Decomposing Red Meat, Poultry, And Fish Expenditures Into Age, Time, And Cohort Effects

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This paper expands life cycle expenditure analysis by separating generational or cohort effects from aging effects. Different generations or age groups may exhibit diverse expenditure patterns that are the result of higher incomes and/or different tastes and preferences. Traditional life cycle analysis ignores these generational effects and concentrates on changes due to the aging effect. It is important to explicitly recognize these generational effects so that education programs about diet and health are designed for a receptive audience. In addition, these cohort effects also have implications for the well being of American households, since income and food consumption are important measures of living standards.

Economists have long been aware that there are life-cycle patterns in earnings and consumption. If income is examined by age group, one finds a steady increase from the early twenties up to the late fifties, and then a steady decline as individuals retire and live on reduced incomes. Consumption patterns can likewise exhibit variations due to changing income and age effects. What is often ignored in life-cycle studies is the generational effect on earning and consumption. For example, if economic growth is continuous then successive generations will be better off than older generations were at the same age with both higher real incomes and increased consumption. Also, different generations or age groups may exhibit diverse expenditure patterns that are the result of higher incomes and/or different tastes and preferences, both possibly due to higher educational attainment.

Attitudes towards diet and health can also vary across generations. Successive generations are usually better educated, and this may lead to preferences that are different from those of the preceding generation. Thus, it is possible that an older cohort may consume more red meat relative to a younger cohort who is aware of and concerned with the health risks associated with a high fat diet. Cohorts are groups of people who can be grouped according to experiences in early childhood and attitudes toward savings, a good meal, and the need for hundreds of products and services (Engel, Blackwell, and Miniard).

In order to isolate the life cycle and age effects from the generation or cohort effects one needs to explicitly take into account the income and consumption patterns of cohorts over time. Unfortunately, data sets that follow a panel of households that would allow researchers to directly study life cycle and generational effects over time are very rare. If household panels are not available, the researcher may elect to use a time series of cross sections, and follow cohorts of individuals over time. Such cohort data have several advantages over household panel data. First, many panels suffer from attrition as households drop out, and thereby run the risk of becoming unrepresentative of the population over time. This problem is avoided in cohort data since the data are constructed from a fresh sample each year. Second, cohort data can be constructed for any characteristic of the distribution that is of interest. The researcher can look at mean values, changes in equality between cohorts, or measures of dispersion. Third, the cohort data may be constructed from more than one data set. For example, one could use food expenditure data from one survey and combine that with nutrient intake from another survey (Deaton).

The research reported in this paper uses data from the Consumer Expenditure Survey (CES) to follow eight cohorts over a 14-year period. The cohort methodology is used to decompose the expenditure effects into age, cohort, and time effects. Deaton and Paxton have applied this methodology to look at income inequality while Attanasio has applied the methodology to an analysis of saving behavior by U.S. households. We hope to gain a clearer picture of the differences in expenditure patterns by older versus younger cohorts (generational effects) versus life cycle and aging effects that may be present. This type of information cannot be extracted by only looking at a single cross-section of data or at the average consumption of different age groups over time, since the age and cohort effects will be confounded. From the perspective of food and nutrition, we hope to indicate what, if any, difference exists between cohorts in the U.S. In the following sections we will discuss the application of the proposed methodology, introduce the data, and present the findings.

The Cohort Concept

Historically, the term "cohort" refers to a Roman military unit and the common dictionary definition refers to "a group of warriors or soldiers" (Glenn). In modern parlance, the idea is carried over to refer to any subdivision of a population. Several types of cohorts can be derived from the basic concept. The most common cohorts are based on age groups and birth cohorts born in a particular time period. Cohorts can also be based on sex and other population characteristics. Many cohort studies are based on charting such groups from a particular point in time. In other words, cohort studies look at the life histories of sections of populations and the individuals who comprise these groups.

We employ the procedure used by Deaton where he follows cohorts of individuals over time and cohorts are defined by date of birth (birth cohorts). For example, one can look at the average consumption of 30-year-olds in one survey, contrast it with 31-year-olds in the next year's survey, and so on. The averages relate to the same group of people and, because of this property, have many of the properties of panel data. Tracking these different cohorts through successive surveys allows us to disentangle the generational effects from the life cycle effects from life-cycle components in income and consumption profiles.

Decomposing Age, Cohort, and time Effects

Given that one wants to analyze cohort data, he or she has to have a method whereby the data can be decomposed into age, cohort, and time effects. The first effect gives the typical age profile (life-cycle effects), the second, the secular trends that lead to differences in the positions of age profiles of different cohorts (generational effects), and the third, the aggregate effects that may temporarily move all cohorts off their profiles or time effects (Deaton).

In matrix form we can define the model that we wish to estimate as:

$$y = B + A\alpha + C\gamma + T\varphi + \varepsilon,$$

where y is a vector of cohort-year observations with each row corresponding to a single observation of a cohort, A is a matrix of age dummies, C is a matrix of cohort dummies, and T is a matrix of year dummies. The equation above can be given a theoretical interpretation from life cycle theory. Consumption is the product of lifetime wealth, which is modeled by a cohort element that is constant over time and an age element that is dependent upon preferences. Temporary digressions from the cohort element are captured by a time element since aggregate consumption is subject to fluctuations in the economy. Needless to say, this decomposition is based on assumptions underlying the model and is not free of structural assumptions. For example, in the above we have assumed away interaction effects between cohort, age, and time.

Age and time dummy variables are created in the usual way. Cohorts are conveniently created by choosing their age in year t=0. Thus, for a group of cohorts who are between 26 and 30 years of age in the first period of observation, each individual in the year prior to the start of the data set will be between 25 and 29 years of age, inclusive. The following year, the group will be 26 to 30 years of age and so on. Dummy variables are then created for each cohort group for each year. As usual, we must drop one column from each of the three matrices since for the full matrices, the sum of the columns is a column of ones, which will be contained in the constant term of the above equation.

However, there is still an additional linear relationship across the three matrices. In any given year in the data set, we can determine the age of a cohort group since we know the time (year) and the cohort's age prior to the first observation. In order to estimate the model, we need to drop one more column from any of the three matrices. Following Deaton and Paxton's lead, one way of handling the problem is to attribute any growth or decline in income or food expenditures to age and cohort effects, and assume that the time effects capture cyclical fluctuations that average to zero over the long run. The simplest way to proceed is to drop one dummy from the cohort group, one dummy from the age group, and the first and second year dummy variables. The remaining yearly dummy variables are then defined as:

$$D_t = d_t - (t-1)d_2 - (t-2)d_1,$$

where d_t is the usual zero or one dummy variable. This transformation makes the year effects orthogonal to a time trend and imposes the restriction that all of the year dummies sum to zero. The D_1 and D_2 coefficients can be recovered from the fact that all the year effects sum to zero.

Data

The Consumer Expenditure Survey (CES) was used to construct the cohort data set and to estimate the model for the years 1982 to 1995. The CES is composed of two components, each with its own questionnaire and sample. The diary survey for urban households was utilized in this study which includes an interview panel of 3,500 to 5,000 households who are surveyed every 3 months over a 1-year period. The diary survey obtains data on small, frequently purchased items normally difficult to recall, consisting of food, beverages, tobacco, housekeeping supplies, nonprescription drugs, personal care products and services, fuels, and utilities. Two weeks of data are normally collected, although some households report only one week. Households that reported only one week of expenditures were eliminated, and the remaining household observations were averaged over the two reporting weeks. Following this procedure, the data set had 35,508 observations for the 14-year time period.

Real per capita income and food expenditures were regressed against 8 cohort groups, 14 different age dummy variables, and 14 yearly dummy variables. Cohort groups were defined over 5-year intervals, starting with cohort 1, which was 26-30 years of age in 1982, and ending with cohort 8 which was 61-65 in the same year. As noted above, one cohort group, one age dummy, and two yearly dummy variables were also dropped from the regression model. Since some households reported zero expenditure for some food categories over the two-week survey period, a Tobit model was used. The reported results have been adjusted for both censored and non-censored observations.

Mean income and expenditures for beef, pork, poultry, and fish for cohort groupings are shown in table 1. Real per capita income rose from about $11,126 for cohort 1 to a high of $13,400 for cohort 4 before declining to approximately $9,020 for cohort 8. Expenditures on beef vary from $1.26 per capita to $1.82 per capita and then decline to $1.69 per capita for cohort 8. Pork expenditures increase almost linearly with the age of the cohort from $.75 for cohort 1 to $1.17 for cohort 6 before declining to $1.16 for cohort 8. Poultry and fish both display similar patterns. For poultry, expenditures rise from $.63 for cohort 1, to $.87 for cohort 7, the drop slightly to $.83 for cohort 8. Fish follows a similar pattern, starting at $.45 for cohort 1, rising to $.70 for cohort 6, and falling slightly to $.66 for cohort 8.

Table 1. Mean real per capita income and expenditures on beef, pork, poultry, and fish (dollars).

Cohort8	Cohort 1 26-30*	Cohort 2 31-35	Cohort 3 36-40	Cohort 4 41-45	Cohort 5 46-50	Cohort 6 51-55	Cohort 7 56-60	61-65
Income	$11,126	$12,090	$12,441	$13,400	$12,865	$11,746	$10,270	$9,020
Beef	1.26	1.38	1.50	1.71	1.82	1.74	1.64	1.69
Pork	.75	.84	.95	1.06	1.14	1.17	1.13	1.16
Poultry	.63	.66	.74	.78	.79	.86	.87	.83
Fish	.45	.52	.54	.59	.65	.70	.67	.66

*Age of cohorts in 1982.

Results

The results of the decomposition of expenditures of the individual meats are shown are shown in figures 1-4. Each figure consists of four sub-figures. The first sub-figure in each chart depicts expenditures for the meat in question, adjusted for inflation, for each cohort group from 1982 to 1995. The next three sub-figures present the cohort, age, and time effects over the same period. Time effects are noted but not discussed in detail since they are constrained to zero for identification purposes. However, for a variable such as income we would expect to find major downturns in the economy captured by these estimates. For other variables, the time effect should capture major increases or decreases in spending that may be the result of economic or non-economic influences, such as relative price changes or health and nutrition concerns.

At times, we may speak of a cohort as if they were one age, for instance, we may refer to cohort 4 as being 43 years of age or cohort 4 when they were 50 years old. When we do this we are using the median age of the cohort age interval in 1982 plus the appropriate number of years to arrive at the age of interest.

Prior to analysis, likelihood ratio tests were performed to determine whether or not cohort effects were statistically significant relative to one coefficient for all cohorts. Each likelihood ratio test had a chi-squared critical value of 14.07 at the 5-percent level of significance with 7 degrees of freedom. The cohort effects were found to be statistically significant, at or better, than the 5-percent level for each of the four meats.

Real Expenditures on Beef

Figure 1 presents the analysis of real expenditures on beef. In figure 1B, expenditures increase by cohort group and we find a positive and approximately linear relationship between successive cohorts and expenditures. All of these cohort effects were statistically significant. In general, older cohorts spend more on beef. For example, cohort 8 spends approximately $.80 more per capita per week, on average, than cohort 1 does. One is tempted to speculate that the older generation continues to eat red meat while the younger generation minimizes the consumption of this good. In figure 1C, we see that around age 47-years, the age effects are negative. Coefficients for the age effect variables are all significant from age 50 through age 65. The negative age effects suggest a decrease in the consumption of beef independent of the cohort effect as individuals age, possibly due to health concerns or other reasons.

Real Expenditures on Pork

Figure 2 depicts the result of the analysis on pork. Like beef, figure 2B indicates an approximately linear increasing relationship between expenditures and cohort (generation). All of the cohort effects are statistically significant except for cohort 2. Again, the results indicate that older cohorts spend more on pork than younger cohorts. Cohort 8 spends, on average, approximately $.35 per week per capita than cohort 1. Looking at age effects (figure 2C), only age 41 and age 44 were statistically significant. However, the overall trend of the age effects increases then fall sharply at age 65.

Real Expenditures on Poultry

Result for the poultry expenditure analysis are shown in figure 3. Cohort effects are shown in figure 3B. All of the cohort effects are statistically significant and indicate strong negative effects. Cohort 5 spends approximately $.13 less per week per capita than cohort 1, while cohort 8 spends about $.11 less. Figure 3C depicts strong age effects which increase almost linearly to age 50 and level out with increased age. All of the age effects are statistically significant. Here, age effects are clearly greater than the cohort effects. One can clearly speculate that increasing expenditures for poultry are clearly being driven by increasing expenditures as individuals age.

Real Expenditures on Fish

The results for the analysis of fish expenditures are shown in figure 4. Figure 4B depicts the relationship between cohorts and expenditures on fish. There appears to be a strong increasing relationship between older cohorts and expenditures. Cohorts 4 through 8 are statistically significant and expenditures for cohort 8 are approximately $.18 per week per capita more than cohort 1. None of the age effects are statistically significant. Age is negative for ages 29 and 32, then positive for age 35 thru 53, and negative for age 56 through 65 except for age 59. The results indicate that cohort effects are more important in terms of explaining expenditures on fish, particularly for older cohorts.

Conclusions

Our analysis attempts to expand life cycle analysis by separating generational or cohort effects from aging effects. Different cohorts or generations may exhibit diverse expenditure patterns that are the result of higher incomes and/or different tastes and preferences. Our results indicate that cohort effects do exist for beef, pork, poultry, and fish. That is, statistically significant cohort effects were found for each type of meat studied. Comparing specific results by type of meat presents an interesting contrast.

Beef, pork, and fish display strong positive cohort effects for older cohorts relative to the youngest cohort group, while poultry displays strong negative cohort effects. Older cohorts spend more for beef, pork, and fish compared to poultry. At a minimum, one might say that younger cohorts prefer more poultry relative to older cohorts.

For the most part, age effects for individual cohorts were found to be positive for pork, poultry, and fish. However, age effects were negative for beef. This means that, for all cohorts, beef expenditures decline as they age.

Further research will be required to explain the factors influencing age and cohort effects. A greater understanding of these factors would lend to better explanation of the contrasting differences in expenditure patterns.

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Appendix

Appendix table 1. Tobit Regression Results for beef, pork, poultry, and fish.

Variable	Beef	Pork	Poultry	Fish
Intercept	0.704***	0.011	- 0.245**	- 0.504***
Cohort 2	0.137***	0.065	- 0.116***	0.040
Cohort 3	0.374***	0.171***	- 0.161***	0.089
Cohort 4	0.666***	0.345***	- 0.203***	0.142**
Cohort 5	1.001***	0.410***	- 0.249***	0.267***
Cohort 6	1.267***	0.497***	- 0.140*	0.294***
Cohort 7	1.330***	0.572***	- 0.212***	0.286**
Cohort 8	1.557***	0.675***	- 0.229***	0.359***
Age 29-31	0.006	- 0.002	0.13328	- 0.088
Age 32-34	- 0.104	0.069	0.232**	- 0.030
Age 35-37	- 0.022	0.081	0.318***	0.051
Age 38-40	0.013	0.195	0.418***	0.075
Age 41-43	- 0.020	0.222	0.497***	0.055
Age 44-46	- 0.002	0.270**	0.593***	0.061
Age 47-49	- 0.158	0.192	0.634***	0.053
Age 50-52	- 0.328*	0.211	0.771***	0.040
Age 53-55	- 0.360**	0.226	0.694***	0.108
Age 56-58	- 0.601***	0.153	0.725***	- 0.044
Age 59-61	- 0.681***	0.198	0.784***	0.026
Age 62-64	- 0.861***	0.130	0.698***	- 0.014
Age 65+	- 1.251***	- 0.058	0.722***	- 0.111
1984	- 0.065	- 0.017	0.057*	- 0.045
1985	- 0.099**	0.061*	- 0.027	- 0.055

1986	- 0.036	0.002	- 0.009	0.020
1987	- 0.114***	- 0.096*	- 0.100***	0.043
1988	- 0.169***	- 0.161***	- 0.108***	- 0.039
1989	- 0.044	- 0.089**	- 0.020	0.010
1990	- 0.031	- 0.097***	- 0.023	0.118**
1991	0.096**	0.018	0.075**	0.041
1992	0.017	0.152***	0.072**	- 0.069*
1993	0.071	0.054	0.012	- 0.083**
1994	- 0.054	0.029	- 0.017**	- 0.043
1995	0.104	- 0.001	0.012	0.045
Log-likelihood	- 66522.89	- 56817.99	- 49914.54	- 46742.46
Probability	0.528	0.512	0.505	0.490

*** p <.01.
** p <.05.
* P <.10.

Appendix table 2. Birth years included in cohorts.

Cohort	Birth Years
1	1952-56
2	1947-51
3	1942-46
4	1937-41
5	1932-36
6	1927-31
7	1922-26
8	1917-21

Figure 3. Real Weekly Per Capita Expenditures On Poultry Decomposed By Cohort, Age, and Time

Figure 3A. Average Real Per Capita Expenditures on Poultry

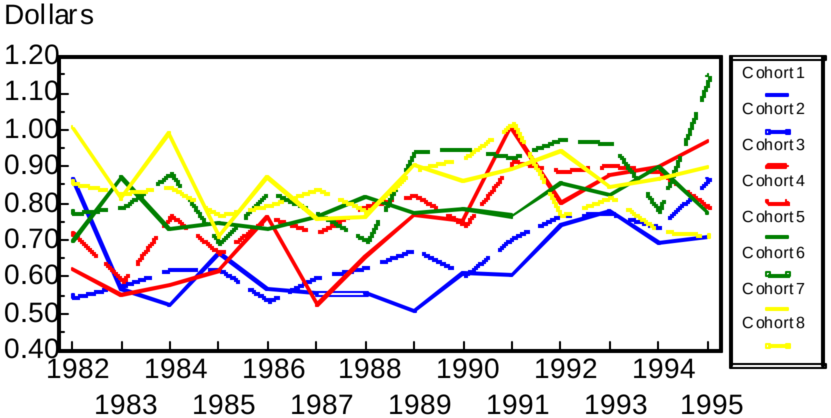

Figure 3B. Cohort Effects on Per Capita Expenditures on Poultry

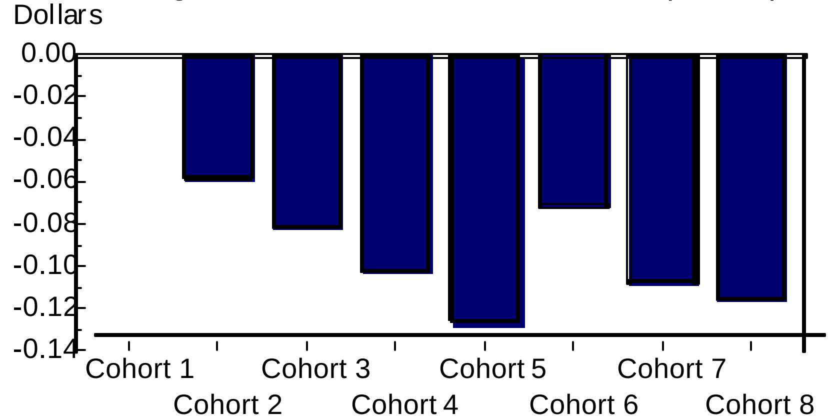

Figure 3C. Age Effects on Per Capita Expenditures on Poultry

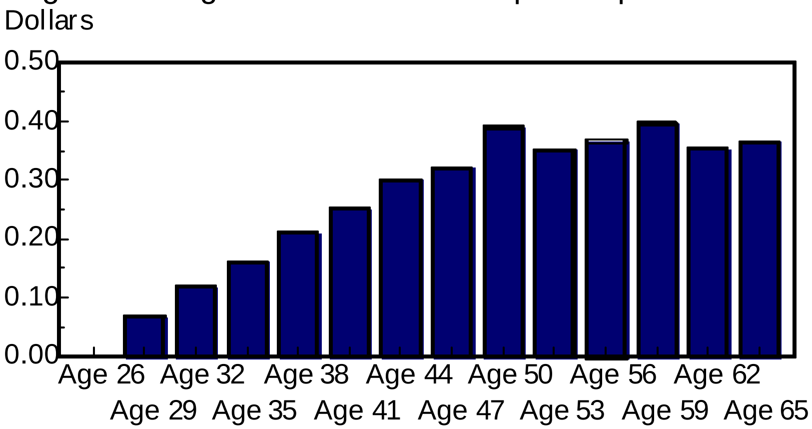

Figure 3D. Time Effects on Real Per Capita Expenditures on Poultry