AGE PROFILES OF U.S. INCOME, CONSUMPTION, AND LIFECYCLE DEFICITS, 1888-2003

DRAFT

Gretchen Donehower
Department of Demography
University of California at Berkeley
2232 Piedmont Avenue, #2120
Berkeley, California, 94720-2120
gretchen@demog.berkeley.edu

Presented at the Population Association of America Annual Meeting
New York, New York
March 30, 2007

This research is part of the National Transfer Accounts project (www.ntaccounts.org), supported by the National Institutes of Health, NIA R37-AG025488 and NIA R01-AG025247. The author thanks Ronald Lee and Timothy Miller for their input and support. Many thanks also to Avi Ebenstein, who did much of the early work with the Consumer Expenditure Survey.

Age Profiles of U.S. Income, Consumption, and Lifecycle Deficits, 1888-2003
Gretchen Donehower
gretchen@demog.berkeley.edu
Population Association of America Annual Meeting
March 30, 2007

ABSTRACT

The lifecycle deficit – the difference between consumption and income at each age – is a basic problem of social and economic organization, indicating who needs resources and who has them to give. Thanks to a long-running series of surveys in the United States, we can observe the evolution of this aspect of economic life over a long period of time. Since the late 19th century, the federal government has been collecting data on the consumption and income of the non-institutionalized population using expenditure surveys. Supplementing this source with administrative data, we can construct age profiles of privately and publicly financed consumption of education, health, housing, and other current and durable consumption, as well as various sources of labor income and, ultimately, the lifecycle deficit. A final adjustment of the age profiles to known aggregate levels of economic activity from the National Income and Product Accounts generates a consistent time series of estimates with a common calibration.

The results show consistency and change. Not surprisingly, the basic pattern of consumption, income and lifecycle deficits is very consistent. Consumption at the beginning and end of life is higher than income, resulting in childhood and old-age lifecycle deficits. The relative size and age-range of those deficits has changed greatly over time, however. Early profiles of consumption and income are flatter than later profiles, resulting in smaller deficits at the childhood and elderly dependent stages. As time moves on, the beginning of the working years is pushed to later ages as people attain higher levels of education before entering the labor force. We also see earlier exits from the labor force as retirement becomes a possibility for older workers. Both of these changes result in a more peaked income profile, concentrated in the middle of life. At the same time, the increase in education consumption by the young and health-related consumption by the elderly raises relative consumption at these ages. The most striking change seen in the age profiles is seen in elderly consumption. Up until 1981, consumption decreases some time after age 60. After 1981, however, this downward slope changes to upward, rising with age due to health-care consumption increases, largely through the publicly financed Medicare program. On net, these changes in income and consumption result in much larger childhood and old-age lifecycle deficits at the beginning of the 21st century, compared to the end of the 19th. The surplus years when income is greater than consumption are concentrated into a smaller range of ages in mid-life.

Through examining the profiles, we see the evolution of the economy as it changed from manufacturing-based to service- and knowledge-based, with clear implications for the shape of the age profile of labor income. We also see the evolution of consumption over time as the government takes a larger role in providing certain goods to the young and old, paid for with taxes on workers. The net effect is a trend of increasing lifecycle deficits that do not appear sustainable in the long run.

Introduction

The National Income and Product Accounts (NIPA) are an accounting system that generates aggregate data on every type of economic activity in a nation, with varying levels of dis-aggregation. The accounts have been calculated for the United States back to 1929 and provide an invaluable resource for answering *how much* questions about the U.S. economy (http://www.bea.gov/bea/dn/nipaweb/index.asp). What if in addition to *how much*, we also want to know *whom*? We know that not everyone in an economy works for pay, so who in the economy generates the Gross Domestic Product? Who consumes it? The National Transfer Accounts (NTA) project (www.ntaccounts.org) seeks to answer a specific type of *how much* and *who* question - how much economic activity is being performed by each age group? What is the age shape of consumption and production, saving and dis-saving, receiving and giving transfers? The goal of the NTA project mirrors that of the NIPA in seeking to derive estimates for as many countries as possible with as much historical depth as possible. The NTA project has already produced published accounts of age-profiles for different countries and in different times (Lee, Lee and Mason, 2006; Mason et al., 2006; see www.ntaccounts.org for others), but this paper presents the longest time series of results for one country to come out of the project so far. Specifically, results on income and consumption are reported here for the non-institutionalized population of the United States, from the first available data in 1888 up to 2003. This long time series allows us to examine the evolution of the economic lifecycle in the United States.

The difference between income and consumption at each age gives the age profile of the lifecycle deficit. The lifecycle deficit is a basic problem of social and economic organization, indicating who needs resources and who has them to give. The way in which surpluses and deficits are worked out and needs are met across age groups impacts economic, political and social life (Lee, Mason and Miller, 2002). The age profiles and age structures prevailing in an economy combine to determine aspects of macroeconomic growth and generational equity, impacting economic and population policy (Mason, 1988; Gruber and Wise, 2001). Adding the longitudinal perspective of this paper, we can also consider the possible impact of continuing observed time trends or sustaining current levels of activity into the future. Another benefit of the longitudinal perspective comes in comparison with other countries. Do countries have similar longitudinal experiences? Do countries with levels of economic development or institutional structures similar to the United States in the past have similar age shapes of consumption, income and lifecycle deficit as the United States had at that time? If so, can we read the future of other societies in our own past longitudinal history?

This paper proceeds with a discussion of the theoretical focus, data and methods, and then results. As an orientation to the results, the pieces of the lifecycle deficit are first presented for the non-institutionalized population in 2003, the most recent year calculated. These results represent our current situation, where we have arrived after many years of economic development and social and political change. Longitudinal results are then presented, showing how we got here. The results tell a story of increasing deficits for older people as their labor income decreases and their spending on health through private and public sectors rises steadily. Deficits for the young rise as well, mostly in recent years because of later entry into the labor force for greater education. These deficits are financed through transfers from the income of working age people but also, in the most recent periods, through more non-labor income sources.

Increasing lifecycle deficits at the same pace observed in this paper are certainly not sustainable. Increasing use of some of the sources for funding these deficits, such as foreign borrowing, is also unsustainable in the long run.

Theoretical Focus

As mentioned above, this work is part of the National Transfer Accounts (NTA) project, a global research effort to estimate economic flows across age groups that arise primarily because children and the elderly consume more than they produce, relying on transfers from the working ages or other reallocation of resources. NTA methods links with the National Income and Product Accounts (NIPA) system, a well-established accounting of national economic activity. Using current and historical NIPA totals for labor income, consumption, government spending, and many other types of economic activity, the NTA project's contribution to our understanding of economic life is to disaggregate these totals by age group. An additional focus of the NTA project is to specify the institutional channels through which transactions flow (governments, markets and families) and the forms of the flows (asset-based transactions versus transfers). The project is linked with long-standing areas of research in economics and generates empirical data that can be used to evaluate the lifecycle theory of consumption, microeconomic models of labor force participation, and studies of productivity differentials within the labor force. It also relates to demographic research on dependency ratios, family co-residence, and changes in life histories over time.

This paper focuses on the sub-set of accounts that make up the lifecycle deficit – the difference between labor income and consumption at each age. Labor income and consumption are made up of components defined by their sources and uses. Labor income has three components: labor earnings (i.e. wages and salary income), fringe benefits such as employer-provided health insurance, and self-employment income. Consumption is comprised of four private consumption components related to health, education, the flow-value of durables,[1] and "other," plus three public consumption components related to health, education, and "other." When we observe cross-sectional estimates of income and consumption, we see the choices and constraints that define our economic lives. On the consumption side, choices of how much to consume and in what proportions are determined by needs, wants and tastes. They are constrained for each individual by his own income and his ability to sell or borrow resources, or obtain transfers. They may also be constrained by the individual's obligation to give transfers. For labor income, we see the choices of how much to work and at what type of job, constrained by the ability to work, the availability of employment, and the necessity of obtaining training for specific types of employment. Wages can be both a choice and a constraint – a choice to specialize in types of employment based on the wages of that type of employment, and the constraint of prevailing wages across the economy. All of these factors come together in the lifecycle deficit. The lifecycle deficit and its components form the basic problem, which must be solved through asset-based reallocations and transfers. The work presented here thus attempts to describe the economic needs that gave rise to our current intergenerational transfer system. This work is

[1] The flow value is the amount of services provided by a durable in a time period. This is used as the amount of consumption of that durable, rather than the purchase price. For example, the amount of owned housing consumed in a period would be the equivalent rental value of the property rather than the purchase price in the period it was purchased, or any amounts paid on the mortgage if purchased with credit.

essentially descriptive rather than causal, as the shapes of related age profiles and their changes over time are certainly not independent of one another.

Note also that this work takes the individual as its unit of analysis, rather than the household or the nation. Much economic activity happens within the household and much of it is transfer-based, as when parents transfer resources to dependent children. Observing economic activity at the household level would miss all of these important transactions. The difficulty of looking within the household, however, arises because most consumption data are gathered at the household level. Many assumptions are necessary, therefore, to estimate individual levels of economic activity when only household totals are given. Specifics are given in the methodology discussion.

Finally, although the results here are presented with age along the x-axis, it is important to remember that this is age in the cross-sectional or period sense, rather than the longitudinal or cohort sense. While it is possible to construct cohort-based profiles with the repeated cross-sections data, that is not the focus here. Data are presented as repeated cross-sections so that the focus remains on the allocation of resources across individuals alive at a given time. Although it is tempting to read across the graph as the life experience of one person, the results here reflect only the life experiences of a group of individuals of different ages.

Data and Methods

General Principles

The methodology used to construct the estimates presented here are discussed generally and then in detail, but more detailed information is available on the NTA project website, www.ntaccounts.org. To give the most general description, developing an age profile in the NTA project has three main components: calculation of age-specific means, smoothing and adjusting to NIPA aggregates.

First, the age shape for the profile is found using a data source that indicates relative amounts of the particular economic activity by age. Ideally, survey data is available which indicates the amount of activity for each individual in the household. This is most often the case for labor income. If only household-level amounts of a particular activity are available, some method must be used to allocate the household total to individuals within the household. For some types of economic activity, such as public education consumption, survey data is not sufficient and administrative data is used. Once individual-level allocations are found, age-specific averages form the age shape.

The first step results in a series of age-specific means which can have a great deal of noise, depending on the size of the survey and the number of respondents in each age group. The second step in producing age profiles is to smooth the age-specific means. The usual NTA methodology is to use a local regression model smoother, but that method is computationally intensive and was not feasible for the long time series of data here. Instead, a cross-validation smoother is used, with the number of individual observations in each age-specific mean used as weights. In practice, using both types of smoothers on a few series yielded similar smoothed

results, but future iterations of this work will change the smoother to the local regression method. The smoothed lower-level components are summed to make the higher-level series.

Third and finally, the resulting age shape is adjusted up or down so that its implied population aggregate matches that measured by the Bureau of Economic Analysis following NIPA methodology. The NIPA aggregates are referred to as control totals. The adjustments are necessitated by slight differences in survey age distributions compared to population age distributions, by the necessity of using proxy variables for some profiles, and by biases in answering survey questions. The effects of any biases that are not age-specific will thus be eliminated from the estimates. Age-specific biases, however, will still color the results to some degree. Barring this, the adjustment to control totals means that all profiles are in proper ratios to one another, facilitating comparison across different contexts and types of economic activity. Adjustment to control totals is also important because profiles are built up from components. Adjustment of the lowest-level components to control totals insures that they are in the correct ratios before summing to higher-level components. Adjustment to control totals is done separately for smoothed and unsmoothed series, though in practice the adjustments are almost identical because of the functioning of the smoother. With a few exceptions, only the smoothed, control total-adjusted series are presented in this paper.

Data

Most of the age shapes shown in this paper are estimated from household-based Consumer Expenditure Surveys (CEX) or their early precursors. The surveys for 1888, 1917, 1935, 1960, and 1980 up to the present contain enough data to estimate most of the profiles that are examined in the paper. The annual CEX from 1980 on is a nationally representative sample of the non-institutionalized population. The early surveys, however, present some difficulties in analysis due to their irregular sampling frames, or having no real sampling frame at all.

The 1888 sample pre-dates the regular Consumer Expenditure Surveys, with the study title "Cost of Living of Industrial Workers in the United States and Europe, 1888-1890." The European sample is dropped for the current research. A sample of industrial workers from nine industries was taken, with information gathered about the workers and their families. The only family members appearing in the household rosters are spouses or own children. There are no other family members or non-relatives present in the data as given. There is no record in the sampling process that non-nuclear households were specifically excluded from the sample, but that is in fact what seems to have happened. It is possible that other people were present but no information was given about them, or that part-time residents were not recorded, but there is no record of either occurrence. Thus, this sample misses out on any person outside of the life-stage of the nuclear family. Young people in pre-family formation years are excluded, as are elderly persons not working. This constrains the interpretations we can make about the results from 1888, but does not preclude using them for comparison. The Bureau of Labor Statistics took another survey in 1917, calling it the "Cost of Living Survey." This time the sample was of the households of married wage earners or salaried workers in 99 industrial locales around the country. Relatives other than spouse or children appear in the households in this sample, as do a few non-relatives. Thus, while we do miss rural persons in this sample and unmarried workers who are not in the household of a married worker, we do get a more representative sample of the

elderly population. Extended families and elderly co-residence with adult children was much more common in the early 20th century than it is today (Stockmayer, 2004), so it is important to be able to include them as much as possible.

By the time of the "Study of Consumer Purchases in the United States, 1935-1936," the sample was of all families in the United States, rural and urban, excluding only families in which the household head was not native-born. The current Consumer Expenditure Survey series begins in 1960, with a household sample drawn, excluding only persons living in institutions. Overall, the main aspects to keep in mind when comparing across time are in the first two samples. Because of the way the samples were drawn in the 1888 and 1917 surveys, we miss young persons in between leaving the parental home and establishing their own family home. In addition in 1888 we also miss the non-working elderly co-residing with family members or non-family members.

As mentioned above, all of the surveys exclude the institutionalized population. While for most age groups, this is only a small portion of the population, for some age groups in some years, this is a much larger exclusion. Figure 1 shows the proportion of each five-year age group in any type of group quarters which includes nursing homes, prisons, mental institutions and any residence with five or more non-related persons living there. By 1960, a large proportion of the elderly were residing in institutions and our data cannot pick them up. Future work on this project involves the integration of this population's profiles, along with their distinctive levels of consumption of health care and very low profile values for other types of economic activity. It is interesting to note the growing share of young persons in institutions as of 2000. This reflects the recent rapid growth in the US prison population. While it is still a small proportion of the age group overall, its growth in recent years warrants careful consideration of how to incorporate them into the overall age profiles.

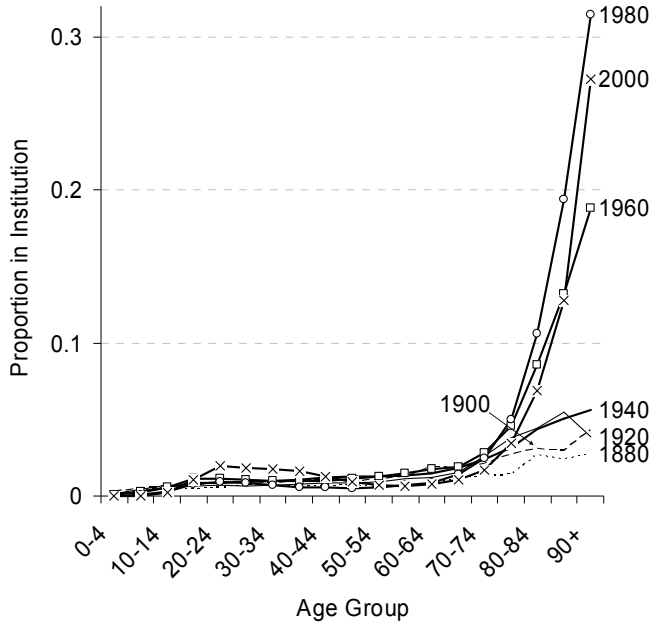

Figure 1. Proportion of five-year age group living in an institution, by census year. Author's calculations from the Integrated Public Use Microdata Samples (IPUMS.org; Ruggles et al.,2004).

In addition to the CEX, some other sources of data are necessary. Publicly provided consumption cannot be estimated from household consumption surveys because households do not pay for the consumption themselves, and so have little information on its costs. For consumption of public education and health, administrative data are used. Specifically, school enrollments or health program participation by age are combined with information on the public health and education budgets to estimate the age profile of consumption of publicly provided health and education services. Publicly provided "other" represents public goods including national defense and other non-age allocated government services. These amounts are calculated from government budget records.

The final data piece is the control totals. These come from the NIPA framework implemented by the Bureau of Labor Statistics, with some adjustments to fit the accounting items into the transfer framework. This series of data reaches back to 1929. The totals for 1917 and 1888 that are used here are created by continuing the annual change seen from 1930 back to 1929 back in time to 1917 and 1888. This is unimportant in some ways, but contains a strong assumption as well. Most of the comparative results shown here are scaled to an average labor income measure, making the overall dollar values irrelevant. It does make the strong assumption, however, that the relative size of different types of control totals remains fixed from 1929 back to 1888. For example, it assumes that at the aggregate level, the ratio of public to private consumption was the same in 1888 and 1917 as it was in 1929.

Age-Profile Specifics

Different types of profiles require different techniques to estimate age shapes. Labor income is the most straightforward. For wages or labor earnings, all of the CEX surveys used here give individual-level earnings information for each individual in the household. We know each individual's age as well, so calculating the age profile is a simple average of the individual labor earnings by age. For self-employment income, some surveys give individual-level amounts, but others give only total household self-employment income and the ages of those in the household who are self-employed. In this case, a regression technique is used similar to that of Attanasio et al. (1999). A regression equation is estimated with the number of self-employed by age group in each household as the independent variables and total self-employment income for the household as the dependent variable. The age group coefficients generated are used as weights to apportion the total self-employment income in the household to self-employed members. Age shapes can then be calculated from the apportioned amounts. For fringe benefits such as employer-provided health insurance premiums, for those years where these quantities are not measured directly for individuals, we look for some individual-level variable thought to be roughly proportional to the individual shares. Fringe benefits are probably distributed in the household in rough proportion to the wage or salary income of full-time workers. That is used to calculate the age-shape, which is then adjusted to the appropriate level using the control total for fringe benefits. Recall that the process of adjusting to control totals means that it is not necessary to measure the exact quantity in question, just to get a good estimate of its age shape.

Data on private consumption is given at the household level exclusively. Its apportionment is largely accomplished using consumer weights. Consumption of individuals living within any household is assumed to be proportional to an equivalence scale that is equal to 1 for adults aged

twenty or older, declines linearly from age 20 to 0.4 at age 4, and is constant at 0.4 for those age 4 or younger, as shown in Figure 2. For example, total consumption in a household with two parents over age 20 and an infant would be divided up by 1, 1, 0.4 respectively, or 41.7% for each of the adults and 16.7% for the infant. This method is very similar to that suggested by Deaton (1997), but with a smooth change in the weights from age 4 to 20 instead of a step function.

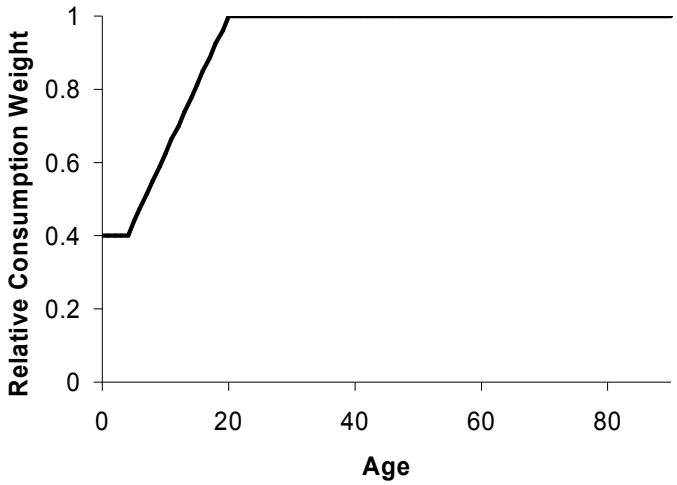

Figure 2. Relative consumption weights used to divide some types of household consumption among household members.

Some categories of private consumption tend to be specific to certain age groups, however. In these cases, such as education and health consumption, regression techniques similar to the self-employment regression are used. The amount spent on private health care is allocated using the same regression technique described for the self-employed, although all persons are included (only those designated as self-employed are included in the self-employed regression). Unfortunately, there is no other data that would help indicate which persons in the household were doing the consuming. With education, the most reliable estimates would come from only including those enrolled in school in the regression estimation, but none of the CEX surveys has enough consistent data on current enrollments to allow for this technique. Instead, the regressions are separated by age group to take advantage of the reporting of education spending by different types: primary or secondary, post-secondary, and other (mostly adult education programs or specific types of job training). The regression that generates the weights to allocate spending on primary or secondary education includes ages 4-17. For post-secondary, ages 18-39 are included. All ages are included for other private education spending. While this technique does generate a two-humped profile as we would expect for the relatively large private spending on pre-school and then college, there are many concerns with this technique. First of all, the private education spending amounts at the household level probably do not include amounts received as grants, and how families would account for spending through education loans is unclear. We would like to count these amounts as consumption, but if the household does not feel the costs of that consumption, it may not give an accurate estimate of it in the survey. Also, many parents are spending money on college students who are not in the household but living

outside of the parental home. In this case, the regression technique may incorrectly attribute that spending to younger siblings. The final control total adjustment helps to correct some of the estimation problems, but it will not fix a problem of underestimating spending on college students relative to pre-school students. Future iterations of this work will incorporate outside estimates of private education consumption to address these problems.

As mentioned above, public consumption categories must be estimated outside of the household, as they constitute expenditures that the household does not make itself and would not be able to estimate accurately for a survey. Age-specific expenditures and age-specific utilization of public education and publicly provided medical care programs are estimated from administrative data sources. Age profiles of publicly provided or financed health care in the US (Medicare, Medicaid, and other public programs) are based on age estimates from the Medical Expenditure Panel Survey (http://www.meps.ahrq.gov/). That age profile, calculated on data from 1996 to 2003, is used for all years of Medicare and Medicaid operation, adjusted up or down so the aggregate consumption is equal to the control totals (the total budgets of those programs). For government spending on public goods, each person is understood to have an equal share of the control total regardless of age, creating a constant per-capita age profile.

Results

The Economic Lifecycle in 2003

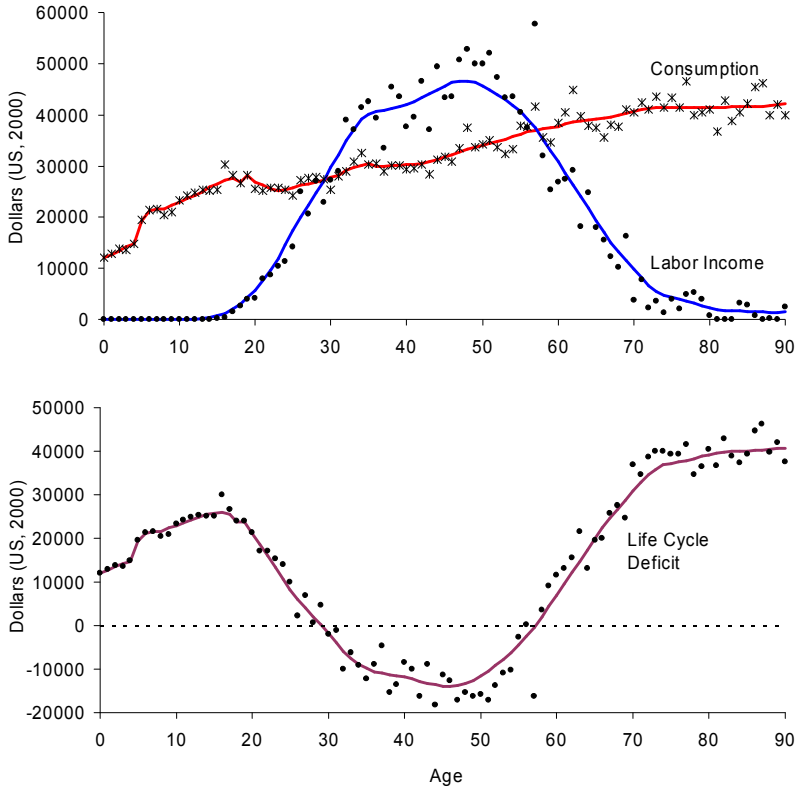

Figure 3. Smoothed and unsmoothed age profiles for consumption, labor income and the lifecycle deficit for the non-institutionalized population of the United States in 2003. All units are in year 2000 constant dollars.

To begin, Figure 3 shows consumption, labor income, and the lifecycle deficit for 2003, the most recent year presented. The age-specific means are plotted as points, with the smoothed series as lines. Including the unsmoothed data gives some indication of the variability of the estimates, which for 2003 seems fairly consistent over age, although larger for labor income in the peak earning years. Later we will see variability increases with age for some of the earlier samples. Consumption rises steadily over the age range, with a discontinuity at young ages due to education consumption. Labor income has a familiar inverted-U shape, combining both the increasing and then decreasing labor force participation with age, as well as an increase and decrease in wages with age, on average. The inverted-U shape of labor force participation will be examined more closely in the discussion of longitudinal results. The difference between the two curves is the lifecycle deficit, shown in the bottom panel. Note that the first year of surplus instead of deficit is 30, and from surplus back to deficit the age is 57. The 27-year width and small depth of the surplus area in mid-life appears dwarfed by the two areas of deficit in childhood and old age. These areas must also be weighted by population to see if there is an overall imbalance between surplus and deficit, of course, but it is very striking to note that the consumption of the average 90-year-old is found to be almost equal to the labor income of a prime working age adult.

In the United States, we know that lifecycle deficits in youth are financed very differently from those in old age. The young receive most of their education consumption through the government, with almost all of the rest of the childhood deficit being financed by parents. The government does make some other transfers to poor children, but most of the consumption of children is provided by parents within the household. For the elderly, there is a large mix of sources to finance the lifecycle deficit. The elderly receive public transfers through Social Security and other programs for the elderly. They spend their own savings and receive private pensions, and there is still some role for private family (or non-family) transfers to elderly persons (Mason, et al., 2006). This most likely occurs through co-residence with their adult children. Note this discussion leaves out all notions of the time transfers that family members and others make to dependents. While those transfers are certainly vast, we consider only monetary consumption, income and transfers in this discussion.

Figure 4 displays the composition of the labor income and consumption curves. The vast share of labor income is made up of wages and salaries (labor earnings) with self-employment income and fringe benefits representing much smaller portions. Comparatively, the self-employed income goes to slightly older workers than labor earnings – the labor earnings profile peaks at 47 while the self-employment income profile peaks at 51 and has a larger right-hand side tail. Fringe benefits make up a sizeable portion of the total, with a very similar age distribution to labor earnings. On the consumption side, two types of consumption have obvious age-shapes. Public and private education are mostly consumed by those below age 25, while health consumption grows beginning in the middle-age years and is a very large component of total consumption at the oldest ages. Other private consumption plus consumption of services from durables (including owned homes) together have a hump-shape, with consumption rising from childhood and declining after about age 60.

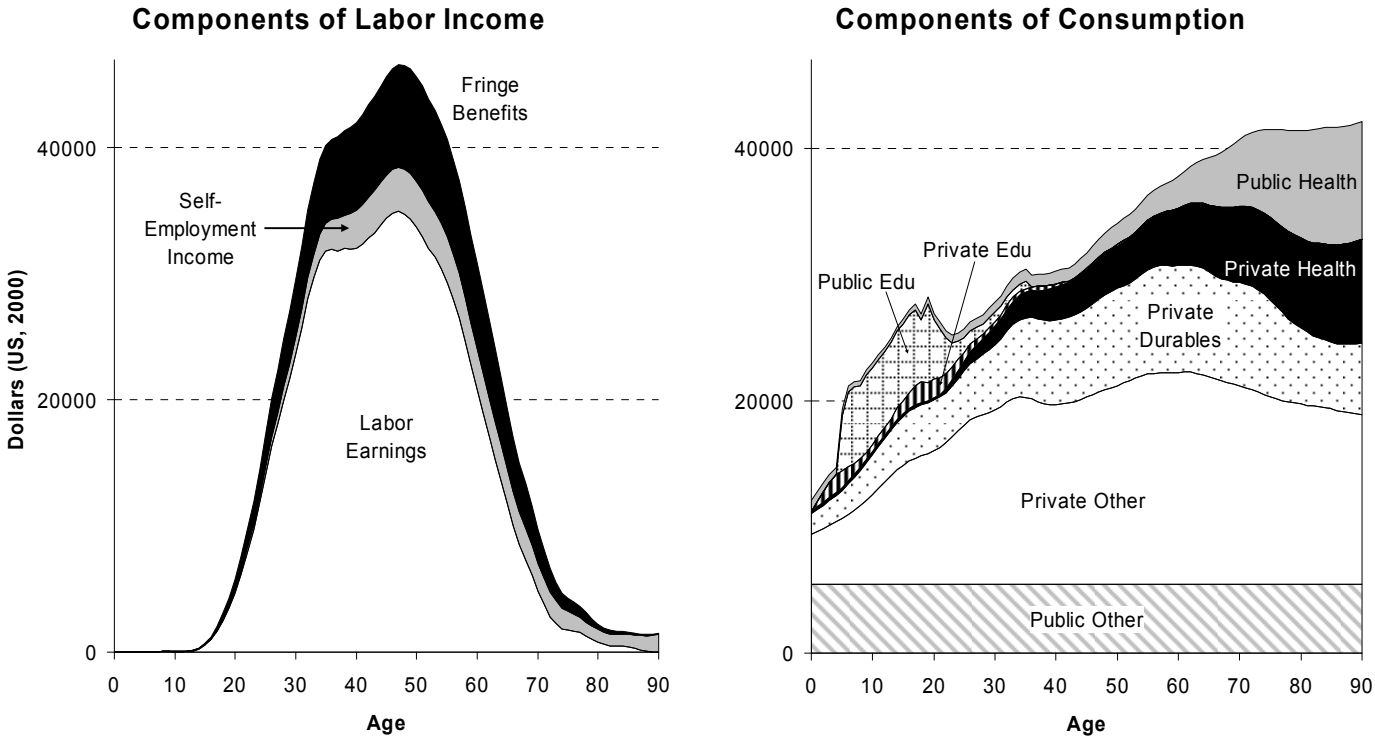

Figure 4. Smoothed age profiles for consumption and labor income showing the composition of each, United States non-institutionalized population, 2003. All units are in year 2000 constant dollars.

What causes the observed age shapes? Labor earnings are low at the beginning of life but begin to rise as human capital is accumulated. The downward trend in old age could be the product of increasing frailty driving down potential wages and ability to work, the erosion of returns to human capital that may become out of date in a fast-changing economy, or the increasing opportunity cost of work when public and private pensions are available to supplement income. For the case of consumption, it is understandable that education and health-related consumption are age concentrated. Education is necessary before entering the labor force and health care is more important during old age when health problems are more likely to occur. Looking at other types of consumption by children, our consumer equivalence scale has "baked in" a certain degree of increasing private consumption by children because after age 4 their value in the equivalence scale increases. Additionally, children have to share household resources with parents and other siblings, reducing their share compared to an adult living alone or a married couple with children even if the consumption weights were constant by age.

Longitudinal Consumption, Labor Income and Lifecycle Deficits, 1888-2003

The top panel of Figure 3 is repeated in Figure 5 for a group of years spanning the available data. There is annual data available between 1981 and 2003, but to keep things visually manageable, only those two years are shown. First note that the pre-1960 samples require much more smoothing, especially at the oldest ages, than the later years. Recall also that the 1888 and 1917 samples are very different from the others, missing some life stages. The sharp elbow after age 20 in the consumption shapes for these two years is probably due to the fact that these samples

are missing the life stage in between leaving the parental home and the establishment of a new family household. We see in the 1888 and 1917 elbows, then, the consumption changes caused by a direct exit from the parental household where consumption for a young person is relatively low to a period of higher relative consumption when a new household has been established but before there are many children claiming a share of resources. The high labor income of the elderly in the 1888 sample may be due to the fact that the only elderly included in the sample are those still working. However, we do include non-working co-resident elderly in the 1917 and 1935 sample and we still observe relatively high labor earnings even at very old ages. As mentioned before, we are not including institutionalized elderly in this picture, but we also know from Figure 1 that there were not that many of them to include in the first three samples. So, it may have been the case that many more elderly worked in these years before Social Security or the widespread availability of pensions. If you were still alive, you still needed to work. Contrast this to the samples from 1960 on: those aged 70+ were making very little labor income, mostly because they were not working much if at all.

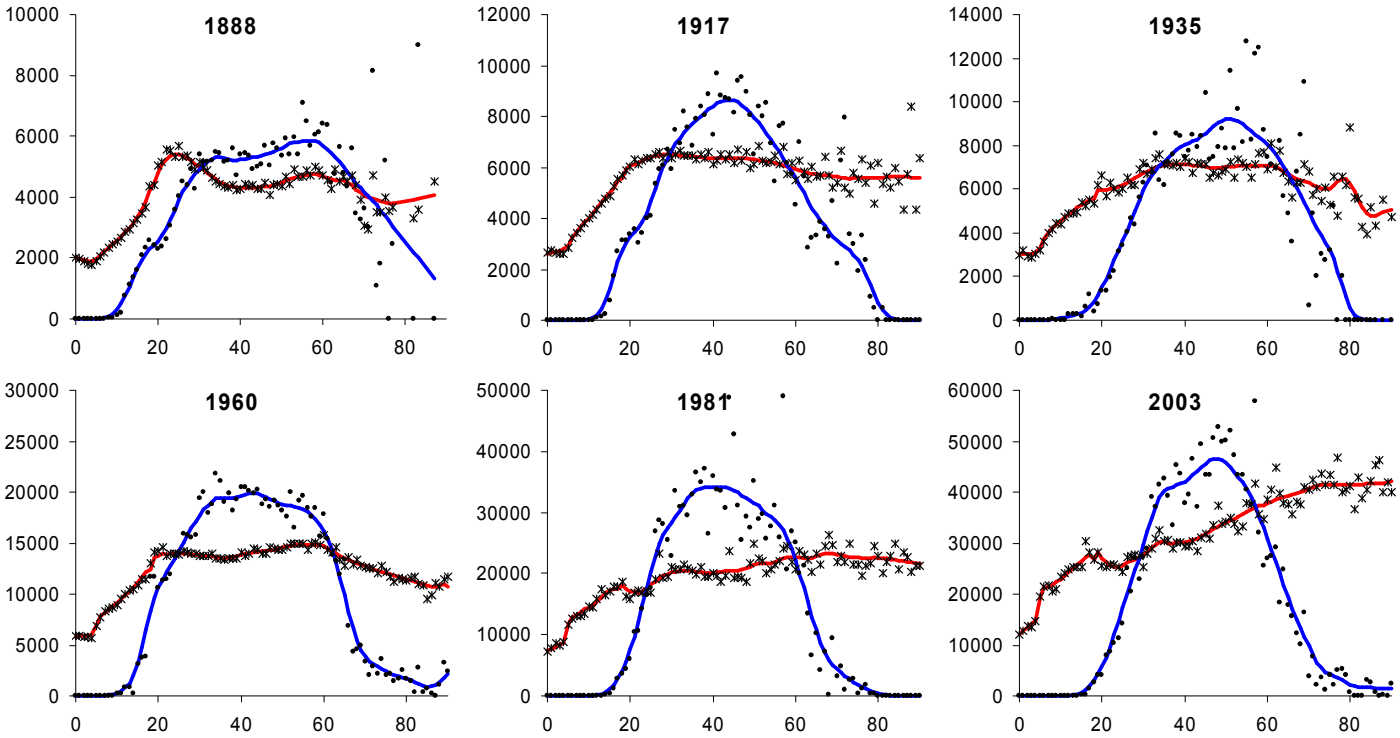

Figure 5. Smoothed and unsmoothed age profiles for consumption, labor income and the lifecycle deficit for the United State, 1888-2003. All units are in year 2000 constant dollars

At the earlier end of the age spectrum, we see the age of entry into the labor market when the labor income curve turns sharply upward happening at later and later ages, with the exception of 1935. The devastated labor market that marked the Great Depression seems to have been excluding younger workers to a large extent at this time. Excepting the Great Depression, however, the march of time was one of later entry into the labor force and lower pay for those entering the labor force young but without much education. Taking these two trends of younger exit and older entry to the labor force, the overall profile becomes more peaked and concentrated.

One way to gain confidence in the age and time trends of labor income is to find alternate data sources to estimate the profiles. While there is no time series of age-specific labor earnings available for direct comparison, the decennial U.S. Census samples gathered in the Intergrated Public Use Microdata Samples (ipums.org; Ruggles et al., 2004) offers a long time series of labor force participation by age. Unfortunately, the definition of labor force participation changed in 1940 in a way that most likely effects the data for women, so only the male labor force participation is comparable over a long time period. Figure 6 shows male labor force participation for 5-year age groups (with the exception of the first age group which is for ages 16-19 because the data was not gathered for 15-year olds for all years) for Census samples every 20 years from 1880 to 2000. It is clear from this graph that labor force participation at the oldest and youngest ages used to be much higher than it is today. We also see some indication that the trend toward lower labor force participation at oldest age has reversed slightly between 1980 and 2000.

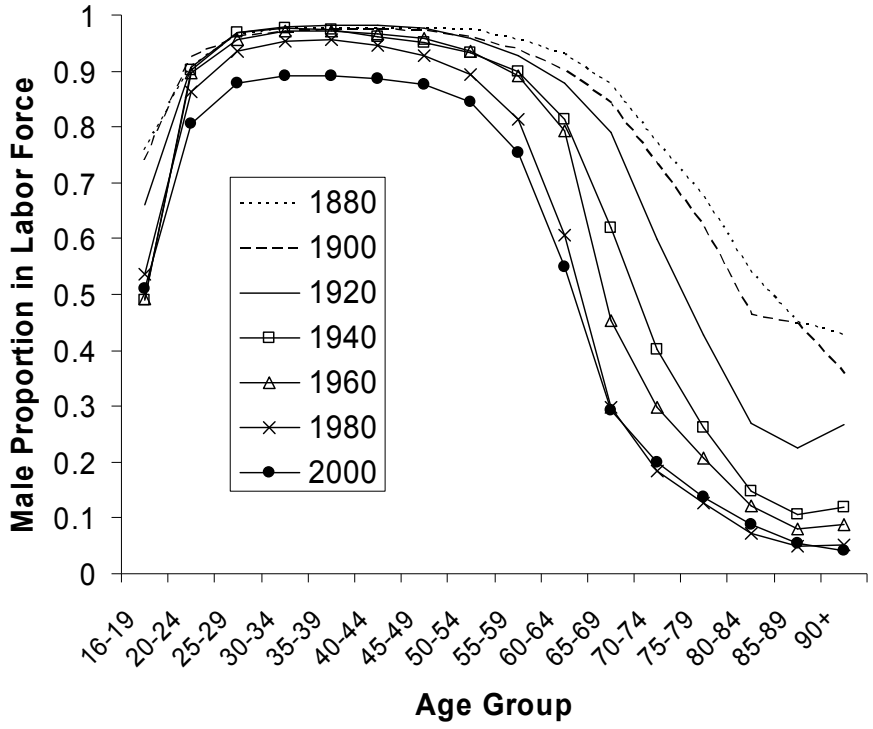

Figure 6. Proportion in labor force of non-institutionalized males by five-year age group and census year. Author's calculations from the Integrated Public Use Microdata Samples (IPUMS.org).

Going back to Figure 5 to examine the consumption profiles, we mentioned the possible sample distortions causing the "elbow" effect in 1888 and 1917, but they are consistent overall with the hump shape consumption curve seen in 1935 and 1960. By 1981, the downward part of the hump shape at oldest ages is almost gone and in 2003 the curve turns to an unprecedented constant increase, with the oldest individuals in the sample consuming almost as much on average as the average peak-earning adult is bringing home in labor income.

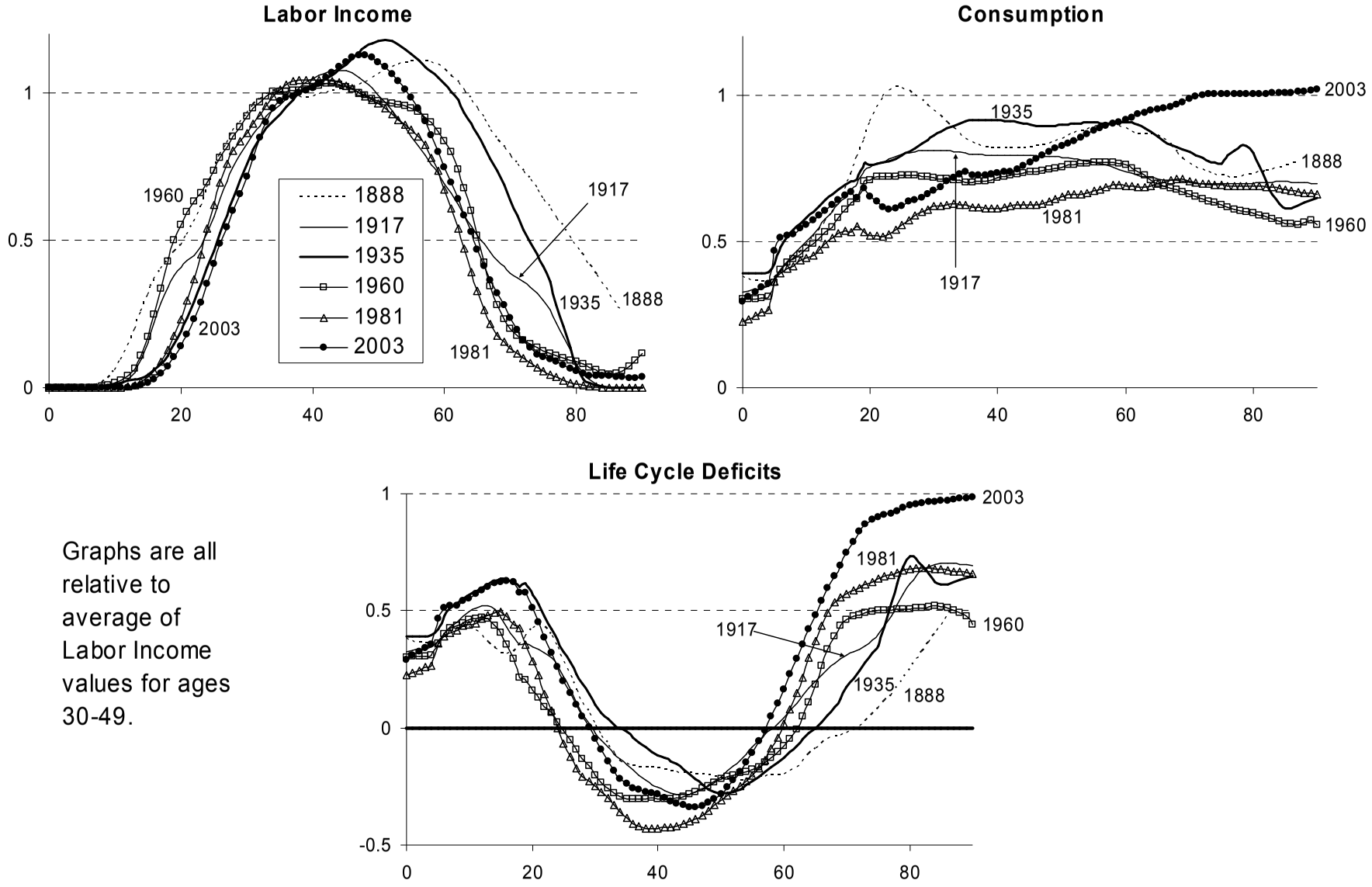

Figure 7. Labor income, consumption and lifecycle deficits, United States non-institutional population, 1888-2003. Values are scaled to the average labor income profile value for ages 30-49. Note that the earlier years are plotted with lighter lines and no plotting characters, the later years with plotting characters.

It is easier to compare age shapes when the profiles appear on the same graph, so the rest of the age profile graphs will appear scaled to the average level of the labor income profile for ages 30-49. This takes out the effect of productivity growth raising living standards over time while avoiding age effects that would confuse a standardization on per capita income. Figure 7 shows plots of consumption, labor income and the resulting lifecycle deficit on the relative scale. On the labor income plot, we see the early labor market entries in 1888 and 1917, along with the shift to much later in 1935. The post-war manufacturing boom can be seen in the early labor market entry and high wages for young workers of 1960, but for 1981 and 2003, the change is to later ages of labor market entry and a steeper rise with age once work begins. At later ages, we see very clearly how older people in the first three time points were still working at very old ages, and how the shape changes dramatically starting in 1960. Interestingly, we see some reversal of this trend from 1981 to 2003, supporting recent findings that the trend towards earlier ages of retirement has stopped or even reversed (Norris, 2006). Why this has happened is still unclear. There are many factors that might be contributing to this change. Older workers may now be healthier and able to work longer. They may have found they have not saved enough to live on now that the generous private pension systems of the past are no longer available. The wages on offer for older workers may have improved, making it more attractive to keep working after the usual retirement age. Since 1962, the growth of average wages of those working (so stripped of the effect of changing labor force participation) has grown faster for those age 70+ than for those aged 25-54 (author's calculations from the Current Population Survey, King et al., 2004). Perhaps healthier workers command better wages and the elderly are now healthier, or older workers have become more valuable in the workplace.

On the consumption side, the change in shape of the curve from the hump shape of 1888, 1917, 1935 and 1960 samples to the flat or constant rise of the 1981 and 2003 sample is clearer. The picture is somewhat muddied, however, by the fact that overall consumption was relatively lower than labor income in 1981 and 1960 compared to the other years on the chart.

Finally, the resulting lifecycle deficit graph produces a strong result – lifecycle deficits at the oldest ages have changed a great deal, increasing steadily over a period of time when the numbers surviving to these ages has increased steadily as well. In mid-life, notice that the current deficit profile in 2003 matches most closely that of 1917, a year in which deficits at older ages and, to a lesser extent, younger ages were smaller. At younger ages, we see much more continuity over time in the overall deficit than at older ages, even while consumption of public education increased steadily. This more constant size of childhood lifecycle deficits over time may suggest some quantity-quality trade off: recent childhood deficits with fewer children per household and large education consumption are similar in size to past deficits in periods where many children per household shared resources but did not receive as much education.

A mysterious result shows up in the lifecycle graph at youngest ages, looking at the age where deficit changes to surplus. That age is latest for the earliest samples, even while they were working and making money at younger ages. The answer must be that they were consuming relatively large amounts, but how was this consumption financed? We know that these individuals are too young to have had the chance to save very much, so it seems unlikely that they are living off of savings. We know the government was much less involved in transfer

programs during these years than it is now, and that these people are too young to be drawing army or other civil service pensions. Their consumption must be financed then by transfers from outside the household, most likely from other relatives. This seems unlikely, but perhaps intrahousehold exchanges played a more important role in family formation and risk management processes in this early period. Of course, another explanation for this mystery is that the profiles are misestimated. There are several ways this may have happened. We have already mentioned the problems with the early samples, but it is possible also that there were other family members not recorded in the survey who were consuming household resources but were not counted in the allocation if they were not full-time residents. Alternately, younger householders may have had greater downward bias in their estimates of income or upward bias in their estimates of consumption compared to older householders.

Composition of Consumption and Labor Income, 1888-2003

Figures 8 and 9 show the composition of the labor income and consumption profiles, scaled to the average labor income profile from age 30-49 as in Figure 7. Observing the grey area representing self-employment income, it is interesting how much self-employment income we see in the early samples compared to the later samples. Even for the first two samples which include industrial workers and their families only, there is a lot of self-employment income. Much of this income was home production, goods made at home by the wife and children and sold for extra cash. The early surveys show that animals such as chickens, pigs and goats were raised at home and sold, produce raised by the household was canned and sold, and some services were performed in the home like washing and mending or repairing items. Early on, the amount of fringe benefits received, shown in black on the plots, was very low but it grows to a significant portion of labor income by 2003. This move away from self-employment income to fringe benefits as the major non-wage source of income has definite age-shape consequences. As the older-age tilt of self-employment earnings goes away, the peak age concentrated fringe benefits take over. The curve becomes much more concentrated in the peak earning ages of 30-60.

The composition of consumption shown in Figure 9 shows a great deal of change over time. As mentioned before, the height of each stacked up chart is determined by the relative size of overall consumption compared to labor income, but the shapes and shares are the pieces to keep in focus. We see the rise of public education spending over time, and private education as well, although it is much smaller than the average public education consumption. The difference in public and private shares is probably overstated at the level of post-secondary education. (See the discussion in the methods section on possible sources of underestimation of spending on private college students.) Private health-related consumption at older ages rises rapidly from mid-20th century to the present. In the earliest samples, the largest levels of private health consumption are seen in the mid-adult years. This may have been money spent on women having children, or money spent to maintain the health of the main breadwinners in the household. By the end of period, health care consumption is a much higher share of total consumption and is concentrated at the oldest ages.

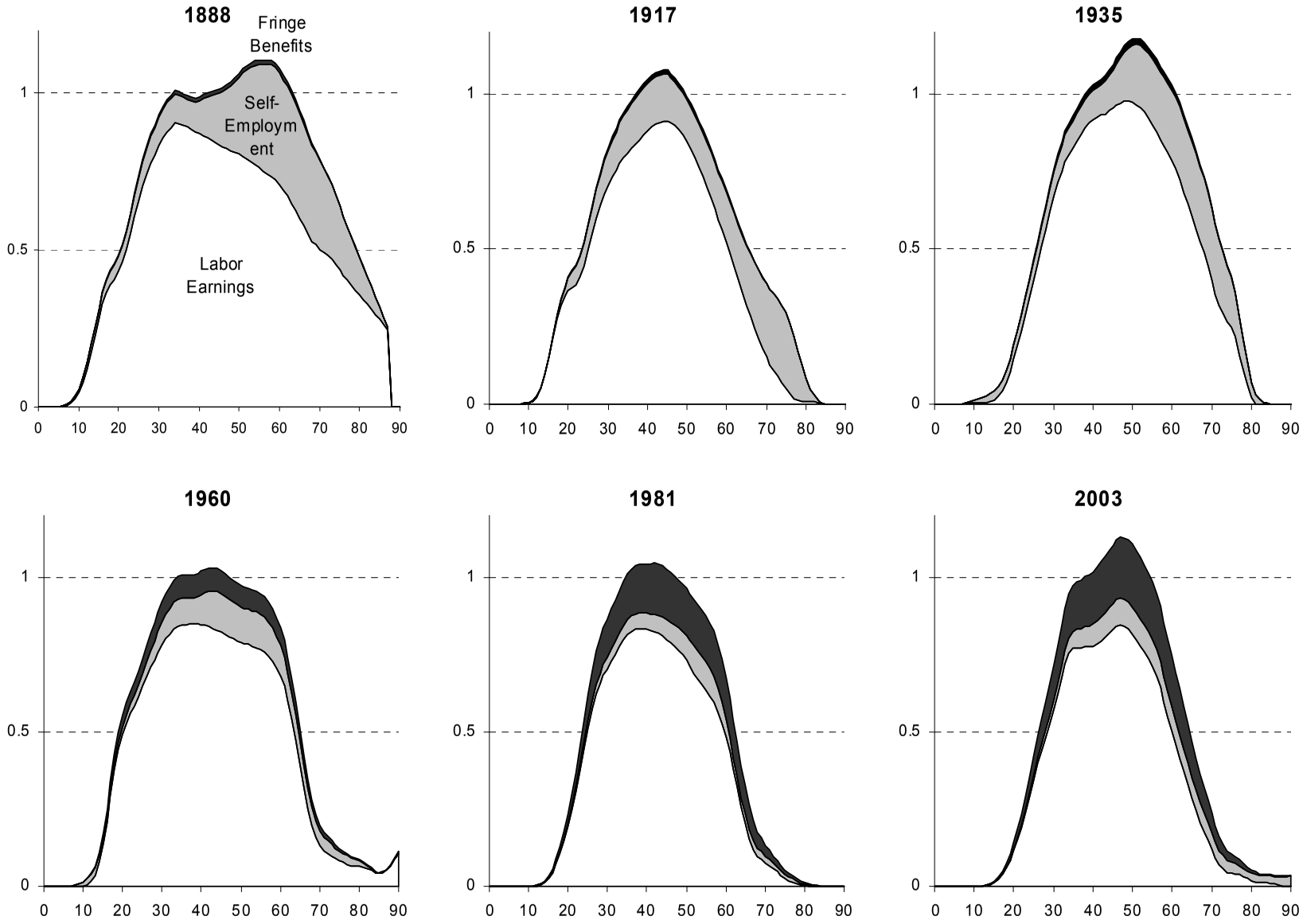

Figure 8. Labor income age profiles by composition, United States non-institutionalized population, 1888-2003. Values are scaled to the average labor income profile value for ages 30-49.

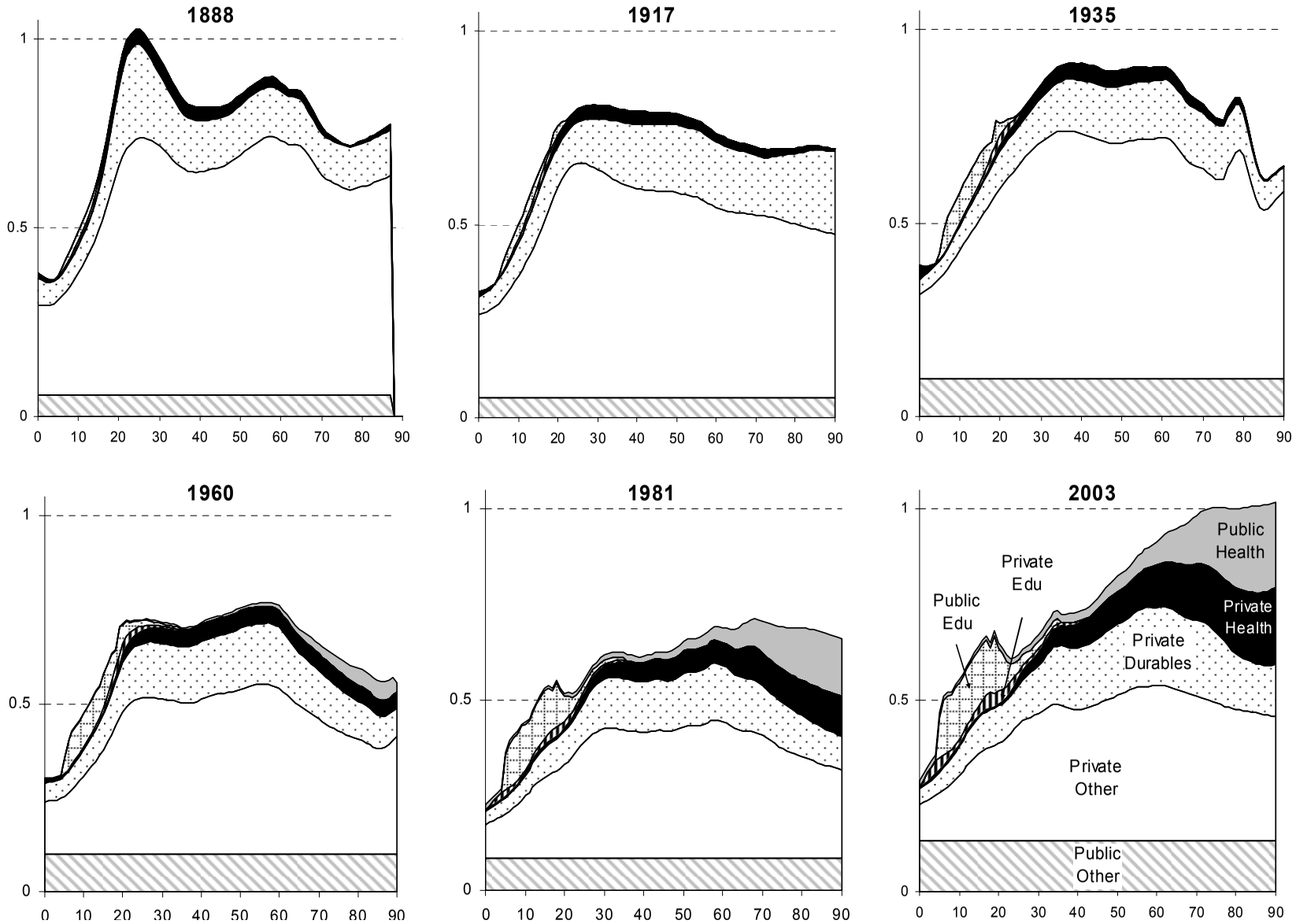

Figure 9. Consumption age profiles by composition, United States non-institutionalized population, 1888-2003. Values are scaled to the average labor income profile value for ages 30-49.

The biggest story by 2003, however, is the rise of public health consumption at the oldest ages. This is financed by the Medicare program and this piece is completely responsible for the rising consumption with age seen in 2003. Take out this last section of the graph, and consumption falls after age 70. Of course, in the absence of the Medicare program, it is possible that we would simply see the private health consumption taking over this large increase, but it is more likely that the full amount of Medicare consumption would not have been realized if it had to be paid for out of pocket.

The last kind of public consumption considered is "other," which is public goods and other types of government-provided services that are not age allocated. That slice has been increasing over time as well. To compare the public/private consumption mix at every age, Figure 10 sums public education, health and other consumption and compares it to total consumption. At each year since 1917, the public portion of consumption has risen for every age, showing the government's increasing role in the total economy. The public role has grown even greater over time for children and the elderly compared to working age adults, showing the government's increasing role in redistributing income from the working ages to the dependent years. The 1888 and 1917 lines are very similar due an assumption necessary to estimate control totals for these years. It was assumed that the ratios of different types of economic activities stayed fixed in the aggregate back in time from the last available data in 1929.

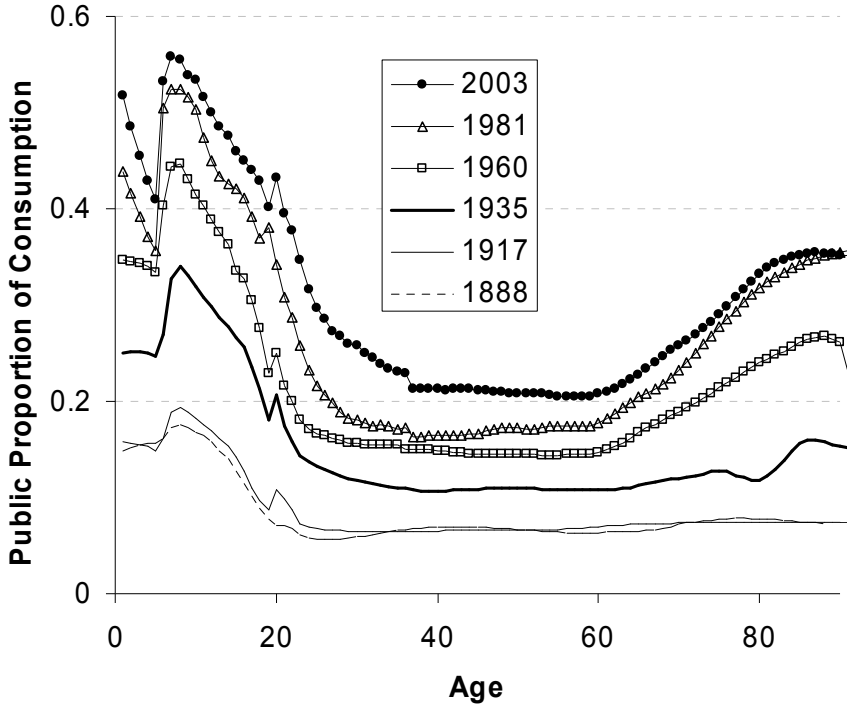

Figure 10. Proportion of age-specific total consumption represented by publicly provided health care, education and non-age allocated other. United States non-institutionalized population, 1888-2003.

Summarizing Age Profiles of Consumption and Labor Income

While we have seen much by examining the full shape of many types of age profiles, summary measures can help describe trends across profiles. One type of summary measure is the cross-over ages, the age in youth when deficit turns to surplus and the age after the peak working years when surplus turns to deficit again. Figure 11 shows these two ages graphed on the left-hand side axis, with the difference between them, the number of years of surplus, graphed on the right-hand side axis. The puzzle of the very late age at which surplus begins in the earliest samples was discussed above, so the first three points in the bottom line are either suspect or present a very interesting transfer mystery. The shrinking years of surplus since 1960, however, seem like a reliable result – the product of beginning surplus generation later and ending it earlier.

Another summary measure of the labor income and consumption profiles is the average age of labor income dollar earned or consumption dollar spent. This calculation depends on the profile shape and the age distribution of the population. Figure 12 shows the average age calculations in two ways: using the current population for the sample year and using a constant population, the United States in 1950 in this case. For the average age with current populations, the long term trend is for the age of labor income and consumption to rise. On net, the difference falls for most of the period, changing direction since 2000 as the average age of labor income begins to rise very rapidly. This is related to the reversal of the early retirement trend mentioned above. Since 2000, older persons are working more and earning more money for it. Removing the population age-distribution effects, we see the same trends since 1980, although flatter. So the aging of the baby boom was some, but not all, of the story seen after 1980 in the left-hand panel of Figure 12. Before 1980, however, the role of population age distribution is less clear.

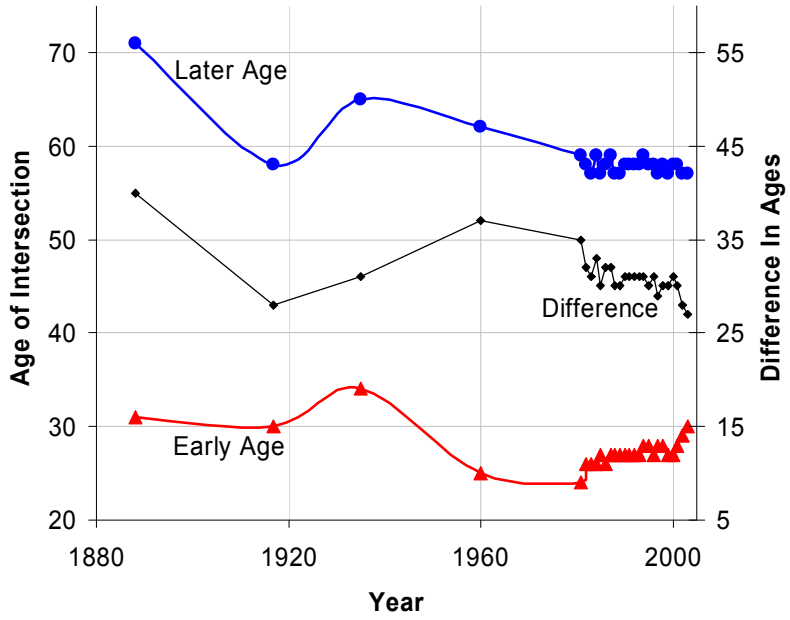

Figure 11. Age of cross-over from deficit to surplus and from surplus to deficit, with the difference between the two ages, United States non-institutional population, 1888-2003. Note that the early and late transition ages are graphed on the left-hand side axis. The difference between early and late age transitions is graphed on the right-hand side axis.

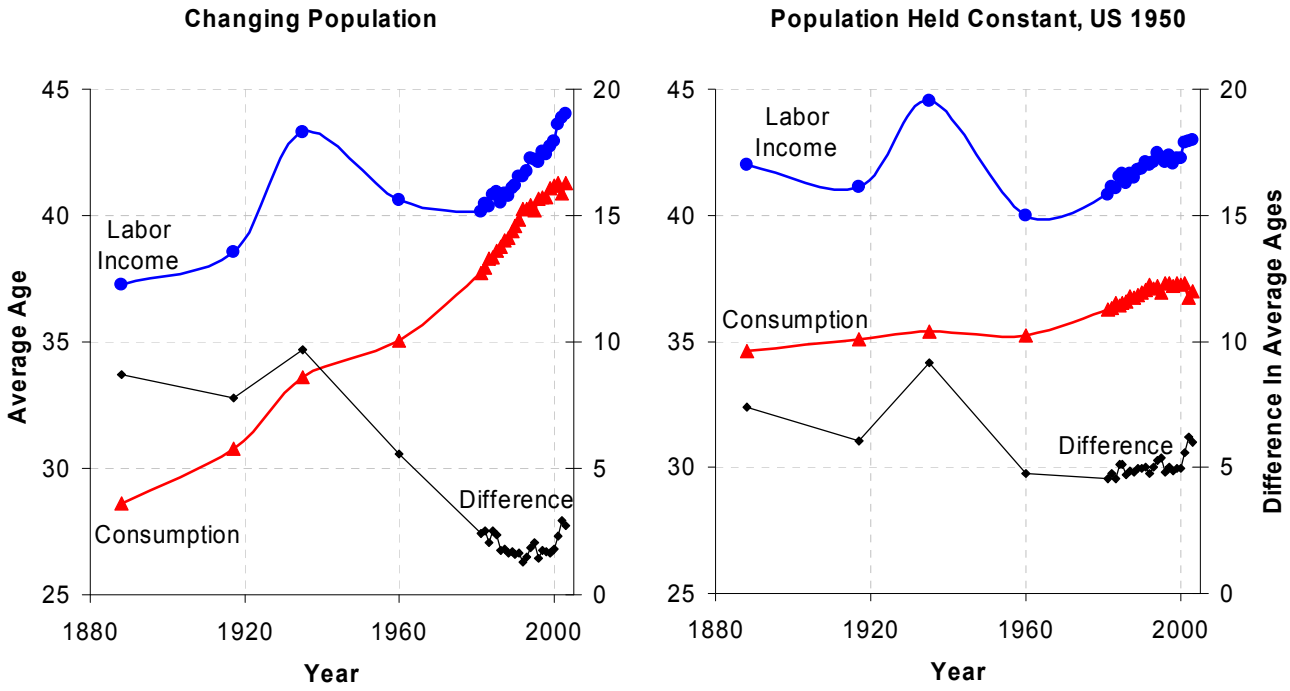

Figure 12. Average age of labor income dollar earned and consumption dollar spent, with the difference in these ages, United States non-institutional population, 1888-2003. Note that the average ages are plotted on the left-hand side axes and the difference is plotted on the right-hand side axes. The graph on the left shows the average ages computed with population weights as they were observed in the profile year. The graph on the right shows the average ages computed with constant population weights. The U.S. population in 1950 was used as the constant population.

Conclusions

Financing Lifecycle Deficits

We have seen through the empirical work presented here that age-specific lifecycle deficits have increased over time relative to the available surpluses. For more and more years of age, we consume more than we make working. That feat must be accomplished by public transfers, private transfers, or reallocations of assets by selling or borrowing. We have discussed the public transfer means of financing the lifecycle deficit – the government mediates a transfer from one age group to another by taxing one age group's income and using that money to provide another age group with services. We have seen that this type of transfer has increased over the period in question. Although the profiles of private within- and between-household transfers that provide for lifecycle deficits have not yet been estimated for these samples, there is evidence that transfers of labor income from working ages to dependent ages are providing less of the total need now than in the recent past. In fact, since the United States has been keeping records of aggregate economic activity, we have never consumed less than labor income. Lifecycle deficits have never been financed by labor income alone since national records have been kept. Figure 13 shows the ratio of aggregate national consumption to labor income and the history of the

series shows it has always been above one. While aggregate consumption equaled 15-20% above aggregate labor income from 1940 to 1980, it has grown to 30% by 2003.

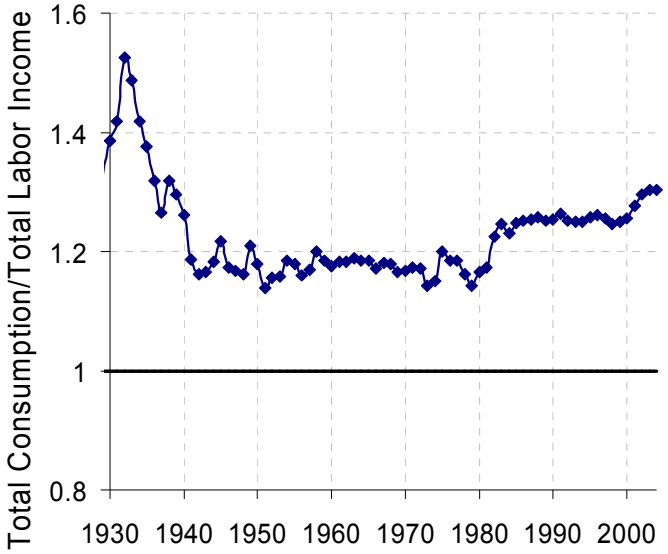

Figure 13. Total consumption relative to total labor income. United States, 1929-2005.

Means of financing lifecycle deficits that do not rely on current labor income are: the use of income from accumulated capital, spending down of accumulated capital, and borrowing from abroad. Two of these means – spending down accumulated capital and borrowing from abroad – are not sustainable in the long run. The other means – capital income – is not large enough to cover the amount of consumption above labor income seen in Figure 13, and is certainly not large enough to do so in the long term without harming future economic growth. The long term prospects, then, are that the level of consumption observed is simply not sustainable without much faster economic growth in the future than we have seen in the recent past. Depending on the mix of sources to finance the lifecycle deficits we have seen and how the ratio of consumption to income changes in the future, the profiles we see today may have to change drastically in the future.

United States Past and the Present in Other Countries

Although much more comparative work from the NTA project on many countries at varying stages of economic development is forthcoming, some comparative works have been published. Early indications from that work show striking similarities between past United States consumption and income profiles and the present profiles of developing countries. For example, the labor income and consumption profiles in Thailand in 1998 (Lee and Mason, 2006) look most similar to the United States profiles in 1917 or 1935 with a wide base of ages for the labor income profile and a gradually increasing then gradually declining consumption profile. Indonesia in 1996 also looks in its consumption pattern much like the United States in 1917

(Lee, Lee and Mason, 2006). Indonesian labor income is distinctive, however, with a much younger peak earnings age group than any period seen in the United States.

The question for these developing countries is whether they will follow the same path as the United States. That path involves increasing lifecycle deficits, a greater government role in providing for those deficits, and a possible crowding out of the family's role in that task.[2] Of course, Indonesia and Thailand are very different places than the United States, but then again the United States was a very different place in 1917 as well. The historical record presented here gives at least one glimpse of a possible future in those countries.

Further Research

The ongoing effort and ultimate goal is to estimate age profiles of transfers and reallocations for the same historical period as for the lifecycle deficits presented in the paper. Transfer and reallocation profiles will show us how we have "solved the problem" of lifecycle deficits in the past and how that compares with the solutions of today. Certainly our transfer systems have evolved with the economic and institutional changes that have taken place over the last century and beyond. In addition, the profiles from the past estimated here can be used to examine the implications in the future of different ways of dealing with the lifecycle deficit problem.

[2] While the description of the decreasing role of family transfers as the product of a "crowding-out effect" speaks of causality, the direction of the causality is still an open question. Decreasing family involvement in financing old-age lifecycle deficits may have necessitated government transfer programs to some extent, at least early on in the history of Social Security.

References

Attanasio, O.P., J. Banks, C. Meghir, and G. Weber. 1999. "Humps and Bumps in Lifetime Consumption." *Journal of Business and Economic Statistics.* 17(1):22-35.

Deaton, A. 1997. *The Analysis of Household Surveys: A Microeconomic Approach to Development Policy.* Baltimore: Johns Hopkins University Press.

Gruber, J. and D.A. Wise. 2001. "An International Perspective on Policies for an Aging Society." *NBER Working Papers* W8103.

King, M., S. Ruggles, T. Alexander, D. Leicach, and M. Sobek. 2004. Integrated Public Use Microdata Series, Current Population Survey: Version 2.0. [Machine-readable database]. Minneapolis, MN: Minnesota Population Center [producer and distributor]. http://cps.ipums.org/cps. Accessed February and March 2007.

Lee, R., A. Mason, and T. Miller. 2002. "Saving, Wealth, and the Transition from Transfers to Individual Responsibility: The cases of Taiwan and the United States." *The Swedish Journal of Economics*. 105(3): 339-357.

Lee, R., S. Lee, and A. Mason. 2006. "Charting the Economic Life Cycle." *NBER Working Papers* W12379.

Lee, R. and A. Mason. 2006. "What is the Demographic Dividend?" *Finance and Development* (September): 16:17.

Mason, A. 1988. "Saving, Economic Growth, and Demographic Change." *Population and Development Review.* 14(1):113-44.

Mason, A., R. Lee, A. Tung, M. Lai and T. Miller. 2006. "Population Aging and Intergenerational Transfers: Introducing Age Into National Accounts" *NBER Working Papers* W12770.

Norris, F. 2006. "Now Bringing Home the Leaner Bacon; She Works, Her Grandson Doesn't." New York Times Week in Review, September 3, 2006.

Ruggles, S., M. Sobek, T. Alexander, C. A. Fitch, R. Goeken, P. Kelly Hall, M. King, and C. Ronnander. 2004. Integrated Public Use Microdata Series: Version 3.0 [Machine-readable database]. Minneapolis, MN: Minnesota Population Center [producer and distributor]. http://usa.ipums.org/usa/. Accessed February and March 2007.

Stockmayer [Donehower], G. 2004. *The Demographic Foundations of Change in U.S. Households in the Twentieth Century.* PhD Dissertation, Department of Demography, University of California, Berkeley.

U.S. Dept. of Labor. COST OF LIVING OF INDUSTRIAL WORKERS IN THE UNITED STATES AND EUROPE, 1888-1890 [Computer file]. 3rd ICPSR ed. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [producer and distributor], 1986.

U.S. Dept. of Labor, Bureau of Labor Statistics. COST OF LIVING IN THE UNITED STATES, 1917-1919 [Computer file]. 5th ICPSR ed. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [producer and distributor], 1986.

U.S. Dept. of Labor, Bureau of Labor Statistics, U.S. Dept. of Agriculture, Bureau of Home Economics, et al. STUDY OF CONSUMER PURCHASES IN THE UNITED STATES, 1935-1936 [Computer file]. 2nd ICPSR ed. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [producer and distributor], 1999.

U.S. Dept. of Labor, Bureau of Labor Statistics. CONSUMER EXPENDITURE SURVEY, 1960-1961 [Computer file]. ICPSR version. Washington, DC: U.S. Dept. of Labor, Bureau of Labor Statistics and U.S. Dept. of Agriculture [producers], 1980. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 1983.

U.S. Dept. of Labor, Bureau of Labor Statistics. CONSUMER EXPENDITURE SURVEY FAMILY LEVEL EXTRACTS, 1960-1961 [Computer files]. Washington, DC: U.S. Dept. of Labor, Bureau of Labor Statistics and U.S. Dept. of Agriculture [producers], 2005. Consolidated Files Compiled By the Congressional Budget Office. NBER [distributor], www.nber.org.