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**Distributional Effects of Social Security:  
The Notch Issue Revisited\***  
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by

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## **Abstract**

In this paper, we provide the first empirical estimates of the effects of the Social Security benefit notch on lifetime benefits based on *actual* Social Security records, the 1988 Continuous Work History Sample. Our results show that the notch occurred in the context of a maturing social insurance system in which all early cohorts have received very high rates of return. As a group, the 1917-1921 notch cohorts could expect to receive roughly \$500 billion (in 1988 dollars) more than if they were paid the same rate of return on their contributions that the Social Security system earns on its invested funds.

## I. Introduction

As a result of the 1977 Social Security Amendments, persons born on or after January 2, 1917 received significantly different benefits from those received by persons born before that date. Since the Amendments became effective in 1979, debate has persisted over whether subsequent cohorts C primarily those born in 1917 to 1921 C received benefits that were too low, or whether prior cohorts C primarily those born in 1911 to 1916 C received benefits that were too high. The benefit disparity is commonly termed the Social Security benefit "notch" and the 1917-1921 birth cohorts are often referred to as "notch babies." Legislative proposals to eliminate the benefit disparity, usually through an increase in benefits for the notch cohorts, have been offered nearly every year since 1979 (see, e.g., General Accounting Office, 1992). Recently, Congress enacted a Social Security Notch Commission to conduct a comprehensive study of the issue.<sup>1</sup> Moreover, the notch generation continues to be a popular subject of economic research (Krueger and Pischke, 1992).

Despite the attention given to the Social Security notch issue, little is known about the actual experience of the notch generation. Prior studies of this issue (e.g., American Enterprise Institute (1985), Myers, *et al.* (1988), General Accounting Office (1988), Koitz and Kollmann (1992)) have relied on a "representative worker" approach to illustrate *possible* effects of the notch on current benefits and replacement rates (i.e., initial retirement benefit as a proportion of previous earnings for new retirees). These studies generally find that the "notch problem" is one of unintended windfall benefits paid to the pre-notch generation (1911-1916 birth cohorts) and conclude that correcting the problem, though possibly desirable, could create new inequities and would be administratively complex and financially burdensome.

Although instructive, the representative worker approach necessarily portrays an incomplete, and therefore potentially misleading, picture of the experience of the notch and pre-

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<sup>1</sup>The Notch Commission was authorized October 6, 1992 by Public Law 102-393 and issued a final report December 31, 1994 (Commission on the the Social Security ANotch@Issue, 1994).

notch generations. As we show below, most members of those generations were not the hypothetical workers with steady earnings assumed in that approach. In addition, an analysis of current benefits and replacement rates neglects the extremely important roles of Social Security contributions (succeeding cohorts pay higher rates on higher earnings bases) and life expectancies (which increase over time). Finally, year-to-year variations in initial retirement benefits are sensitive to the timing of legislated benefit changes and are likely to give an exaggerated picture of the variations in lifetime Social Security benefits.

In this paper, we provide the first empirical estimates of the effects of the Social Security benefit notch on lifetime benefits based on a file of *actual* Social Security records. Our data file is the Social Security Administration's (SSA) 1988 Continuous Work History Sample (CWHS), an earnings history sample for one percent of Social Security records. It contains over 2.5 million records with actual earnings histories spanning the period 1951 to 1988.<sup>2</sup> We also employ recent official mortality rate projections to more accurately forecast how life expectancies and benefit streams vary by race, as well as by sex and birth cohort.

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<sup>2</sup>An appendix, available from the authors upon request, describes our analysis of the CWHS in more detail.

Our results provide a new perspective on the notch issue and contribute new evidence on the lifetime experience of these early participants in the Social Security program.<sup>3</sup> The broader perspective of this paper emphasizes that the notch occurred in the context of a maturing social insurance system in which all early cohorts have received very high rates of return, well above the expected returns for later cohorts.<sup>4</sup> We show in particular that, as a group, the 1917-1921 notch cohorts could expect to receive roughly \$500 billion (in 1988 dollars) more than what they would receive if they were paid the same rate of return on their contributions that the Social Security system earns on its invested funds. As of 1988, they had approximately recouped the present value of their contributions, and the entire excess return still remained to be paid.

In the next section we describe and illustrate the nature of the Social Security benefit notch.<sup>5</sup> The third section compares the earnings profile of the average insured worker in our sample with the hypothetical profile often used for evaluating the notch experience. In section IV we present our estimates of net benefits and real rates of return for birth cohorts 1904-1922, and

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<sup>3</sup>Duggan, Gillingham, and Greenlees (1993) analyze the distribution of rates of return and net social security benefits across sex, race, household type, and income categories for the 1895 to 1922 birth cohorts.

<sup>4</sup>Boskin, *et al* (1987) and Steuerle and Bakija (1994) calculate that many future retirement cohorts can expect net losses from their Social Security contributions.

<sup>5</sup>In this paper, we focus on the Old-Age and Survivors Insurance (OASI) program. We do not include disability benefits or income taxes in our calculations. However, we do not exclude disabled individuals from our sample. Upon reaching age 65, they are automatically reclassified as old-age beneficiaries and their subsequent benefits are paid from the OASI trust fund. We include these OASI benefits as returns to their prior contributions.

in section V we break down our results by income group and retirement age. Section VI concludes.

## **II. The Social Security Benefit Notch**

A technical flaw in the 1972 Social Security Amendments resulted in continuously rising replacement rates that threatened the financial viability of the system. The 1977 Amendments corrected this problem by phasing in level replacement rates, while lowering the general benefit level. All persons born after January 1, 1917 have their benefits computed differently from the benefits of those born earlier and, as per Congressional intent, have lower replacement rates. As a result, there is a benefit notch, or discontinuity, between persons initially affected by the "new law" (post-1977 Amendments) and those who continue to have benefits computed under "old law" (pre-1977 Amendments).

Under both new and old laws, benefit computation at initial entitlement comprises three fundamental steps: calculation of average monthly earnings (AME) in covered employment, calculation of the Primary Insurance Amount (PIA) by applying a progressive rate formula to the AME, and calculation of the benefit by applying appropriate beneficiary percentages to the PIA (e. g., 100 percent for old-age benefits at normal retirement age (65 in 1988, the year of our sample), 50 percent for spousal benefits). The result is then adjusted downward for early retirement or upward for delayed retirement.

A key difference between the laws is in the procedures used for adjusting the benefit formulas for economy-wide wage and price growth. Under old law, AME is an average of nominal earnings over a number of years that depends upon the age at retirement and year of attaining age 62. Because nominal earnings would rise naturally with prices, both the AME and the PIA would rise during periods of price inflation. Yet, whenever Congress legislated a general benefit increase for retirees, the rates in the PIA formula were similarly increased, though the

formula brackets were not adjusted. This overindexation for inflation caused (sometimes substantial) growth in real Social Security benefits for new retirees, and also resulted in unintended returns to work beyond age 62. This procedure was made automatic by the 1972 Amendments that became effective in 1975.

The 1977 Amendments define new procedures for persons born after January 1, 1917. The AME is based on lifetime earnings that are indexed for economy-wide wage growth (AME becomes AIME, or average *indexed* monthly earnings). The PIA is calculated by applying a three-part declining rate formula to the AIME. The brackets in the PIA formula are also indexed to economy-wide wage growth, and post-retirement benefits are adjusted for price inflation using the Consumer Price Index (CPI).<sup>6</sup> This procedure results in constant-dollar benefits for retirees, as well as initial benefits that generally grow as the economy grows.

Figure 1 shows initial real retirement benefits by year of birth for males in our sample who retired either at age 62 or age 65. For the earliest cohorts, average initial retirement benefits tended to fluctuate due to frequent changes in the Social Security law, legislated increases in benefits, and variations in the size and prior work patterns of retirement cohorts. The figure shows that real benefits generally rose until the 1977 Amendments became effective (birth years past 1916). Legislated nominal increases of 13%, 15%, 10%, and 20% occurred in years 1968, 1970, 1971, and 1972, respectively. When automatic increases started in 1975, real benefits began to rise dramatically for age-65 retirees, reflecting the overindexation of benefits under old law that heavily rewarded work past age 62. With the implementation of the 1977 Amendments,

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<sup>6</sup>Earnings are indexed to the year the worker turns age 60. Earnings subsequent to age 60 are considered in nominal form. The PIA brackets are adjusted for wage growth with a two-year lag. The new law results in a replacement rate of just over 40% for workers with average earnings throughout their work years who retire at age 65.

real benefits fell sharply for the older retirees and much more modestly for age-62 retirees.<sup>7</sup> For the 1922 and subsequent cohorts, initial real benefits naturally rose as real wages grew.

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<sup>7</sup>The benefit amounts shown in Figure 1 are for December of the respective year and therefore incorporate any benefit increases for the year. The large increases that occurred in 1980 and 1981, 14.3% and 11.2%, respectively, tended to obscure the effect on age-62 benefits of the new law.

A transitional guarantee formula was included in the 1977 Amendments to assure that cohorts born in 1917-1921 would get a benefit no lower than what would result under the old-law rules in effect as of December 1978. Benefits were computed under both the new law and transitional guarantee rules, and retirees would receive the greater of the two.<sup>8</sup> As compared to old-law procedures, however, the guarantee had two significant limitations: earnings in the year a worker reached age 62 and later could not be used in calculating benefits, and CPI increases that occurred before the worker reached age 62 would not be factored into the computation of initial benefits.<sup>9</sup> Those limitations, combined with the high inflation rates of the late 1970s and early 1980s, had the effect of rapidly eroding the value of the transitional guarantee for retirement past age 62 and for retirement beyond 1979. This is illustrated in Table 1, which shows average real retirement benefits with and without the transitional guarantee for the notch cohorts, along with the percent of retirees receiving the guarantee. The data show clearly that most retirees in the notch generation did not gain from the transitional guarantee. The dotted lines in Figure 1 show the pattern of initial retirement benefits that would occur for males receiving the transitional guarantee.

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<sup>8</sup>Benefits were also computed under minimum benefit provisions and old-start rules. Beneficiaries always received the highest benefit. Many low-wage earners were helped by an expanded special minimum benefit in the 1977 Amendments.

<sup>9</sup>For persons born in 1917 and retiring at age 62 in 1979, initial benefits would be comparable to an age-62 retiree in 1978, the only difference being that age-62 earnings would be ignored for the 1979 retiree.

**Table 1**  
**Monthly Initial Social Security Benefits for the Notch Cohorts**  
**With and Without the Transitional Guarantee Benefit**  
**(Constant 1982-84 Dollars)**

Benefits & Percent	Birth Year				
	1917	1918	1919	1920	1921
<i>Males, Retirement Age= 62</i>					
With Guarantee	\$440	\$437	\$420	\$421	\$437
Without Guarantee	424	433	420	421	437
% with Guarantee	57%	34%	3%	2%	0%
<i>Males, Retirement Age= 65</i>					
With Guarantee	\$648	\$606	\$548	\$576	\$591
Without Guarantee	638	606	547	576	591
% with Guarantee	57%	4%	1%	1%	0%
<i>Females, Retirement Age= 62</i>					
With Guarantee	\$269	\$277	\$264	\$253	\$247
Without Guarantee	258	272	262	252	246
% with Guarantee	44%	28%	12%	9%	7%
<i>Females, Retirement Age= 65</i>					
With Guarantee	\$501	\$438	\$416	\$393	\$408
Without Guarantee	494	434	415	393	408
% with Guarantee	44%	18%	3%	0%	0%

Source: Calculations based on Continuous Work History Sample. Benefit Amounts are for the month of December.

Retirees who did gain from the guarantee tended to be those with earnings profiles steeply sloped toward later years of work, a common characteristic of high-wage earners. The reason is the nature of indexation under the post-1977 law. Covered earnings before age 60 are indexed by

the ratio of economy-wide average wages in the year in which the worker turns age 60 to economy-wide average wages in a given year. Because earnings during early years receive the greatest indexation adjustment, workers with their highest earnings during those years were more likely to gain from the new law formula as compared to old law. This can be seen in Figure 2, which illustrates the average earnings profile for a sample of 62-year-olds who received the transitional guarantee and for a similar sample who did not benefit from the guarantee. Also shown is the profile of wage-indexing factors used under new law for 62-year-olds retiring in 1979. The transitional guarantee was most effective for retirees with earnings profiles that tilt sharply up in later years. Those are the retirees who would experience the greatest reduction under the new law rules.

### **III. Hypothetical and Actual Earnings Profiles**

Simulations of benefits using "representative" or other hypothetical individual cases can highlight the essential elements of the 1972 and 1977 rule changes. However, the best way of determining the overall importance of these rule changes is to examine a sample of actual Social Security program participants, from birth cohorts both before and after these rule changes. To the extent that income, retirement age, and other individual characteristics play a role, the use of actual case histories provides information not revealed by the hypothetical worker approach.

Figure 3 addresses the question of the similarity between these sample workers and the "representative individual." The figure displays the actual average 1951-1978 taxable earnings profiles of the 314 men and 333 women in our sample who were born in 1917 and who retired at age 62 in 1979.<sup>10</sup> These profiles are compared to national average Social Security taxable

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<sup>10</sup>Contributions were first collected from employees and employers in 1937, but years prior to 1951 were not typically used in benefit computation for this cohort. Another reason for beginning Figure 2 in 1951 is that our data set contains total earnings for the 1937-1950 period, but does not report earnings in individual years. As discussed in the Appendix, the present values of contributions reported in subsequent figures and tables are based on a proration

earnings, the series often used as the basis for hypothetical earnings profiles.<sup>11</sup> All the profiles in the figure are affected by changes in the statutory Social Security taxable earnings base, and are therefore lower than corresponding mean total wage profiles would be. This also accounts for the somewhat erratic movements in the series. For example, in 1966 the ceiling on taxable earnings was raised from \$4,800 to \$6,600, and average taxable earnings for male workers in our sample simultaneously increased from \$3,562 to \$4,550.

The profiles for our sample 1917 birth cohort incorporate the effects of increasing experience and job tenure, and are therefore steeper than the national average series over most of the period. Perhaps more significantly, many of our sample workers had periods of unemployment or non-covered employment, particularly in the years just prior to retirement. As Figure 3 demonstrates, although the males in our 1917 birth cohort earned above the national average in most years, both the female profile and the sample average profile are consistently below the average taxable earnings series. In 1951, at age 34, the average sample worker had taxable earnings of \$1,319, 37 percent below the national average of \$2,078. At age 50, the differential was only about 10 percent (\$3,406 compared to \$3,791). However, at age 60, two years before retirement, the sample average earnings of \$5,363 were again more than 30 percent below the national average of \$7,718. In 1978, even male sample average earnings were below the national series.

Myers, *et al.* (1988, p. 3) note that the effects of Social Security provisions on hypothetical workers with average or maximum taxable earnings are not necessarily typical of the experience of individual workers under the program. Figure 3 confirms this point. Most Social Security retirees in the notch and pre-notch cohorts, especially women, earned less than the national-

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of the 1937-1950 total to individual years, based on national average earnings in covered employment.

<sup>11</sup>These figures are taken from Department of Health and Human Services (1991, p. 134).

average taxable wage during their working years. Consequently, discussions of the notch, or of the impacts of the 1972 and 1977 amendments in general, will be incomplete or even potentially misleading if confined to analyses of "typical" wage earners.

#### **IV. Contributions, Benefits, and Net Benefits**

As noted earlier, our CWHS data base enables us to go beyond traditional measures of Social Security returns, such as replacement rates and initial PIA's. For several reasons, those measures give only an incomplete picture of the relative treatment of different cohorts. First, they ignore the role of changes in FICA contribution rates; later cohorts paid higher rates on higher earnings bases. Second, they measure only benefits in the initial year of retirement, and thus are sensitive to the timing of benefit increases. Particularly in the years prior to implementation of the 1972 amendments, succeeding cohorts could experience large changes in real initial benefits that would imply much smaller changes in total lifetime benefits (because benefit schedule adjustments applied equally to previous retirees). Third, since life expectancies increase over time, later cohorts will receive higher total returns even if benefit rules are unchanged. Finally (and conversely), economy-wide real wage growth implies that both real contributions and benefits *should* also increase over time. Therefore, a rising real initial benefit need not imply a change in the generosity of the Social Security program.

The use of present values makes it possible to compare contributions to benefits received subsequently, and to reflect differences in mortality rates and other factors affecting the length of payment and income streams. For example, in the next section we compare the net benefits of age-62 retirees to those retiring at age 65, who could expect to receive a higher benefit stream for a shorter period of time.

The present value approach also gives greater value to the returns received by earlier cohorts. This offsets the aforementioned difficulty that real earnings increase over time.

Moreover, since we use the interest rate on the special-issue obligations held by the Social Security system to compute present values, our results have implications for the relative burdens placed on the system by the benefits paid to different cohorts. That is, a high interest rate would decrease the estimated *relative* level of later benefits, since higher trust fund interest earnings would make the system more able to afford those later benefits. Our discount rate series, which averaged 1.2 percent in real terms between 1937 and 1990, is the same one used in U.S. Congress (1992) to evaluate the long-run actuarial status of Social Security in present value terms.

Our sample consists of 32,118 covered workers, selected from a 10 percent subsample of the CWHS, who were born between the years 1904 and 1922. We analyze benefits paid to three principal beneficiary types: insured workers (old-age benefits), their spouses (spousal benefits), and surviving spouses (widow(er) benefits). Benefits paid to children and other nonspouse survivors, which account for about four percent of OASI benefits, are excluded from our calculations. In general, all old-age, spousal, and widow benefits are matched to the worker on whose contributions those benefits are based. The exception to this rule involves the treatment of dually entitled spouses, former workers who are receiving either spousal or survivor benefits that exceed the benefits to which they would be entitled based on their own history of contributions. The structure of the CWHS does not allow us to match these dual beneficiaries to their spouses. Assignment of the dual benefits to the beneficiaries=records increases the measured rate of return to their own contributions, and lowers the rate of return to their spouses=contributions.<sup>12</sup>

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<sup>12</sup>Additional information, including our criteria in forming subsamples for this analysis, can be found in Duggan, Gillingham, and Greenlees (1993) and an appendix that will be provided upon request.

Figure 4 displays sample average present values (as of 1988) of benefits and contributions for the birth cohorts from 1904 to 1922.<sup>13</sup> The curve in the figure measures the present value of lifetime benefit payments, and the two areas under the curve show the decomposition into the present value of FICA contributions and the present value of net benefits (benefits minus contributions).<sup>14</sup> The most consistent trend shown in the figure is the rising importance of FICA payments. The first birth cohort was 33 years old when contributions began in 1937; the succeeding cohorts faced a pattern of higher rates and higher taxable ceilings, over greater proportions of their working lives. The present value of contributions rises from \$19,635 for birth year 1904 to \$42,685 for birth year 1922. The figure also shows that total gross benefit payments fluctuated within a range of approximately \$118,000 to \$129,000 in the old-law cohorts, and then decreased under new law. The combined impact of increasing contributions and declining real benefits caused real net benefits to drop by approximately 63 percent over the range of birth cohorts, from \$105,723 in 1904 to \$39,479 in 1922.

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<sup>13</sup>Values of contributions are based on the OASI self-employment and (combined employer and employee) wage and salary rates. We do not attempt to deal with the partial taxation of Social Security benefits. Also, we ignore the fact that employers can deduct their share of contributions in computing income taxes. Thus, our estimated payments include only FICA contributions, and out benefit estimates are gross of income taxes.

<sup>14</sup>The relatively narrow range in gross benefits for the 1904-1916 cohorts reflects the present value computation made as of 1988 (not retirement age) using the nonconstant real trust fund rate. The pattern of gross benefits also reflects a declining average retirement age over the period, which has the effect of dampening any upward trend in average benefits.

Income Class		Birth Cohort		
		1904-1910	1911-1916	1917-1921
Low	Net Benefits	\$65,922	\$56,868	\$47,260
	Rate of Return	13.3%	9.9%	8.0%
Medium	Net Benefits	\$106,369	\$86,457	\$54,615
	Rate of Return	10.2%	7.9%	6.2%
High	Net Benefits	\$133,930	\$122,573	\$67,361
	Rate of Return	8.1%	7.0%	5.3%
All Insureds	Net Benefits	\$100,816	\$89,596	\$56,619
	Rate of Return	9.5%	7.7%	6.0%

Source: authors=calculations based on the 1988 Continuous Work History Sample.

Figure 4 shows that the decline in net benefits increased somewhat for cohorts born after 1916. Nevertheless, rather than the abrupt qualitative break that appears in Figure 1, the figure reveals a relatively smooth transition between old and new law. The present value of net benefits was falling prior to 1917, and continued to fall through 1922, the last birth year in our sample and the birth year of the first "post-notch" cohort.

Net benefits are presented again for each cohort in Figure 5 along with the real rate of return to contributions. As in Figure 4, the present value series displays a downward trend both before and after the notch. The real rate of return series decreases even more smoothly and consistently, from 10.6 percent to 5.2 percent between the 1904 and 1922 cohorts. The present value and rate of return series are both consistent with a maturing social insurance system, in which early participants are typically granted substantial benefits even though they have made only minimal contributions. Consequently, early cohorts receive large, above-market returns. Rates

of return then decline as the number of years in which contributions to the system are made increases.

## **V. Net Benefits by Income Class & Retirement Age**

In this section we compare the effects of law changes on different categories of insured workers. While the 1977 Amendments generally reduced the benefit structure, some features of the new law were favorable to certain worker subgroups. The new minimum benefit provisions, for example, should have cushioned the impact on lower-income workers. The indexation of wage histories should have favored workers with relatively flat earnings profiles.

Table 2 displays net benefits and rates of return for three income groups and three subperiods, chosen to correspond roughly to benefit determination prior to the 1972 amendments, between the 1972 and 1977 amendments, and during the notch period, respectively.<sup>15</sup> The table shows rates of return and present values fell in succeeding subperiods for each income group, with the net effect being a narrowing of the between-group differentials. In particular, the present value of net benefits for high-income workers averaged \$122,573 for the 1911-16 cohorts and only \$67,361 in the new-law 1917-21 cohorts, a 45 percent decrease. The corresponding decreases were 37 percent for the middle group and only 17 percent for low-income workers.

Next, we contrast the experience of age-62 and age-65 retirees. Myers, *et al.* (1988) assert that one consequence of the 1972 amendments was an unintended increase in the net benefits resulting from work after age 62 for workers born between 1911 and 1916. The 1977

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<sup>15</sup>The income groups were obtained by computing average wage-indexed earnings from age 42 to age 62 for each worker in our sample (any years after death were excluded from the average). The sample was then ranked by average earnings and divided into three equal quantiles.

amendments were designed to eliminate this windfall return, through the indexation of wage histories and other provisions designed to rationalize the effects of wage and price increases.

Mean net benefits for the age-62 and age-65 retiree samples are shown in Figure 6. If a goal of the 1977 law was to equalize net benefits across retirement ages, it appears from this figure to have been remarkably successful. Workers who postponed retirement until 65 received much higher returns than age-62 retirees throughout the pre-1917 cohorts, but the groups received very similar returns in each cohort thereafter. In Figure 6, the notch period is primarily noteworthy for this equalization of the two benefit streams. As expected, returns fall more rapidly after 1916, but were already declining for both retirement ages. Neither group experiences an increase in net benefits in 1922, the year after the notch.

The figure gives partial support to the hypothesis of windfall returns to post-62 retirement under 1972 law. The difference in returns widens sharply in 1911, and remains above its 1904-1910 average in both dollar and percentage terms until disappearing in 1917. As Koitz and Kollman (1992) note, however, most workers in these cohorts began receiving benefits prior to age 65. The common practice of focusing on the experience of age-65 retirees tends to exaggerate the notch, as can be seen by a comparison of Figure 6 to the aggregate results displayed in Figure 5.

## **VI. Conclusion**

In this paper we have estimated the net returns and internal rates of return to Social Security contributions for persons born in the years 1904 to 1922. This group includes the notch generation born in the years 1917 to 1921. Our results show that each succeeding birth cohort received a lower real rate of return, reflecting in part the greater Social Security contributions required of succeeding cohorts. Although the present value of net returns fell for the notch cohorts, it was already falling for the pre-notch cohorts and continued to fall for workers born in 1922. Numerous writers and commentators have pointed to a discontinuity in net benefits for the 1917 cohort and to a "windfall" paid to retirees preceding them. We observe these same effects in terms of initial benefits, and for workers retiring at age 65. However, for a representative sample of all covered workers, and recognizing the role of contributions as well as benefits, we find the notch to be less striking than the overall downward trend in net benefits. Our estimated real rate of return series declines smoothly from 10.6 percent to 5.2 percent between the 1904 and 1922 birth cohorts, a result that is consistent with a maturing social insurance system.

Our results also show that nearly all early program participants, including the notch group, received rates of return far exceeding the interest rate paid on Social Security bonds. This point can be made more dramatic by noting that our results indicate that, taken as a group, the 1904 to 1922 cohorts will receive an excess return from the Social Security system of approximately \$2.6 trillion, in 1988 dollars C most of which has yet to be paid. The 1917-1921 notch cohorts are due to receive roughly \$500 billion more than what they would receive if they were paid the same rate of return on their contributions that the Social Security system earns on its invested funds.

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## Technical Appendix

*The Continuous Work History Sample.* The CWHS extracts information from several sources connected to administration of the OASDI program. The process by which the CWHS is constructed is important to understanding its usefulness and limitations for purposes such as ours. Basic demographic information on date of birth, sex, and race are reported on application forms for Social Security numbers (SSN). Annual earnings data from W-2 and W-3 tax reporting forms are balanced to employer-provided totals on earnings and employment and matched by name and SSN to the demographic data (prior to 1978, taxable wages were reported quarterly on various forms depending upon the type of employment). The result is the Earnings Reference File, the file in which individual lifetime earnings and quarters of coverage are maintained for use in determining benefit entitlement and amount. This file contains employment data on years employed and type of employment (farm, nonfarm, wage or self-employment); cumulative pre-1951 Social Security earnings; annual Social Security taxable earnings, 1951 to date (1988 in our file); and total compensation, 1978 to date.

Each year, a 1 percent sample based on specified digits from the last four digits of the SSN is extracted from the Earnings Reference File. This extract forms the basis for updating the previous year's CHWS. This file was originally intended as a source to study the earnings and employment behavior that underly the Social Security tax base. The file was expanded, however, to include information from the benefit side of the OASDI program. Thus, each year selected information corresponding to the same SSNs is extracted from SSA's Master Beneficiary Record (MBR) file, which contains data collected when an individual files a claim for benefits. The MBR extract is then matched to the earnings extract as part of the annual update to the CWHS. The beneficiary data extracted for inclusion in the CWHS are dates of entitlement, benefit amounts for the current year, and types of benefit (old-age, survivor, or disability).

The benefit amount on the file generally represents a payment to the account record in the form of old-age, disability, or survivor benefits. "Dual entitlements" differ in this regard. The most common example of dual entitlement occurs when an individual is entitled to a spousal benefit as well as a benefit based on his or her own earnings history. In this case, the benefit paid is the higher of the two. For most female working spouses in the past the spousal benefit has been higher. SSA allocates this amount to the CWHS record of the dually entitled person and not to the record of the person on whose earnings history the benefit amount was based. For example, a married person eligible for an old-age benefit of \$800 would entitle his or her spouse to a benefit of \$400 (at normal retirement age) for a total benefit of \$1,200. If the spouse had no earnings history (and consequently no CWHS record), the full \$1,200 would be allocated to the primary old-age beneficiary record. If the spouse had an earnings history which entitled the spouse to less than \$400, then \$800 would be allocated to the primary record and \$400 to the spouse record. If the spouse were entitled to more than \$400 on his or her own account, that amount would appear on the spouse's record and \$800 on the primary record. For these cases, direct computation of benefits from the CWHS earnings data will generally underestimate the benefit amount being paid.

No dual-beneficiary indication is given on the "primary" worker's record. Our understanding from the SSA is that the presence of a spouse date of birth on a CWHS record indicates that a spouse has applied for benefits from the insured's account. This condition would apply only to dependent (i.e., non-worker) spouses. Thus, treated all cases in which there was a spouse date of birth but no current (1988) spousal or survivor benefit as cases in which there was a deceased dependent spouse.

As part of the updating process, but not part of the master records, SSA analysts add and/or modify a benefit status code, an insured status code, and a family benefit code. The latter reflects, for the current benefit year only, the type of family benefit (e. g., insured worker and spouse). The benefit status code indicates, for the years 1956 to date, whether (and what type of) benefits are being paid to the account and when the insured worker died. Insured status measures, also for 1956 to date, the potential eligibility for benefits, based on quarters of coverage.

The 1988 file has just under 3.4 million records, of which over 2.5 million are "active" accounts, that is, with any history of social security earnings. For computational purposes, we selected a subsample from the 2.5 million (active) records on the full file. From the 20 CWHS tape reels, we drew every tenth record from these tapes. In combination with the editing procedures described above, this subsampling resulted in a data set with 38,313 observations. All individual social security numbers were removed from our file by SSA.

*Computed Benefit Streams.* Estimation of historical benefit streams for CWHS sample workers required the programming of current and past Social Security benefit formulas. Complete benefit histories are not maintained in any official central file. We employed two independent checks on our calculations. First, for current beneficiaries, we compared our 1988 estimated values with those contained in the CWHS file. As shown in Table A1, we get very high correlations between CWHS and estimated benefits. We considered eliminating those cases with wide, unexplained discrepancies. However, this would have biased our results, by eliminating a subset only of those individuals who were alive or paying survivor benefits in 1988. Therefore, no cases were deleted from our sample on the criterion of imputation accuracy.

Second, we made extensive use of a PIA program developed by SSA (McKay, 1990) to check results for many individual cases. The SSA PC-based program is fast, accurate, and very detailed but is designed for a single case only. We check numerous individual records with the McKay program which led us to make a number of corrections to our PIA and benefit calculation program. Our program now gives essentially the same PIA result as McKay's program.

**Means of CWHS Observed Values and Estimates of 1988  
Benefits for Three Principal Beneficiary Types<sup>1</sup>**

	Retired Worker Only	Retired Worker with Spouse	Widow(er)
		<i>New Law</i>	
CWHS	\$526.45 (2.83)	\$890.72 (9.78)	\$555.16 (9.05)
Estimate	\$526.56 (2.83)	\$882.06 (9.69)	\$547.69 (8.77)
Correlation	.99	.99	.94
Error	-\$ .11 (.28)	\$8.66 (1.24)	\$7.46 (3.18)
N	5,044	882	336
		<i>Old Law</i>	
CWHS	\$555.41 (3.04)	\$960.29 (9.72)	\$504.39 (2.76)
Estimate	\$553.42 (3.07)	\$944.06 (9.59)	\$491.91 (2.75)
Correlation	.99	.99	.97
Error	\$1.99 (.25)	-\$16.22 (1.04)	\$12.48 (.72)
N	6,159	1,542	3,557

<sup>1</sup>Numbers in parentheses are standard errors.

Some qualitative information on benefit reciprocity is indicated by the annual benefit status code, as noted above. For records with current beneficiaries, the CWHS also contains a family benefit code (for the current year only), which provides information on the type of beneficiaries (e. g., primary and spouse, primary and children, widows, parents, etc.). The family benefit code does not fully distinguish among the different types of beneficiaries on the record, however, thereby limiting the potential to reconstruct prior family situations. For this reason, we ignored the presence of beneficiaries other than the insured worker and/or spouse. For records with current beneficiaries, once the AME (or AIME) and PIA are computed, we use the benefit status codes, benefit rules, and mortality probabilities (described in the text) to reconstruct primary/spouse benefits back to the year of initial entitlement. Given the historical benefits, future nominal benefits (beyond 1988) depend only on projected mortality rates and cost-of-living increases.

For records with no current beneficiaries, the insured worker and survivors, if any, have died sometime before 1988. The family benefit code is set to zero in the CWHS so is of no help in determining historical benefits. For these records, we computed annual benefits for the insured worker between the year of initial entitlement and the year of death (indicated on the file) based on the procedures described above. If the record indicated that a spouse had applied for benefits at some time, we also simulated a year of death of the spouse (not indicated on the CWHS file) following the procedures described in the text. We then computed a spousal benefit between the year in which the spouse was first eligible (using the insured worker's PIA and the benefit rules that apply to the spouse's age at eligibility) and the year of death of the insured worker or of the spouse, whichever came first. Finally, if the spouse survived the beneficiary, we computed a widow(er)'s benefit from the year of death of the insured until the simulated year of death of the spouse.

Many insured workers die before receiving benefits. Survivor benefits may nevertheless be paid on the deceased worker's account if the worker was insured at the time of his death. If the record indicated that a spouse had applied for benefits at some time, we computed a widow's benefit in a manner similar to that described in the preceding paragraph. If the record indicated that survivor benefits had been awarded but contained no indication of a spousal presence, we made no benefit computation, consistent with our abstraction from payments to beneficiaries other than spouses.

We handled dual entitlements somewhat differently. As described above, dual beneficiaries as identified in the CWHS are receiving a spousal or survivor benefit derived from another insured worker's contributions. A computed benefit based on their own earnings record would generally underestimate the benefit actually received. Consequently, for dual beneficiary spouses of living insured workers, we assigned the observed benefit, properly deflated, to each year back to the year of initial entitlement. For dual beneficiary survivors, we also used the observed benefit to compute a widow's benefit (through deflation) back to an estimated year of death of the insured worker.<sup>16</sup> For the years between initial entitlement and the death of the insured worker, we computed the benefit as the maximum of the own-record benefit (using the standard procedures) and a spousal benefit defined as 50 percent of the delated survivor benefit.

*Computed Contribution Streams.* The CWHS provides total taxable earnings for each of the years 1951-1988. In addition, for each of these years the file also contains the value of earnings that were subject to the self-employment, rather than the wage and salary, contributions rate. In some cases, the reported CWHS values exceeded the maximum value of earnings subject to tax. We recoded total taxable earnings to the minimum of the reported value and the statutory cap, and limited self-employment earnings to the recoded value of total taxable earnings.

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<sup>16</sup>For purposes of simulating years of death of the unidentified spouses, we assumed that husbands (wives) were two years older (younger) than the dual beneficiaries.

For the period 1937-1950, only wages and salaries were subject to FICA. However, the CWHS reports only total taxable earnings for the 14-year period. Following Boskin *et al* (1987), we prorated these total earnings under the assumption that from the first year of employment through 1950, earnings grew at one percent per year of age beyond the economy-wide growth in wages for male individuals and one-half percent per year for females, through age 50. Our average earnings series for the 1937-1950 period is taken from Myers and Schobel (1983). We also imposed the restriction that taxable earnings in any year could not exceed \$3000, the taxable maximum throughout that period.

*Mortality Rates.* For the purpose of simulating future benefit flows of recipients and their spouses, we estimated separate mortality rate functions for men and women. The underlying data were unpublished historical and projected death rates provided by the Population Division of the Bureau of the Census for the years 1990, 2000, and 2050, broken down by age, sex, race, and Hispanic origin. For each sex, we employed 108 mortality rates, corresponding to eleven five-year age groups beginning with 45-49 plus the open-ended interval 100 or above, the three racial categories of White, Black, and Other (or Unknown), and the three calendar years given above.

Our racial categorization was governed by the limited detail in the CWHS for our sample cohorts. More detail is available for newly insured workers. Our three categories each include Hispanics, and our computed death rates for the Other category are averages of the American Indian, Eskimo, or Aleut and the Asian or Pacific Islander values, using contemporaneous Census population projections as weights.

We regressed the logarithm of the mortality rate on age, year, and dummy variables for White and Black race, with the age variable evaluated at the midpoint of the five-year age range (and using 102 for the open-ended interval). The coefficient estimates and standard errors are:

$$\ln \text{ DEATHRATE} = 14.32 + 0.079 \text{ AGE} - 0.012 \text{ YEAR} + 0.447 \text{ WHITE} + 0.584 \text{ BLACK}$$

$$(2.37) \quad (.002) \quad (.001) \quad (.076) \quad (.076)$$

for males, and

$$\ln \text{ DEATHRATE} = 7.82 + 0.083 \text{ AGE} - 0.009 \text{ YEAR} + 0.439 \text{ WHITE} + 0.588 \text{ BLACK}$$

$$(1.97) \quad (.001) \quad (.001) \quad (.063) \quad (.063)$$

for females.

Deaths were simulated for current recipients by evaluating these functions at the recipient's age and with YEAR= 1988. A random number was drawn from the uniform distribution bounded by zero and one, and a year of death was chosen by evaluating the regression function successively with both year and age incremented by one, until the cumulated probability of death exceeded the random draw. The same procedure was used for spouses.

In many cases, we also needed to simulate past lifetimes when, for example, we observed a deceased spouse with known date of birth but unknown date of death. The same simulation procedure was followed in such cases, iterating until a death year was obtained that preceded 1988, the year of observation.

## References

McKay, S. F., "User's Guide for PIA Calculation Program (version 1991.1)," Office of the Actuary, Social Security Administration, 1990.

Myers, Robert J., and Bruce D. Schobel, "A Money's-Worth Analysis of Social Security Retirement Benefits," *Transactions of the Society of Actuaries*, 1983, pp. 533-545.