .9964	Spareribs---1.0000
Sausage------1.0000	Picnics----- .8369
Bacon-------- .7686	Lunch meat--1.0000

The weight of each cut derived is not listed by month because of the need for further adjustments. Table A-5 summarizes total weight of each cut for the 5 year period to indicate each cut's portion of all pork products.

Conversion Among Cuts

Although the amount of each pork cut is fairly well determined by carcass composition, pork is not actually consumed in such proportions. For example, picnics (especially heavier ones) are often ground and used for pork sausage or lunch meat. Earlier computations applied standard proportions to obtain weights by cut, although additional adjustments were needed.

Table A-5--Total weight of pork products after processing adjustments, by cut, 1965-69

Cut	Weight	Percentage each cut represents of total
	Million pounds	Percent
Loin	12,336.9	21.43
Ham	13,331.2	23.15
Butts	5,401.0	9.38
Spareribs	2,687.6	4.67
Sausage	4,664.6	8.10
Picnics	5,742.0	9.97
Bacon	8,412.0	14.61
Lunch meat	5,001.4	8.69
Total	57,576.7	100.00

The amount of each pork cut actually consumed relative to the current cutout proportions (table A-5) provides information for the adjustment needed. Home consumption data, by season, are available from the household food consumption survey. (See footnote 2.) The away-from-home food survey provides data on the consumption of pork by cut in restaurants, institutions, etc. (See footnote 1.) The computations for obtaining the proportions of each cut consumed seasonally from the 1965 household survey are shown in table A-7. The percentages of each pork cut consumed away-from-home were computed from the away-from-home survey data. These percentages are shown in table A-6.

Table A-6--Share of each cut of total pork consumed only in away-from-home markets, 1965-66

Cut	Percent	Cut	Percent
Ham	11.59	Sausage	13.54
Loin	33.80	Picnics	1.06
Butts	2.85	Bacon	16.62
Spareribs	11.79	Lunch meat	8.75

Source: The Foodservice Industry; Type, Quantity, and Value of Foods Used. (See footnote 2.)

Several computations are needed to make the data derived from production consistent with the percentage breakdown of consumption (tables A-6 and A-7). Division of all pork consumed into the amount purchased through retail outlets and away-from-home markets is the next step.

Table A-9 presents the estimated shares of pork cuts moving through retail outlets.

The percentage not sold through retail outlets is assumed to be sold through nonretail (HRI) markets. If data in table A-9 indicate 71 percent is sold through retail, then 29 percent is sold through nonretail markets.

Table A-8 shows the proportion of cuts currently in adjustment (from table A-5). The second column, table A-8, shows the total breakdown in the form consumed. This was obtained by adding the following two products:

1. Consumption by cut percentages in the away-from-home market (table A-6) multiplied by the average share of each cut sold through nonretail markets (100 minus the average of all values in a column for any cut, table A-9).

2. Average the proportion of seasonal weights in table A-7, then multiply these annual percentages by the average proportion of each cut sold through retail markets (average of all values in a column for any cut in table A-9).

Column 3 in table A-8 shows the rectified or after adjustment percentages of pork cuts. The transfers among cuts made to obtain percentages in column 3 are explained in the following paragraph. The fourth or last column in table A-8 is the ratio of rectified (col. 3) to current (col. 1) percentages. These

Table A-7--Breakdown of 8 cuts and their shares of all pork consumed per household during survey week, each season, 1965-66

Season and 8 selected cuts	Weight	Cut shares of total pork consumed 1/	Breakdown (subcuts) of 8 selected cuts 1/
Winter:			
Loin	0.67 lb.	20.68 %	Chops 0.52 lb. + loins 0.15 lb.
Ham	.64	19.75	Fresh .07 lb. + cured .47 lb. + canned .10 lb.
Butts	.21	6.48	Other fresh 2/ .34 x 61.5 %
Spareribs	.09	2.78	Other fresh 2/ .34 x 25.7 %
Sausage	.43	13.27	Sausage .35 lb. + salt pork .8 lb.
Picnics	.25	7.72	Other cured .21 lb. + (Other fresh .34 lb. x 12.8%)
Bacon	.60	18.52	Bacon .60 lb.
Lunch meat	.35	10.80	Lunch meat 1.17 lb. x 30 % (pork content)
Total	3.24	100.00	
Spring:			
Loin	0.76	18.86	Chops 0.59 lb. + loins 0.17 lb.
Ham	1.04	25.81	Fresh .10 lb. + cured .79 lb. + canned .15 lb.
Butts	.24	5.96	Other fresh 2/ .39 x 61.5 %
Spareribs	.10	2.48	Other fresh 2/ .39 x 25.7 %
Sausage	.41	10.17	Sausage .34 lb. + salt pork .7 lb.
Picnics	.25	6.20	Other cured .20 lb. + (Other fresh .39 lb. x 12.8%)
Bacon	.80	19.85	Bacon .80 lb.
Lunch meat	.43	10.67	Lunch meat 1.42 lb. x 30 % (pork content)
Total	4.03	100.00	
Summer:			
Loin	0.65	17.76	Chops 0.53 lb. + loins 0.12 lb.
Ham	.85	23.22	Fresh .08 lb. + cured .65 lb. + canned .12 lb.
Butts	.21	5.74	Other fresh 2/ .34 x 61.5 %
Spareribs	.09	2.46	Other fresh 2/ .34 x 25.7 %
Sausage	.40	10.93	Sausage .31 lb. + salt pork .09 lb.
Picnics	.25	6.83	Other cured .21 lb. + (Other fresh .34 lb. x 12.8%)
Bacon	.78	21.31	Bacon .78 lb.
Lunch meat	.43	11.75	Lunch meat 1.44 lb. x 30 % (pork content)
Total	3.66	100.00	
Fall:			
Loin	0.76	21.72	Chops 0.56 lb. + loins 0.20 lb.
Ham	.72	20.57	Fresh .09 lb. + cured .54 lb. + canned .09 lb.
Butts	.23	6.57	Other fresh 2/ .37 x 61.5 %
Spareribs	.09	2.57	Other fresh 2/ .37 x 25.7 %
Sausage	.42	12.00	Sausage .35 lb. + salt pork .07 lb.
Picnics	.25	7.14	Other cured .20 lb. + (Other fresh .37 lb. x 12.8%)
Bacon	.66	18.86	Bacon .66 lb.
Lunch meat	.37	10.57	Lunch meat 1.22 lb. x 30 % (pork content)
Total	3.50	100.00	

1/ This shows how the many cuts reported in the 1965-66 household food consumption survey make up the eight selected cuts.

2/ "Other fresh" comprises spareribs, 25.7 percent; butts, 61.5 percent; and picnics, 12.8 percent. 30 percent of lunch meat is assumed to be pork.

Table A-8--Rectification of production and consumption data by transfers among cuts

	Percentages of pork cuts thus far in adjustment process (1)	Percentages of pork cuts as consumed (2)	Rectified percentages (3)	Transfer adjustment coefficients (4)
Loin	21.43	16.56	19.43	0.907
Ham	23.15	25.72	24.15	1.043
Butts	9.38	4.83	6.38	.680
Spareribs	4.67	6.30	5.67	1.214
Sausage	8.10	12.11	12.11	1.495
Picnics	9.97	5.28	5.28	.530
Bacon	14.61	18.70	16.68	1.142
Lunch meat	8.69	10.30	10.30	1.185
Total	100.00	1/99.80	100.00	

1/ The procedure used to obtain these numbers does not require that the cuts add exactly to 100.

are the transfer adjustment coefficients needed to adjust the quantities of cuts derived from production to those consistent with the rectified percentages in column 3, table A-8.

Transfers among cuts--some arbitrary--were made to reflect practices in the industry and to remedy possible reporting errors in the data sources used. The excess of picnic production over consumption was transferred to sausage and lunch meat, a common practice in the industry. Butts also may be ground, and a 2-percent transfer to lunch meat reflects this industry practice. Consumers in the household survey, responding to questions about use of bacon, probably did not differentiate between regular, end cut, or jowl bacon. In the original division these were assumed to go into lunch meat; thus a transfer was made from lunch meat to bacon. Some of the rib-end loin cuts were transferred to spareribs to represent country-style ribs. Canadian-style bacon is made from the tenderloin portion of the loin so 1 percent was transferred from loin to spareribs. Consumers may not know under which primal cut pork steaks should be categorized so an arbitrary value of 1 percent was transferred from the loin. Comparison of columns 2 and 3, table A-8, indicates that although transfers did not make proportions in these columns identical they are much closer than the current percentages in column 1 are to those in column 2. The coefficients in column 4 were then applied to the data obtained to this point.

Division Between Retail and Other-Than-Retail Outlets

Relative amounts moving to retail outlets were obtained from an annual trade survey.5/ Annual trends were interpolated to quarterly percentages. The estimated percentages of each cut sold through retail outlets are presented in table A-9. The difference between each percentage and 100 is the percentage moving through nonretail outlets for that cut and time period.

Table A-9--Estimated percentages of pork cuts moving through retail outlets, by quarter, 1965-69

Year and quarter	Loin	Ham	Butts	Spare-ribs	Sausage	Picnics	Bacon	Lunch meat	All pork cuts weighted
				Percent					
1965									
I	59.6	71.0	59.6	59.6	70.0	71.4	71.4	71.4	67.60
II	59.5	71.0	59.5	59.5	70.0	71.5	71.5	71.5	67.95
III	59.4	71.0	59.4	59.4	70.0	71.6	71.6	71.6	68.12
IV	59.3	71.0	59.3	59.3	70.0	71.7	71.7	71.7	67.52
1966									
I	59.1	71.0	59.1	59.1	70.0	71.8	71.8	71.8	67.59
II	59.0	71.0	59.0	59.0	70.0	71.9	71.9	71.9	67.95
III	59.0	71.0	59.0	59.0	70.0	72.0	72.0	72.0	68.17
IV	59.0	71.1	59.0	59.0	70.0	72.1	72.1	72.1	67.60
1967									
I	59.0	71.2	59.0	59.0	70.0	72.2	72.2	72.2	67.76
II	59.0	71.4	59.0	59.0	70.0	72.3	72.3	72.3	68.19
III	59.0	71.6	59.0	59.0	70.0	72.4	72.4	72.4	68.46
IV	59.0	71.8	59.0	59.0	70.0	72.5	72.5	72.5	67.89
1968									
I	59.0	71.9	59.0	59.0	70.0	72.6	72.6	72.6	68.04
II	59.0	72.0	59.0	59.0	70.0	72.7	72.7	72.7	68.50
III	59.0	72.0	59.0	59.0	70.0	72.8	72.8	72.8	68.72
IV	59.0	72.0	59.0	59.0	70.0	72.8	72.8	72.8	68.04
1969									
I	59.0	72.0	59.0	59.0	70.0	72.9	72.9	72.9	68.17
II	59.0	72.0	59.0	59.0	70.0	73.0	73.0	73.0	68.62
III	59.0	72.0	59.0	59.0	70.0	73.0	73.0	73.0	68.81
IV	59.0	72.0	59.0	59.0	70.0	73.1	73.1	73.1	68.16

5/ Supermarketing, a trade magazine, issues each September results of a survey. It includes data on the share of total consumption of pork, retailed, in several categories: fresh pork; packaged bacon, cured hams and picnics, and other provisions; and canned meats.

The weighted average percentage of all pork moving through retail outlets is shown in the last column, table A-9. This was computed by multiplying the appropriate seasonal distribution of pork cuts (last column, table A-7) by the entries in each row of table A-9.

Division of quantities of pork cuts between retail and nonretail is completed by first totaling the quantities of all eight cuts for the month (at the present stage of adjustment). The weighted percentage of all pork cuts sold at retail for that month (right-hand column of table A-9) is then multiplied by the total pork quantity for the month to obtain the total amount of pork moving through retail outlets that month. This total is then multiplied by the appropriate seasonal percentage to obtain the amount of each cut moving through retail outlets for the month. The difference between this retail quantity for each cut and the total quantity for this cut in the previous stage of computation gives the quantity moving through nonretail outlets. The monthly quantities of each cut for nonretail (could be called away-from-home or hotel, restaurant, institution [HRI]) outlets are listed in table A-10.

A summary of the last set of computations is useful at this point; the Supermarketing data determines the amount of total pork going through retail outlets. The 1965 decennial household survey (table A-7) determines the retail breakup of cuts. The away-from-home survey helped to determine amounts available for consumption of each cut. Thus, the allocation to HRI is conditioned by the away-from-home data, but the final distribution to HRI is a residual.

Division of Retail to Chain, Independent, and Convenience Type Outlets

Chain and independent classifications for grocery outlets are fairly clear cut, but the convenience classification is less well defined. The convenience classification really contains all retail sales other than chain and independent. In addition to convenience stores as such, small specialized meat markets and delicatessen stores also are included. Progressive Grocer reports data from their survey on total sales of chain and independent stores by year.6/ Although this covers sales of all products, it is assumed that the ratio of pork to total sales is probably about the same for both chain and independent stores. Data for the 1965-69 period indicate a trend toward more chain sales relative to independent sales. Chain sales were 41 percent of total chain and independent sales in 1965, and were 46 percent in 1969. The percentage of total grocery sales by convenience (or other retail) stores seemed to remain about the same for the 1965-69 period, because the increase in convenience store sales is offset by the decrease in specialty store sales.

The relative proportions of cuts sold by convenience stores also differ from those sold by chain and independent stores. Convenience stores do not usually sell fresh meat. About 5 percent of their total sales consist of lunch meat, sausage, weiners, bacon, and other meat of this type, including some frozen meats.7/ Specialty meat markets, included under the convenience classification, do sell fresh meat, however.

6/ Progressive Grocer, a trade magazine, each May publishes prior year's data on the grocery industry in its annual report.

7/ ---------, Oct. 1967. Convenience stores as such, not "other retail".

Table A-10--Monthly quantities of pork moving through nonretail (HRI) outlets, by cut, 1965-69

Year and month	Loin	Ham	Butts	Spareribs	Sausage	Picnics	Bacon	Lunch meat
1965:								
Jan.	59.5	96.3	20.8	36.0	34.4	1.3	36.9	29.7
Feb.	52.2	86.8	18.5	33.3	27.9	1.5	27.2	32.8
Mar.	63.8	115.0	21.3	39.5	27.9	1.0	33.7	34.8
Apr.	62.7	63.5	21.8	37.5	52.6	10.6	25.2	22.5
May	46.1	48.0	16.1	33.6	43.7	7.9	34.0	28.2
June	42.2	56.3	16.2	35.0	40.6	7.6	41.4	30.5
July	48.7	51.3	16.7	30.1	35.4	3.1	40.0	17.7
Aug.	52.9	73.7	17.8	33.5	35.3	3.8	24.9	19.4
Sept.	65.8	65.0	21.2	35.1	43.0	4.8	30.4	17.8
Oct.	50.4	68.9	20.3	37.3	39.0	6.4	42.7	23.8
Nov.	48.4	84.4	19.0	35.2	38.0	5.0	32.8	31.4
Dec.	46.5	79.1	18.8	33.4	36.0	4.5	30.4	26.4
1966:								
Jan.	48.1	76.0	17.2	31.3	29.0	1.0	32.3	27.3
Feb.	48.6	71.7	16.6	31.2	25.2	2.2	28.5	27.8
Mar.	57.3	117.5	20.1	34.9	24.3	1.4	33.5	20.2
Apr.	64.5	47.6	21.9	31.6	42.4	12.0	23.5	20.3
May	54.4	59.9	19.6	37.4	39.5	10.4	23.9	21.3
June	48.7	64.6	17.3	35.9	42.7	8.9	34.0	21.9
July	51.9	60.3	17.0	30.3	35.8	7.7	29.5	14.2
Aug.	60.7	81.6	20.8	35.5	43.4	4.8	18.6	20.2
Sept.	66.8	75.2	22.3	33.7	41.9	6.1	7.8	17.5
Oct.	52.2	87.8	20.5	39.9	38.2	6.0	40.0	29.5
Nov.	51.5	117.5	22.2	38.1	37.6	5.2	33.7	29.3
Dec.	52.5	134.0	21.3	38.6	42.0	4.7	24.0	21.9
1967:								
Jan.	62.2	97.5	22.4	39.1	35.2	1.9	43.8	36.0
Feb.	57.3	97.0	20.4	34.9	28.2	2.1	28.0	30.5
Mar.	62.5	126.8	21.9	38.7	31.3	1.8	29.8	26.5
Apr.	72.5	43.0	24.5	37.0	51.1	12.5	21.0	25.2
May	53.2	68.7	19.4	39.5	47.6	7.8	25.9	36.3
June	52.5	62.9	19.4	40.6	50.5	7.6	29.8	30.4
July	54.8	59.4	18.3	32.9	40.4	3.0	34.9	22.9
Aug.	63.0	83.6	21.6	39.8	48.0	3.2	37.8	19.9
Sept.	73.0	74.4	23.8	37.3	44.1	5.4	31.1	20.8
Oct.	57.3	98.3	23.1	44.2	44.1	6.4	39.2	30.2
Nov.	51.7	125.2	21.6	38.0	38.7	5.0	30.9	34.1
Dec.	47.7	143.9	20.0	37.3	37.3	3.6	23.0	30.4
1968:								
Jan.	61.8	109.2	22.2	41.5	40.1	.5	47.9	32.4
Feb.	52.8	99.0	19.4	36.2	31.8	.9	31.3	35.0
Mar.	55.0	125.0	20.5	37.3	31.0	.0	31.2	29.2
Apr.	74.0	63.2	26.0	41.6	57.9	12.9	20.0	31.0
May	66.4	61.6	23.3	40.3	48.4	11.8	22.2	29.2
June	53.6	54.5	20.1	42.5	48.4	8.6	41.7	29.2
July	57.5	66.3	21.5	40.1	45.7	2.7	46.2	23.6
Aug.	60.5	82.7	21.1	40.0	42.5	2.8	40.9	17.6
Sept.	64.1	75.9	25.2	37.7	46.6	6.6	31.6	20.5
Oct.	59.7	111.1	23.0	48.1	46.6	5.2	44.0	36.6
Nov.	49.0	129.0	20.7	38.1	41.2	4.4	31.7	32.8
Dec.	52.8	139.9	22.1	37.9	42.8	4.9	31.7	20.0
1969:								
Jan.	58.1	111.6	21.8	40.4	39.4	.0	45.7	40.3
Feb.	58.2	103.4	20.4	37.8	28.3	.8	34.7	31.0
Mar.	57.7	131.2	20.9	41.5	32.6	.0	28.7	37.8
Apr.	74.5	55.5	24.2	42.1	59.3	13.6	23.6	28.4
May	60.4	60.3	23.6	43.3	53.2	8.6	26.4	33.4
June	50.6	66.0	20.2	40.4	46.7	7.3	30.3	40.3
July	63.0	68.4	20.4	36.3	47.8	2.7	43.7	21.5
Aug.	61.5	71.2	20.0	38.4	37.1	3.7	35.0	17.9
Sept.	71.6	80.2	22.5	37.8	42.1	5.5	29.7	25.6
Oct.	58.0	106.8	21.6	44.4	42.3	5.5	40.2	32.1
Nov.	45.2	107.2	18.5	33.7	31.9	3.9	31.5	31.3
Dec.	46.5	139.0	19.3	38.5	37.2	3.0	29.2	33.0

1/ These are residuals in the computation procedure.

A retail breakdown was assumed after examining trade journals and various retail studies, visiting with industry representatives, and considering information from many other sources, table A-11. This was used to breakdown the estimates of the total amount of each cut moving through retail outlets into estimates for chain, independent, and convenience stores. These final estimates, which are used in the regression analysis, are presented in table 1 of the text.

SOURCES OF OTHER VARIABLES

While other variables used in the regressions did not require a complicated derivation procedure, the sources of these data are discussed.

Dummy Variables

A consistent seasonal variation in prices of pork cuts was apparent. Monthly dummies--11 variables with zero or one values--were used to remove this explainable variation. January serves as the base month.

A simple regression study reported in appendix B indicates a probable shift in the demand curve between 1965 and 1966. As the slope appears similar both before and after the shift, a dummy variable for 1965 allows this demand shift to be included.

Income Series

In early runs of the regression analysis, time, population, and income variables were examined. These were very closely correlated. The simple correlation varied from 0.957 between time and income to an almost perfect correlation between time and population. The population and income correlation was 0.998. Income seemed to be the better variable in explaining variations in price. It functions as a trend variable in addition to reflecting the effect of changes in income on the amount purchased. The income variable selected for use was per capita disposable income. It was derived using quarterly disposable income, monthly total personal income, and the civilian population by months.8/ The quarterly disposable income was adjusted to monthly data by using the relative monthly changes in the total personal income. This was then divided by the population to give per capital disposable income by months. This series is presented in text table 2.

Price Series

Prices for all pork cuts except lunch meat are the individual prices of

8/ Population is from Current Population Reports--Population Estimates and Projections, Bur. of the Census, U.S. Dept. Commerce, Washington, D.C. Monthly total and quarterly disposable income is from the Biennial Supplement to the Survey of Current Business, Off. of Bus. Econ., U.S. Dept. Commerce.

Table A-11--Estimated percentages of pork cut movements by type of retail outlet, 1965-69

Year	Chain	Independent	Convenience
		Percent	
LOINS, BUTTS, AND SPARERIBS			
1965	42.9	56.1	1.0
1966	43.4	55.6	1.0
1967	44.1	54.9	1.0
1968	44.9	54.1	1.0
1969	45.9	53.1	1.0
HAM			
1965	43.2	55.8	1.0
1966	43.8	55.2	1.0
1967	44.5	54.5	1.0
1968	45.3	53.7	1.0
1969	45.8	53.2	1.0
SAUSAGE			
1965	41.4	52.9	5.7
1966	42.0	52.3	5.7
1967	42.6	51.7	5.7
1968	43.1	51.2	5.7
1969	43.6	50.7	5.7
PICNICS			
1965	44.1	55.1	.8
1966	44.5	54.7	.8
1967	45.0	54.2	.8
1968	45.4	53.8	.8
1969	45.8	53.4	.8
BACON			
1965	43.7	54.1	2.2
1966	44.1	53.7	2.2
1967	44.5	53.3	2.2
1968	45.0	52.8	2.2
1969	45.3	52.5	2.2
LUNCH MEAT			
1965	38.9	48.2	12.9
1966	39.4	47.8	12.8
1967	39.8	47.6	12.6
1968	40.3	47.2	12.5
1969	40.7	46.8	12.5

cuts used to form composite pork prices for the market basket.9/ The ham and loin prices are weighted averages from the more detailed breakdown of cuts in the market basket procedure. These weights are:

Loin	Percent	Ham	Percent
Center chops	11.9	Butt end	28.3
Center-rib chops	16.4	Shank end	36.5
Center-loin chops	15.9	Center slices	20.4
Rib-end roast	23.4	Whole ham	14.8
Loin-end roast	21.4		100.0
No. 2 chops	6.5		
Tenderloin	4.5		
	100.0		

Lunch meat prices were obtained by using the average of the pound price of frankfurters and bologna sausage reported by the Bureau of Labor Statistics.10/ Chain and independent prices were assumed to be the same and the level correct as obtained. For the convenience stores these same prices are all multiplied by 1.05, because of the assumption that prices in these "all other stores" were about 5 percent higher then in the chain and independent stores. Prices of cuts are listed in text table 2.

Composite beef prices, table 2, are taken from the market basket series.

The poultry price comes from a selected broiler price series. Its designation is "Broiler Prices: Frying Chickens in Retail Stores in Urban Areas, Whole or Cutup, Ready-to-cook Monthly Average Price per Pound."11/

Production Variables

Commercial production of all red meat was included as a variable to measure the size of the competing market.12/ Commercial production of ready-to-cook poultry was used to represent poultry production.13/

Data Adjustment for Days in Month

An adjustment was made in all quantity data--pork quantity, total red meat,

9/ The market basket series is published quarterly in Marketing and Transportation Situation, Econ. Res. Serv., U.S. Dept. Agr., Washington, D.C. Procedure for obtaining prices is reported in Revised Price Spreads for Beef and Pork by Lawrence A. Duewer, ERS-435, Econ. Res. Serv., U.S. Dept. Agr.,

10/ Estimated Retail Food Prices by Cities, monthly report, Bur. of Labor Stat., U.S. Dept. Labor, Washington, D.C. U.S. prices were used.

11/ Selected statistical series for poultry and eggs, Annual Supplement to the Poultry and Egg Situation, ERS-232, Econ. Res. Serv., U.S. Dept. Agr. Washington, D. C.

12/ See footnote 3.

13/ See footnote 11.

and poultry production--to eliminate differences caused by the varying number of days per month. The quantity for each month, divided by the number of days in that month, provided the quantity per day. This daily average quantity was multiplied by the average number of days per month in that year, 30.42 in a 365-day year, and 30.50 in a 366-day year. Data presented in text tables 1 and 2 do not reflect this adjustment, because it was made with transformations in the regression program used.

APPENDIX B

THEORY OF PORK DEMAND, ALTERNATIVE APPROACHES, AND ELASTICITY ESTIMATES

The theory of demand related to the prediction of individual prices of pork cuts, and several approaches considered in addition to the regression technique selected, receive brief reviews. Elasticities supplementing the analysis in the text were computed and are reported here.

THEORY OF PORK DEMAND

Consumers desire a product because (1) it satisfies some need, ranging, perhaps, from an absolute physical requirement to some small pleasure, and (2) another product which might satisfy that need at lower cost does not exist.

The ratio of the percentage change in the quantity purchased to the percentage change in its price is termed "elasticity of demand." The ratio of the percentage change in the quantity purchased to the percentage change in the price of a competing product is termed "cross elasticity of demand." Different products have different elasticities; that is, the changes in purchases resulting from price changes vary for different products. The elasticity of a particular product also might vary at different price levels.

The demand for food (fig. B-1a) is very inelastic because food is a basic necessity of life. Thus, the relative changes in price can vary greatly relative to the change in amount purchased. The quantity of meat purchased can vary more with price, because the makeup of the diet is more flexible than the mere physical need for food (fig. B-1b). Pork demand is even more elastic than demand for other meats, because other meats as well as other foods can substitute for pork (fig. B-1c). The demand for an individual pork cut may be highly elastic because of very close substitutes (fig. B-1d). Whether a consumer eats center-cut rib chops or center-cut loin chops may produce almost a negligible difference in his satisfaction. Yet, there is variation in elasticity among the different pork cuts. While two kinds of pork chops may be very close substitutes, spareribs do not have a close substitute. The degree of specification of the cut may also affect its elasticity. Ham can be considered a cut or it can be broken down into center-cut ham slices, ham-butt end, etc.

Demand Shifters

Five factors can cause shifts in demand: 14/

(1.) Consumer preferences--Tastes, habits, preferences, etc., may change

14/ Due, John F., and Robert W. Clower. Intermediate Economic Analysis. 4th ed., Richard D. Irwin, Inc., Homewood, Ill., 1961, pp. 93-97.

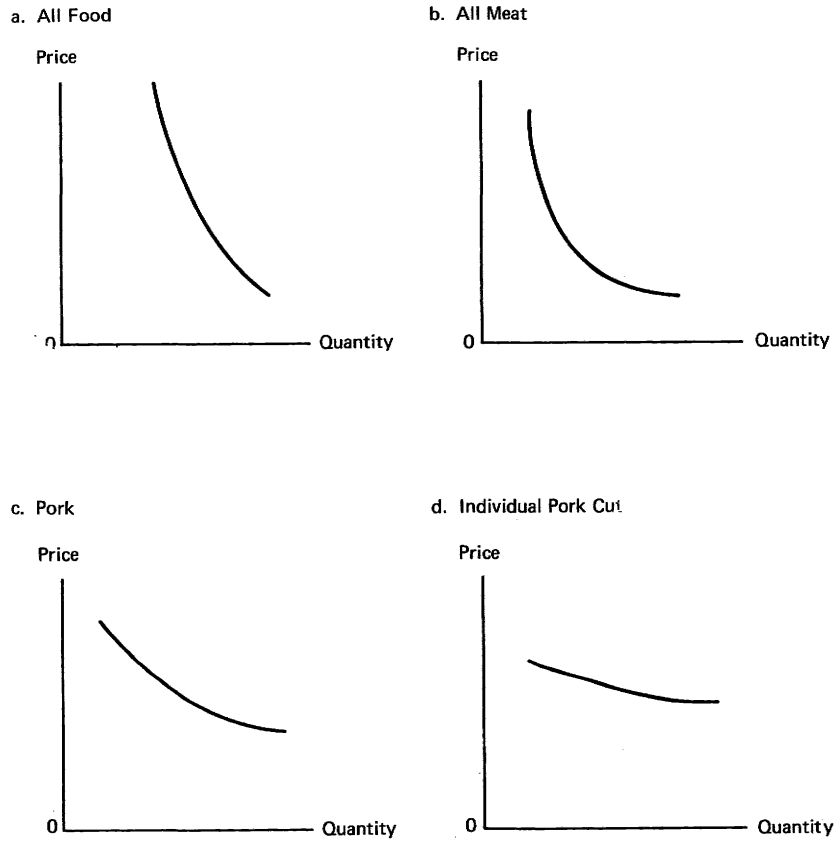


Figure B-1

from one period to another.

(2.) Level of income--As levels of income change, a consumer's desire for a product also may change.

(3.) Prices of other products--Both the number and closeness of substitute products, and their prices, affect the decision to purchase a particular product.

(4.) Expectations of future prices--People make decisions about purchases today after considering both today's price and the price they expect in the future.

(5.) Population--As the number of potential customers change, the total quantity desired also will change.

Historical Pork Demand

Over the years, the total demand curve for pork has shifted mainly because of increasing population. Supply-demand intersection points are plotted in figure B-2, using per capita consumption to eliminate the shift due to population. Prices are in current dollars, unadjusted to reflect the dollar's changing value. The supply-demand intersection points could be joined to make a demand curve if changes in the quantity demanded were due only to obvious shifts in the supply curve. But this is not the case--both supply and

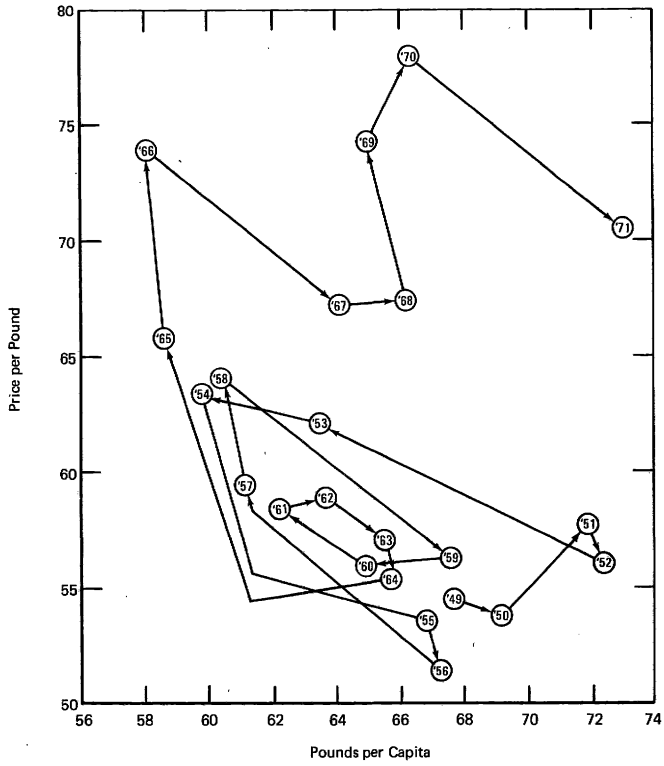


Figure B-2

demand are constantly adjusting. Year-to-year moves are traced on figure B-2.

Figure B-3 also presents the series of supply-demand intersection points for 1949-70, with prices for each year in constant dollars using the consumer price index as a price deflator. Consumption data is per person as in figure B-2. If a simple equation is estimated with price as a linear function of quantity, the resulting relationship is the line labeled 1949-70 (fig. B-3). "Fit" is not statistically significant. Examination of the dispersion indicates past shifts in the demand curve by sub-groups of years between 1949 and 1970. When four functions are estimated for these periods, four demand curves can be identified which have statistical significance (fig. B-3). Shifts in demand occurred downward and to the left between 1954 and 1955, and between 1959 and 1960, then shifted upward to the right between 1965 and 1966. Information about these functions appears below:

Years	t	R^2
1949-70	0.776	0.0293
1949-54	4.143	.8110
1955-59	5.266	.9024
1960-65	6.190	.9055
1966-70	6.354	.9308

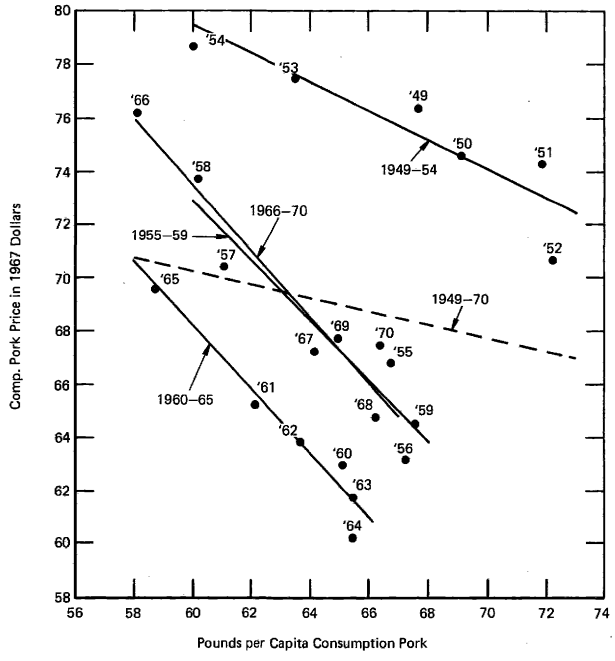


Figure B-3

These results prompted use of the 1965 dummy variable in the equations reported in the main text.

If poultry price is used along with pork consumption to explain the composite price of pork, the 1949-70 equation becomes statistically significant. Its R^2, using constant dollar prices, is 0.6688 and both variables have significant "t" values. Poultry price slightly improved the explained variation (R^2) in the subgroup equations. But the "t value" is insignificant in three of the four cases.

TECHNIQUES FOR STUDYING DEMAND

A summary of alternative techniques examined and the selection of the technique used for this study are presented here.

Least-squares regression for composite pork demand reported in connection with figure B-3 was used in an exploratory study. This method was not adequate for the major objective of this study, which requires estimates by cut and type of outlet.

Quantity had to be predetermined rather than determined simultaneously with price, because one objective of this study was to provide functions for a recursive model. Simultaneous equations thus proved inappropriate.

A graphic method using preference scale values also examined was considered

too subjective, thus inadequate, for this study.

In an attempt to include effects of price specials in the analysis, a theory involving price specials was considered but discarded because it could not be satisfactorily incorporated into the methodology.

A demand curve for pork cuts using data from an experimental situation was considered. Such a plotting derives from allowing many people to select a cut and then raising the price of the selected cut to determine when other items are substituded, or by offering another cut and determining when consumers shift to that cut. Lack of time and money, and skepticism over people's natural reaction, led to rejection of this approach.

Also discarded was an analysis of variance (ANOVA) coupled with a procedure using ratios. In sequence, ANOVA called for estimating the composite pork price; then used the historical ratio of the price of a cut to the composite price to obtain individual cut prices. ANOVA showed that prices of all cuts tend to vary seasonally, and that relationships between prices of cuts tend to vary at different price levels. Although rejected, this technique had serious appeal because one of its characteristics was that the estimated prices of pork cuts would always remain in proper balance with one another.

Seemingly unrelated regression techniques also were examined. While similar to a series of multiple regression equations this computation procedure differs in that it solves all equations allowing each equation to be modified by the others. This seems an appropriate technique because all pork cut prices (dependent variables) tend to fall and rise together. Nevertheless, this approach also was discarded because a program was not available that would permit handling 24 equations with an average of 17 variables per equation.

Equations derived from multiple regression analysis seem especially suited for predicting prices. Although a separate equation can be formulated for each cut for each store type, no assurance exists that individual cut predictions will always stay in proper relationship to each other.

The multiple regression technique was selected after considering and evaluating various techniques in terms of model requirements, the availability of necessary data, and the available computer programs.

ESTIMATES OF PRICE ELASTICITY

Price flexibilities could be computed from the equations estimated in the text. The reciprocal of this flexibility approximates price elasticities. However, this procedure is questionable.[15/] To calculate elasticities directly, a set of equations was estimated in which the quantities of pork cuts were the dependent variable and the pork cut price became an explanatory variable.[16/]

15/ The adequacy and appropriateness of this procedure has been questioned and the theory has not been fully developed. For examples, see Foote, Richard J., Analytical Tools for Studying Demand and Price Structures, Agr. Handb. No. 146, U.S. Dept. Agr., Washington, D.C., 1958, pp. 78-84; and Houck, James P., "A Look at Flexibilities and Elasticities", Journal of Farm Economics, Vol. 48, No. 2, May 1966, pp. 225-232.

16/ See theory of pork demand discussed on p.

Table B-1--Elasticities of pork cut equations by chain, independent, and convenience retail outlets 1/

Equation	Own price 2/	Beef price	Poultry price	Income
Chain loin	-1.23677		0.16456	1.80738
Independent loin	-1.24656		.15022	1.28578
Convenience loin	-1.23549		.16234	1.50570
Chain ham	- .84658		-.18044	1.25993
Independent ham	- .84744		-.13034	.78285
Convenience ham	- .84058		-.16314	1.00186
Chain butts	- .88173		.35988	1.55719
Independent butts	- .90075		.31814	.96293
Convenience butts	- .99876		.27425	1.22450
Chain spareribs	-1.25340		.41621	1.65794
Independent spareribs	-1.27895		.42699	1.08901
Convenience spareribs	-1.23669		.36923	1.30118
Chain sausage	-1.06927	0.27410	.27866	1.30567
Independent sausage	-1.06625	.30098	.29678	.89515
Convenience sausage	-1.06962	.25258	.29331	1.09052
Chain picnics	- .84162		.08599	1.22354
Independent picnics	- .84270		.12071	.93145
Convenience picnics	- .80384		.07123	1.05425
Chain bacon	- .63356		-.04329	.98646
Independent bacon	- .62872		-.02700	.70059
Convenience bacon	- .63198		-.03038	.83908
Chain lunch meat	- .56769	-.06253	-.42645	1.40879
Independent lunch meat	- .50555	-.08369	-.45690	1.09558
Convenience lunch meat	- .52187	-.07879	-.35511	1.07325

1/ See tables 4 and 5 for form of equations. But, the dependent variable (price) and independent variable (own quantity) are interchanged.

2/ Price of the appropriate individual pork cut.

The form of the new set of equations is similar to those in the text, except for the exchanged price and quantity variables.

Linear demand functions have a variable elasticity over their range of estimation. Therefore, specific points must be selected for calculating price elasticities. The elasticities reported in table B-1 were computed using the mean value for each of the variables involved.

The upward trend in the income variable raises serious doubts about the income elasticities. The income variable used is on a per capita basis but the cut quantities are on a total consumption basis. These factors suggest that part of the income coefficient is a result of population increase. In addition, prices and income are not deflated. Therefore, the income variable acts as a trend indicator and price deflator. It is affected by population, and it reflects changes in income.

Price elasticities, cross-price elasticities, and income elasticities for the 24 combinations of retail outlet and cut equations are presented in table

B-1. Elasticities for a cut by the three types of outlet are quite similar. The income elasticity varies the most, but the variation is still comparatively small. This similarity in all elasticities for a cut by type of outlet implies that when examining one type of outlet the other two outlets are not really considered as substitute sources.

The elasticities vary from around -0.55 for lunch meat to about -1.25 for spareribs. Loin, spareribs, and sausage have greater than unitary elasticity, while hams, butts, and picnics fall between -0.8 and -1.0. Bacon and lunch meat fall in the -0.5 and -0.6 area. These "own price" elasticities are consistent with estimates of the elasticity at retail made by other researchers for all pork. Elasticity estimates of individual pork cuts were not found in other studies.

Some retail pork elasticities estimated by others are as follows: Brandow presents an estimate of -0.75 for pork.17/ Trierweiler and Hassler list the price elasticity of demand for pork as -0.84.18/ A pork elasticity estimate of -0.734 was found by Myers, Havlicek, and Henderson.19/ They also summarize retail pork price elasticities from several studies that vary from -0.62 to -1.83.

Computed cross elasticities for sausage and lunch meat related to beef prices were of opposite signs (positive, negative). These were not necessarily in conflict. According to economic theory a substitute or competing product such as beef, would have a positive sign. Lunch meat, which includes about as much beef as pork, would have a negative sign--similar to the products own price elasticity. Beef and pork could be considered as jointly used products in the manufacture of lunch meat.

Although cross elasticities of pork cuts regarding poultry price have both positive and negative signs, they are quite inelastic. The positive sign is expected for a competing product. Advances in poultry prices would cause small gains in the quantities sold of loin, butts, spareribs, sausage, and picnics. However, an increase in poultry price appears to cause small decreases in the quantities of ham, bacon, and lunch meat sold. Consumers might not consider poultry as a substitute for these products. For example, bacon is a breakfast meat and poultry is not; also, some poultry may now be used in lunch meat, but ham is a unique product. Although poultry may substitute for fresh pork products, it will not for ham, bacon and lunch meat.

The income variable represents many effects in addition to income changes. The "income" elasticities of demand are reported in table B-1. The values

---

17/ Brandow, G.E. Interrelations Among Demands For Farm Products and Implications For Control of Market Supply. State Univ., Agr. Exp. Sta., Bul. 680, Univ. Park, Pa., 1961, p. 17.

18/ Trierweiler, John E., and James B. Hassler. Orderly Production and Marketing in the Beef-Pork Sector. Univ. Nebr., Agr. Exp. Sta., Res. Bul. 240, 1970, p. 6.

19/ Myers, L. H., Joseph Havlicek, Jr., and P.L. Henderson. Short-Term Price Structure of the Hog-Pork Sector of the United States. Purdue Univ., Agr. Expt. Sta., Res. Bul. No. 855, Lafayette, Ind., 1970.

obtained are more elastic than would be expected for a true income elasticity. The loin cut (pork chops) was the most income elastic. This agrees with expected consumer behavior because chops are considered a more favored pork product. The income elasticities for the individual cuts are expected to be higher than the income elasticity for all pork.

"Own price" elasticities are perhaps the most meaningful of the elasticities examined. A transformation of a price inelastic cut to a price elastic form should result in greater total revenue from a given quantity of total pork. This determination must include not only the elasticity but also the conversion rate and the relative prices of the cuts. An example would be the conversion of picnics (price elasticity of -0.84) to sausage (-1.07), which uses the equations for chain outlets and a 0.90 conversion from picnics to sausage. One million pounds of picnics will be converted to 0.9 million pounds of sausage. The mean values of the variables are:

Sausage price	66.517 cents
Sausage quantity	32.396 pounds*
Picnic price	49.200 cents
Picnic quantity	20.554 pounds*

* (pounds in millions)

The original total revenue computations are:

$$\begin{aligned} 49.200 \times 20.554 &= 1011.26 \quad \text{(picnic)} \\ 66.517 \times 32.396 &= \underline{2154.88} \quad \text{(sausage)} \\ & \quad 3166.14 \end{aligned}$$

The total revenue after conversion can be calculated using coefficients from chain outlet equations. The picnic price coefficient is -0.35160 and the sausage price coefficient is -0.63048. Thus, for a decrease of one unit in the dependent variable, price must change by $\frac{-1}{-.35160}$ or +2.8441 cents (picnics).

An increase of 0.9 in the dependent variable for sausage would be $\frac{.9}{-.63048}$ or -1.4275 cents.

$$\begin{aligned} 49.200 + 2.8441 &= 52.0441 \text{ cents (picnic)} \\ 66.517 - 1.4275 &= 65.0895 \text{ cents (sausage)} \end{aligned}$$

These are the new prices after the conversion. They are then multiplied by the new quantities (32.396 + .9 = 33.296 and 20.554 - 1. = 19.554).

$$\begin{aligned} 52.0441 \times 19.554 &= 1017.67 \quad \text{(picnic)} \\ 65.0895 \times 33.296 &= \underline{2167.22} \quad \text{(sausage)} \\ & \quad 3184.89 \end{aligned}$$

$$3184.89 - 3166.14 = 18.75$$

Thus, product sales would increase $187,500 if picnics were converted into sausage. An increase in total revenue could be obtained if both cuts were elastic or both inelastic, as long as the elasticities were sufficiently different. There are, of course, physical limitations on which cuts--and the amounts of cuts--that can be converted.

Differences in income elasticity for a cut among the outlets probably result from the trend aspect included in the income variable used. Quantities sold by chains were increasing, compared with sales by independent outlets during 1965-69.