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Income and Food Expenditures Decomposed by Cohort, Age, and Time Effects

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Abstract

This report expands aggregate lifecycle expenditure analysis by separating generational or cohort effects from aging effects. This is important since different generations or age groups may exhibit expenditure patterns that are the result of higher incomes and/or different tastes and preferences. Ignoring these generational effects produces income and consumption age profiles that can be misleading. With accurate consumption and age profiles, policymakers can gain a better idea of food intake patterns by cohort, and thereby identify groups that may need additional diet and health information. Using survey data to follow eight cohort groups from 1982 through 1995, this study found that: real per capita income increased for all cohorts, except for the very youngest, with a peak in earnings between the ages of 50 and 59; all food categories except for vegetables and sugar and sweets have statistically significant cohort effects; younger cohorts spent less than older cohorts on food at home, meat, poultry, fish, eggs, and dairy products, but more on cereal and bakery goods as well as miscellaneous prepared foods. This study found no evidence that younger cohorts spend more than older cohorts on food away from home.

Keywords: Food spending, food expenditures, Consumer Expenditure Surveys, households.

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Summary

This research separated generational effects from aging effects by analyzing the income and food expenditure patterns of eight cohort groups from 1982 through 1995. The youngest cohort was 26 to 30 years of age in 1982, whereas the oldest cohort was 61 to 65 years of age. Different generations or age groups may exhibit diverse expenditure patterns that result from differences in incomes and/or tastes and preferences, possibly due to differences in educational attainment. Traditional life-cycle analysis ignores these generational effects and concentrates on changes due to the aging effect. Ignoring generation or cohort effects produces age-consumption profiles that can be misleading because, as age increases, lower real income earnings influence the consumption patterns of earlier cohorts compared with succeeding cohorts. Hence, the age-consumption profiles can be very different across cohorts, particularly cohorts widely separated by time. In addition, since each succeeding generation tends to be better educated, tastes and preferences can change over time. Hence, younger cohorts may spend less on red meats than older cohorts do for health reasons and, as a result, diet and health information might need to be designed for older cohorts. In short, cohort effects have implications for the well-being of American households, since income and food consumption are important measures of living standards and household well-being.

Income and food expenditures were regressed on variables representing cohort, age, and time. Real per capita income increased for each succeeding cohort, from older to younger, except for a perceptible decline in income for the youngest cohort. In addition, earnings peaked between the ages of 50 and 59. Food-at-home expenditures varied almost linearly by cohort: the youngest cohort spent the least per capita while the oldest cohort spent the most. Food-away-from-home expenditures varied by cohort, with cohorts aged 36-40 and 51-55 spending the most. However, a log-likelihood test indicated that cohorts 31 to 60 years in age (cohorts 2-7) are better represented by just one cohort coefficient.

Food-at-home expenditures were further disaggregated into nine subcategories. Red meats, poultry, fish, and eggs were aggregated to represent nondairy protein. The remaining eight categories were cereal and bakery goods, miscellaneous prepared foods, dairy products, nonalcoholic beverages, fats and oils, sugar and sweets, fruits, and vegetables. All food categories had statistically significant cohort effects, except for sugar and sweets and vegetables. Older cohorts tended to spend more on red meats, poultry, fish, eggs, dairy products, fruits, beverages, and fats and oils, while younger cohorts spent more on cereal and bakery products as well as miscellaneous prepared food.

Introduction

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 in earnings from one's early twenties up into one's 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 earnings and consumption. In a growing economy, individuals of a younger generation will generally be better off at a given age than were individuals of an older generation. This generational effect is termed the cohort effect, and it is distinct from the age effect that is usually highlighted in studies of life-cycle patterns. For example, while a younger generation may earn an income that is smaller than the generation between the prime income earning ages of 40 and 60, it may nevertheless be true that the younger generation has realized a higher real income than did the older generation at the same age. These generational effects can also be responsible for differences in tastes and preferences, and therefore different spending patterns, between generations or cohorts.

Attitudes toward diet and health can also vary across generations. Besides higher real incomes, successive generations are usually better educated and better informed, which may lead to preferences that are different from those of the preceding generation. Thus, it is possible that an older cohort may consume more foods higher in fat (such as red meat) relative to a younger cohort that is more aware of and concerned with the health risks associated with a high-fat diet. To isolate the life-cycle and age effects from the generational or cohort effects, this study explicitly takes into account the income and consumption patterns of cohorts over time.

Unfortunately, data sets that follow a panel of households from different generations (and 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, following cohorts of individuals over time. Such cohort data have some 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 or median values, or consider changes in inequality between cohorts and work with measures of dispersion. Third, the cohort data may be constructed from more than one data set. For example, one could use food expenditure and income data from one survey and combine that with nutrient intake from another survey (Deaton).

For this study, I used data from the Consumer Expenditure Survey (CES) to follow 8 cohorts over a 14-year period. I then decomposed income and food expenditures into age, time, and cohort effects. Deaton and Paxson applied this methodology in looking at income inequality, while Attanasio applied the methodology to an analysis of saving behavior by U.S. households. By decomposing income and food expenditures into time, age, and cohort effects we hope to gain a clearer picture of the differences in expenditure patterns by older versus younger cohorts, as well as any aging effects that may be present. This type of information cannot be extracted by looking only 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 intake, this analysis hopes to indicate what, if any, difference exists between cohorts in America. For example, the analysis may indicate lower expenditures for meat and higher expenditures for fruits and vegetables for younger cohorts.

Decomposing Age, Cohort, and Time Effects

To analyze cohort data, a method is needed to decompose the data into age, cohort, and time effects. The first effect gives the typical age profile associated with lifecycle changes, the second the secular trend that is associated with generational effects, and the third the aggregate effects that may temporarily move all cohorts off their trend and age profiles (Deaton).

In matrix form, one can define the model that one wishes to estimate as:

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

where y is the 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 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 and age elements 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, such as the assumption of no interaction effects between age, cohort, and time. In the empirical section of this report, we will plot the net effects of the cohort, age, and time estimates, as well as the level of expenditures and income by cohort.

The coefficients of the above model are interpreted in the usual way. Hence, α represents the net effect of age regardless of the cohort or time effects. Likewise, γ is the net cohort effect regardless of the age or time effects, and φ is the net effect of time regardless of age or cohort effects. The age and time dummy variables of the model are created in the usual way. Fourteen age dummy variables were created beginning with age 26 and ending with those 65 years or older, in 3-year intervals. 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. 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 the sum of the columns for the full set of matrices 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 age prior to the first observation. To estimate the model, we need to drop one more column from any of the three matrices. Following the lead of Deaton and Paxson, one way of handling this 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 year dummy variables are then created 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, for the first two years of the data set, can be recovered from the fact that all the year effects sum to zero.

Data Source, Model, and Means

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 was utilized in this study, which includes an interview panel of 3,500 to 5,000 households 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 and 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 1 week. Households that reported only 1 week of expenditures were eliminated, and the remaining household observations were averaged over the 2 reporting weeks. Given this, the data set had 35,508 observations on individual households 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 year 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 the dummy variables for 1982 and 1983 were also dropped from the regression model. Since some households reported zero expenditures for some food categories over the 2-week survey period, the Tobit model was used in this study. The reported results have been adjusted to account for both censored and noncensored observations, thereby representing the total sample, and not just purchasing households.

Mean income and food expenditures from 1982-95 for each cohort are reported in table 1. Real per capita income rises 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. Food-at-home expenditures increase linearly by age of cohort with cohort 1 spending about $5.10 per capita and cohort 8 spending about $10.45 per capita. Food-away-from home expenditures range from approximately $9.40 per capita for cohort 1 to about $10.45 per capita for cohort 3, and then declines rather steadily to about $7.20 per capita for cohort 8. Red meats, poultry, fish, and eggs increase linearly with the age of the cohort from about $3.60 per capita for cohort 1 to about $5.20 per capita for cohort 6, before declining to approximately $5.15 for cohort 8. Dairy expenditures increase steadily, with cohort 1 spending about $1.70 per capita and cohort 8 spending about $2.15 per capita.

These descriptive statistics ignore the cohort effects that will be reported in the following section, and may even be misleading. In looking at the distribution of expenditures of red meats, poultry, fish, and eggs, one would conclude that expenditures increase from age 26 to 55 and then decline slowly thereafter. However, this is not the whole story, and in 10 or 15 years this distribution may look very different. For example, if younger cohorts spend less on this food group than older cohorts do, this distribution will shift downward as younger cohorts age and older cohorts die off. Likewise, the income distribution will shift upwards over time if younger cohorts are realizing higher real incomes than the older cohorts did. If the cohort effect is present, the following analysis will give some indication of what differences may exist in both income and food expenditures.

Table 1—Comparison of means between cohorts for real per capita income and food expenditures

	Cohort 1 Age* 26-30	Cohort 2 Age 31-35	Cohort 3 Age 36-40	Cohort 4 Age 41-45	Cohort 5 Age 46-50	Cohort 6 Age 51-55	Cohort 7 Age 56-60	Cohort 8 Age 61-65
					Dollars			
Income	11,125.57	12,090.47	12,441.25	13,400.00	12,865.15	11,745.70	10,270.04	9,020.38
Food at home	5.09	5.17	5.52	6.43	7.36	8.30	9.23	10.44
Food away from home	9.41	9.96	10.43	10.01	9.66	9.01	7.82	7.21
Red meats, poultry, fish, and eggs	3.59	3.89	4.28	4.72	5.03	5.21	5.05	5.13
Cereal and bakery products	2.02	2.14	2.24	2.36	2.51	2.65	2.67	2.84
Dairy products	1.71	1.72	1.79	1.88	2.00	2.09	2.07	2.14
Fruits	1.17	1.22	1.29	1.41	1.54	1.72	1.87	2.03
Vegetables	1.02	1.10	1.18	1.31	1.41	1.51	1.56	1.66
Sugar and sweets	.51	.54	.56	.61	.67	.69	.73	.75
Nonalcoholic beverages	1.30	1.36	1.48	1.58	1.61	1.58	1.50	1.50
Fats and oils	.42	.45	.48	.52	.58	.60	.61	.65
Miscellaneous prepared food	1.93	1.93	1.96	2.02	2.02	2.04	1.93	1.95

*Age of cohorts in 1982
Per capita income is on annual basis, food expenditures are on weekly basis
Source: Economic Research Service

Results of Analysis

Analyses of cohort income and food expenditures are contained in figures 1-12, which cover the same categories as table 1. Each figure consists of four graphs. The first graph depicts the variable in question, adjusted for inflation, for each cohort group from 1982 to 1995. The next three graphs then present the net cohort, age, and time effects over the same time period. Time effects will be noted in the following analysis, but not discussed in detail. This is mainly because they are constrained to sum to zero for identification purposes. However, for a variable such as aggregate 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 aggregate spending that may be the result of economic or noneconomic influences, such as income fluctuations or short-term health concerns that influence all cohorts.

Note that at times this report may refer to a cohort as if they were one age. For example, the report may refer to cohort 4 as being 43 years of age, or talk about cohort 4 when they were 50 years old. In these instances the report is 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 statistical significance with 7 degrees of freedom. The cohort effects were found to be statistically significant, at the 5-percent level or better, for per capita income and all food categories except for vegetables and sugar and sweets.

Real Per Capita Income

Real per capita income for the three oldest cohorts was clearly lower than that of the other cohorts (figure 1a). This is not surprising, since cohorts 7 and 8 are at retirement age while some members of cohort 6 are eligible for retirement in the later years of the data set. In general, cohort 6 lies above cohort 7, which in turn lies above cohort 8. The remaining cohorts appear to overlap, doubtless the result of the life cycle. For instance, cohort 4, who were 41-45 in 1982, had the highest incomes of all cohorts from 1988 to 1995. During this interval, they were approximately 48 to 56 years of age (using a representative age of 43 in 1982 for this cohort) and in their prime income-producing years.

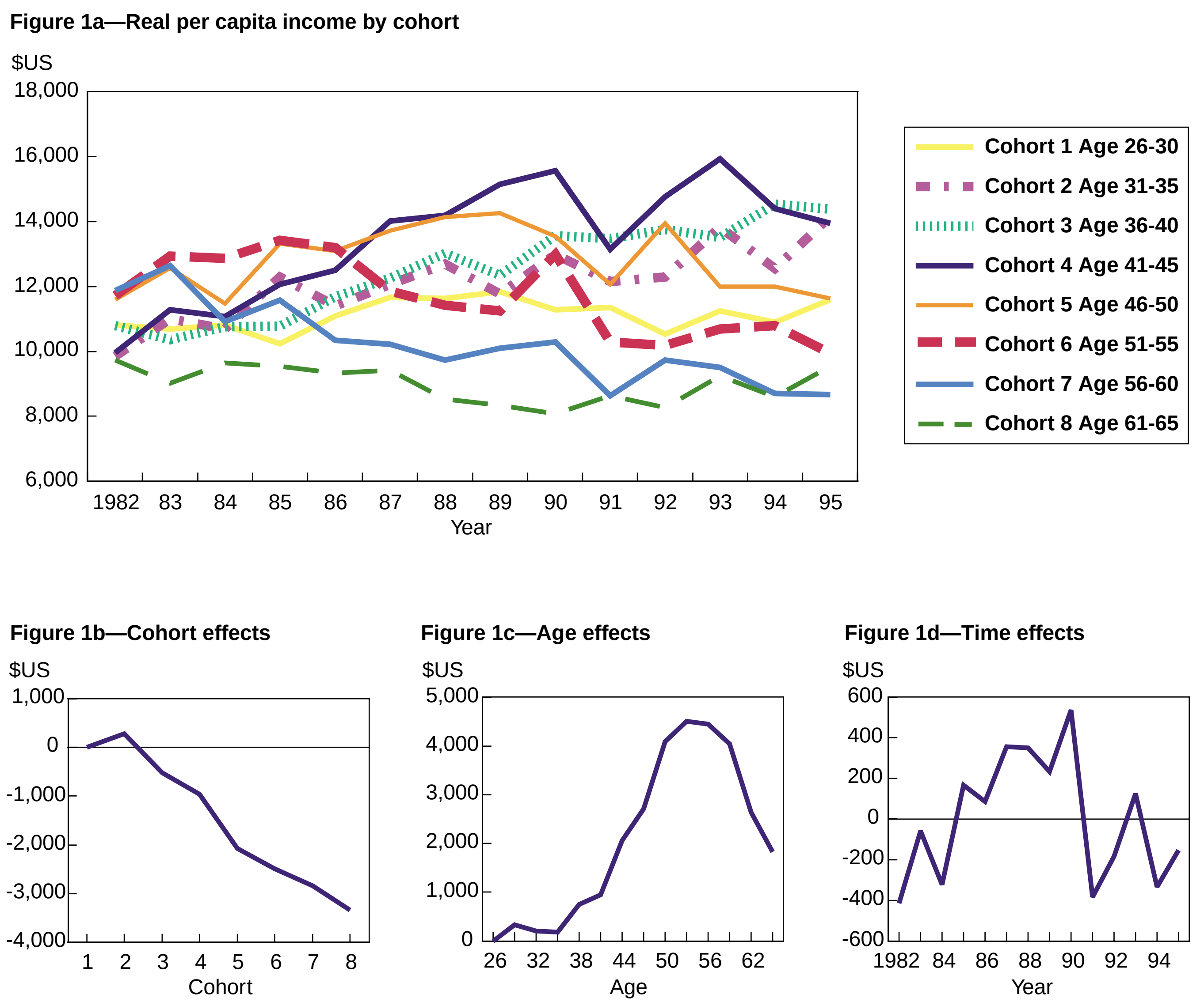
Figure 1b shows a negative relationship from cohort 2 to cohort 8, although cohort 2 is not statistically different from cohort 1. This indicates that succeeding cohorts have realized a higher real per capita income than the cohorts that preceded them. In looking back to figure 1a, this is easily seen with cohorts 6, 7, and 8 as noted above, but it is less clear with cohorts 3 through 5. However, careful analysis of figure 1a reveals that, in general, each succeeding cohort has realized a real income that is higher at the same age than the cohorts that preceded them. For instance, cohort 3's real income is higher when they are 45 years old versus cohort 4's real income at the same age. Furthermore, cohorts who are 46 to 55 years of age tend to be the dominant cohort, or at least equal to the next youngest cohort. The end result is that each succeeding cohort, other than cohort 1, has had real income equal to or higher than the one preceding it as depicted in figure 1b due to the increased productivity of each succeeding cohort.

Figure 1c reveals the effect of age on real income. This is the typical concave curve that one would expect to find over the life cycle of income earnings. From age 26 to about 35 there is very little change in real terms, and these individual ages are not statistically different from age 26, which is in accord with the statistical insignificance of cohort 2 relative to cohort 1, although there is no a priori reason for this. However, real per capita income steadily increases from age 38 up to a peak between the ages of 53 and 56, then slowly declines into the retirement years. Finally, figure 1d depicts the effect of time on earnings. Remember, we assume that time captures cyclical fluctuations that average to zero over the long run. Note that the time effects clearly capture the downturns in the economy in 1982-84 and again in 1991-92.

Real Expenditures on Food at Home

Figure 2a presents the raw data on real expenditures on food at home by cohort. In general, the oldest cohorts spend the most on food at home while the youngest cohorts spend the least. In fact, there is little overlap between the cohorts, and they are in almost perfect order from youngest to the oldest. It also appears that these expenditures have declined as the cohorts have

Figure 1—Real yearly per capita income decomposed by cohort, age, and time



aged. In figure 2b there is a positive and approximately linear increase in food expenditures at home from the youngest to the oldest cohort. This implies a shift in food-at-home expenditures whereby younger cohorts spend less per capita than older cohorts do.

Figure 2c indicates the effects of age on food expenditures at home. All age effects were statistically significant, and, contrary to the cohort effect, age has a negative effect, especially from age 26 to 32. However, from age 32 through age 62 the effect is mostly flat, while after age 62 the effect becomes negative again. As the economy cycles and personal income expands and contracts, one would expect some influence on food expenditures, especially for food at home versus food away from home. Indeed, the time effects in figure 2d demonstrate an increase in food-at-home expenditures, probably to save on total food costs, during the economic downturns of 1982-83 and 1991-92, which seems entirely reasonable.

Real Food-Away-From-Home Expenditures

Somewhat surprisingly, figure 3a is not the mirror image of food expenditures at home. Some economists have speculated that younger cohorts have made a permanent shift to spending more on food away from home and will continue to spend more as they age. However, in figure 3a it is not clear whether this is true

Figure 2—Real weekly per capita expenditures on food at home decomposed by cohort, age, and time

Figure 2a—Average real per capita expenditures

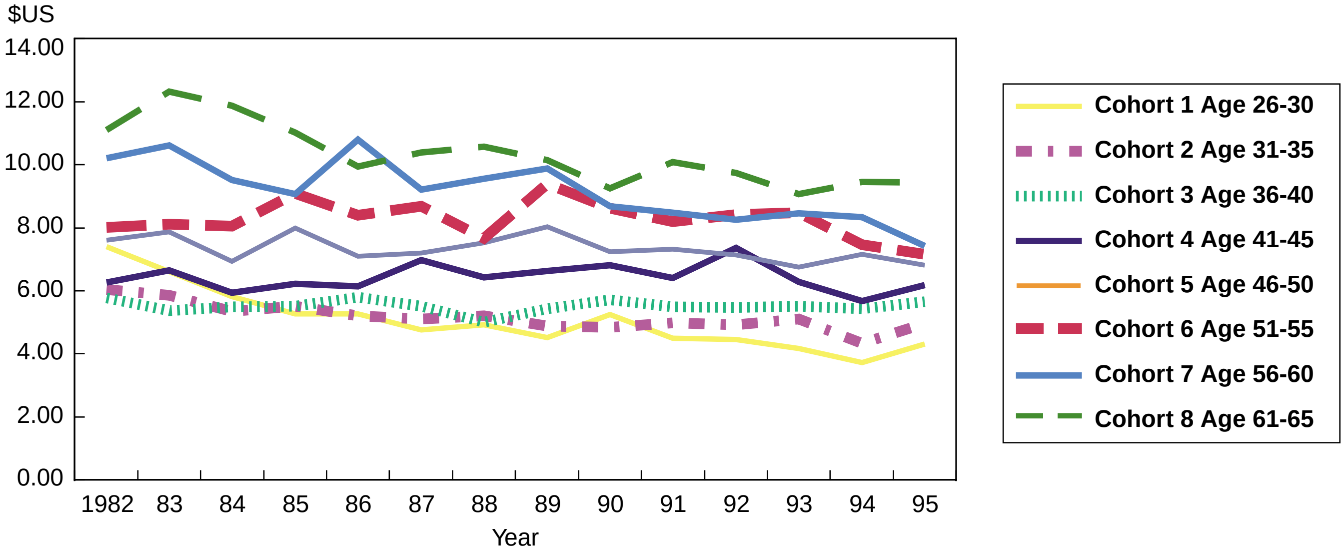


Figure 2b—Cohort effects

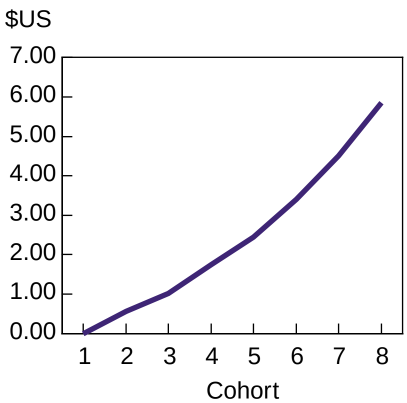


Figure 2c—Age effects

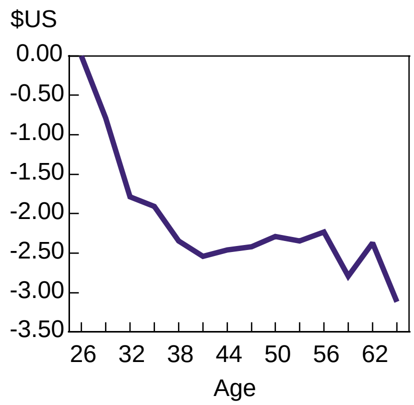
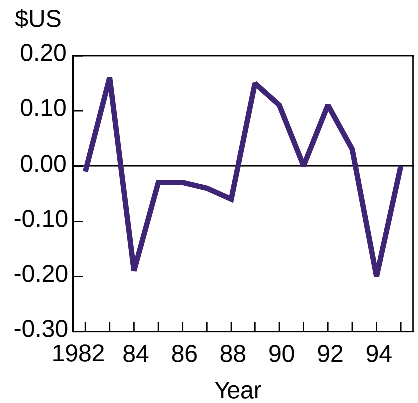


Figure 2d—Time effects



or not. Clearly the oldest cohorts, 7 and 8, appear to spend the least, but other than that it is hard to come to any definite conclusion other than that cohort 3 appears to dominate or at least equal any other cohort in most if not all years. This is confirmed in figure 3b, which indicates that of all net cohort effects, cohort 3 does indeed have the highest per capita expenditures on food away from home. Surprisingly, per capita expenditures decline for cohorts 4 and 5 before rising again for cohort 6, then declining again for cohorts 7 and 8. However, only expenditures by cohorts 7 and 8 are not statistically different from expenditures by cohort 1, at the 10-percent level of significance or better. Note that although cohort 7's expenditure level is approximately the same as cohort 5's, it is not measured as accurately and is statistically insignificant, perhaps due to the sample size, since this sample of cohorts becomes smaller over time. However, a log-likelihood test was performed to test the hypothesis that cohorts 2-7 are better represented by one coefficient. Not surprisingly, this hypothesis could not be rejected at the 5-percent level. Hence, we would conclude that cohorts 2-7 have a relatively higher level of spending than cohorts 1 and 8 on food away from home. Note that this is not the same as having a negative sloping set of cohort effects, where each younger

Figure 3—Real weekly per capita expenditures on food away from home decomposed by cohort, age, and time

Figure 3a—Average real per capita expenditures

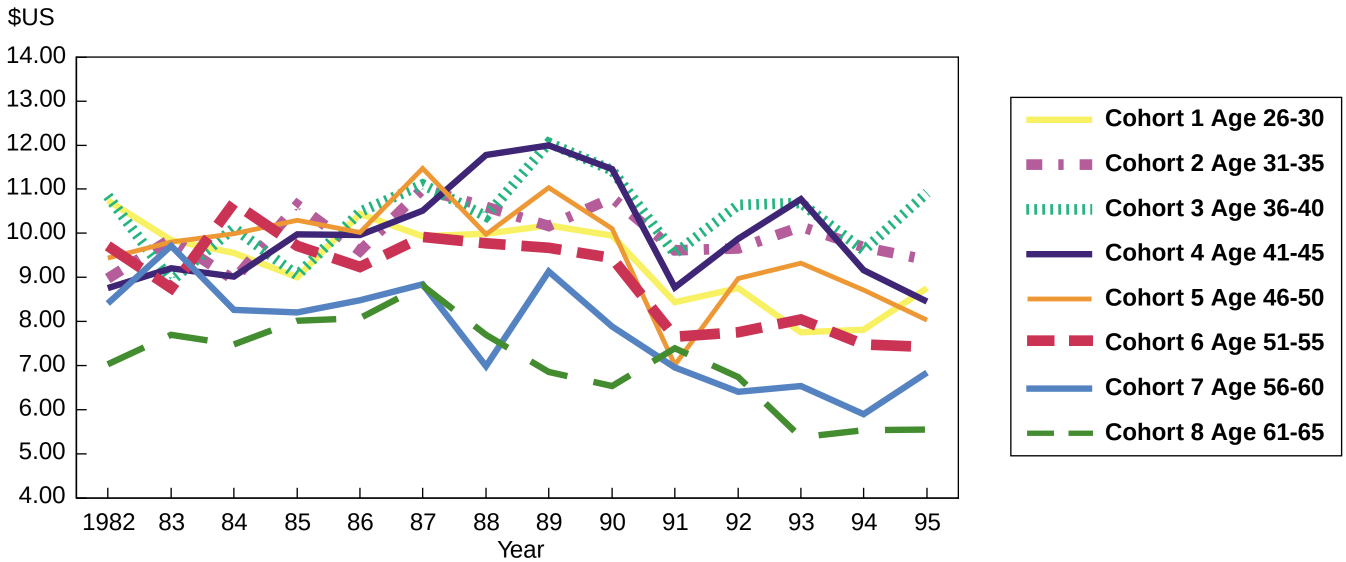


Figure 3b—Cohort effects

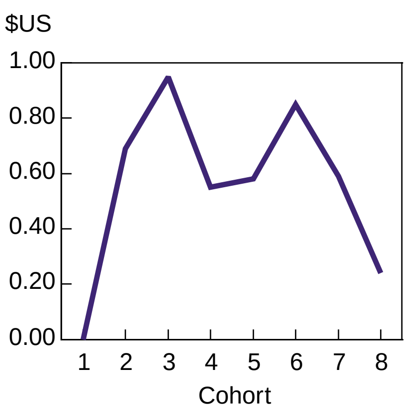


Figure 3c—Age effects

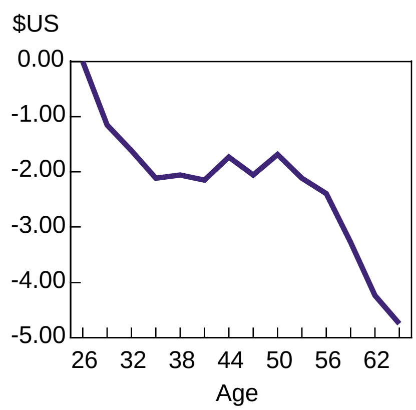
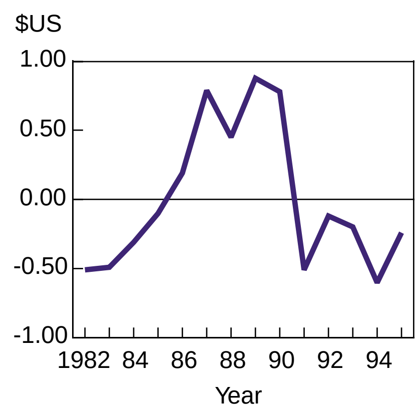


Figure 3d—Time effects



cohort spends more than the next oldest cohort. Rather, our finding is for one net cohort effect for all persons between 31 and 60 years of age in 1982, and one net effect for cohorts 1 and 8.

The age effects in figure 3c are somewhat more typical of life-cycle studies in that younger people have higher expenditures than older people do. As noted above, all age effects were found to be statistically significant. However, it might appear surprising that expenditures are rather flat between the ages of 35 and 53. This is somewhat like the age pattern in food expenditures at home, except that the decline resumes at an earlier age. One might speculate that as people retire and leave the workforce they eat out less often, particularly lunches, and hence the resumption in the decline in expenditures. Note also that the time effects in figure 3d indicate a reduction in food-away-from-home expenditures during the downturns in the economy in 1982-83 and 1991-92 and in adjacent years, the mirror image of that for food at home. These reductions in spending would appear to be entirely feasible.

In short, there is no evidence to support the hypothesis that younger cohorts have higher expenditures on food away from home and that they will continue to have higher expenditures as they age. Rather, the evidence supports the hypothesis that the life-cycle effect is clearly tied to age.

Real Expenditures on Meat, Poultry, Fish, and Eggs

In figure 4a it appears that expenditures increase by age of the cohort, although there is some overlap between cohorts 4-8. In figure 4b, where the cohort effect is isolated, we find a positive and approximately linear relationship between cohorts and expenditures. All of these cohort effects were statistically significant. In general, older cohorts spend more on meat, poultry, fish, and eggs than do younger cohorts. For example, cohort 8 spends approximately $2.00 more per capita per week than cohort 1. One is tempted to speculate that perhaps the older generation eats more red meat than the younger generation. The isolated age effects in figure 4c tend to be close to zero; in fact, ages 29-62 are not statistically different from the effect for age 26. Hence, it is interesting that there are significant cohort effects but not age effects. In figure 4d the most prominent feature is the decrease in expenditures in 1988. One wonders if this is not due to large meat supplies, lower prices, and thus lower expenditures, rather

Figure 4—Real weekly per capita expenditures on meat, poultry, fish, and eggs decomposed by cohort, age, and time

Figure 4a—Average real per capita expenditures

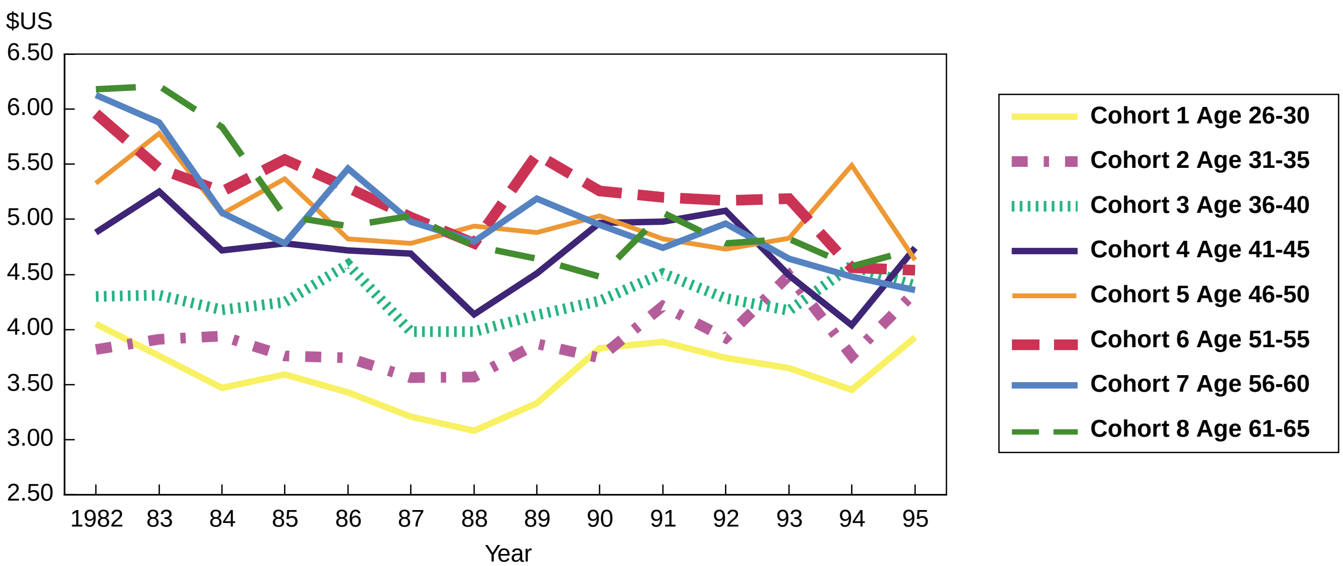


Figure 4b—Cohort effects

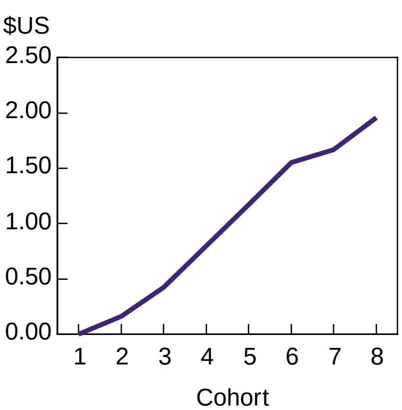


Figure 4c—Age effects

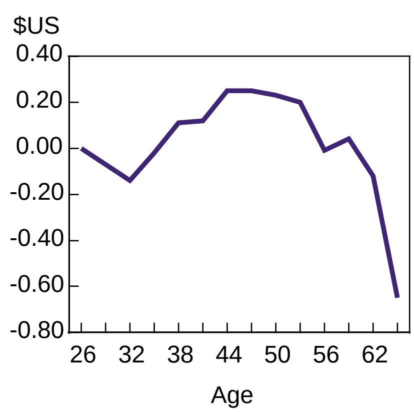
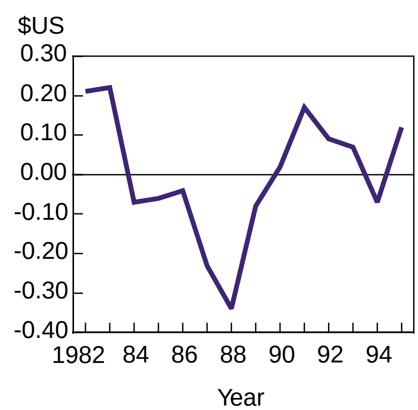


Figure 4d—Time effects



than substitution away from meats, all other things equal.

Real Expenditures on Cereals and Bakery Products

In figure 5a it appears that per capita expenditures increase by the age of the cohort from youngest to oldest, and over time. Given the results in figure 5a, it is somewhat surprising to encounter the negative relationship between the cohort effect and expenditures in figure 5b. This graph indicates that younger cohorts spend more, per capita, on cereal and bakery goods than older cohorts do. Note that all cohort effects (as well as age effects) are statistically significant. Cohort 2 spends approximately $.15 less per capita than cohort 1, while cohort 7 spends about $.80 less per capita. Like income, one needs to look at differences in cohort expenditures at the same age. This is most easily seen between cohorts 3 and 7. For example, cohort 3 spends more per capita at age 45 than cohort 4 did at the same age. Hence, when the cohort effects are isolated in figure 5b they are negative from the youngest cohort to the oldest (except for cohort 8). The isolated age effect in figure 5c confirms the increase in expenditures due to age that is apparent in Figure 5a. This effect is positive, with household heads

Figure 5—Real weekly per capita expenditures on cereal and bakery goods decomposed by cohort, age, and time

Figure 5a—Average real per capita expenditures

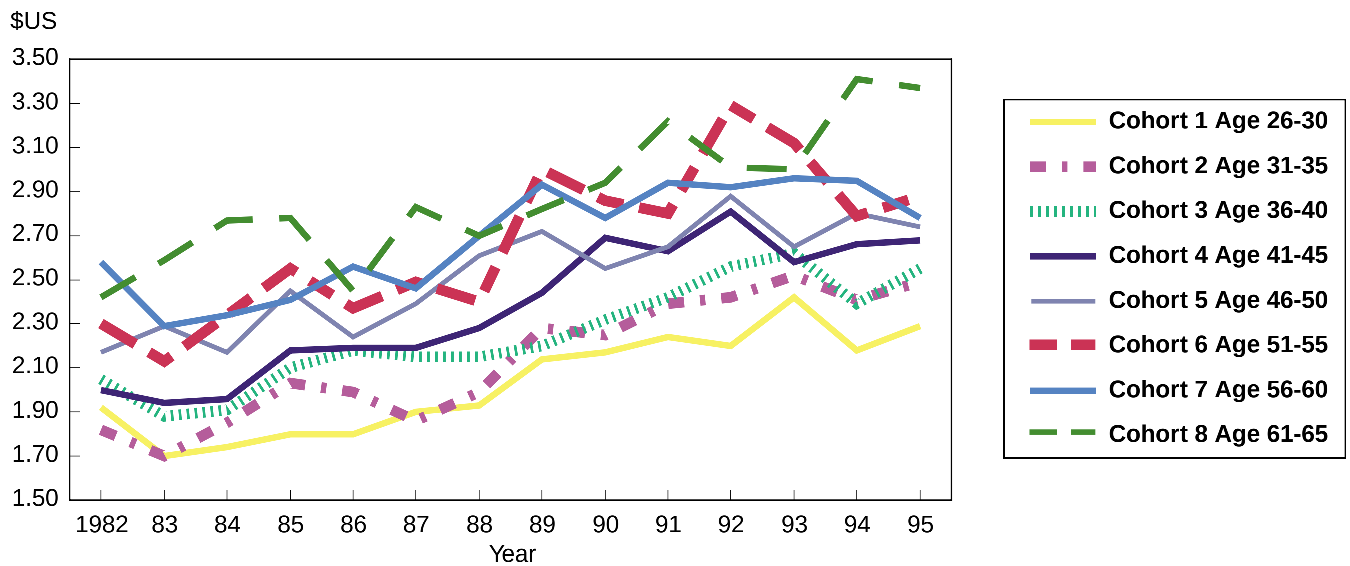


Figure 5b—Cohort effects

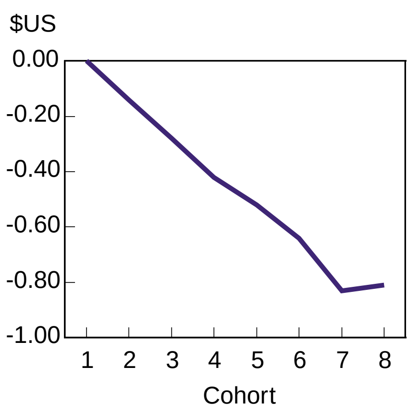


Figure 5c—Age effects

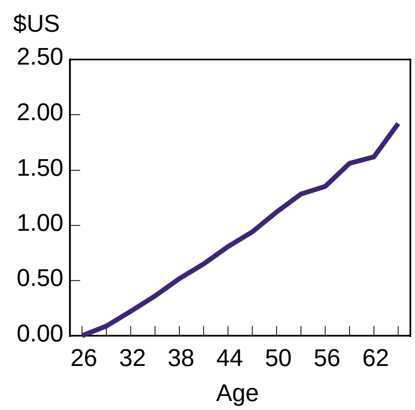
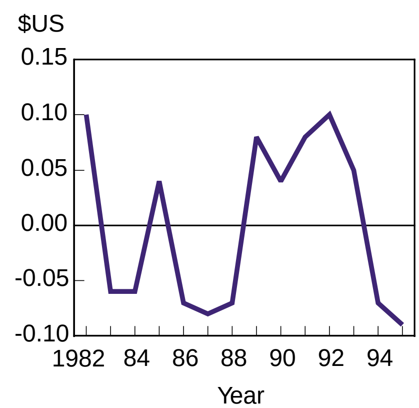


Figure 5d—Time effects



aged 29 spending about $.25 more per capita, whereas household heads age 65 spend approximately $2.00 more per capita. The net time effect offers a very mixed picture with negative effects in the 1980s and positive effects in the 1990s.

Real Expenditures on Dairy Products

Two things are notable about figure 6a. First, younger cohorts have lower per capita expenditures than older cohorts do. Second, the graph for each cohort tends to decline over time, indicating that real per capita expenditures decrease with age. Figure 6b indicates that dairy expenditures increase by cohort, with the second cohort group spending about $.06 per capita more than the youngest group, and the oldest cohort group spending about $.80 more per capita per week in real terms. This finding implies that dairy expenditures will continue to decline as younger cohorts age and replace older cohorts who pass on, unless younger cohorts (younger than cohort group 1 and not depicted in this study) reverse this trend, perhaps by increasing their consumption of nonfat dairy products. There is also evidence that adolescents and "Gen X'ers" are much more likely to consume sugared and non-sugared cola and carbonated beverages than milk, thus enhancing this trend.

Figure 6—Real weekly per capita expenditures on dairy products decomposed by cohort, age, and time

Figure 6a—Average real per capita expenditures

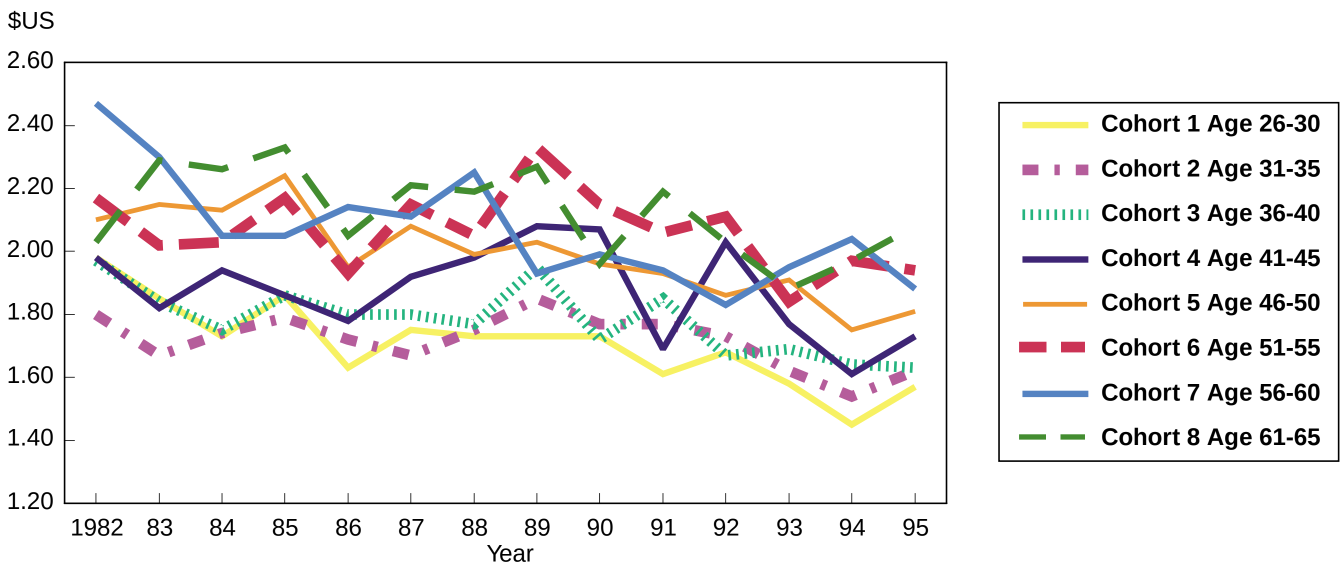


Figure 6b—Cohort effects

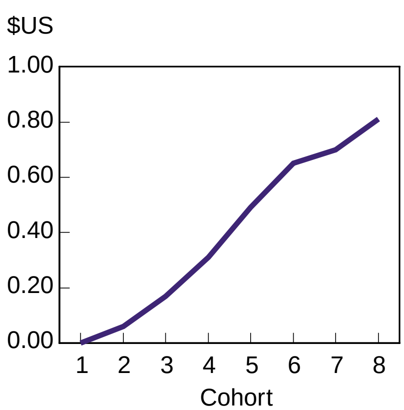


Figure 6c—Age effects

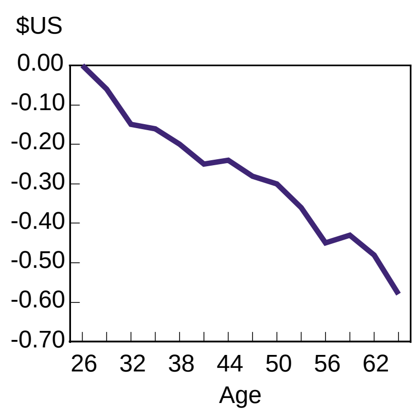


Figure 6d—Time effects

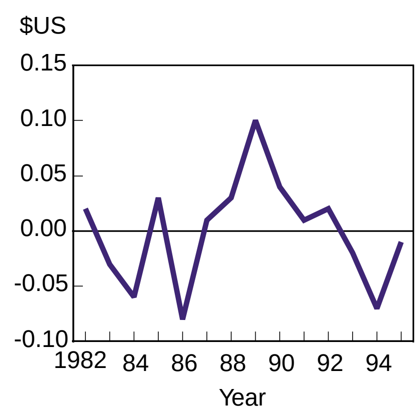


Figure 6c presents the age effects on weekly per capita dairy expenditures. After accounting for cohort and time effects, age has a negative effect on per capita spending for dairy products. All age effects above 35 years were statistically significant. These effects range from approximately $.16 per capita per week less for someone between age 32 and 35 to about $.58 cents less per capita per week for someone age 65 or older. This finding will be troubling for dairy producers and processors. Not only do younger cohorts spend less per capita on dairy products, but spending actually declines with age. This again implies that per capita dairy expenditures will continue to decline over time.

Figure 6d presents the net effect of time on dairy consumption. Note that the time effects have captured the decline in per capita expenditures in 1986 and 1994, as well as the increases in 1989 that are evident in figure 6a.

Real Expenditures on Fruits

The raw data in figure 7a indicate that young cohorts spend the least while older cohorts spend the most on all fruits (fresh and frozen). While this appears to be confirmed in figure 7b, in reality cohort effects 2 through 5 are not significantly different from cohort 1. However, cohort 5 spends about $.08 more per capita

Figure 7—Real weekly per capita expenditures on fruits decomposed by cohort, age, and time

Figure 7a—Average real per capita expenditures

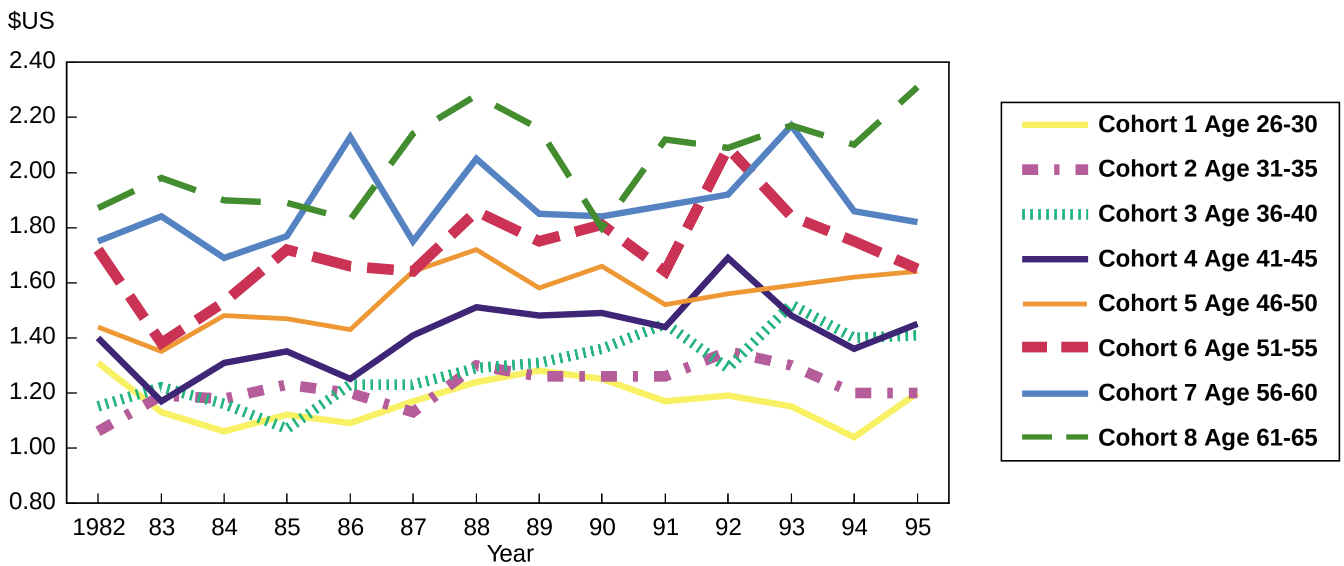


Figure 7b—Cohort effects

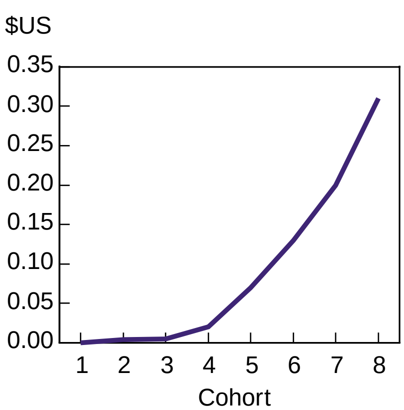


Figure 7c—Age effects

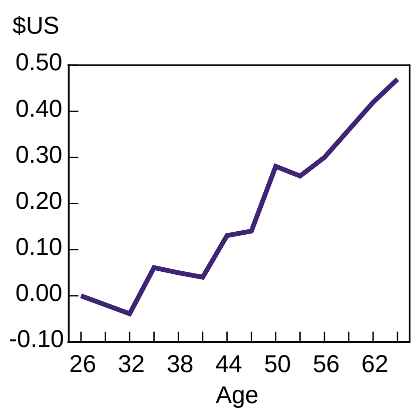
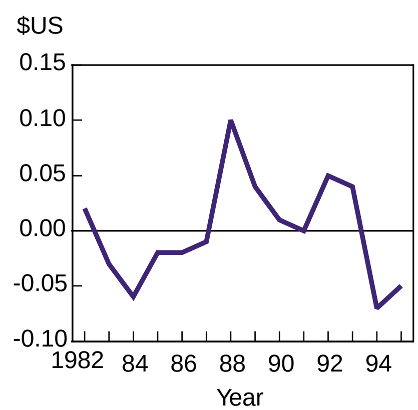


Figure 7d—Time effects



whereas cohort 8 spends approximately $.30 more per capita than cohort 1. The age effects in Figure 7c present a mixed picture. Expenditures for ages 29-47 are not significantly different from the expenditures of a household head aged 26. Expenditures for someone aged 50 are approximately $.30 more per capita, while someone aged 65 spends approximately $.58 more per capita. The net time effects in figure 7d have captured the general increase in expenditures in 1988 and the decline of 1994.

Real Expenditures on Vegetables

Since the main variable of concern, cohorts, was found not to be statistically significant (figure 8b), an indepth analysis was not performed. However note that age does have a positive effect on spending, with household heads age 65 or older spending approximately $.65 more per capita than those age 26.

Figure 8—Real weekly per capita expenditures on vegetables decomposed by cohort, age, and time

Figure 8a—Average real per capita expenditures

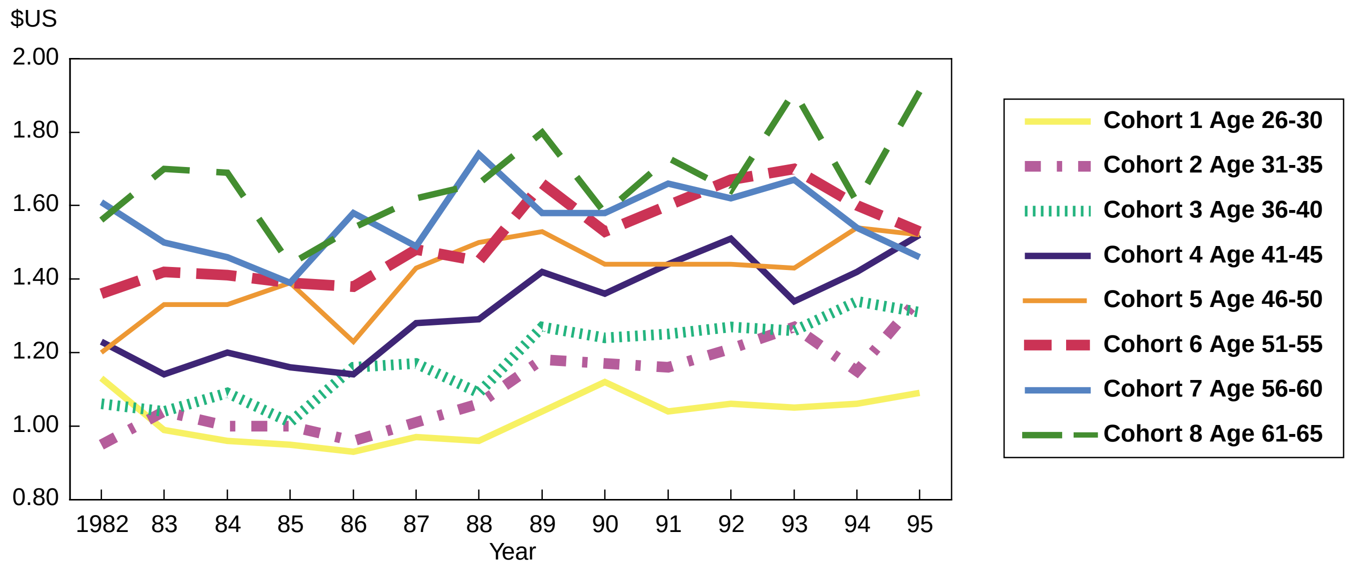


Figure 8b—Cohort effects

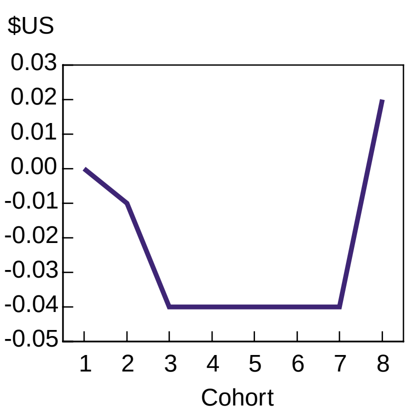


Figure 8c—Age effects

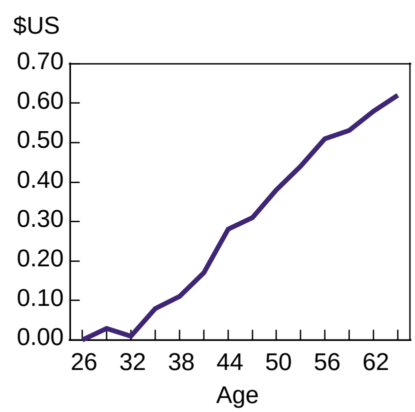
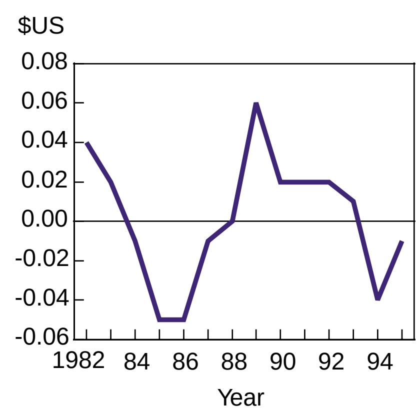


Figure 8d—Time effects



Real Expenditures on Sugar and Sweets

Since the main variable of concern, cohorts, was found not to be statistically significant (figure 9b), an in-depth analysis was not performed. Note, however, that age does have a positive effect on expenditures in this category with the oldest household heads spending approximately $.35 more per capita than the youngest household heads.

Figure 9—Real weekly per capita expenditures on sugar and sweets decomposed by cohort, age, and time

Figure 9a—Average real per capita expenditures

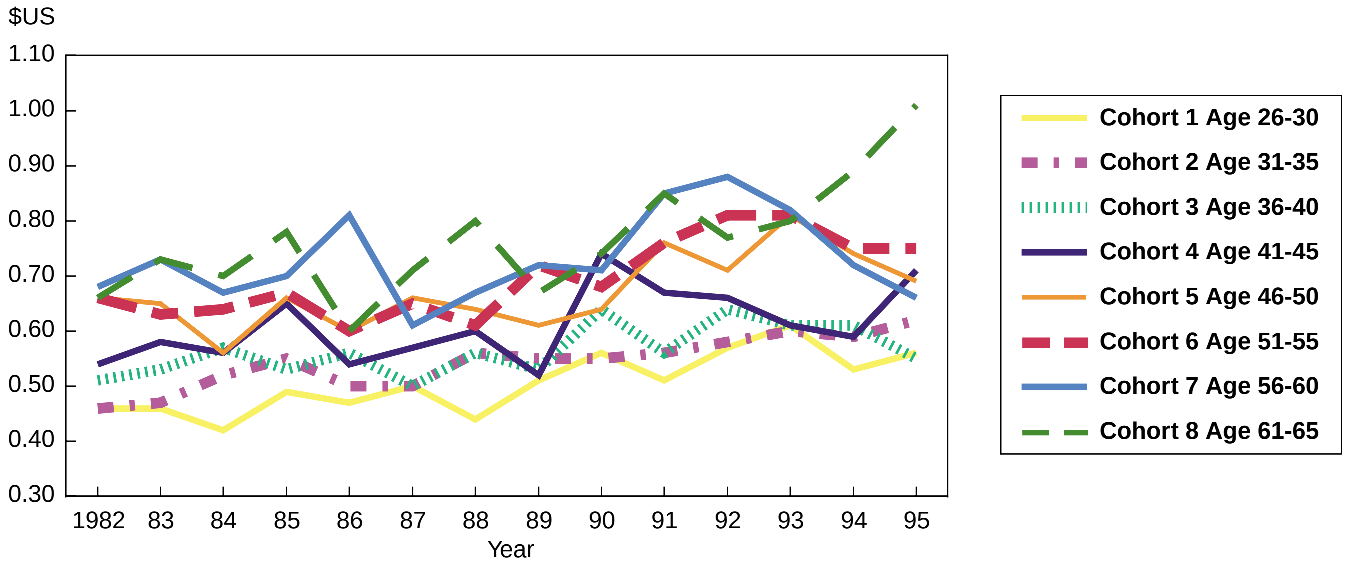


Figure 9b—Cohort effects

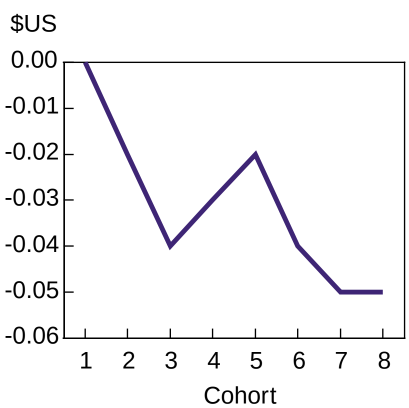


Figure 9c—Age effects

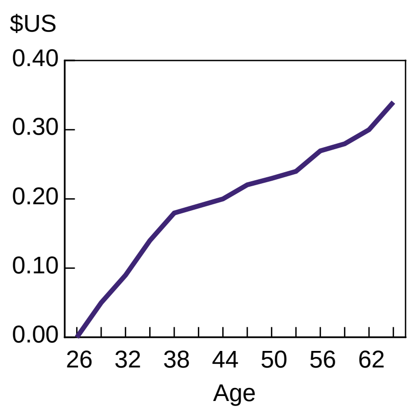
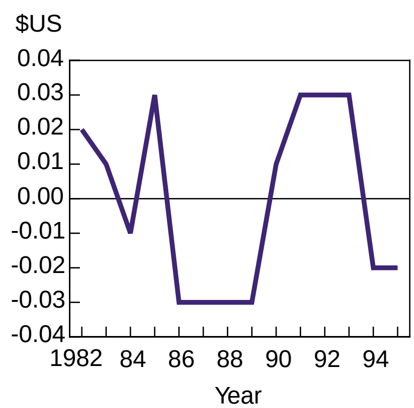


Figure 9d—Time effects



Real Expenditures on Beverages

Figure 10a implies that per capita spending on beverages increases with the age of the cohort, and that real spending tends to be flat over time or slightly declining. Figure 10b confirms that per capita spending increases with the age of the cohort. Cohorts 1 and 2 have virtually the same expenditures, while all other cohort effects are statistically significant. Expenditures increase at a decreasing rate from cohort 3 to 7, with cohort 3 spending approximately $.10 more per capita relative to cohort 1 and cohort 7 spending approximately $.22 more per capita than cohort 1. Expenditures then increase to approximately $.27 per capita for cohort 8, relative to cohort 1. Somewhat surprisingly, the age effects were not statistically different from zero, except for heads of households age 65 or older. The time effect in figure 10d captures peak expenditures by most cohorts in 1986 and 1989, as well as the decline of 1992.

Figure 10—Real weekly per capita expenditures on beverages decomposed by cohort, age, and time

Figure 10a—Average real per capita expenditures

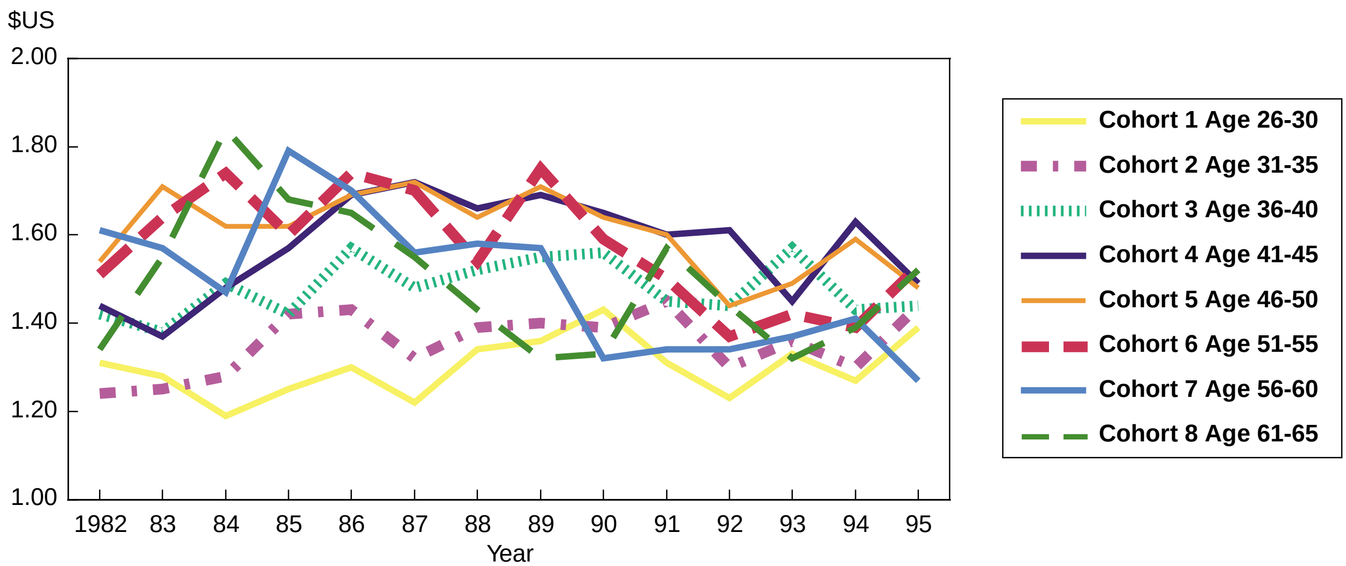


Figure 10b—Cohort effects

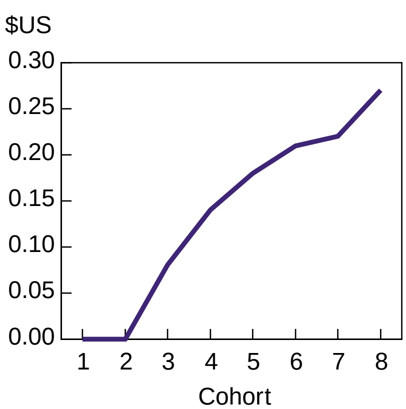


Figure 10c—Age effects

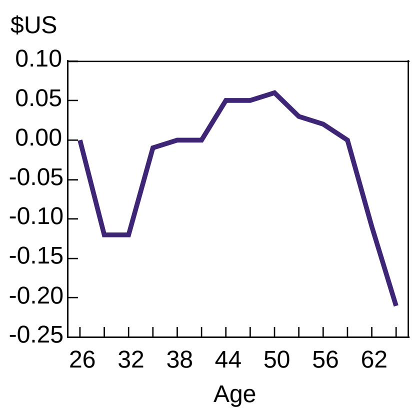
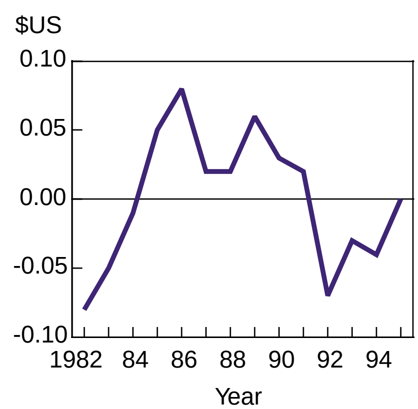


Figure 10d—Time effects



Real Expenditures on Fats and Oils

Figure 11a implies that expenditures increase by cohort, but probably not with time. Figure 11b indicates that there are cohort effects. While cohorts 2 through 4 are not statistically different from cohort 1, cohorts 5 through 8 are all statistically significant. Hence, the cohort effect ranges from approximately $.03 per capita for cohort 5 to approximately $.09 per capita for cohort 8, relative to cohort 1. The age effect in figure 11c presents very mixed results. Ages 26 through 53 were not statistically different from zero. However, ages 56 through age 65 were all statistically significant with a per capita expenditure of about $.10 more per capita than households whose head was age 26. In addition, the time effects (figure 11d) caught the highs that occurred in 1985 and 1992-93, as well as the low of 1987.

Figure 11—Real weekly per capita expenditures on fats and oils decomposed by cohort, age, and time

Figure 11a—Average real per capita expenditures

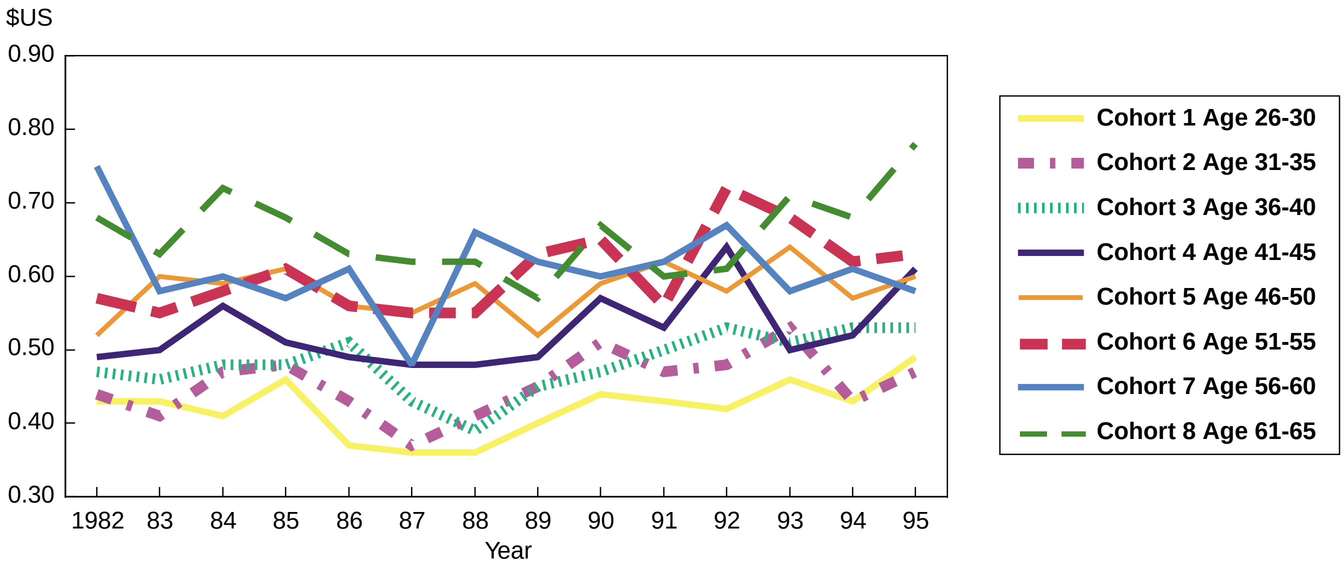


Figure 11b—Cohort effects

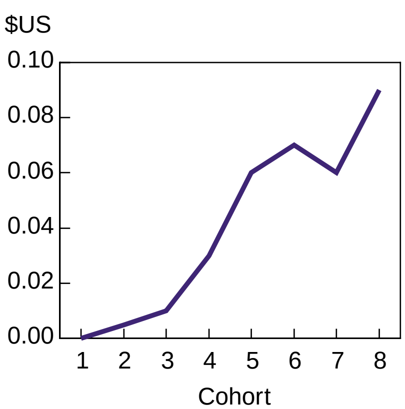


Figure 11c—Age effects

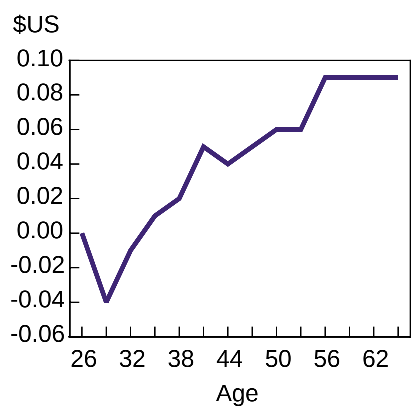
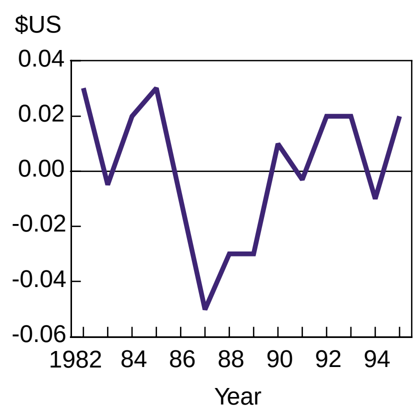


Figure 11d—Time effects



Real Expenditures on Miscellaneous Prepared Foods

Figure 12a implies that there is little difference in expenditures among the cohorts, and that expenditures have increased slightly over time in real terms. The results in figure 12b reflect a negative and statistically significant relationship between expenditures on miscellaneous prepared foods and the age of the cohort. For instance, cohort 2 spends approximately $.20 less per capita relative to cohort 1, while cohort 8 spends about $1.30 less per capita. This indicates that, over time, expenditures on this food category should rise as older cohorts pass on. The age effects in figure 12c indicate a positive relationship between the age of the household head and real per capita expenditures. The first three age variables were not statistically significant, although household heads who were 35 years of age had expenditures about $.20 higher per capita than 26-year-old household heads, while household heads who were 65 years old had per capita expenditures about $1.50 higher. Over time, the age effect will reinforce the cohort effect, and real expenditures on this category should continue to rise. The time effects captured peaks in expenditures in 1985 and 1990-92, as well as the declines of 1986-88 and 1993-95.

Figure 12—Real weekly per capita expenditures on miscellaneous prepared foods decomposed by cohort, age, and time

Figure 12a—Average real per capita expenditures

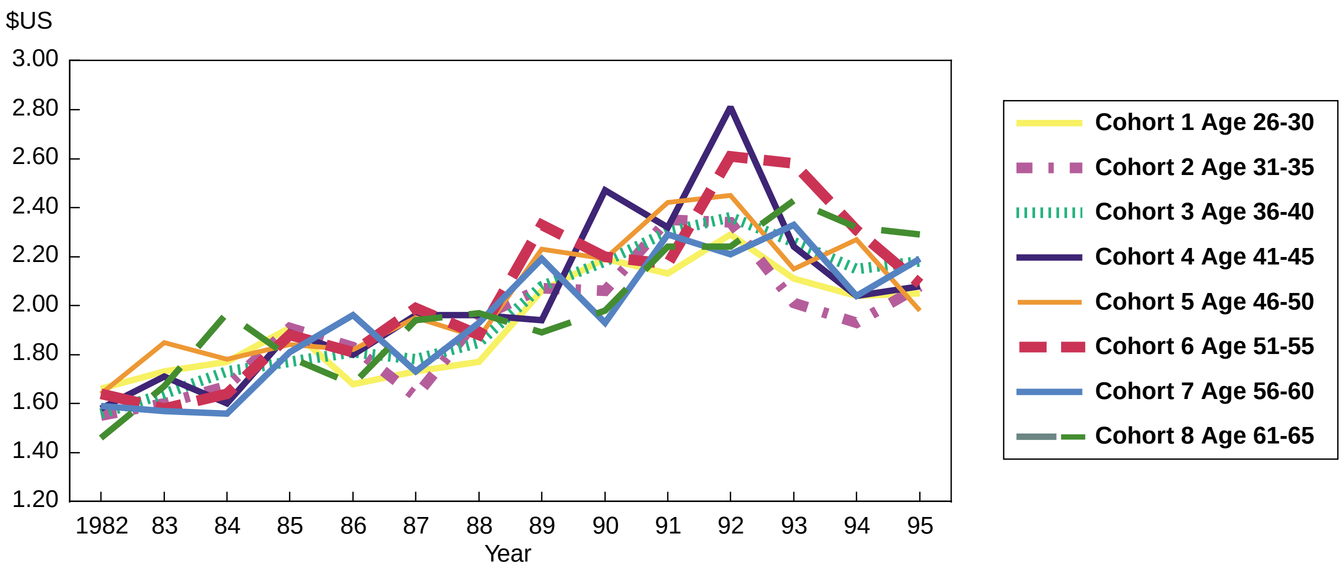


Figure 12b—Cohort effects

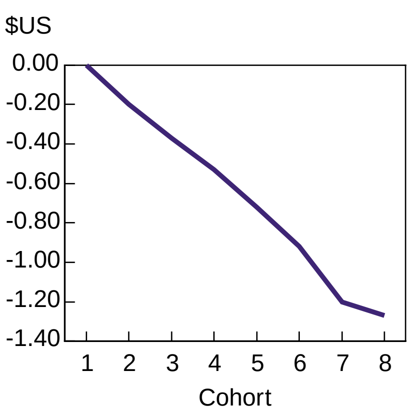


Figure 12c—Age effects

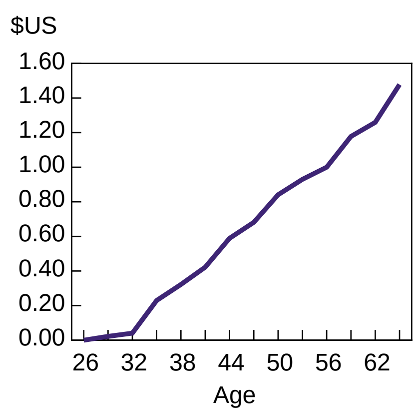
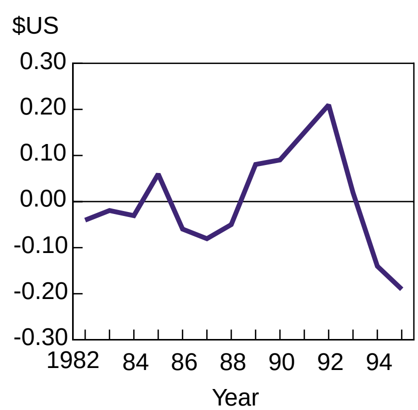


Figure 12d—Time effects



Conclusions and Implications

In general, results from this study indicate that there are statistically significant cohort effects in income and food expenditures. The analysis indicates that each succeeding cohort has realized a higher real per capita income than the cohort that preceded it. This implies that food expenditures should continue to increase since income elasticities for food are generally positive.

The data did not support the hypothesis that younger cohorts spend more than older cohorts on food away from home. The analysis indicates that the oldest cohorts definitely spend less on food away from home relative to all other cohorts except the youngest. However, among the remaining cohorts there was no clear pattern to expenditures, and tests indicated that cohorts 2-7 are better represented by just one cohort coefficient.

The analysis also found that older cohorts have higher expenditures than younger cohorts on food at home, red meats, poultry, fish, eggs, dairy products, fruits, beverages, and fats and oils, while younger cohorts have higher expenditures on cereal and bakery products as well as miscellaneous prepared foods. While not directly addressed, these findings have implications about the nutritional intake and future health of U.S. citizens. Our finding that dairy expenditures decrease by younger cohorts and also decline with age implies that calcium intake may be too low among younger cohorts, which may lead to increases in the incidence of osteoporosis in the future, unless calcium is acquired by some other means. Conversely, lower expenditures on meats, poultry, fish, and eggs by younger cohorts implies that they may ingest less saturated fat and cholesterol than older cohorts do. In addition, increased expenditures on cereal and bakery products by younger cohorts indicates that these consumers should have higher intakes of carbohydrates, dietary fiber, and various minerals than older cohorts do. Further work on nutrient intakes by cohorts is needed to validate this conclusion.

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Appendix table 1—Estimated Tobit models

	Income	Food at home	Food away from home	Meat, poultry, fish, and eggs
Constant	10,623.23	7.13	11.15	3.44
	(588.86)	(0.39)	(0.73)	(0.25)
Cohort 2	317.62	0.66	0.91	0.19
	(198.11)	(0.13)	(0.24)	(0.08)
Cohort 3	-585.39	1.19	1.25	0.49
	(251.51)	(0.17)	(0.31)	(0.10)
Cohort 4	-1,085.58	2.05	0.73	0.93
	(312.69)	(0.21)	(0.39)	(0.13)
Cohort 5	-2,340.21	2.89	0.76	1.36
	(368.43)	(0.25)	(0.45)	(0.15)
Cohort 6	-2,824.01	4.00	1.12	1.81
	(414.29)	(0.28)	(0.51)	(0.17)
Cohort 7	-3,212.58	5.30	0.77	1.94
	(454.09)	(0.30)	(0.56)	(0.19)
Cohort 8	-3,775.76	6.88	0.31	2.27
	(486.10)	(0.33)	(0.60)	(0.20)
Age 29-31	369.41	-0.93	-1.51	-0.08
	(650.80)	(0.43)	(0.80)	(0.27)
Age 32-34	225.99	-2.10	-2.13	-0.16
	(631.78)	(0.42)	(0.78)	(0.26)
Age 35-37	206.47	-2.25	-2.78	-0.02
	(626.25)	(0.42)	(0.77)	(0.26)
Age 38-40	851.98	-2.77	-2.70	0.13
	(623.45)	(0.42)	(0.77)	(-0.26)
Age 41-43	1,071.61	-2.99	-2.83	0.14
	(631.96)	(0.42)	(0.78)	(0.26)
Age 44-46	2,327.15	-2.89	-2.28	0.28
	(649.16	(0.44)	(0.80)	(0.27)
Age 47-49	3,065.48	-2.85	-2.70	0.29
	(665.11)	(0.45)	(0.82)	(0.28)
Age 50-52	4,629.98	-2.70	-2.22	0.27
	(682.02)	(0.46)	(0.84)	(0.29)
Age 53-55	5,098.81	-2.76	-2.77	0.24
	(699.78)	(0.47)	(0.87)	(0.29)
Age 56-58	5,027.30	-2.62	-3.14	-0.01
	(715.47)	(0.48)	(0.89)	(0.30)
Age 59-61	4,577.61	-2.56	-4.30	0.05
	(734.28)	(0.49)	(0.91)	(0.31)
Age 62-64	2,986.55	-2.79	-5.55	-0.13
	(746.93)	(0.50)	(0.93)	(0.31)
Age 65-67	2064.90	-3.67	-6.23	-0.76
	(750.51)	(0.50)	(0.93)	(0.31)

—continued

Appendix table 1—Estimated Tobit models—continued

	Income	Food at home	Food away from home	Meat, poultry, fish, and eggs
D84	-366.79	-0.23	-0.41	-0.09
	(172.40)	(0.11)	(0.21)	(0.07)
D85	187.53	-0.04	-0.13	-0.06
	(178.65)	(0.12)	(0.22)	(0.07)
D86	98.28	-0.03	0.24	-0.04
	(173.11)	(0.12)	(0.21)	(0.07)
D87	403.21	-0.05	1.04	-0.27
	(172.51)	(0.12)	(0.21)	(0.07)
D88	395.83	-0.07	0.59	-0.39
	(187.63)	(0.13)	(0.23)	(0.08)
D89	265.81	0.18	1.16	-0.09
	(184.65)	(0.12)	(0.23)	(0.08)
D90	606.66	0.13	1.02	0.03
	(184.65)	(0.12)	(0.23)	(0.08)
D91	-436.06	0.01	-0.67	0.19
	(182.98)	(0.12)	(0.23)	(0.08)
D92	-208.29	0.13	-0.16	0.10
	(185.18)	(0.12)	(0.23)	(0.08)
D93	141.03	0.03	-0.27	0.09
	(185.46)	(0.12)	(0.23)	(0.08)
D94	-377.96	-0.23	-0.79	-0.09
	(186.71)	(0.13)	(0.23)	(0.08)
D95	-174.62	-0.00	-0.32	0.14
	(186.46)	(0.12)	(0.23)	(0.08)
Probability of nonlimit	.88	.85	.76	.86

Standard errors in parenthesis

—continued

Appendix table 1—Estimated Tobit models—continued

	Cereals and bakery	Dairy	Fruits	Vegetables	Sugar and sweets	Beverages
Constant	1.61 (0.11)	1.84 (0.09)	1.02 (0.10)	0.84 (0.08)	0.10 (0.07)	1.24 (0.10)
Cohort 2	-0.15 (0.04)	0.07 (0.03)	0.01 (0.03)	-0.01 (0.03)	-0.03 (0.02)	0.00 (0.03)
Cohort 3	-0.31 (0.05)	0.19 (0.04)	0.01 (0.04)	-0.05 (0.03)	-0.05 (0.03)	0.10 (0.04)
Cohort 4	-0.47 (0.06)	0.35 (0.05)	0.02 (0.05)	-0.05 (0.04)	-0.05 (0.04)	0.17 (0.05)
Cohort 5	-0.58 (0.07)	0.55 (0.06)	0.08 (0.06)	-0.05 (0.05)	-0.03 (0.04)	0.22 (0.06)
Cohort 6	-0.71 (0.08)	0.73 (0.06)	0.16 (0.07)	-0.05 (0.06)	-0.06 (0.05)	0.26 (0.07)
Cohort 7	-0.93 (0.09)	0.79 (0.07)	0.25 (0.07)	-0.05 (0.06)	-0.07 (0.05)	0.27 (0.08)
Cohort 8	-0.90 (0.09)	0.91 (0.08)	0.38 (0.08)	0.02 (0.06)	-0.08 (0.05)	0.34 (0.08)
Age 29-31	0.10 (0.12)	-0.06 (0.10)	-0.03 (0.10)	0.04 (0.09)	0.08 (0.08)	-0.15 (0.11)
Age 32-34	0.25 (0.12)	-0.17 (0.10)	-0.05 (0.10)	0.01 (0.09)	0.14 (0.07)	-0.15 (0.11)
Age 35-37	0.40 (0.12)	-0.18 (0.10)	0.08 (0.10)	0.09 (0.09)	0.22 (0.07)	-0.01 (0.11)
Age 38-40	0.58 (0.12)	-0.22 (0.10)	0.06 (0.10)	0.14 (0.08)	0.27 (0.07)	0.00 (0.10)
Age 41-43	0.73 (0.12)	-0.28 (0.10)	0.05 (0.10)	0.21 (0.09)	0.30 (0.07)	0.00 (0.11)
Age 44-46	0.90 (0.12)	-0.27 (0.10)	0.16 (0.11)	0.33 (0.09)	0.31 (0.07)	0.06 (0.11)
Age 47-49	1.05 (0.13)	-0.31 (0.10)	0.18 (0.11)	0.38 (0.09)	0.33 (0.08)	0.06 (0.11)
Age 50-52	1.24 (0.13)	-0.34 (0.11)	0.35 (0.11)	0.46 (0.09)	0.36 (0.08)	0.08 (0.11)
Age 53-55	1.43 (0.13)	-0.40 (0.11)	0.32 (0.11)	0.54 (0.10)	0.38 (0.08)	0.04 (0.11)
Age 56-58	1.51 (0.13)	-0.50 (0.11)	0.37 (0.12)	0.62 (0.10)	0.41 (0.08)	0.03 (0.12)
Age 59-61	1.73 (0.14)	-0.48 (0.12)	0.45 (0.12)	0.65 (0.10)	0.43 (0.08)	-0.00 (0.12)
Age 62-64	1.80 (0.14)	-0.54 (0.12)	0.52 (0.12)	0.70 (0.10)	0.47 (0.09)	-0.13 (0.13)
Age 65-67	2.14 (0.14)	-0.66 (0.12)	0.58 (0.12)	0.75 (0.10)	0.52 (0.09)	-0.27 (0.13)

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Appendix table 1—Estimated Tobit models—continued

	Cereals and bakery	Dairy	Fruits	Vegetables	Sugar and sweets	Beverages
D84	-0.06	-0.06	-0.07	-0.01	-0.01	-0.01
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
D85	0.04	0.04	-0.03	-0.06	0.04	0.06
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
D86	-0.07	-0.09	-0.02	-0.06	-0.05	0.10
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
D87	-0.09	0.02	-0.01	-0.01	-0.04	0.03
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
D88	-0.08	0.04	0.12	-0.00	-0.04	0.02
	(0.04)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)
D89	0.09	0.11	0.05	0.07	-0.04	0.07
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
D90	0.05	0.04	0.02	0.02	0.02	0.04
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
D91	0.08	0.01	0.00	0.03	0.04	0.02
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
D92	0.10	0.02	0.06	0.02	0.04	-0.08
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
D93	0.06	-0.02	0.05	0.01	0.04	-0.03
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
D94	-0.07	-0.08	-0.08	-0.05	-0.02	-0.05
	(0.04)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)
D95	-0.10	-0.02	-0.07	-0.01	-0.02	0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)
Probability of nonlimit	.90	.89	.81	.82	.65	.80

Standard errors in parenthesis

—continued

Appendix table 1—Estimated Tobit models—continued

	Fats and oils	Miscellaneous prepared foods
Constant	0.26	1.57
	(0.05)	(0.13)
Cohort 2	0.01	-0.25
	(0.02)	(0.04)
Cohort 3	0.01	-0.46
	(0.02)	(0.06)
Cohort 4	0.04	-0.67
	(0.03)	(0.07)
Cohort 5	0.09	-0.90
	(0.03)	(0.08)
Cohort 6	0.09	-1.15
	(0.03)	(0.09)
Cohort 7	0.08	-1.50
	(0.04)	(0.10)
Cohort 8	0.13	-1.58
	(0.04)	(0.11)
Age 29-31	-0.05	0.02
	(0.05)	(0.15)
Age 32-34	-0.02	0.04
	(0.05)	(0.14)
Age 35-37	0.01	0.28
	(0.05)	(0.14)
Age 38-40	0.03	0.40
	(0.05)	(0.14)
Age 41-43	0.07	0.53
	(0.05)	(0.14)
Age 44-46	0.06	0.73
	(0.05)	(0.15)
Age 47-49	0.08	0.84
	(0.05)	(0.15)
Age 50-52	0.09	1.05
	(0.06)	(0.15)
Age 53-55	0.09	1.15
	(0.06)	(0.16)
Age 56-58	0.12	1.25
	(0.06)	(0.16)
Age 59-61	0.13	1.48
	(0.06)	(0.16)
Age 62-64	0.13	1.57
	(0.06)	(0.17)
Age 65-67	0.13	1.84
	(0.06)	(0.17)

—continued

Appendix table 1—Estimated Tobit models—continued

	Fats and oils	Miscellaneous prepared foods
D84	0.03	-0.04
	(0.01)	(0.04)
D85	0.04	0.08
	(0.01)	(0.04)
D86	-0.02	-0.07
	(0.01)	(0.04)
D87	-0.08	-0.10
	(0.01)	(0.04)
D88	-0.04	-0.06
	(0.02)	(0.04)
D89	-0.04	0.10
	(0.01	(0.04)
D90	0.02	0.11
	(0.01)	(0.04)
D91	-0.00	0.19
	(0.01)	(0.04)
D92	0.04	0.27
	(0.01)	(0.04)
D93	0.02	0.24
	(0.01)	(0.04)
D94	-0.02	-0.17
	(0.02)	(0.04)
D95	0.03	-0.23
	(0.01)	(0.04)
Probability of nonlimit	.69	.80

Standard errors in parenthesis

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