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Historical Redistribution Under the Social Security Old-Age and Survivors Insurance Program

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Abstract

This study uses Social Security administrative data on past earnings and benefits by year, age, sex, and race to analyze historical redistribution under the Old-Age and Survivors Insurance program across and within cohorts born through the year 1922. The results generally support the findings of closely related previous research, confirming that early cohorts have received large accumulated net transfers to date, that females, as a group, have experienced substantially higher accumulated benefit/tax ratios and internal rates of return than their male counterparts in these cohorts, and that the "Other Races" group fared better by these measures than the "White" race group in most of the cohorts considered. Differences by race in the accumulated benefit/tax ratios estimated in this analysis are sensitive to the choice of the interest rate series and cohort grouping, however, and differ sharply between males and females under some of the interest rate assumptions.

I. Introduction

An important feature of the Social Security program is the expectation that workers and their families will both pay taxes and receive benefits over the course of their lifetimes. This feature makes it important to analyze the lifetime redistributional effects of the program across program participants who differ in various characteristics of policy interest. Such analysis can help determine if intended differential treatment is effective and to identify any areas of unintended differential effects.

This study uses Social Security administrative data on past earnings and benefits by year, age, sex, and race to analyze historical redistribution under the Old-Age and Survivors Insurance (OASI) program. Specifically, the study examines the relationship between the OASI taxes paid and benefits received *to date* for early birth cohorts as a whole and for specific race and gender groups within those cohorts.

The phrase "to date" is emphasized because no cohorts have experienced the OASI program over a full potential life span—cohorts born in 1940, for example, when monthly benefit payments first began, were only age 57 in 1997, the last year of historical data available for this analysis. The lifetimes of many of

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the earliest cohorts affected by the program are now largely complete, however, so that the historical data do provide a fairly complete picture of the program's treatment of these cohorts over the portion of their lifetimes that the program was in existence.

Relatively few studies of lifetime redistribution under the OASI program have been based on historical administrative data. A more common approach is to construct lifetime tax and benefit profiles for hypothetical workers varying by characteristics of interest such as birth cohort, race, gender, earnings level, and family composition. The generality of hypothetical worker outcomes is typically limited, however, because critical inputs to the analyses (such as the shapes of the earnings profiles, ages of labor force entry, labor force participation patterns, unemployment spells, changes in family status, mortality rates, and changes in beneficiary status) for the hypothetical cases are not realistically differentiated by the same characteristics of interest represented in the results.

Given adequate data and analysis, of course, it is possible to construct synthetic tax and benefit streams that are actually representative of particular groups of workers, at least within certain constraints. The more detailed the worker categorizations, however, the more deficient available data sources and the more difficult the attendant analyses become. Regardless of the care that is taken, there is always the possibility that some characteristic that affects analysis outcomes has not been modeled appropriately or estimated accurately.[1]

Because this study uses administrative data based on actual program outcomes, the results are not subject to many of the limitations of the hypothetical worker approach—differences across race and gender groups, for example, in earnings profiles and levels, ages of labor force entry, labor force participation patterns, unemployment spells, changes in family status, mortality experience, and beneficiary status are implicitly incorporated into the administrative tax and benefit data and reflected in the analysis results. On the other hand, there is still a lack of sufficient years of historical data to analyze the full lifetime effects of the OASI program on successive birth cohorts, and *ex post* results are not necessarily indicative of future outcomes. Moreover, limitations of the administrative tax and benefit data used in this analysis prevent the present study from isolating the differential treatment of the race and gender groups while controlling for associated differences in other characteristics of interest, such as earnings levels; *i.e.*, while the present analysis describes the differential historical treatment of these race and gender groups, the analysis is unable to identify the extent to which this differential treatment would persist in the absence of certain other differences observed historically between the groups.

In terms of redistribution across birth cohort, gender, and race groups, the results presented below generally support the findings of the most closely related previous research, confirming that early cohorts have received large accumulated net transfers to date under the OASI program, that females, as a group, have

experienced substantially higher accumulated benefit/tax ratios and internal rates of return than their male counterparts in these cohorts, and that the "Other Races" group fared better by these measures than the "White" race group in most of the cohorts considered.[2] Differences by race in the accumulated benefit/tax ratios estimated in this analysis are sensitive to the choice of the interest rate series and cohort grouping, however, and differ sharply between males and females under some of the interest rate assumptions.

A main contribution of this analysis, then, is to confirm in broad terms the results of earlier analyses that were also based largely on historical administrative data; while broadly supporting these results, however, the present analysis suggests that historical differences in lifetime distribution by race are less pronounced than were found in the most closely related previous literature and that race differentials differ sharply by gender under some interest rate assumptions. The finding of broadly similar results is important, however, because this analysis uses a much different approach from that generally employed in even the most closely related previous research.

In particular, this analysis is based on aggregated data that cover all OASI benefit types and taxes over the complete historical period and uses different administrative data sources for historical benefits than for historical taxes; in contrast, previous research considers a much narrower range of benefit types and even the most closely related studies that are based on sample data have access to

administrative data over a much shorter historical time period and require the introduction of hypothetical worker methods or simplifying assumptions to complete individual life cycles historically as well as prospectively. The somewhat different picture of race differentials that emerges from the present analysis may be due in part to its comprehensive accounting of historical taxes and benefits that is unmatched in the earlier studies and in part to its exclusive use of historical data and lack of reliance on hypothetical worker methods in its main findings.

Another distinguishing feature of this analysis relative to the most closely related previous research is the incorporation and discussion of the increasing importance of accounting for benefit income taxation in lifetime redistributional analyses. Other distinguishing features include discussions of (1) the importance of differentiating redistributional results based on the allocation of benefits to those who receive them as opposed to those on whose account the benefits were earned, (2) the importance of the choice of redistributional measures and the choice of the interest rates used in those measures relative to the specific question being addressed (*e.g.*, whether from a program or individual perspective, whether gross or net of income taxes in general and whether gross or net of benefit income taxes allocated to the Health Insurance trust fund in particular), and (3) the importance of recognizing the wedge that administrative costs introduce between accumulated taxes and benefits in a self-financed social security program and how

money's worth measures that compare only taxes and benefits but ignore these administrative costs are biased against the social security alternative.[3]

Most of these issues require a clear formulation of the specific question being addressed, and no one approach or assumption in most of these areas is likely to be appropriate across the variety of questions that are addressed by measures of lifetime redistribution under the program. This is one reason why it is important for studies of this type to use a variety of redistributional measures and interest rates, for example, to expand the range of questions to which the results can be applied.

In the remainder of this paper, section II describes previous research that is most closely related to the present analysis. Section III describes the methods used to develop the redistributional estimates that are presented in section IV. Section IV presents lifetime redistributional results to date for early birth cohorts as a whole and for specific race and gender groups within those cohorts. Section V summarizes the main findings of the analysis.

II. Previous Research

Relatively few studies of lifetime redistribution under the OASI program have examined historical outcomes across race or gender groups as a whole using administrative data. The studies meeting those criteria that are most closely

related to the present analysis are Freiden *et al.* (1976), Hurd and Shoven (1985), and Duggan *et al.* (1993).

In its examination of average outcomes across gender groups, the Freiden *et al.* study found that females fared relatively better than males by a substantial margin. Specifically, they estimate average real internal rates of return of 17.57 percent for females and 11.67 percent for males under the Old-Age Insurance (OAI) portion of the Social Security program for a sample of worker-only beneficiaries retiring between 1967 and 1970; this sample was drawn from the Continuous Work History Sample (CWHS).[4]

Relative outcomes for women have tended to be more favorable than those for men under the OASI program, even when earnings are held constant, because of the generally lower mortality rates experienced by women.[5] The historically lower average earnings of females have further enhanced their relative treatment as a group under the program because of the progressivity of the benefit formula.[6] Historically, women have also received a large majority of benefits to dependents and survivors.[7]

In terms of differential effects by race, both the Freiden *et al.* (1976) and the Duggan *et al.* (1993) studies found that, on average, other race groups fared relatively better than whites under the OAI or OASI portions of the program. The Freiden *et al.* study estimated the average real internal rate of return from their sample as 11.46 percent for white males, 13.39 percent for males of other races,

17.03 percent for white females, and 22.45 percent for females of other races; within each gender group in these cohorts, then, these results suggest that the other races group fared substantially better than the corresponding white race group. For a sample of workers born between 1895 and 1922 drawn from the CWHS, the Duggan *et al.* analysis estimated the real internal rate of return under the OASI program as 9.1 percent for the white race group, 9.6 percent for the black race group, and 10.7 percent for the other race group;[8] the corresponding accumulated lifetime benefit/tax ratios for these groups in the Duggan *et al.* analysis were, respectively, 4.33, 4.41, and 5.34.[9]

Hurd and Shoven (1985) developed estimates of accumulated lifetime benefit/tax ratios and internal rates of return for a sample drawn from the Retirement History Survey with matched earnings records from the Social Security Administration (SSA); this survey covers the cohort born between 1905 and 1911.[10] Their estimates of median real internal rates of return for this cohort considering earnings only through 1979 were 7.55 percent for whites and 6.95 percent for other races; the corresponding estimates of median accumulated benefit/tax ratios were 2.84 for whites and 2.52 for other races. In contrast to the race differentials estimated in the other studies, then, the Hurd and Shoven results suggest that median outcomes under the program were less favorable for the other race group than for the white race group.

It is difficult to assess the causes of these potentially conflicting estimates of the race differential for early cohorts, because the studies used different samples, methods, assumptions, and measures and because the methods were sometimes described insufficiently. Because of data limitations, the Hurd and Shoven race differentials were derived under the assumption that tax payments of young decedents, while they were alive, were the same as for those who survived to interview age. Because mortality rates have been higher historically for other races as a group than for whites over early ages, and because earnings and taxes for young decedents were likely to have been lower, on average, than for those who survived to later ages,[11] this assumption probably biases their estimates of relative outcomes for the other race group downward relative to those for whites. In contrast, Duggan *et al.* were able to include the actual earnings of young decedents in their analysis (because the CWHS includes earnings records for all cohort members), suggesting that more weight be given to the Duggan *et al.* results.[12]

Each of these studies has different strengths and weaknesses. None provides a comprehensive view of the net effect of the OASI program because of these weaknesses. All of the studies exclude some of the benefit types provided by the OASI program. All of the studies required the simulation of benefit streams because of incomplete historical records, and all made simplifying assumptions about or simulated the tax streams for later cohort ages, introducing

potential biases into the results. All but the Freiden *et al.* (1976) analysis also had to simulate or ignore annual earnings and tax streams prior to 1951.[13] The net effects of the program on different race groups are especially difficult to assess and sensitive to simulation assumptions and methods because the differential mortality and earnings experiences of these groups are interrelated and tend to work in opposite directions.[14] For the same reasons, relative outcomes for these groups cannot be inferred *a priori*. The present analysis can contribute to our understanding of these outcomes by considering all of the OASI taxes and benefits experienced to date by past participants in the program, providing a more complete and comprehensive accounting of historical taxes and benefits than that available in prior analyses. By utilizing administrative data sources that cover the full historical period, the present analysis avoids many of the simplifying assumptions or hypothetical worker methods required in previous analyses to fill in missing historical information. For members of the earliest cohorts, then, this approach provides a fairly complete picture of the net effects of the OASI program on their lifetime resources.

III. Method

The approach adopted in this analysis is similar to that used in an earlier study (Leimer 1998) of historical redistribution under the Disability Insurance (DI) program. Social Security administrative data were used to develop estimates of

the OASI taxes paid and benefits received by persons of each race, sex, and single year of age for the years 1937–1997, where 1937 was the first year of the OASI program and 1997 was the last year of historical data available for this analysis.

The nature of the administrative data imposed a number of constraints on the analysis. The first concerns the allocation of secondary benefits[15] to specific age, race, and gender groups. The present analysis assigns such benefits to the cohort, race, and gender group to which the dependent or surviving beneficiary belongs;[16] this approach is referred to in this analysis as the "individual-specific" approach. An alternative approach, referred to in this analysis as the "worker-account" approach, would allocate such benefits to the age, race, and gender group of the insured worker on whose account the benefits are paid. These two alternative approaches offer different perspectives on the redistributional effects of the program—each has advantages and disadvantages, depending on the specific question being addressed. As a practical matter, however, the data sources used in the present analysis permit the use of the individual-specific approach but not the worker-account approach.

The second constraint imposed by the use of Social Security administrative data relates to the race variable, which has a number of problems that cloud its interpretation.[17] One of these problems arises because the form that the SSA uses to collect race information has changed over time. Prior to November 1980, the form allowed only three responses to the race question,

corresponding to "White," "Black," and "Other." The administrative race information for most present beneficiaries is based on this three-way classification. Beginning in November 1980, the race question was expanded to allow five race/ethnic responses: "White (not Hispanic)," "Black (not Hispanic)," "Hispanic," "Asian or Pacific Islander," and "American Indian or Alaskan Native."

As discussed in Appendix A, this five-way race/ethnic classification does not map cleanly into the prior three-way race classification, and additional problems are created by the grouping of race categories in the benefit data underlying this analysis. In brief, these benefit data collectively support only two race categories over the full analysis period, 1937–1997; these two categories are referred to in this study as "White" and "Other Races." The White category consists of persons coded as White under the old SSA race code, persons coded as White (not Hispanic) under the new SSA race code, and persons coded as Unknown under either the old or new SSA race codes.[18] The Other Races category consists of persons coded as Black or Other under the old SSA race code and persons coded as Black (not Hispanic), Hispanic, Asian or Pacific Islander, or American Indian or Alaskan Native under the new SSA race code. Most Hispanics or Latinos in this analysis are probably represented in the White race category, despite the grouping of those classified as Hispanic under the new SSA race code with Other Races, since the new SSA race codes were not introduced until late 1980;[19] this is discussed further in Appendix A.

The allocation of taxes in this analysis assumes full backward shifting of the employer portion of the payroll tax to workers in the form of lower wages. Although there is disagreement among economists about the incidence of the payroll tax, full backward shifting is by far the most common tax incidence assumption in analyses of the redistributional effects of the Social Security program.[20]

The aggregate OASI taxes paid by persons of each race, sex, and age in each year from 1937 through 1997 were derived from a combination of CWHS data files. These files contain information on annual Social Security taxable earnings for a sample of all Social Security numbers. The last available version (1977) of the 0.1 percent CWHS file was used to identify the distribution of taxes prior to 1951, while the 1997 version of the 1 percent CWHS file was used for years from 1951 on.[21] The general approach required the identification of OASI taxable wages and self-employment income for each valid record in each year. The associated OASI tax payment was then computed using the OASI tax rates and rules for that year, adjusting for potential complications such as multiple employers and the mix between taxable wages and self-employment income.[22] Aggregate tax payments by race, sex, and age in each year were calculated for the sample and then adjusted proportionally to sum to the actual aggregate OASI tax liability for that year.[23] In effect, then, the sample data were used to define the

proportional distribution of aggregate OASI tax liability by race, sex, and age in each year.[24]

A similar approach was adopted for identifying historical benefit payments, except that summary tables on OASI monthly benefit payments as of year-end by beneficiary type, race, age, and year from issues of the *Social Security Yearbook* and *Annual Statistical Supplement* to the *Social Security Bulletin* were used in place of individual sample data.[25] Individual sample data files derived from administrative records do not contain complete historical benefit records, precluding their use in the present analysis.[26]

This analysis includes all of the lump-sum and monthly benefits paid from the OASI trust fund since the inception of the program. During the period 1937–1939, only lump-sum payments at age 65 or death were made under the 1935 Social Security Act.[27] Monthly cash benefit payments began in 1940 under legislation passed in 1939. Lump-sum death payments continued, but were dwarfed in the aggregate by monthly benefit payments in later years.

Monthly benefit payments under the OASI program were treated as falling into one of five beneficiary categories in this analysis. The largest category by far combines total monthly benefit payments to retired workers, spouses of retired workers, widows and widowers, and dependent parents.[28] The remaining four categories respectively correspond to monthly benefit payments to children of retired workers, children of deceased workers, widowed fathers and mothers, and

special age-72 beneficiaries.[29] Within each of these five monthly beneficiary categories, the proportional distribution by race, sex, and age of the corresponding type of benefits from the summary benefit table for that year was used to allocate aggregate benefits paid from the OASI trust fund for that beneficiary category in that year across the race, gender, and age groups;[30] for example, the proportional distribution by race, sex, and age of total benefit payments to retired workers, spouses of retired workers, widows and widowers, and dependent parents in current-payment status at the end of 1988, as derived from the summary benefit table for that year, was used to allocate aggregate benefit payments during 1988 to those combined beneficiary categories across the corresponding race, gender, and age groups.[31] In effect, then, this approach assumes that the proportional distribution by race, sex, and age of benefits in current-payment status at year-end is representative of the corresponding proportional distribution of aggregate benefit payments during the year within each of the five monthly beneficiary categories.[32] Additional details of the historical benefit estimation are provided in Appendix A.

These estimates of historical OASI benefits were adjusted to reflect the income taxation of Social Security benefits that began in 1984.[33] Accurately identifying the incidence of benefit income taxation across the race, gender, and age groups in each year would require much more information than was available in the source data used in this analysis. Consequently, the effective rate of benefit

income taxation was assumed to be constant across the race, gender, and age categories in any given year. In each year from 1984 on, the effective benefit income taxation rate was identified from Department of the Treasury estimates of the aggregate income tax liability in that year accruing from OASI benefits.[34] The assumption of identical effective benefit taxation rates across the race, gender, and age categories introduces potential biases into the analysis. The actual effective benefit taxation rate will tend to be higher, *ceteris paribus*, for groups with higher earnings and taxable income.[35]

Three alternative interest rate series are used in this analysis to accumulate taxes and benefits over time; these three series correspond to a nominal rate equal to the rate of inflation (a zero real interest rate), the rate of return earned on OASI trust fund assets, and the total rate of return to an index of large company stocks.[36] The tables and most of the discussion in the main body of this paper are based on the OASI trust fund rate series. Tables containing estimates based on the other two interest rate series are presented in appendices.

The appropriate interest rate series to use in analyzing the OASI program, of course, depends on the particular question being addressed.[37] Using the historical interest rates at which the OASI program was actually able to transform funds over time, for example, can be interpreted as identifying *ex post* redistribution from a program perspective—using these rates, the accumulated value of lifetime benefits less taxes for each cohort, race, and gender group

reflects the cost to the OASI trust fund of providing those net transfers, *i.e.*, it reflects the amount by which the trust fund would have been larger as of a selected valuation date had the net transfers not occurred.[38] Alternatively, the three interest rate series used in this analysis might be interpreted from an individual perspective, with the OASI trust fund rate series interpreted as a proxy for a government bond rate series,[39] the zero real interest rate series interpreted as incorporating a downward adjustment for various risk-reducing characteristics of the Social Security program,[40] and the large company stock series interpreted as providing a comparison with a private investment alternative that has exhibited both higher risk and higher return, on average, over the historical period.[41] The variety of interest rates and redistributional measures included in this analysis, then, are intended to facilitate comparison with previous analyses and to increase the range of questions to which the results can be applied.

As a final note, the redistributional measures presented in this paper do not adjust for the costs of administering the program; *i.e.*, some of the taxes collected have been used to cover the expenses of administering the program, which necessarily creates an imbalance between taxes and benefits.[42] Analogous, and potentially much higher, expenses would be associated with private alternatives to the retirement saving, annuity, and survivors insurance features of the OASI program.[43] Reported benefit/tax ratios less than one, or benefit-tax differences less than zero, then, do not by themselves suggest that the corresponding program

participants were net redistributional losers from a program perspective[44] or that the participants failed to receive their money's worth under the program from an individual perspective.[45]

IV. Analysis

This section presents results on the estimated lifetime redistribution to date under the OASI program across and within specific cohorts born through the year 1922. Although the historical treatment of each cohort under the OASI program is identified through 1997, the program has not been in existence sufficiently long for any cohort to have participated in the program over a full potential life span. Nevertheless, a sense of typical patterns of treatment under the program over the life cycles of individual cohorts can be garnered by piecing together the treatment of different cohorts who have experienced the program at different points in their life cycles. Chart 1 displays the aggregate annual real net transfer flows experienced by selected decennial year birth cohorts at various points in their life cycles; *i.e.*, for a given cohort, this chart plots aggregate annual OASI benefits less taxes, adjusted for inflation, at each age across all cohort members. For example, aggregate annual net transfers for the cohort born in 1920 are shown for ages 17 through 77, corresponding to the calendar years 1937–1997 during which the OASI program has been in existence and for which data are available in this analysis.

This chart illustrates the typical life cycle pattern of aggregate net transfers under the OASI program for any given cohort, assuming the individual-specific allocation of secondary benefits. At the earliest ages, prior to entry into the labor force, the cohort experiences positive net transfers as some members receive benefits as children of retired and deceased workers. As the cohort attains typical labor force entry ages, the OASI taxes paid by working cohort members begin to offset and eventually outweigh child benefits, and net transfers under the OASI program become negative, on balance. OASI net transfers to the cohort as a whole tend to remain negative over most of the high labor force participation ages, as the taxes paid by working cohort members continue to outweigh the benefits received by cohort members who receive OASI benefits as dependents, survivors, and possibly early retirees. After the age at which cohort members become eligible for retirement and other old-age benefits, however, net transfers begin to increase and become positive once again, with benefits outweighing the taxes paid by cohort members who continue working. Aggregate net transfers for the cohort begin to decline later in the retirement period, as mortality claims more cohort members.

The same pattern of net transfers by age is evident in Chart 2, which displays the cross-section of aggregate annual OASI net transfers by age in selected years, adjusted for inflation; *i.e.*, for a given year, this chart plots aggregate annual OASI benefits less taxes, adjusted to 1997 dollars, at each age

across all program participants. In Chart 2, then, the graph of aggregate net transfers for a particular year reflects a different birth cohort at each age.

The estimated net effect of the aggregate benefits and taxes experienced to date by cohorts born through 1922 is shown in Table 1, where the benefits and taxes experienced historically by members of each cohort group are accumulated through 1997 using the interest rate earned on OASI trust fund assets. The youngest of the cohorts included in this table (the 1922 birth cohort) had attained age 75 in 1997, the last year of historical data available for this analysis. As such, the tax histories for these cohorts are largely complete, but substantial benefit payments remain for the youngest cohorts.[46] Nevertheless, the size of the accumulated net transfers to date for these cohorts is impressive, reflecting the large transfers that a pay-as-you-go social insurance program grants to early cohorts. The accumulated net transfer from the start of the program through 1997 to all of these cohorts combined was over $8.6 trillion,[47] evaluated as of year-end 1997 using the interest rate earned by the OASI trust fund. Appendices B and C respectively provide the corresponding estimates of accumulated net transfers to date using the zero real interest rate series and the total rate of return to large company stocks series.

The estimates shown in Table 1 suggest that the accumulated net transfer to date is positive for all of the race and gender groups in all of these early cohorts when evaluated using the interest rate earned by the OASI trust fund. As shown

in Appendix B, this statement also holds when historical taxes and benefits are accumulated at a zero real interest rate. When the generally higher total rate of return to large company stocks is used,[48] however, accumulated historical taxes exceed accumulated historical benefits for some of the race and gender groups in cohorts born after 1910, as shown in Appendix C.[49]

The absolute sizes of the accumulated aggregate net transfers to the various cohort, race, and gender groups, of course, depend on the sizes of the groups as well as on the relative balance between accumulated taxes and benefits for each group. One measure of the relative balance between the taxes and benefits experienced to date for the various groups is the internal rate of return.[50] As shown in Table 2, the estimated real internal rate of return to date falls rapidly over these early cohorts, from nearly 30 percent for cohorts born prior to 1885 to about 4.5 percent for cohorts born between 1917 and 1922.[51] Again, the relatively large internal rates of return estimated for these cohorts reflect the large transfers that a pay-as-you-go social insurance program grants to early cohorts. As found in other studies, the internal rate for females is substantially higher than that for males in all of the cohort groups, with absolute differences ranging from about 5 percentage points for the 1917–1922 cohort group to about 43 percentage points for the pre-1885 cohort group. Although the internal rate of return for Other Races falls short of the internal rate for Whites in the pre-1885 cohort group by 0.3 percentage points, the internal rate of return for Other Races exceeds that for

Whites in all of the later cohort groups, with differences ranging from around 0.3 to 1.3 percentage points. Looking at the individual race and gender groups, the internal rates of return for Other Races males exceeded those for White males in all of the cohort groups, with differences ranging from 0.2 to 2.0 percentage points; in all but the pre-1885 cohort group, the rates for Other Races females exceeded those for White females, with differences ranging from 0.2 to 1.3 percentage points. Disaggregating further to the level of individual (single year) birth cohorts, the real internal rate of return for Whites exceeded that for Other Races in only one of the individual cohorts born between 1885 and 1922. There were no individual cohorts in that range for which the internal rate for White males exceeded that for Other Races males and only five of the 38 cohorts for which the internal rate for White females exceeded that for Other Races females. By this measure, then, both Other Races males and females in these cohorts have generally experienced more favorable outcomes than their White counterparts, with the gender differential dominating the race differential.

The cohort groupings in the tables were chosen largely for consistency with the groupings used in the Duggan *et al*. (1993) paper, which is the most directly comparable study to the present analysis and which considered birth cohort groups in the 1895–1922 range. A number of differences between the approaches adopted in the Duggan *et al.* and present analyses should be kept in mind, however, when interpreting differences in results. One difference, of

course, is that the Duggan *et al.* analysis presents estimates of the full lifetime effects of the OASI program for cohort members included in their sample, while the primary estimates for the broader range of cohorts considered in the present analysis are limited to the 1937–1997 historical period.[52] Another difference arises from the sample selection method used in the Duggan *et al.* analysis; specifically, their sample excluded all cohort members who had OASI taxable earnings in 1988, the last year of data in their CWHS file, thereby excluding a portion of the taxes paid and benefits received by these cohorts. In contrast, the estimates in the present analysis include all taxes paid and benefits received by all cohort members through 1997.[53] There are also important differences in the methods used by the two analyses to allocate secondary benefits. Because of age differences between workers and secondary beneficiaries, the worker-account allocation method used by Duggan *et al.* can lead to substantial differences in the allocation of secondary benefits across cohorts compared to the individual-specific allocation method used in the present analysis. These two allocation methods can also lead to substantially different allocations of secondary benefits across gender groups, for obvious reasons, and differences in the cohort and gender group allocations under the two methods may vary substantially across race groups. Other differences in assumptions and methods between the Duggan *et al.* and present analyses include (1) benefit income taxation is included in the present analysis but not in Duggan *et al.*;[54] (2) all secondary benefits are included

in the present analysis, while Duggan *et al.* include only aged spouse and aged surviving spouse secondary benefits; (3) the present analysis groups those of unknown race in the "White" category, while Duggan *et al.* group them in the "other" race category; (4) the present analysis adjusts tax and benefit data gathered from separate administrative data sources to aggregate controls, while the Duggan *et al.* analysis aggregates across sample cases from a single administrative data source without adjustment; and (5) Duggan *et al.* use a different OASI trust fund interest rate series.[55]

The Duggan *et al.* paper reports a real internal rate of return of 12.5 percent for the 1895–1903 cohort group, compared to the 12.1 percent reported in Table 2. For the 1904–1910 cohort group, they report a rate of 9.4 percent, compared to the Table 2 rate of 8.8 percent. Similarly, for the 1911–1916 and 1917–1922 cohort groups, they report rates of 7.6 and 5.9 percent, respectively, compared to the 6.9 and 4.5 percent rates reported in Table 2. For each cohort group that they considered, then, Duggan *et al.* report a higher internal rate of return than the rate for the corresponding cohort group in Table 2, with the divergence increasing across the later cohort groups. The increasing divergence across cohort groups is expected, of course, because the *to date* estimates in Table 2 do not reflect all of the benefits that will be received by the later cohorts.[56]

As indicated above, the Duggan *et al.* study estimates the real internal rate of return within the entire 1895–1922 cohort group as 9.1 percent for whites, 9.6

percent for blacks, and 10.7 percent for others. This contrasts with the Table 2 estimates for that broad cohort group of 8.3 percent for Whites and 8.5 percent for Other Races, a difference of about 0.2 percentage points.[57] The internal rate of return race differentials for the 1895–1922 cohort group taken as a whole, then, are somewhat smaller in this analysis than in the Duggan *et al.* study.

Note, however, that the race differential for the 1895–1922 cohort group taken as a whole is smaller than the race differential within any of the narrower cohort groups in Table 2 that make up the combined 1895–1922 cohort group. The difference by which the internal rate of return for the Other Races group exceeds that for the White group in these narrower cohort groups ranges from about 0.3 percentage points for the 1917–1922 cohort group to 0.7 percentage points for the 1895–1903 cohort group in Table 2.[58] Such outcomes can occur when, for example, internal rates of return are generally falling (or rising) across cohorts for all race groups at the same time that the relative sizes of the race groups are changing across cohorts.[59]

Another measure of the relative balance between taxes and benefits for the various groups is the accumulated benefit/tax ratio.[60] Table 3 displays the ratio of accumulated benefits to accumulated taxes to date for the various race, gender, and birth cohort groups, where all values are accumulated through 1997 using the OASI trust fund interest rate. Appendices D and E present the corresponding results using the two alternative interest rate series. The accumulated benefit/tax

ratio to date falls over each successive cohort group, as expected, corresponding to the decline in internal rates of return over those cohort groups.[61]

Also as expected, the accumulated benefit/tax ratio to date for females is substantially higher than that for males within all of the cohort groups in Table 3, although the relative and absolute advantage of females declined monotonically over these cohort groups.[62] While the female share of accumulated benefits to date within these cohort groups increased from about 42 percent for the pre-1885 cohort group to about 56 percent for the 1895–1903 cohort group, it generally declined or remained flat across the remaining cohort groups, ending up at about 52 percent for the 1917–1922 cohort group.[63] In contrast, the female share of accumulated taxes to date increased consistently across the cohort groups. This share increased sharply from about 12 percent for the pre-1885 cohort group to about 26 percent for the 1904–1910 cohort group, but the rate of increase slowed markedly across the remaining cohort groups, with the female share of accumulated taxes to date ending up at about 27 percent for the 1917–1922 cohort group.

The race differentials in Table 3 for the combined 1895–1922 cohort group differ qualitatively from those reported by Duggan *et al.* As indicated above, accumulated lifetime benefit/tax ratios for the 1895–1922 cohort group can be estimated from the Duggan *et al.* study as 4.33 for whites, 4.41 for blacks, and 5.34 for other races. Using sample sizes to weight the reported mean benefit and

tax present values for each race group in the Duggan *et al.* study implies an accumulated benefit/tax ratio for all races other than white combined of 4.58 for the 1895–1922 cohort group, an estimate about 5.7 percent above the corresponding estimate for whites. In contrast, the Table 3 estimates of the accumulated benefit/tax ratio to date for that combined cohort group are 3.747 for Whites and 3.679 for Other Races, with the Other Races estimate about 1.8 percent below the corresponding estimate for Whites.[64] Note, however, that the accumulated benefit/tax ratio to date for the Other Races group in Table 3 exceeds that for the White group in each of the component cohort groups making up the combined 1895–1922 group, despite the opposite qualitative result for the combined cohort group taken as a whole.[65]

Expanding the discussion to include all of the cohort groups shown in Table 3, the Other Races accumulated benefit/tax ratio to date generally increases relative to the White ratio across the cohort groups, with the Other Races ratio ranging from about 5.8 percent below the White ratio for the pre-1885 cohort group to 4.0 percent above the White ratio for the 1917–1922 cohort group. While the Other Races share of accumulated taxes to date within these cohort groups has increased from about 4.4 percent for the pre-1885 cohort to 7.9 percent for the 1917–1922 cohort, the Other Races share of accumulated benefits to date within these cohort groups has increased even more rapidly, from about 4.1 percent to 8.2 percent over the same cohort range.[66] The lower overall

accumulated benefit/tax ratios for Other Races relative to Whites in the earliest two cohort groups is largely attributable to race differentials for females. In fact, accumulated benefit/tax ratios for Other Races males exceed those for White males in all of the Table 3 cohort groups by proportions ranging from about 5 to 13 percent. In contrast, accumulated benefit/tax ratios for Other Races females are lower than those for White females in all but the 1895–1903 cohort group. The female race differential is especially large for the pre-1885 and 1885–1894 cohort groups, but accumulated benefit/tax ratios to date for Other Races females still fall below those for White females by proportions ranging from about 2 to 8 percent in the three cohort groups born between 1904 and 1922.[67]

Disaggregating to the level of individual birth cohorts, the accumulated benefit/tax ratio to date for Other Races exceeded that for Whites in 24 (or about 63 percent) of the 38 individual cohorts born between 1885 and 1922. While there were no individual cohorts in that range for which the accumulated benefit/tax ratio for White males exceeded that for Other Races males, the ratio for White females exceeded the ratio for Other Races females in 25 (or about 66 percent) of the 38 individual cohorts.[68]

In sum, the race differentials implied by the accumulated benefit/tax ratios in Table 3 using the OASI trust fund rate of return paint a somewhat different picture than the internal rate of return estimates in Table 2. The generally more favorable outcomes observed for Other Races compared to those for Whites under

the internal rate of return measure do not appear as pronounced under the accumulated benefit/tax ratio measure. The overall White versus Other Races differentials represent the net result of generally opposing differentials between the gender subgroups, with accumulated benefit/tax ratios to date for Other Races males exceeding those for White males in all of the individual cohorts and cohort groups, but the corresponding ratios for Other Races females falling short of those for White females in most of the individual cohorts and cohort groups.

Interestingly, relative outcomes are more favorable for Other Races in some respects if *either* of the alternative interest rate series is used to develop the accumulated benefit/tax ratios to date, so relative race differentials for these cohorts are somewhat sensitive to the interest rate pattern as well to the general interest rate level.[69] Under the zero real interest rate assumption in Appendix D, for example, the Other Races accumulated benefit/tax ratio to date is larger relative to that for Whites in the first three narrow cohort groups and in the combined 1895–1922 group than under the OASI trust fund interest rate series. Still, the accumulated benefit/tax ratio for Other Races exceeds that for Whites in only three of the six narrow cohort groups under the zero real interest rate assumption, compared to four of the six using the OASI trust fund interest rate series. Disaggregating to the level of individual birth cohorts under the zero real interest rate assumption, the accumulated benefit/tax ratio to date for Other Races exceeded that for Whites in 24 of the 38 individual cohorts born between 1885

and 1922, the same number as under the OASI trust fund interest rate series. Under the zero real interest rate assumption, there were two individual cohorts in that range for which the accumulated benefit/tax ratio for White males exceeded that for Other Races males and 26 individual cohorts for which the accumulated benefit/tax ratio for White females exceeded that for Other Races females; again, these results are very close to those under the OASI trust fund interest rate series, with slight increases in the number of relative outcomes favoring White males (2) and White females (1).

Using the generally higher large company stocks interest rate series[70] to accumulate historical taxes and benefits has a dramatic impact on the estimated race differentials for the early cohorts, as shown in Appendix E. Under this interest rate assumption, the accumulated benefit/tax ratios to date in all of the cohort groups except the pre-1885 cohort group suggest that relative outcomes for Other Races have been more favorable than those for Whites. The accumulated benefit/tax ratios to date for Other Races exceed those for Whites in those cohort groups by proportions ranging from 9 to 12 percent. Even the accumulated benefit/tax ratios to date for Other Races females exceed those for White females in all but the first two cohort groups by proportions ranging from about 8 to 16 percent. For the combined 1895–1922 cohort group, the accumulated benefit/tax ratio to date for Other Races exceeds that for Whites by over 6 percent. Disaggregating to the level of individual birth cohorts under the large company

stocks interest rate assumption, the accumulated benefit/tax ratio to date for Other Races exceeded that for Whites in 36 of the 38 individual cohorts born between 1885 and 1922, a sharp increase over the number of such cases under either the zero real or OASI trust fund interest rate series. Under the large company stock interest rate assumption, there were no individual cohorts in that range for which the accumulated benefit/tax ratio to date for White males exceeded that for Other Races males and only six individual cohorts for which the accumulated benefit/tax ratio for White females exceeded that for Other Races females; again, the latter result represents a sharp increase in the number of individual cohorts in which relative outcomes favored Other Races compared with estimates under either the zero real or OASI trust fund interest rate series. For some of these early individual cohorts and cohort groups, then, the direction as well as extent of the race differential measured by the accumulated benefit/tax ratio is sensitive to the choice of the interest rate series.

V. Summary

This study uses Social Security administrative data on historical taxes and benefits by year, age, sex, and race to analyze redistribution to date under the OASI program across and within cohorts born through 1922. The size of the accumulated net transfer to date for these cohorts is impressive, reflecting the large transfers that a pay-as-you-go social insurance program grants to early cohorts. The accumulated benefit/tax ratio and real internal rate of return to date fall over these early cohort groups, reflecting the expected pattern for a maturing pay-as-you-go social insurance program.

All of the race and gender groups in all of these early cohorts are estimated to have received positive accumulated net transfers to date using either the zero real interest rate series or the OASI trust fund interest rate series. When the generally higher total rate of return to large company stocks series is used to accumulate past taxes and benefits, however, some of the race and gender groups in cohorts born after 1910 are estimated to have received negative accumulated net transfers to date, at least before adjustment for the costs of administering the program.

As found in earlier studies, the accumulated benefit/tax ratio and internal rate of return for females are estimated to be substantially higher than those for males in all of the cohort groups considered. Under the accumulated benefit/tax ratio measure, however, the relative advantage of females declined monotonically over

those cohort groups. Relative gender outcomes would also tend to be less favorable for females under a worker-account allocation of secondary benefits, compared to the individual-specific allocation of secondary benefits adopted in the present analysis.

The relative redistribution estimated in this analysis across race groups is more difficult to summarize, exhibiting some sensitivity to the choice of redistributional measure, cohort grouping, and interest rate series. Differences between races in the internal rates of return estimated in this analysis are smaller than those estimated in the most closely related previous research but still suggest that relative outcomes for Other Races have generally been more favorable than those for Whites in the cohorts considered. The accumulated benefit/tax ratios estimated in this analysis suggest that relative outcomes for Other Races have generally been more favorable than those for Whites in most of the cohorts considered, but the strength of the characterization depends on the choice of interest rate series and cohort grouping, and the race differentials differ sharply between males and females under some of the interest rate assumptions.

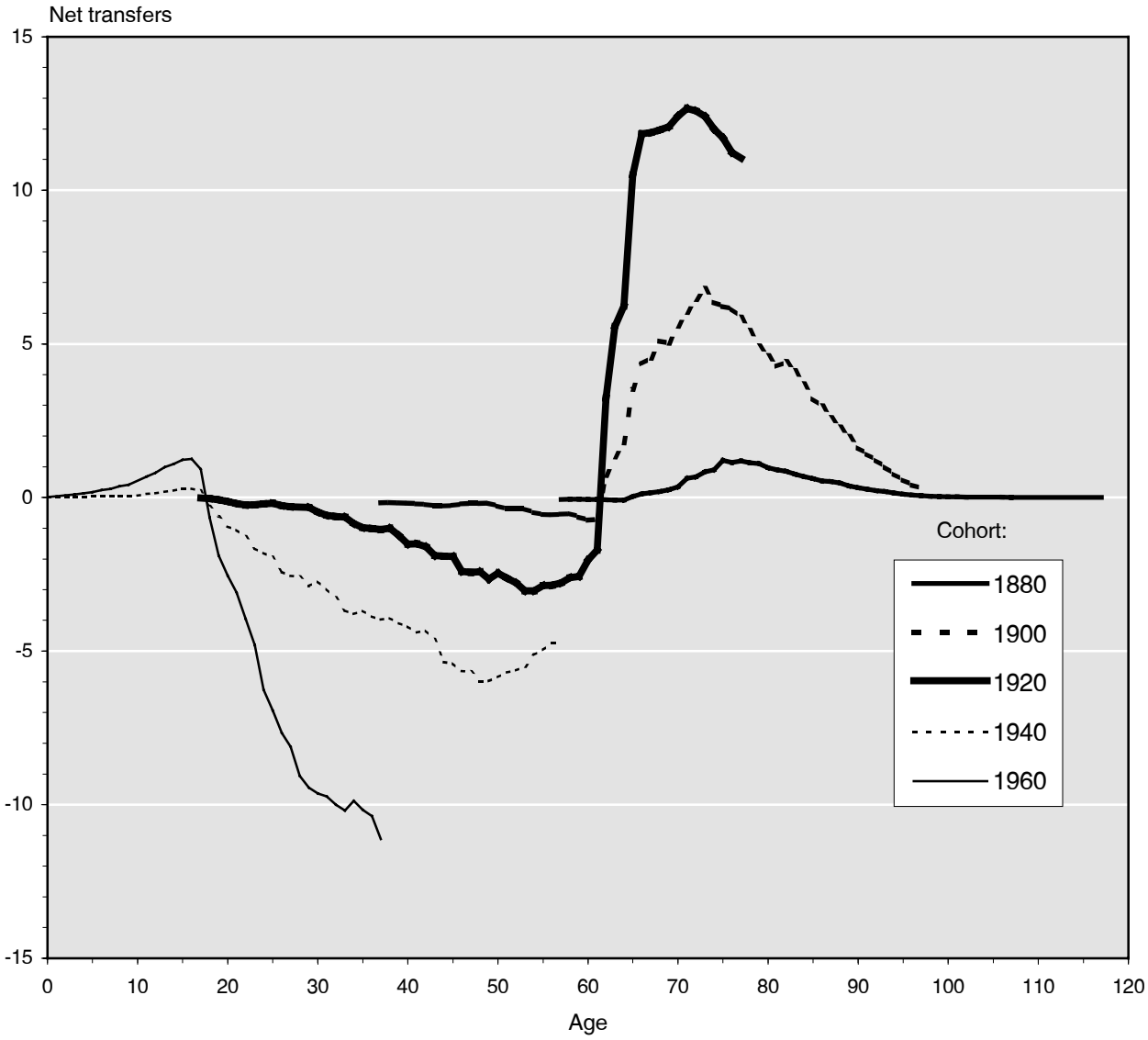
The somewhat different picture of race differentials that emerges from the present analysis may be due in part to its comprehensive accounting of historical taxes and benefits that is unmatched in earlier studies. In addition to the retired worker, aged dependent spouse, and aged surviving spouse benefits sometimes included in previous analyses, this study also includes all other benefit types,

including various types of child and disabled child benefits, spouse and surviving spouse with entitled child benefits, disabled widows and widowers benefits, various types of divorced spouse benefits, surviving dependent parent benefits, special age-72 benefits, and lump-sum benefits. On the tax side, this study includes all tax payments by cohort members, including those paid by cohort members who continue working past typical retirement ages. At the same time, there are important differences in assumptions and methods between this analysis and closely related previous research that may account for the differences in results. In particular, the allocation of secondary benefits to specific cohort, race, and gender groups can differ substantially between the individual-specific and the worker-account allocation methods.

As a final note, it bears repeating that this analysis covers only the OASI portion of the Social Security program for early cohorts. The redistributional results presented in this paper would likely be affected for some cohorts both quantitatively and qualitatively by extending the analysis to include the DI portion of the program. There is evidence, for example, that redistributional outcomes under the DI program have generally been more favorable for Other Races than for Whites and have generally been more favorable for males than for females in some of the early cohorts.[71] In addition, redistributional outcomes for later cohorts may differ significantly from those for the early cohorts considered in this analysis, reflecting program changes, greater emphasis on benefit types associated

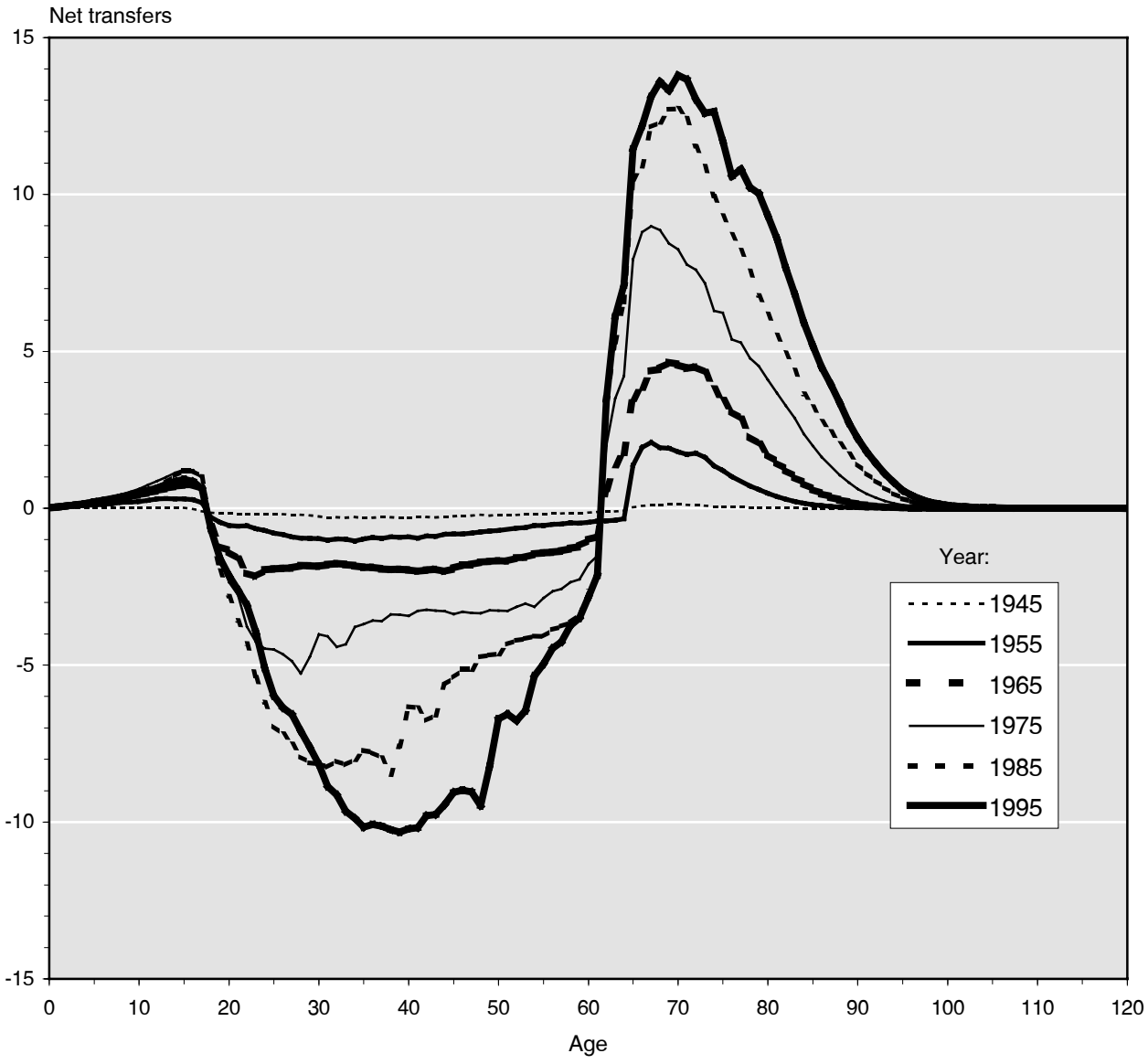
with early life cycle ages, and changes over time in such factors as the earnings, family status, net immigration, and mortality experience of the various race and gender groups.

Chart 1.
Aggregate annual OASI real net transfers over the period 1937-1997 for selected birth cohorts, by age (in billions of 1997 dollars)



SOURCE: Author's calculations.

Chart 2.
Aggregate annual OASI real net transfers in selected years, by age
(in billions of 1997 dollars)



SOURCE: Author's calculations.

Table 1.
Accumulated net transfers through 1997 evaluated as of year-end 1997 using the interest rate earned by the OASI trust fund, by cohort, race, and sex (in billions of dollars)

	White			Other Races			All Races		
Cohort	Males	Females	Total	Males	Females	Total	Males	Females	Total
Before 1885	250	199	450	13	7	19	263	206	469
1885–1894	646	749	1,395	38	34	71	683	783	1,466
1895–1903	789	1,222	2,011	63	77	140	852	1,299	2,151
1904–1910	752	1,215	1,967	67	89	155	819	1,303	2,122
1911–1916	594	956	1,550	52	80	132	646	1,036	1,682
1917–1922	90	572	662	11	51	62	101	623	724
1895–1922	2,225	3,964	6,189	193	297	489	2,418	4,261	6,679

SOURCE: Author's calculations.

Table 2.
Real internal rate of return through 1997, by cohort, race, and sex (in percent)

	White			Other Races			All Races		
Cohort	Males	Females	Total	Males	Females	Total	Males	Females	Total
Before 1885	24.3	68.4	29.9	26.3	52.5	29.6	24.4	67.8	29.9
1885–1894	14.4	28.5	17.8	16.4	28.7	19.1	14.5	28.5	17.8
1895–1903	9.0	18.9	12.1	10.0	20.2	12.8	9.0	18.9	12.1
1904–1910	6.3	13.2	8.7	6.8	14.3	9.2	6.3	13.3	8.8
1911–1916	4.8	10.4	6.9	5.1	11.4	7.3	4.9	10.5	6.9
1917–1922	2.5	7.7	4.5	2.7	8.2	4.8	2.5	7.8	4.5
1895–1922	5.6	13.1	8.3	6.0	13.8	8.5	5.6	13.1	8.3

SOURCE: Author's calculations.

Table 3.
Ratio of benefit/tax accumulated values through 1997 using the interest rate earned by the OASI trust fund, by cohort, race, and sex

	White			Other Races			All Races		
Cohort	Males	Females	Total	Males	Females	Total	Males	Females	Total
Before 1885	10.914	59.602	16.693	12.023	41.606	15.728	10.962	58.776	16.651
1885–1894	8.434	40.868	14.199	9.518	33.907	14.136	8.486	40.506	14.196
1895–1903	4.961	21.409	8.763	5.467	21.810	8.838	4.995	21.432	8.768
1904–1910	3.296	11.581	5.447	3.542	11.289	5.455	3.314	11.561	5.447
1911–1916	2.282	6.874	3.476	2.407	6.756	3.603	2.291	6.864	3.485
1917–1922	1.132	3.347	1.715	1.199	3.088	1.783	1.137	3.324	1.721
1895–1922	2.331	7.823	3.747	2.461	6.847	3.679	2.340	7.744	3.742

SOURCE: Author's calculations.

Appendix A: Data Details

This appendix provides additional details of data development issues that arose during this analysis. The discussion focuses on problems related to the administrative race variable and problems related to the summary benefit tables used to develop estimates of the proportional distribution of benefits by age, race, and sex in each historical year.

Administrative Race Variable

The Social Security administrative data race variable presents a number of problems for redistributional analyses. The most serious of these problems for the present analysis arises because the SS-5 form used by Social Security to collect race information has changed over time. Prior to November 1980, the form allowed only three responses to the race question, corresponding to "White," "Black," and "Other." Beginning in November 1980, the race question was expanded to allow five race/ethnic responses: "White (not Hispanic)," "Black (not Hispanic)," "Hispanic," "Asian or Pacific Islander," and "American Indian or Alaskan Native."

Unfortunately, there is no way to cleanly map the new SS-5 race categories into the old SS-5 categories. The situation is made worse for this analysis because the summary benefit tables maintain a three-way white/black/other classification from 1968 on, but include those selecting "Hispanic" on the new SS-5 form with

other races, rather than with whites. This creates a potential problem because survey data matched to administrative records suggest that the vast majority of persons of Hispanic origin are coded as white in these surveys and selected the white category on the old SS-5 form.[72] A more consistent race categorization over time might have been created, then, if new SS-5 Hispanics had been placed in the white category instead of in the other category in the benefit tables.

Because Social Security card applicants were first given the Hispanic race/ethnic response option in November 1980, new SS-5 Hispanics are likely to be concentrated in the youngest cohorts. As such, the inconsistency introduced to date into the benefit table race classifications is probably not severe, particularly for the early cohorts considered in this analysis. One approach, then, would be to group all new SS-5 Hispanics with whites in the tax data under the assumptions that (1) the vast majority of Hispanics or Latinos are grouped with whites under the old SS-5 code in both the benefit tables and the tax data, (2) the number of new SS-5 Hispanics included with others in the benefit tables is relatively low, and (3) including new SS-5 Hispanics with others in the tax data, where new SS-5 Hispanics are more prevalent than in the benefit data, might introduce more of an inconsistency with the benefit data than including new SS-5 Hispanics with whites in the tax data. An alternative approach would be to maintain consistency in the grouping of new SS-5 Hispanics with others in both the tax and benefit data despite the probability that the vast majority of Hispanics or Latinos are grouped

with whites under the old SS-5 code. Because the choice between these alternative race allocations is not clear, estimates were generated under both alternatives. Fortunately, none of the main conclusions of the analysis were sensitive to the grouping of new SS-5 Hispanics. The results presented in this paper are for the second alternative, with new SS-5 Hispanics included with others in both the tax and benefit data. Under either alternative, it must be kept in mind that the administrative race allocations are somewhat muddled, with most Hispanics or Latinos probably represented in the White race category regardless of the allocation of new SS-5 Hispanics.

Another problem associated with the race variable is that the benefit data underlying this analysis include an inconsistency in the race classifications beginning in 1992. Specifically, some of those erroneously coded as other or unknown in previous years were reclassified to specific race groups in the benefit tables for 1992 and later years. The apparent net effect of this reclassification was to increase somewhat the share of benefits allocated to the White race category relative to the Other Races category beginning in 1992, implying that the Other Races share of benefits is overstated to some extent in the summary benefit tables for some of the years prior to 1992.

Benefit Data

The degree of age detail in the summary benefit tables varies by detailed beneficiary type and year. In nearly all years, most benefit payments are disaggregated by single year of age. For some quantitatively less important benefit types, generally five-year age groups or "age and under" or "age and over" age groups are reported. For four years, 1946–1949, benefit payments are only disaggregated by generally five-year age groups. In all cases where the tables include one or more age groups as part of the age detail for a particular beneficiary type, race, and year case, the total number of beneficiaries for each age group was allocated among individual ages within that age group using an iterative smoothing technique.[73] Average benefits were then assigned to individual ages within each age group using a similar iterative smoothing technique that preserved the beneficiary allocations and age group benefit aggregates.[74]

The summary benefit tables provide no information on the race or gender distribution of lump-sum payments at age 65, which were paid during the 1937–1939 period. These payments were allocated by race and gender in the same proportions as for age-65 retired worker benefits in 1940, the closest year for which the race and gender distribution of retirement benefits was available.[75]

The summary benefit tables also provide no information on the race, gender, and age distribution of lump-sum death benefits. The proportional distribution by race, sex, and age of these benefits in each year was assumed to be

identical to the corresponding distribution of total monthly benefit payments to widow and widower beneficiaries of all types (widow, widower, widowed mother, widowed father, disabled widow, and disabled widower) in that year. Because monthly benefit payments did not exist until 1940, lump-sum death payments during the 1937–1939 period were allocated using the 1940 relative distribution of total widow and widower benefits of all types.[76]

Beginning in 1967, age detail is not provided separately in the summary benefit tables for the relatively small subcategory of husbands of retired workers. From 1967 on, then, the proportional age distribution of benefits for each race group of the husbands of retired workers subcategory was assumed to be the same as for the corresponding race group of the combined husbands of retired and disabled workers category, for which age detail was reported.[77]

Age detail is not provided separately in the summary benefit tables for either the disabled widows or the disabled widowers beneficiary categories beginning in 1968, when such benefits were first paid. Consequently, the proportional age distribution of benefits for each race group of these categories was assumed to be the same as for the corresponding race group of the combined disabled widows and widowers beneficiary category, for which age detail was reported.[78] In addition, the 1976 summary benefit table provides age detail for the combined disabled widows and widowers category but no information at all for the separate disabled widows and disabled widowers subcategories. Consequently,

synthetic estimates of total benefits to the disabled widows and disabled widowers subcategories in 1976 were constructed for each race group from the corresponding data in the 1975 and 1977 summary benefit tables; the estimation method preserved consistency between these estimates and the total benefits reported in the 1976 table for the combined disabled widows and widowers category.

Beginning in 1969, age detail is reported in the summary benefit tables for the combined parents benefit category, but not separately for the male and female subcategories of that benefit type. Beginning in that year, then, the proportional age distribution of the total benefits reported for each race group of the male and female subcategories was assumed to be the same as for the corresponding race group of the combined parents race category.[79]

Beginning in 1975, when widowed fathers benefits were first paid, age detail is reported in the summary benefit tables for the combined widowed mothers and fathers benefit category, but not separately for the mothers and fathers subcategories of that benefit type. Beginning in that year, then, the proportional age distribution of the total benefits reported for each race group of the mothers and fathers subcategories was assumed to be the same as for the corresponding race group of the combined widowed mothers and fathers race category.[80]

A different problem is posed by the children of retired and deceased workers beneficiary categories, which are not reported by sex of recipient in the summary benefit tables beginning in 1950. To allocate these benefits by sex, the

reported average benefit for each race and age group was assumed to apply equally to male and female child beneficiaries, and the proportion of male and female beneficiaries at each age was assumed equal to the proportion of males and females in the underlying population of that age.[81] These allocations were not of much significance for the birth cohorts included in this analysis, however, since even the youngest cohort included was age 18 in 1940, when child benefits were first paid; age 18 is also the oldest age at which child benefits were paid in that year. Beginning in 1957, disabled child benefits were paid to eligible disabled children or grandchildren (ranging in age from 18 to over 65) of retired and deceased workers; although this is a relatively small beneficiary category, some benefits of this type affected the cohorts included in this study.[82]

Finally, in a number of other instances involving very small beneficiary categories, special approaches had to be adopted to compensate for incomplete data in the summary benefit tables. These instances were nearly all related to special age-72 benefits in years after 1982. The approaches adopted in these cases are not detailed here, because the descriptions would be tedious and because the details are of little significance to the results.[83]

Appendix B

Table B–1.
Accumulated net transfers through 1997 evaluated as of year-end 1997 using a zero real interest rate, by cohort, race, and sex (in billions of dollars)

	White			Other Races			All Races		
Cohort	Males	Females	Total	Males	Females	Total	Males	Females	Total
Before 1885	107	87	194	5	3	8	112	90	202
1885–1894	288	337	625	17	15	32	305	352	657
1895–1903	369	580	949	30	36	66	398	617	1,015
1904–1910	383	630	1,013	34	46	79	417	676	1,092
1911–1916	374	559	933	32	47	78	406	605	1,011
1917–1922	201	419	620	18	38	56	219	457	676
1895–1922	1,326	2,188	3,514	114	166	280	1,440	2,355	3,794

SOURCE: Author's calculations.

Appendix C

Table C–1.
Accumulated net transfers through 1997 evaluated as of year-end 1997 using the total rate of return to large company stocks, by cohort, race, and sex (in billions of dollars)

	White			Other Races			All Races		
Cohort	Males	Females	Total	Males	Females	Total	Males	Females	Total
Before 1885	1,732	1,490	3,222	82	43	125	1,814	1,533	3,347
1885–1894	1,450	2,883	4,333	102	126	227	1,552	3,009	4,560
1895–1903	716	3,601	4,318	89	229	318	805	3,830	4,636
1904–1910	362	3,095	3,457	68	233	301	430	3,328	3,758
1911–1916	- 392	1,952	1,561	- 5	175	170	- 396	2,127	1,731
1917–1922	- 1,869	536	- 1,333	- 144	59	- 85	- 2,013	595	- 1,418
1895–1922	- 1,182	9,184	8,002	8	696	704	- 1,174	9,880	8,706

SOURCE: Author's calculations.

Appendix D

Table D–1.
Ratio of benefit/tax accumulated values through 1997 using a zero real interest rate, by cohort, race, and sex

	White			Other Races			All Races		
Cohort	Males	Females	Total	Males	Females	Total	Males	Females	Total
Before 1885	9.949	56.099	15.332	11.166	38.160	14.632	10.001	55.250	15.302
1885–1894	8.354	41.211	14.139	9.462	33.829	14.099	8.407	40.821	14.137
1895–1903	5.130	22.723	9.183	5.703	23.112	9.312	5.167	22.745	9.191
1904–1910	3.592	13.160	6.076	3.858	12.727	6.058	3.611	13.130	6.075
1911–1916	2.789	8.579	4.298	2.916	8.381	4.426	2.798	8.563	4.308
1917–1922	1.649	4.760	2.473	1.745	4.366	2.561	1.656	4.724	2.480
1895–1922	2.756	9.296	4.449	2.910	8.214	4.393	2.767	9.209	4.444

SOURCE: Author's calculations.

Appendix E

Table E–1.
Ratio of benefit/tax accumulated values through 1997 using the total rate of return to large company stocks, by cohort, race, and sex

	White			Other Races			All Races		
Cohort	Males	Females	Total	Males	Females	Total	Males	Females	Total
Before 1885	3.360	20.633	4.980	3.717	18.015	4.832	3.374	20.548	4.974
1885–1894	1.838	10.965	3.146	2.315	10.677	3.518	1.859	10.953	3.162
1895–1903	1.285	6.938	2.382	1.540	8.041	2.613	1.300	6.995	2.396
1904–1910	1.125	4.662	1.923	1.316	5.131	2.110	1.138	4.691	1.936
1911–1916	0.875	2.998	1.380	0.979	3.374	1.549	0.882	3.024	1.392
1917–1922	0.465	1.422	0.720	0.489	1.538	0.784	0.467	1.432	0.725
1895–1922	0.902	3.484	1.509	1.009	3.550	1.602	0.909	3.489	1.515

SOURCE: Author's calculations.

Notes

[1] See Leimer (1995) for a more thorough critique of the hypothetical worker approach, along with a discussion of the major assumptions, key analytical methods, measures, and uses of Social Security "money's worth" analyses. Some money's worth analyses employ a mix of historical data and hypothetical worker methods. Survey data matched with Social Security administrative earnings and benefit records, for example, can provide the basis for such analyses. As discussed further below, however, historical administrative data of this type are incomplete, as are other critical inputs such as family and mortality histories for all cohort members disaggregated by characteristics of interest. Inevitably, then, simplifying assumptions or hypothetical worker methods must be introduced into the analyses to simulate the missing historical information and project any required prospective data. See Leimer (1995), Chen and Goss (1997), and Leimer (1999) for references to the broader Social Security money's worth literature representing a wide variety of data and methods.

[2] The specific race groupings referred to in this paper as "White" and "Other Races" are defined in the discussion below.

[3] Many of these issues are also discussed, often in greater detail, in Leimer (1995).

[4] Worker-only beneficiaries receive benefits based on their own earnings records, but have no dependents drawing benefits on that account. The Freiden *et al.* analysis defines the OAI portion of the program to include only benefits paid to workers and their families after the worker's retirement age, and the analysis develops estimates of the historical tax rates required to fund that portion of the program. See Smith (1989) for a description of the CWHS.

[5] Because the largest share of benefits under the OASI program is paid at older ages, groups with lower mortality tend to receive more favorable relative treatment, *ceteris paribus*, compared to groups with higher mortality; *i.e.*, members of groups with lower mortality are more likely to survive to receive benefits at older ages and to collect those benefits for a longer period of time.

[6] The progressive benefit formula is based on a measure of average lifetime earnings, and benefits relative to that measure are higher, *ceteris paribus*, for workers with lower average lifetime earnings by that measure; as such, groups that experience generally lower average earnings over their lifetimes tend to receive more favorable relative treatment, *ceteris paribus*, compared to groups with higher average earnings.

[7] Based on estimates derived in this analysis, the female share of annual OASI

benefits paid to dependents and survivors ranged from 81 to 90 percent over the 1940–1997 period.

[8] The Duggan *et al.* (1993) analysis considers only benefits to retired workers, their age-entitled spouses, and age-entitled surviving spouses under the OASI program. Internal rates of return in the present analysis and in the Duggan *et al.* analysis were computed from the aggregate annual net transfers for each group of interest, while the internal rates of return reported for the Freiden *et al.* analysis are averages of rates of return computed for individual cases in each group of interest.

[9] The Duggan *et al.* paper does not report accumulated benefit/tax ratios as such but does report accumulated benefits and taxes separately for the various groups, allowing the computation of benefit/tax ratios.

[10] Although not stated explicitly in their paper, the Hurd and Shoven analysis appears to include only OASI benefits to retired workers, age-entitled spouses, and age-entitled surviving spouses. Gender- and race-specific survival probabilities (from life tables for a single year) were used to adjust the past taxes and benefits for each sample observation in an attempt to include the past taxes and benefits of cohort members who did not survive to interview age. Benefits for sample members were projected under the assumption that they had no further earnings or taxes after the interview year. There is no indication whether tax rates were adjusted downward for excluded benefit types.

[11] Studies of socioeconomic mortality differentials have found a strong negative association between mortality and income. As examples, see Duleep (1986) and Menchik (1993).

[12] Although not directly reported as such in their paper, the sample results presented in the Hurd and Shoven paper appear to permit the inference that, on average, accumulated benefit/tax ratios for whites were lower than those for other races before adjustment for the taxes paid by young decedents. Hence, the relatively crude approach used by Hurd and Shoven to estimate the taxes of young decedents appears to be critical to their conclusion that white benefit/tax ratios exceeded those for other races.

[13] The SSA Summary Earnings Record that these studies relied on for historical earnings does not provide annual OASI taxable earnings prior to 1951, only the simple sum of such earnings over the 1937–1950 period.

[14] Historically, other races have experienced higher mortality at early ages and lower average earnings than whites. In the CWHS samples used to develop the tax data for this analysis, for example, the annual ratio of average OASI taxable

earnings for Whites relative to Other Races averaged 1.46 over the 1937–1997 period. See Anderson (1999) for data on relative mortality experience by race and gender for selected years from 1900 to 1997.

[15] Monthly benefits payable to dependents of a retired worker or survivors of a deceased worker are referred to as "secondary" benefits, while benefits payable to the insured worker on whose account the benefits were earned are referred to as "primary" benefits. A glossary of program terms can be found in the *Annual Statistical Supplement* to the *Social Security Bulletin*.

[16] The administrative benefit data underlying this analysis assume, however, that the race of a secondary beneficiary is the same as that of the worker on whose account the benefits are paid.

[17] Some of these problems arise because the race information is collected from Social Security card applicants through voluntary self-reporting. If the number of applicants choosing not to supply race information increases over time, for example, or if attitudes affecting the selection of race change, the racial composition of each administrative race category can also change over time. In fact, the proportion of records with unknown race has been increasing over time for various reasons, gradually eroding the quality of the race variable; although this problem does not appear to be serious for the present analysis, it may become so for future analyses. See Leimer (1998) and Scott (1999) for further discussion of problems posed by the administrative race variable.

[18] While the inclusion of Unknowns with Whites was imposed by the administrative benefit data used in this analysis, there is some evidence that the vast majority of Unknowns would be categorized as white in survey data. An examination of the 1973 Exact Match File, which links the 1973 Current Population Survey (CPS) with Social Security administrative data, indicates that 95 percent of those with any Social Security covered earnings and whose Social Security Summary Earnings Record race was unknown were coded as whites in the CPS portion of the file.

[19] Because of this, it is not clear how best to group in the tax data those classified as Hispanic under the new SSA race code. Consequently, estimates were also developed under an alternative grouping that included those classified as Hispanic under the new SSA race code with Whites (rather than with Other Races) in the tax data. Fortunately, none of the main conclusions of the analysis were sensitive to this alternative grouping. This is discussed further in Appendix A.

[20] Of course, any general assumption other than full backward shifting would greatly complicate the identification of the specific individuals bearing the tax, but

the assumption that the employer share of the tax is shifted directly or indirectly to workers is supported by a number of analyses. See Dye (1984) for a summary of a number of empirical analyses of payroll tax incidence.

[21] The 1 percent file includes annual OASI taxable earnings data only back to 1951. The 0.1 percent file includes annual OASI taxable earnings data back to 1937.

[22] For example, only the employer's portion of the tax was included for taxable wages above the annual maximum taxable earnings, a situation that can arise with multiple employers. In such cases, the employee portion of the tax on taxable wages above the annual maximum taxable earnings is refundable via the employee's Federal income tax return.

[23] The aggregate OASI tax liability for each year was derived by applying historical OASI tax rates to taxable wage and salary earnings and self-employment earnings (Tables 2.A3 and 4.B2 in the 1999 *Annual Statistical Supplement* to the *Social Security Bulletin*). Sample taxes were adjusted to aggregate controls for consistency with the benefit estimates described below and because of evidence that individual wage records tend to underestimate actual taxable earnings each year based on employer reports. The specific adjustment adopted effectively assumes that the proportional underestimate in a given year is the same for each race, gender, and age group.

[24] This estimate of tax liability does not adjust for some income tax offsets associated with the program. For example, the assumption that payroll taxes are backward shifted (in the form of lower wages) implies that workers' true earnings are higher than actually observed, and this unobserved portion of true earnings avoids the personal income taxation applied to observed earnings.

[25] Although the format and specific detail in these tables have varied over time, all of the summary tables except for the years 1940–1942 report monthly benefits in current payment status as of year-end. The summary tables for 1940, the first year that monthly benefits were paid, report benefits awarded during the year. The tables for 1941 and 1942 report benefits in force at year-end, where benefits in force represent benefits awarded after adjustment for subsequent changes due to terminations and other factors. Additional detail is provided in various issues of the *Social Security Yearbook* and the *Annual Statistical Supplement*. As examples of the tables used, see Tables 25–29 in the 1940 *Social Security Yearbook* and Table 5.A1 in the 1998 *Annual Statistical Supplement*.

[26] As indicated above, this problem does not arise for annual earnings records, which are complete from 1951 to date in the 1 percent CWHS file and from 1937 through 1977 in the last available 0.1 percent CWHS file.

[27] In addition to lump-sum death payments based on cumulative wage credits for decedents of any age, the 1935 Act also provided for lump-sum refunds based on cumulative wage credits for persons who had not attained insured status at age 65. The lump-sum refund provision was eliminated, beginning in 1940, under the 1939 Act.

[28] As a proportion of total annual OASI benefits, this combined category has grown from 54 percent in 1940 to 95 percent in 1997.

[29] The *Annual Statistical Supplement* provides additional information on all of these beneficiary categories. As examples, dependent parents benefits are paid to eligible parents of deceased workers; widowed fathers and mothers benefits are paid to surviving spouses or surviving divorced spouses caring for an eligible child; special age-72 benefits are paid to members of some of the earliest birth cohorts if those members attained age 72 without qualifying for retired-worker benefits. Special age-72 benefits differ from the other beneficiary categories in that the OASI trust fund receives transfers from the general fund of the Treasury to offset special age-72 benefit payments and associated administrative expenses. As such, special age-72 benefits might be excluded from the analysis on the grounds that these benefits are not financed by the OASI payroll tax. The rationale for inclusion is that these are OASI benefits targeted to many of the early cohorts included in this analysis and represent a very small proportion of total OASI benefits and taxes over the analysis period. In particular, had special age-72 benefits been financed through an increase in the payroll tax, the required pay-as-you-go tax rate increase would have never reached as much as 0.1 percent of taxable payroll in any year; over the entire 1966–1997 historical period during which special age-72 benefits have been paid, all of these benefit payments could have been financed by an increase of 0.02 percentage points in the combined employer-employee payroll tax rate over that period. Consequently, the inclusion of special age-72 benefits in the analysis does not seriously violate the "financial balance" principle (*i.e.*, the principle of comparing benefits and taxes in the context of an essentially self-financed system that is in long-run financial balance).

[30] A summary table of benefits by beneficiary type, race, and age for 1981 was not published in the *Annual Statistical Supplement*, so the distribution of benefits by race, gender, and age within each beneficiary category in that year was derived by interpolating between the corresponding summary benefit table estimates for 1980 and 1982. Total annual benefits paid from the OASI trust fund by beneficiary category were taken from Table 91 in the 1963 *Annual Statistical Supplement* for

the years 1937–1963 and from Table 4.A5 in the 1999 *Annual Statistical Supplement* for later years.

[31] The combined grouping of retired workers, spouses of retired workers, widows and widowers, and dependent parents into one large beneficiary category was necessitated by the different treatment in some years of dual beneficiaries (beneficiaries entitled to a primary benefit on their own account and to a larger secondary benefit on another account) between the summary benefit tables (used to identify the proportional distribution of benefits by race, sex, and age within each beneficiary category) and the annual aggregate benefit tables (used to identify aggregate OASI benefit payments for each beneficiary category). In the summary benefit tables for those years, the total benefit received by dual beneficiaries is usually reported as a retired-worker benefit, even though part of the benefit is attributable to the secondary eligibility. In the annual aggregate benefit tables for those years, however, the total benefit received by dual beneficiaries in the spouses of retired workers, widows and widowers, and dependent parents categories is split into parts, with the primary benefit included in the retired-worker category and the remainder of the total benefit included in the appropriate secondary benefit category (or categories).

[32] These beneficiary categories reflect a variety of beneficiary type conversions that can occur within and across the OASI and DI trust funds. For example, a disabled-worker benefit paid out of the DI trust fund is converted to a retired-worker benefit paid out of the OASI trust fund when the disabled worker attains age 65; analogous conversions are effected for any associated secondary benefits. An essential feature (and advantage) of this analysis, then, is that all of the benefits paid out of the OASI trust fund are contrasted with all of the OASI taxes levied to fund those benefits.

[33] One rationale for this adjustment is to provide redistributional estimates net of income taxation. An additional, independent rationale is created because a large portion of the proceeds from the income taxation of OASI benefits are returned to the OASI trust fund as a transfer from general revenues. Over the long run, then, this portion of benefit income taxation revenues can be viewed as an income source required by the trust fund to fully finance legislated OASI benefits. In this context, the "financial balance" principle (*i.e.*, the principle of comparing benefits and taxes in the context of an essentially self-financed system that is in long-run financial balance) requires that even redistributional estimates gross of income taxation include an adjustment for the portion of benefit income taxation revenues returned to the trust fund. This might be accomplished by subtracting this portion of benefit income taxation revenues from benefits for comparison to OASI payroll taxes or by adding this portion of benefit income taxation revenues to payroll taxes for comparison to benefits gross of income taxation. The measures adopted in this

study are net of income taxation, so all OASI benefit income taxation revenues (including the portion not returned to the OASI trust fund) are subtracted from benefits for comparison to OASI payroll taxes.

[34] For example, U.S. Department of the Treasury (2001) reports estimates for calendar years 1994–1996 based on an analysis of tax returns in those years. A preliminary, unpublished, Treasury estimate was used for the calendar year 1997. The estimated average effective taxation rate on OASI benefits rose from about 1.5 percent in 1984 to 2.0 percent in 1993. In 1994 the estimated average rate jumped to about 3.1 percent, as provisions exposing a greater proportion of benefits to income taxation went into effect. By 1997 the estimated average rate had risen to about 3.8 percent. No attempt was made to identify the additional state income tax liability associated with OASI benefits.

[35] As such, assuming the same rate across all groups may bias the benefit/tax ratios estimated in this analysis upward for Whites relative to Other Races and for males relative to females. This effect is probably not large for most of the cohorts considered in this analysis, however, since (as indicated below) the income taxation of benefits has a relatively small effect on most of these early cohorts. To test of the potential importance of the bias for these cohorts, simulations were also run under the assumption that all revenues from the income taxation of OASI benefits were paid by White beneficiaries (with the annual proportional tax rate on their OASI benefits set at the level that would generate aggregate OASI benefit income taxation revenues equal to those actually observed in that year across all beneficiaries), with no benefit income taxes paid by beneficiaries of Other Races; even this extreme assumption had very little effect on the redistributional measures' relative race rankings within the cohort groups considered in this analysis. Nevertheless, the crude approach adopted in this analysis for incorporating the income taxation of benefits should be improved upon in future analyses to the extent that the data allow, since the income taxation of benefits represents a growing source of trust fund revenue that will have increasingly important distributional consequences for later cohorts. Unfortunately, identifying the incidence of benefit income taxation requires information that is frequently of poor quality or not available in micro data sources, so that incorporating benefit income taxation into redistributional analyses represents a considerable complication.

[36] The inflation rate series and the large company stock index series correspond respectively to the Consumer Price Index for all urban consumers (not seasonally adjusted) and the S&P 500 Composite index with dividends reinvested; these series can be found in Ibbotson (1999). The estimated effective annual interest rate earned by the OASI trust fund is taken from Kunkel (1997) for the years 1940–1996; an unpublished estimate for 1997 was also provided by Jeffrey L. Kunkel of

the Office of the Chief Actuary of the Social Security Administration. The OASI trust fund rate for the years 1937–1939 was assumed to be the same as the rate for 1940.

[37] See Leimer (1994), especially pp. 18–19 and 27–28, and Leimer (1995), pp. 7–8, for a discussion of the interest rate choice in redistributional analyses.

[38] This description assumes that the size of the net transfers has no market effect on the interest rate earned on trust fund assets, an assumption that is potentially unrealistic for large net transfers. Also, the use of the effective rate of return to the entire portfolio of trust fund assets might be deemed to be inappropriate for analyzing the effects of small changes in taxes or benefits, because it neglects details of trust fund financing practice related to investment in new issues and disinvestment of existing assets—these details lose relevance, however, in the context of analyzing the effects of large net transfers over time across different age, race, and gender groups. Finally, since this analysis compares benefits net of income taxation with OASI payroll taxes, the accumulated value of these net lifetime OASI benefits less payroll taxes for various groups is somewhat smaller than the cost to the OASI trust fund of providing these transfers (by the amount of the benefit income taxation revenues that are not returned to the OASI trust fund).

[39] Over nearly all of the historical period, the rates of return on the special Treasury obligations held by the trust funds were based on the rates for marketable Treasury obligations sold to private investors. The mean and sample variance of the real annual rate of return to OASI trust fund assets over the 1940–1997 period, for example, both lie between the corresponding statistics for the Ibbotson (1999) intermediate-term government bond series and U.S. Treasury bill series. See Kunkel (1997) and (1999) for further information on the determination and history of the rates earned on trust fund assets.

[40] Various characteristics of the Social Security program, such as the automatic inflation adjustment of benefits, can reduce overall portfolio risk for program participants. See Leimer and Richardson (1992) for a discussion of the associated theoretical issues as well as empirical estimates; their estimates suggest that consumers may use a zero or even negative real discount rate when discounting expected Social Security taxes and benefits.

[41] Some analysts argue, for example, that the political risks associated with the future level of taxes and benefits justify the use of a higher market rate of return in Social Security money's worth analyses. Again, Leimer (1994) and (1995) discuss these issues in greater detail.

[42] A deficiency of most money's worth analyses is that they ignore the

administrative costs of the alternative to which the Social Security program implicitly is being compared, biasing the comparison against Social Security. To the extent that they can be identified, of course, the administrative costs of specific alternatives to the Social Security program could be incorporated into money's worth analyses.

[43] Administrative costs, operating expenses, and loading charges in private markets in part reflect marketing costs, adverse selection, and the inability to exploit the economies of scale enjoyed by a compulsory, nearly universal, public program. See Leimer (1991) for additional discussion.

[44] Because administrative expenses represent a necessary cost associated with the provision of the retirement saving, annuity, and survivors insurance features of the program, net redistribution from a program perspective might be defined as the accumulated value of a group's benefits plus the accumulated value of their allocated share of administrative expenses less the accumulated value of their taxes.

[45] There are, of course, a variety of other reasons why money's worth measures may not accurately reflect the value of the program to participants, including the failure of money's worth measures to adjust for market imperfections, general equilibrium effects, and individual preferences regarding risk and other program characteristics. See Leimer (1995) for a more complete discussion.

[46] To get a feel for the size of these remaining net transfers, the aggregate benefit and tax streams for each of the birth cohorts represented in Table 1 were extended through age 120 by (1) assuming that real average benefits and taxes over all surviving members of each cohort remain constant after 1997 and (2) applying mortality rates by age, race, and sex from the 1990 decennial Census to simulate the surviving population of each cohort through age 120. While capturing the major effects of mortality on the cohort benefit and tax streams, the corresponding estimate of net transfers may be biased downward to some extent. For example, average real benefits over all surviving cohort members will tend to increase over time due to program provisions affecting survivors (*e.g.*, a surviving spouse's benefit generally exceeds one-half of the couple’s prior combined benefit) and the likely positive correlation between size of benefit and survival probabilities. In addition, the actual mortality rates experienced by these cohorts beyond 1997 are likely to be lower than those applicable to 1990. Similarly, average real earnings and taxes across all surviving cohort members will tend to decline over time due to lower labor force participation rates at older ages and the small decline in the OASI tax rate that took effect in 2000; these effects are likely to overwhelm the probable positive correlation between size of earnings and survival probabilities at those ages. The effect of this "mortality extension" simulation of each cohort's

remaining lifetime taxes and benefits was to increase the accumulated net transfer over that shown in Table 1 by about 57 percent for the 1917–1922 cohort, 12 percent for the 1911–1916 cohort, and 3 percent for the 1904–1910 cohort, with rapidly declining effects well under 1 percent for the earlier cohorts. Looking at taxes and benefits separately, the effect of the "mortality extension" simulation was to increase accumulated taxes by only about 0.5 percent for the 1917–1922 cohort, 0.1 percent for the 1911–1916 cohort, and well under 0.1 percent for the earlier cohorts; accumulated benefits increased by about 24 percent for the 1917–1922 cohort, 9 percent for the 1911–1916 cohort, and 2 percent for the 1904–1910 cohort, with rapidly declining effects well under 1 percent for the earlier cohorts.

[47] This figure does not itself appear in Table 1, but is the sum of the "All persons" accumulated net transfers through 1997 for the "Before 1885" through the "1917–1922" cohort groups in that table.

[48] Over the 1937–1997 analysis period, the geometric means of the zero real interest rate series (with a nominal rate equal to the rate of inflation), the OASI trust fund interest rate series, and the large company stocks total rate of return series were 4.1 percent, 5.2 percent, and 12.5 percent, respectively.
The geometric mean of each rate of return series is defined here as $g = \left[\prod_{t=1938}^{1997} (1 + r_t) \right]^{\left(\frac{1}{1997 - 1937} \right)} - 1$,
where r_t represents the corresponding nominal interest rate in year t.

[49] The same race, gender, and birth cohort groups have negative accumulated net transfers in the "mortality extension" simulation results. The negative accumulated net transfers characterization does not apply to any of the female subgroups in either the "to date" or "mortality extension" simulations. Again, these negative accumulated net transfers do not include any adjustment for the costs of administering the program.

[50] The internal rate of return is defined as the constant interest rate that equates accumulated benefits and accumulated taxes, *i.e.*, that in this case produces an accumulated aggregate real net transfer of zero for the cohort group in question. Multiple internal rates of return are possible given the nature of the lifetime net transfer flows experienced under the OASI program. The internal rate of return algorithm adopted in this analysis searched first for the positive root closest to zero and then searched the negative domain if no positive root was found. A positive root was found, however, for all of the cohorts considered in this analysis. In the case of multiple roots, of course, one root is not more correct than any other root, regardless of the search algorithm adopted.

[51] The real internal rate of return for the 1917–1922 cohort group was estimated as about 5.5 percent under the "mortality extension" simulation. This is within the range estimated for these cohorts in Leimer (1994), which more carefully models projected benefits and taxes for each cohort under present law provisions. An important result for the present analysis is that the "mortality extension" simulation had no effect on the main qualitative conclusions concerning the various race and gender groups for any of the redistributional measures used in this paper.

[52] The "mortality extension" simulation results reported in endnotes throughout the present analysis, however, are intended to provide estimates of the full lifetime effects of the OASI program under simplified assumptions and are more comparable to the Duggan *et al.* estimates in that respect.

[53] The data used in the present analysis suggest that the accumulated value of OASI taxes from 1988 through 1997 ranged from 0.5 percent for the 1895–1903 cohort to 2.6 percent for the 1917–1922 cohort as a percentage of the accumulated value of all OASI taxes paid by these cohorts through 1997 (calculated using the OASI trust fund interest rate series). Under the "mortality extension" simulation, the accumulated value of OASI taxes from 1988 on ranged from 0.5 percent for the 1895–1903 cohort to 3.1 percent for the 1917–1922 cohort as a percentage of the accumulated value of all OASI taxes paid by these cohorts. While the Duggan *et al.* analysis effectively excludes all taxes paid by all cohort members from 1988 on (by ignoring any taxes from 1988 on for cohort members included in the sample), it also excludes any benefits received and taxes paid by cohort members excluded from the sample, so the net effect of the sample selection constraint depends on the balance between these excluded taxes and benefits; *i.e.*, the sample constraints may have also introduced selection bias into the results.

[54] Including the income taxation of benefits lowers internal rates of return, but has a relatively small effect on the internal rates estimated for most of the cohorts considered in this analysis, who were at least age 62 in 1984 when benefits were first subject to income taxation. For the 1895–1922 cohort group as a whole, for example, introducing benefit income taxation drops the estimated real internal rate of return from 8.309 percent to 8.283 percent, a difference that would not even show up in Table 2, which is rounded to tenths of a percent. The potential importance of the remaining differences between the two analyses is more difficult to assess *a priori*.

[55] The interest rate series used by Duggan *et al.* reflects the rate of return on new special public debt obligations issued to the OASI trust fund in each year, while the present analysis uses a series that reflects an average rate of return to the entire OASI trust fund portfolio in each year (not just new issues).

[56] In the "mortality extension" simulation, estimated real internal rates of return remained roughly about a half percentage point below those reported by Duggan *et al.* (1993) for all of their cohort groups.

[57] Within the 1895–1922 cohort group as a whole, the "mortality extension" simulation estimates were 8.4 percent for Whites and 8.6 percent for Other Races, again a difference of about 0.2 percentage points.

[58] The difference ranges from about 0.2 percentage points for the 1917–1922 cohort group to 0.7 percentage points for the 1895–1903 cohort group in the "mortality extension" simulation.

[59] The gender differentials reported in the Duggan *et al.* (1993) paper are not contrasted with those in Table 2, because data limitations forced that study to use somewhat complicated gender groupings that are not directly comparable to those used in this study.

[60] Although the internal rate of return is widely used as a Social Security money's worth measure, the lifetime accumulated net transfer and benefit/tax ratio measures have a sounder theoretical basis, particularly in the context of historical data where interest rates have varied widely over time. In a money's worth context, for example, the essential question underlying these measures is the extent to which the program has affected the lifetime resources of program participants, either in an absolute or relative sense. In weighting the net transfers that have occurred at different points in time for various groups, the weights implicit in the accumulated net transfer or benefit/tax ratio measures reflect the rates at which participants were assumed to be able to transform resources over time. In contrast, the internal rate of return implicitly weights net transfers as if these funds could have been transformed over time at a constant nominal or real rate, depending on the calculation method. For this and other reasons, the internal rate of return is not a reliable indicator of the extent to which (or even the direction in which) the program has affected the lifetime resources of program participants. The accumulated net transfer and benefit/tax ratio measures, however, suffer from a lack of consensus over the appropriate interest rate series to use for particular questions and the likelihood that, for some questions, the appropriate interest rates vary across groups of policy interest. See Leimer (1994) and (1995) for additional discussion.

[61] In the "mortality extension" simulation, the accumulated benefit/tax ratio across all cohort members declined from 16.650 for the pre-1885 cohort group to 2.127 for the 1917–1922 cohort group using the OASI trust fund interest rate series.

[62] This decline in the relative and absolute advantage of females was also evident

in the "mortality extension" simulation results, where the ratio of the female to male accumulated benefit/tax ratio declined from about 5.4 for the pre-1885 cohort group to about 3.1 for the 1917–1922 cohort group; the absolute difference between the female and male accumulated benefit/tax ratios declined from about 48 to about 3 over the same cohort group range.

[63] All of the accumulated values referred to in this paragraph were calculated using the OASI trust fund interest rate series, consistent with the accumulated benefit/tax ratios presented in Table 3.

[64] The corresponding estimates under the "mortality extension" simulation are 4.018 for Whites and 3.947 for Other Races, with the accumulated benefit/tax ratio for Other Races again about 1.8 percent below that for Whites.

[65] This pattern is repeated in the "mortality extension" results. Again, this general effect can occur, for example, when benefit/tax ratios are falling across cohorts for both race groups at the same time that the relative sizes of the race groups are changing across cohorts.

[66] These accumulated benefit and tax shares were calculated using the OASI trust fund interest rate series, consistent with the accumulated benefit/tax ratios presented in Table 3.

[67] With minor differences in some of the numerical values, this paragraph also describes results under the "mortality extension" simulation. The increase across cohorts in the Other Races accumulated benefit/tax ratio relative to that for Whites is not as pronounced, however; under the "mortality extension" simulation, the Other Races accumulated benefit/tax ratio increases from 5.8 percent below that for Whites in the pre-1885 cohort to 2.3 percent above that for Whites in the 1917–1922 cohort. Also, the accumulated benefit/tax ratios to date for Other Races females fall below those for White females in the "mortality extension" simulation by proportions ranging from about 2 to 10 percent in the cohort groups born between 1904 and 1922.

[68] Under the "mortality extension" simulation, the Other Races accumulated benefit/tax ratio also exceeded that for Whites in 24 of the individual cohorts in the 1885–1922 range. There was one individual cohort in that range for which the accumulated benefit/tax ratio for White males exceeded that for Other Races males, and 26 individual cohorts for which the ratio for White females exceeded that for Other Races females.

[69] This is confirmed by simulations using constant nominal rates of return equal to the geometric means of the interest rate series used in this analysis. For example,

simulations using a constant nominal interest rate of 5.2086 percent, the geometric mean of the nominal OASI trust fund interest rate series over the 1937–1997 period, generate accumulated benefit/tax ratios to date for the Other Races group that are larger relative to those for Whites in all of the cohort groups than when using the actual OASI trust fund interest rate series.

[70] As indicated above, the geometric means of the nominal zero real interest rate and OASI trust fund interest rate series over the 1937–1997 analysis period are relatively close at 4.1 and 5.2 percent, respectively, although the year-to-year patterns of these two interest rate series are quite different. In contrast, the geometric mean of the nominal total rate of return to large company stocks interest rate series is much higher (12.5 percent) than the geometric means of the other two interest rate series.

[71] See Leimer (1998).

[72] Two CPS files were examined to identify the racial composition of persons of Hispanic origin in those surveys. In the 1994 CPS, 91 percent of persons of Hispanic origin are coded as white; the corresponding proportion in the 1973 CPS is 97 percent. An examination of the 1973 Exact Match File, which links the 1973 CPS with Social Security administrative data, indicates that 85 percent of persons identified as of Hispanic origin in the CPS part of that file were coded as white in the Social Security administrative data part of that file, indicating that these persons had selected the white race category on the old SS-5 form.

[73] Out of a total of 1,728 beneficiary type, race, and year cases, 1,360 required the allocation of beneficiaries within one or more age groups. The general approach adopted for each beneficiary type, race, and year case was to: (1) for each age group, initially assign an equal number of beneficiaries to each age within the group while preserving the age group beneficiary total; (2) smooth the resulting number of beneficiaries profile across all ages using a three-age moving average (two-age for profile end ages); (3) adjust the smoothed profile proportionally within each age group to preserve the correct age group beneficiary total; and (4) repeat the smooth and adjust cycle until the maximum absolute change between iterations in the number of beneficiaries at any age fell below an arbitrarily selected tolerance level (10^{-8}) close to zero. For cases with age detail that included more than two single ages or age group specifications, the last of which was an open age group that could extend to the maximum age considered (120), the number of beneficiaries was constrained to zero at an end age derived empirically as a function of year and gender from the corresponding population age profiles. Special allocation approaches based in part on the underlying year and gender

population age profile were adopted for the special age-72 beneficiary category in years where the benefit tables provided only one or two age groups; the number of beneficiaries in these cases was relatively small.

[74] In each of the 1,360 beneficiary type, race, and year cases requiring the allocation of average benefits within one or more age groups, the general approach adopted was to: (1) initially assign the average benefit for each age group to each age within the group; (2) smooth the resulting average benefit profile across all ages using a three-age moving average (two-age for profile end ages); (3) adjust the smoothed profile proportionally within each age group, conditional on the number of beneficiaries at each age, to preserve the correct age group benefit aggregate; and (4) repeat the smooth and adjust cycle until the maximum absolute change between iterations in the average benefit at any age fell below an arbitrarily selected tolerance level (10^{-8}) close to zero. For cases involving "age and younger" and/or "age and older" age groups, the smoothed average benefit profile in those age groups was also constrained to fall within the average benefit range specified in the source benefit table across all ages for that beneficiary type, race, and year. For those special age-72 beneficiary cases consisting of only one age group, the average benefit for the age group was simply assigned to each age within the group; again, the number of beneficiaries in these cases was relatively small.

[75] Lump-sum payments at age 65 represented a substantial proportion of total benefit payments during the 1937–1939 period but represent a minuscule proportion of total accumulated benefits to date under the OASI program. Additional information on this and the other benefit types discussed in this appendix can be found in the *Annual Statistical Supplement* to the *Social Security Bulletin*.

[76] Again, while lump-sum death benefits represented a substantial proportion of total benefit payments during the 1937–1939 period, their relative importance rapidly decreased in later years, falling from about 27 percent of all OASI benefit payments in 1940 to less than 5 percent in 1949 and less than 1 percent in 1971. Lump-sum death benefits represent about 0.5 percent of total accumulated benefits to date under the OASI program using the trust fund interest rate.

[77] This proportional age distribution should be relatively accurate, since the husbands of retired workers subcategory dominates the combined husbands of retired and disabled workers category, representing between about 88–98 percent of annual benefits to the larger combined category during the 1967–1997 period. This is also a relatively small beneficiary category; during the 1967–1997 period, benefits to husbands of retired workers never comprised as much as 1 percent of

annual OASI benefits to husbands and wives combined or as much as 0.06 percent of all annual OASI benefits.

[78] This age allocation should be quite accurate for the disabled widows subcategory, which dominates the combined category, representing between about 99–100 percent of annual benefits to the combined disabled widows and widowers category during the 1968–1997 period. While this age allocation is probably less accurate for the disabled widowers subcategory, the small size of this group does not justify a more sophisticated approach. Both of these beneficiary categories are relatively small; during the 1968–1997 period, annual benefits to the disabled widows category, which represents nearly all of the combined disabled widows and widowers category, never comprised as much as 2 percent of benefits to widows and widowers of all types or as much as 0.4 percent of all OASI benefits.

[79] The annual female share of parents benefits ranged from 89 to 96 percent over the 1969–1997 period. Again, the parents beneficiary category is relatively small, never comprising as much as 0.2 percent of all OASI benefits in any year during the 1969–1997 period.

[80] This age allocation should be relatively accurate for the widowed mothers subcategory, which dominates the combined category, representing between about 96–100 percent of annual benefits to the combined widowed mothers and fathers category during the period 1975–1997 when both mothers and fathers benefits were paid. While this age allocation is probably less accurate for the widowed fathers subcategory, the small size of this group does not justify a more sophisticated approach. Although widowed mothers benefits represented nearly 10 percent of total OASI benefits in some of the early years of the 1940s, the relative importance of this category has gradually diminished over time. During the 1975–1997 period, annual benefits to the combined widowed mothers and fathers category fell from about 1.7 percent to less than 0.5 percent as a share of total OASI benefits.

[81] Data on the historical Social Security area population by year, age, and sex, provided by the Social Security Administration Office of the Chief Actuary, were used for this purpose. These data were not given by race, so the male/female composition at each age in each year was assumed to be the same for the White and Other Races race categories. A check of selected decennial census data suggests that this is a reasonable, but obviously not a perfect, assumption for the early childhood ages that comprise the bulk of child benefits. The proportion of males in the 1950 decennial census population aged 0–19, for example, was 0.509 for whites and 0.498 for other races. Differences between the gender compositions

of the beneficiary and general child populations is another source of potential bias that is difficult to assess.

[82] In 1957, when disabled child benefits were first paid, they comprised less than 2 percent of all benefits to children of retired and deceased workers and less than 0.2 percent of all OASI benefits, based on estimates derived from benefits in current payment status at year-end. These relative proportions have grown over time, reaching nearly 29 percent of all benefits to children of retired and deceased workers and about 1.2 percent of all OASI benefits by 1997. While growing, then, disabled child benefits still comprise a relatively small proportion of OASI benefits.

[83] As a share of total OASI benefits, special age-72 benefits had fallen to about 0.07 percent by 1982 and have since steadily declined to minuscule proportions.

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