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Richard Stillman and Mark Weimar

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An Analysis of the Consistency of Public Data Used in Demand Analysis, for Livestock

Richard Stillman and Mark Weimar 1/

A major focus of research by agricultural economists in the last several years has been whether the demand for meat commodities, particularly beef and broilers, has changed. The results of these studies have not arrived at a consensus. Model specification and how the tests were set up appear to have the largest influence on the results. This paper examines some of the data used in these analyses with respect to consistency and original purpose.

Price, quantity and expenditure data have no completely consistent time series over the period studied, 1954 to 1989. Aggregate demand data for prices and quantities come from different sources. The weights used in aggregating data differ between series. Price data are reported by the Bureau of Labor Statistics (BLS), but methods of collection have changed over time. Consumption data reported by the Economic Research Service (ERS), of the U. S. Department of Agriculture are derived net disappearance numbers and are the residual when other uses are subtracted from supply.

This paper will focus specifically on changes in the data used in estimating meat demand. Problems in estimating meat demand are related to the changes in the mix of meat products bought by consumers, their form (ie. boneless beef, pork, and broiler products), the location of consumption (at home verses away from home), and price indices or aggregate prices. In addition, points in time when the data collection methodology changed and data inconsistencies occurred are presented. Finally, data from alternative data sources are examined to see if any changes in statistical results and forecasting ability can be generated from the different data.

Consumption Data

The most commonly used meat consumption series are generated by ERS. Every year since 1982 a new record level of total meat consumption has been reached. Are these estimates of new record levels of meat consumption an indication that people are consuming more or just an overestimation of what people actually consume? ERS consumption data are derived net disappearance. Exports and changes in stocks are subtracted from production and imports. The remainder is identified as consumption. The data are aggregated into large diverse categories (i.e., beef, pork, broilers, etc). This data are not broken into specific markets such as away from home consumption or at home consumption, or product form such as processed or fresh cuts. BLS reports some expenditure data from its Consumer Expenditure Survey, which has been collected annually since 1980. Through this report BLS provides a cross sectional-time series data source that is not as highly aggregated as the ERS data. However, the number of these data series is quite large and creates problems in data handling. In the future as the series becomes longer, it has the potential of being extremely useful. It does not, however, give commodity by commodity breakouts for expenditures for food away from home versus at home.

1/ Agricultural economists with the Commodity Economics Division, Economic Research Service, U.S. Department of Agriculture.

ERS reports consumption of meats in three different forms to reflect different notions of consumption. There are carcass weight, retail weight, and boneless weight series. The carcass weight series is the reported form of the raw data. However, it does not reflect the changing product form and mix that reaches the consumer. Retail weight consumption is an adjustment to remove some fat and bone in the case of beef and fat in the case of pork. (Thus, retail weight is an approximation of the amount of meat that is purchased.) The boneless series approximates the amount of meat and fat consumed after the removal of bone and skin. The boneless weight series is an attempt to place consumption on a raw edible weight basis.

All of these series have their short-comings when used for demand analysis. The retail and boneless weight conversion factors have remained constant since 1960, with the exception of the retail pork and the retail and boneless beef since 1986. The conversion factor for beef from carcass to retail was .74 from 1960 to 1986 reflecting the removal of fat and bone from the carcass. This factor declined to .73 in 1986, .71 in 1987, and .705 in 1989 to 1990 as more fat and bone were removed from the carcass before it reached the consumer. The boneless conversion factor for beef was .698 prior to 1985 and declined to .69 in 1986 and finally to .67 for the last several years.

The retail pork conversion factor is adjusted to remove the amount of lard produced but includes skin and bone. Changes in estimated lard production per hog data reported by the National Agricultural Statistics Service (NASS), is the mover in this pork conversion factor. This factor has increased from .77 in the 1960's to .95 in 1989. The change in the fat/lean composition of the hog has led to this trend. However, the under-reporting of fat removal from hogs not classified as lard has likely biased this conversion factor upward. The boneless conversion factor for pork has remained constant at .67. This factor has not been adjusted for the removal of fat before the consumer purchases the product.

Poultry consumption has shown the most dramatic growth over the last several decades. Broiler and turkey consumption do not differ in the carcass and retail weight classifications. Each of these series is reported as a ready-to-cook weight (RTC) which contains the giblets including neck, skin and bone. Table 1, contains broiler industry information on volumes that broiler integrators report as parts versus whole birds. These data indicate that 90 percent of reported volume in 1962 was sold as whole birds with 10 percent parts. By 1987, whole birds accounted for 27 percent of the volume and parts accounted for 52 percent, with 5.1 percent boneless and the remainder going to other products including pet foods.

Broiler industry data show that broiler consumption has changed dramatically in form over this time period. This is also true of beef, pork and turkey consumption, however no data similar to the broiler data is yet available to make these adjustments.

A second problem with consumption data is separating the at home and the away from home consumption. Aggregate data on expenditures on food at and away from home indicate that the away from home component has grown from 24 percent in 1960 to 37 percent in 1987 [7]. Meats are likely a large part of this away from home consumption as they generally make up the centerpiece of the meal. Thurman tried to address the problem of at home versus away from home consumption, by estimating the changes in the elasticities for meats and then nonparametically relating these back to these changes in food expenditures [9].

Broiler industry data is the only available information that relates the breakout of home versus away from home data into movement through

Table 1, Broiler processors volume.

	Whole bird	Parts	Other	Total
1962	89.8	10.2	0.0	100.0
1967	77.6	22.4	0.0	100.0
1970	75.0	25.0	0.0	100.0
1974	65.3	32.4	2.3	100.0
1978	54.7	40.4	4.9	100.0
1981	43.7	50.1	6.2	100.0
1983	37.3	56.2	6.5	100.0
1985	31.4	56.3	12.3	100.0
1987	26.9	57.1	16.0	100.0

Source: National Broiler Council

marketing channels. Table 2, gives a break out of the market outlets for broiler meat. In 1970, approximately 68 percent of the broiler volume went through the retail channels or approximately 25 pounds per person. By 1987, the percentage purchased at home was 53 percent or about 32 pounds per person. This data also implies that about 9.9 pounds of broilers were consumed in Hotel, Restaurant and Institutional (HRI) outlets in 1970 and that this amount almost doubled to 18.6 pounds in 1987. An interesting change in the proportion of broiler meat in fastfoods outlets has occurred during this period. Broiler meat in fastfoods increased from 9.2 percent (3.4 pounds) in 1970 to 22.1 percent (13.4) pounds in 1987. A large amount of this growth was at the expense of the other foodservice outlets. The amount of broiler meat used for non-human consumption has increased over time. Since 1981, this amount has increased from 1.7 percent to 6.7 percent in 1987. Figure 1, compares broiler consumption since 1981 before and after the adjustment of non-human consumption.

Table 2, Final market outlets for broilers.

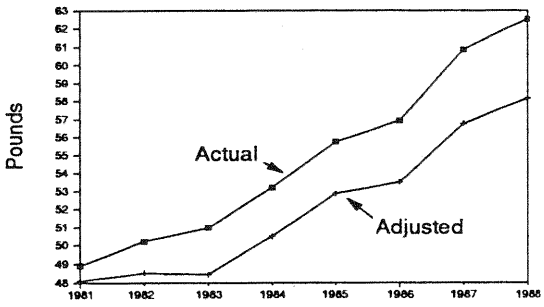
		Final markets							
	Retail grocery	HRI			Govern-ment	Instit-utional	Export	Other	
		Total	Food-service	Fast-food				Broker	Pet food
Year				percent					
1970	69.9	26.9	17.7	9.2	2.2	1.0	2.3	0.0	0.0
1974	68.0	28.0	19.8	8.2	2.2	0.3	1.6	0.0	0.0
1978	64.2	24.2	6.7	17.5	3.4	1.9	6.3	0.0	0.0
1981	63.6	23.5	8.0	15.5	1.8	2.3	7.1	0.0	1.7
1983	60.6	26.0	9.8	16.1	2.0	2.1	4.4	4.4	5.0
1985	53.9	31.0	13.1	17.9	3.4	3.8	2.8	0.0	5.2
1987	52.5	30.5	8.4	22.1	1.7	1.3	5.4	2.0	6.7

Source: National Broiler Council

ERS consumption data falls short of what is ideal for demand analysis. Changes in product form and the effect on the quantity consumed are not readily reflected in these data. Some adjustments have been made in the retail weight series for beef to reflect the adjustments to a closer

trimmed and a larger proportion boneless cuts. Yet, these adjustments have not been made in the other retail weight series. In fact, these series are not constant across meats. The beef retail weight is semi-boneless with the hide removed. Only the amount of lard removed from the carcass is adjusted for in pork, while the skin and bone remain in the series. Poultry makes no adjustment for the removal of bone, skin or giblets. As the broiler industry data shows, this does not reflect what consumers are purchasing. Poultry consumption also includes giblets, where red meats excludes offals.

Figure 1. Broiler consumption comparison



Price Data

Retail price data for time series analysis originates from the Bureau of Labor Statistics (BLS) and is reported monthly for specific food and food groups as both prices and price indices. BLS price indices are available for aggregated food groups as well as for some specific product groups. These groupings can get as detailed as chicken parts, round steak, and oranges. The price levels are for major specialized commodities within each of these groups, such as choice round steak, bone-in chicken breast and red delicious apples. ERS estimates aggregate price series for choice beef and pork from the BLS price level data since 1980. Earlier ERS used their own survey data. Collection methodology over time has changed and the limits the comparability of data between these time periods.

BLS price levels are very specific prices for narrowly defined products. The methodology used to calculate these series has changed over time. Prior to 1964 price levels were averages of actual prices collected by BLS for the calculation of the CPI. Between 1964 and 1978, benchmark prices for the specific items were calculated annually and then inflated by the specific CPI. This caused cut prices to vary within a year by an index of a more aggregate commodity group. Prior to 1978, all prices collected met very specific specifications. After 1978, prices collected by BLS increased in scope while the observations for very specific items were reduced. BLS resumed publishing the price levels after 1980, but recommended that these levels not be used to trace price changes over time.

The BLS price indices better reflect changes in prices over time. All CPI series were changed in 1978 to reflect all urban consumers. Previously, this series was weighted to reflect the changes in the market basket for wage earners only. The weights used to update the specific aggregate indices are based on a continuing consumer expenditure survey. This survey along with market sales information and a rotation of the market outlets over a five year period reflect changes in products and product form. The number of items and numbers of stores sampled were increased. However, the number of price quotes for specific items have declined under this process.

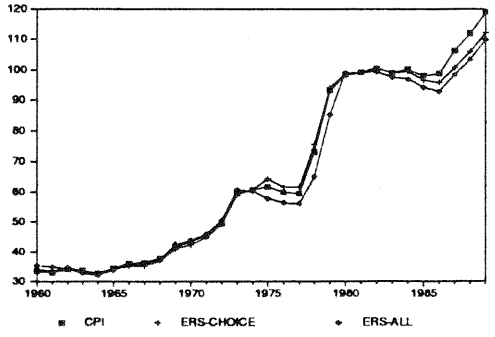
BLS publishes more aggregate price indices of types of meat products. Within the beef category an aggregate beef and veal index along with ground beef, chuck roast, round roast, round steak, sirloin steak and other beef and veal is published. These indices include both Choice and non Choice prices for these categories. The beef and veal price index also contains boneless beef prices. Pork indices include all pork, bacon,

chops, ham and other pork products. Poultry includes whole chicken, chicken parts, and other poultry.

ERS uses BLS price levels to generate two beef retail prices and one retail pork price. The Choice beef and retail pork prices generated by ERS are designed for two specific purposes, to measure the amount of the retail dollar that the farmer receives and to determine the farm to retail price spread. Since 1980, this series aggregates specific BLS choice beef price levels according to their approximate carcass proportion. Prior to 1980 some of the data for this series were collected by ERS in their own survey. During the period of overlap in ERS survey prices and BLS prices, many of the cut prices levels between the two sources did not match. In several cases the correlation between prices for the same cuts were less than 60 percent. The weights on the specific cut prices were changed so that the aggregate ERS retail prices were the same from the two data sources during this periods.

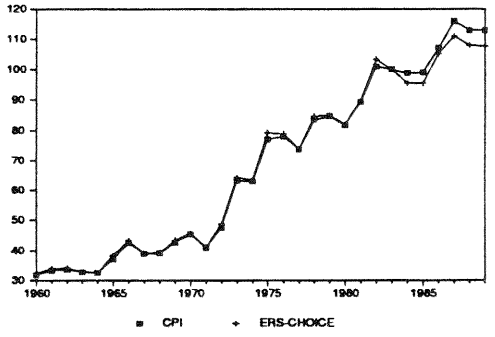
Since 1987 ERS has published an all beef price to represent an aggregate beef price paid by consumers. This price adjusts for changes in the mix of processing beef and beef cuts. An approximation of the ERS All Beef price was made for this study back to 1960. The all beef price is the weighted average of cut and processing beef prices adjusted by the relative quantities of fed beef and nonfed and cow beef production. Figure 2, shows the movement of these various prices over the period 1960 to 1988. The prices diverge in the mid 1970's when the heaviest herd liquidation was taking place. The index of all beef prices indicates that it has increased the slowest of the prices indicators. A very interesting point is that the BLS CPI for beef and veal has increased more rapidly than the ERS series since 1983. This is likely due to the inclusion of some higher value boneless products in the consumption mix used by BLS but not by ERS. BLS will not release a price quote with less than 85 observations, but does include the quotes in its commodity indices.

Figure 2. Beef price comparision



The ERS pork price index and the BLS pork index diverge in the 1980's about the time ERS switched the source of the price cut data from their own survey to data from BLS. ERS composite pork prices increase at a slower rate than do the BLS prices, figure 3. Part of this divergence is caused by the inclusion of higher valued boneless prices in the BLS price series that are not accounted for in the ERS series.

Figure 3. Pork price comparison



Each of these price series has its weaknesses when trying to measure the price that consumers paid in relation to the quantity that was purchased. The BLS CPI price indices appear to be the best choice as a price index because it contains a diversity of prices over grades and form for meat categories. These series are updated on a ongoing basis and

approximate the weights of items that go through the at home consumption market but do not reflect the away from home market or the growing at home prepared food market. The ERS Choice beef price represents less than half of the beef produced and a generally higher value product. The ERS All Beef price attempts to measure the total mix of beef purchased but is limited by the use of specific price levels generated by BLS and does not contain the diversity of product form that is in the BLS index.

Consumption Expenditure Data

Many researchers create a meat expenditure series by multiplying meat prices by reported consumption. This methodology does not relate back to the published aggregate expenditure data. This forces researchers to make explicit separability assumptions and implicit assumptions about the consumers value of meats in away from home consumption. Data on aggregate food consumption is reported by Bureau of Economic Analysis, the Department of Commerce (BEA) and ERS. Table 3, contains three of the expenditure series. For a detailed discussion of the major differences between aggregate food expenditure series see Manchester [6]. The advantage of the ERS Farm Foods expenditure series is its disaggregation into subcomponents [2]. The disadvantage of this series is that it only contains domestically produced foods and excludes quantities of foods imported and exported. ERS also publishes a breakout of meat expenditures, but this data suffers from the use of ERS retail prices and the exclusion of away from home foods.

The aggregate ERS farm food expenditures series published in the Food Cost Review under-reports expenditures on foods because of the exclusion of imported and exported foods. Trends in net trade for many commodities create a bias in this series. The advantage of this series is the inclusion of an away from home component. This segment is not captured in any of the disaggregate series in prices and consumption which creates a problem in relating this data to other series for analysis. Shortfalls in the ERS expenditure series are a result of the purpose for which it was designed. As a spinoff of the food cost analysis, this series is only designed to measure the farmers' share of the domestic food dollar.

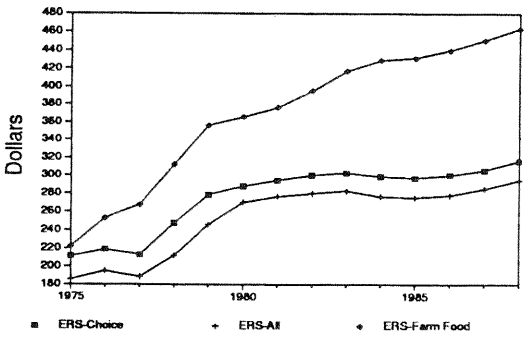
Table 3. Personal consumption expenditure for food from ERS and BEA.

Year	BEA	ERS
	Billion Dollars	
1975	218.7	159.1
1976	236.2	173.4
1977	255.9	187.8
1978	282.2	209.9
1979	317.3	235.4
1980	349.1	260.6
1981	376.5	280.5
1982	398.8	296.3
1983	421.9	316.5
1984	448.5	337.8
1985	471.6	356.9
1986	500.0	370.5
1987	529.2	392.3
1988	559.7	413.8

ERS also publishes a meat expenditure breakout for major livestock categories. This data is calculated as retail weight consumption multiplied by the ERS retail price. In the case of beef, a Choice composite price is applied to total consumption. Expenditures on beef are, therefore overvalued at the retail level, but under valued in the away from home market. This bias changes as the mix of choice beef changes relative to total beef consumption. The application of the ERS all beef price would alter this bias to some degree but this series would under value the away from home market component. Broiler and turkey expenditures are valued as the whole bird price versus the whole bird consumption. This assumes that the value added by cutting up the bird is offset by the loss of product.

Figure 4, relates the different meat expenditure series over time. The ERS retail price series show the biggest changes in expenditures. The aggregate food cost expenditure shows a steady trend without the big changes in the mid 1970's. The all beef retail price series is between these two.

Figure 4. Meat expenditures, per capita



Disaggregate expenditure series leave something to be desired when analyzing demand. If one uses the published series as their weights then there is a problem with the correspondence between the prices and quantities consumed and the expenditures. This becomes a further problem when a complete demand system is used with disaggregate categories where the sum of the expenditure weights must add to one.

Application of Demand Data

In the previous sections of this paper the diverse series of meat retail prices and consumption series were discussed. Each of these data series ignores the important breakout of at home versus away from consumption. Many studies have addressed changes in meat demand parameters and how these have changed over time [1, 9, 12]. It is apparent from these analyses that the functional form and the data period chosen have a great deal to do with the results. The changing market outlets and product form for chicken were outlined in a previous section of this paper. In this section of this paper a test was made to see if the data used makes a difference in the ability to explain price changes in broilers. This is only a partial analysis looking at the removal of non human consumption (pet food) from reported consumption.

The demand system used is an inverse demand system based on relative changes constrained to meet the requirements of demand theory [5]:

$$pi=f(qi, y)$$

where;

pi=consumer price index
qi=per capita consumption
y =consumer expenditures

quantities used are per capita consumption of beef, pork, broilers, turkeys, (both retail and carcass weight), food less these meats, and nonfood. In the first case, the reported broiler consumption data was

used and in the second case this data was reduced by the pet food proportions reported in table 2. Prices used are the CPI series for whole fryers. The income variable is the consumption expenditures on a per capita basis.

Table 4, contains the results from the estimation. The removal of the pet food component of broiler consumption appears to make a slight improvement in price forecasting ability. Forecasting error was reduced by about .7 percent. This marginal improvement is overshadowed by the fact that both models underestimated the actual result. These results would lead to questions about changes in demand. However, the data adjustment only reflects a partial adjustment to quantity. Tables 1 and 2, indicate that much more work needs to be done to reflect the changes in market outlets and product form (in the case of broilers whole bird versus cutup and boneless).

Table 4. Broiler price flexibilities and forecasting results.

Quantity series	flexibility estimates 1/	Mean Error 1/	Mean Absolute Error
Reported broiler consumption	-0.851081	-6.4785	6.4785
Adjusted broiler consumption 3/	-0.888339	-7.1336	7.1336

1/ Flexibility estimates based on data from 1960 to 1986.
2/ Error evaluation was done from 1987 to 1988.
3/ Adjusted broiler consumption = reported broiler consumption x (1-pet food percentage).

Conclusions

In general, the problem with demand data for time series analysis, is that there is no one source where both prices and quantities are provided. The data collection process has changed over the years and may not measure the same thing although the series appear to be continuous. Further study should focus on known periods of discrete data changes to establish whether this has created a shift in the demand parameters. A second area that needs further analysis is the changing market channels for meats and the effects that this might have on demand. The broiler industry has been in the forefront of this type data collection. However, the actual application of this information without information for the other meats leaves much to be desired.

This paper has pointed out some of the inconsistencies in the data used for demand analysis. Because all of the series come from the same source and are different only in some of the aggregation weights, there appears little difference in parameter estimates. The most general price series which covers the largest product scope is the BLS CPI series for the commodities. This series probably best reflects the commodities that are sold at retail. However, this index ignores the growing away from home purchases and the new and expanding prepared meals sold at retail food stores. One fact that is apparent; it is difficult to examine changes in demand for meats when using data series that are emanating from the different sources.

References

[1] Dahlgran, Roger A. "Complete Flexibility Systems and the Stationarity of U.S. Meat Demand", Western Journal of Agricultural Economics, Vol. 12 No.2 December, 1987.

[2] Dunham, Dennis. Food Costs Review, 1988. USDA, ERS, Ag. Econ. Report No.615, July, 1989.

[3] Harp, Harry. Major Statistical Series of the U.S. Department of Agriculture: Agricultural Marketing Costs and Charges. Vol.4, USDA, ERS, AG. Handbook No. 671, July 1987.

[4] Harp, Harry and Karen Bunch. Major Statistical Series of the U.S.: Consumption and Utilization of Agricultural Products. Vol.5, USDA, ERS, AG. Handbook No. 671, Oct. 1989.

[5] Huang, Kuo S. "Forecasting Meat Prices through an Inverse Demand System." in proceedings from NCR-134 Conference on Applied Commodity Price Analysis, Forecasting and Market Risk Management, Chicago, April 20-21, 1989, pp. 207-219.

[6] Manchester, Alden C. Data for Food Demand Analysis: Availability, Characteristics, Options. USDA, ERS, AER 613, April 1990.

[7] Putnam, Judith Jones. Food Consumption, Prices, and Expenditures, 1966-87. USDA, ERS, Statistical Bulletin No. 773, January, 1989.

[8] Rabil, Floyd. Average Retail Food Prices: A Brief History, Technical note, BLS, 1980.

[9] Thurman, Walter M. "Have Meat Price and Income Elasticities Changed? Their Connection with Changes in Marketing Channels." The Economics of Meat Demand, Rueben C. Buse, ed. 1989. pp 157-169.

[10] U.S. Department of Labor. The Consumer Price Index: Concepts and Context over the Years., USDA, BLS, Report 517, May 1978.

[11] _____ The Consumer Price Index: 1987 Revisions, USDA, BLS, Report 736, January 1987.

[12] Wohlgenant, Michael K. "Effects of the Changing Composition of Beef Consumption on the Elasticities for Beef and Poultry." The Economics of Meat Demand, Rueben C. Buse, ed. 1989. pp 170-187.