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The effect of three factors on social security old-age and survivors insurance (OASI) benefits: earnings, mortality, and the consumer price index

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The effect of three factors on social security old-age and survivors insurance (OASI) benefits: earnings, mortality, and the consumer price index

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INTRODUCTION

The elderly, aged 65 or older, now constitute the largest single group receiving governmental cash transfers, with 31.6 million retirees currently receiving Social Security benefits (Social Security Bulletin, 1997). That is, over 93 percent of persons 65 and over receive Social Security benefits. More than one-third of the elderly depend on Social Security for 90 percent or more their annual income (Melcher, 1988). In addition, Radner (1995) also pointed out that increases in mean Social Security benefits were important in the increase in the total income of the elderly since 1967. Therefore, the importance of Social Security as a base for the financial well-being of older Americans is clearly evident here. The motivation for this thesis is to explain the effect of three factors on Social Security Old-Age and Survivors Insurance (OASI) benefits: earnings, mortality, and the Consumer Price Index.

There are six remaining chapters in the thesis. The first examines the role of earnings in the Social Security program. Under current law, Social Security benefits are an earned right in which benefit amounts are determined by the lifetime earnings histories of individuals and their spouses. Namely, the level of one's Social Security benefit is based on a measure of one's lifetime earnings. Earnings differentials related to socioeconomic characteristics, such as race and gender, will be reflected in OASI benefit differentials after retirement. I examine differences in mean earnings of various socioeconomic groups to show how these differences are likely to result in different levels of future OASI benefits.

Several researchers have shown that differential mortality rates may have a significant influence on the distributional character of the Social Security program (Duggan, Gillingham, and Greenlees, 1993; Aaron, 1977; Wolff, 1987). Their results show that mortality rates offset to varying degrees the effect of the progressive benefit formula on rates of return on payroll tax contributions. An illustration from Steuerle and Bakija (1994), shows that the projected lifetime net transfer for low-wage female workers retiring in 2030, for example, will be reduced by about $9,500 when adjusted for differential mortality, whereas the lifetime transfer going to high-wage female workers will be increased by $24,400. Although the shock of differential mortality rates causes a modest reduction in the progressivity of Social Security program, the change is noticeable. From 1995 to 2030, they project that all low-wage groups will experience a 30 to 50 percent drop in the net transfer, except for two-earner couples, but also the net transfer of all high-wage groups will increase by from 13 to 75 percent. In addition, Garrett (1995) compared the net returns of poor households to the net returns of other households after taking into account differential longevity. He tried to discover how significantly differential mortality affects the progressivity of OASI in the 1925 birth cohort. He found that differences in mortality greatly reduce the progressive spread in returns across income categories. The internal rates of return for the lowest quintile decreases from 3.52 percent to 2.90 percent. In contrast, the internal rates of return for the highest quintile increases from 2.46 percent to 2.61 percent. Socioeconomic status and differentials in mortality will be discussed in the second chapter.

Since needs tend to increase and abilities to decrease at older ages, one would expect that a progressive need-oriented system like Social Security would attempt to increase real benefit levels over the aging process. Beginning in 1975, automatic benefit increases, also known as a cost-of-living adjustment or COLA, have been in the effect in the Social Security program. The purpose of the COLA is to maintain a recipient's benefit level at a constant real value, or purchasing power, from age of retirement to age of death. After 1982, the COLA becomes effective with the January benefit payment. It is equal to the percentage increase in the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W) between the third quarter of the previous year and the corresponding third quarter one year earlier. Until 1985 there was a trigger requirement such that the COLA would not be given if the CPI increase is less than 3.0 percent. Suppose, for example, that this provision had been in effect in 1985-87, and the CPI had risen by only 1.3 percent from the third quarter of 1985 to the third quarter of 1986, the latter would not be a base quarter. If the rise measured from the third quarter of 1985 to the third quarter of 1987 had been 5.5 percent, the latter would be the new base quarter, and benefits would be increased by this amount, beginning with the benefit payment in January 1988. If the CPI has an upward bias, federal programs like OASI would overcompensate for the effect of price changes on living standards, and wealth would be transferred from younger and future generations to current recipients of indexed federal programs. The third chapter discusses alleged bias in the Consumer Price Index.

The fourth chapter uses a numerical example to explain the effect of the annual cost-of-living adjustment on Social Security benefits. The fifth chapter discusses whether elderly people need a separate Consumer Price Index to protect them from being affected by inflation. The last section summarizes the thesis's findings and suggests directions for further research.

THE ROLE OF EARNINGS IN THE SOCIAL SECURITY PROGRAM

Average Indexed Monthly Earnings (AIME)

The level of one's Social Security benefit is based on a measure of one's lifetime earnings, or more precisely, the average indexed monthly earnings (AIME). A worker's earnings are "indexed" to reflect the change in general wage levels that occurred during the worker's years of employment. Such indexation ensures that a worker's future benefits reflect the general rise in the standard of living that occurs during his or her working lifetime. To accomplish this, each year's wage is multiplied by an "indexing factor", which equals the ratio of the average national wage in the year the worker turns 60 to the average national wage in the year to be indexed. For instance, for a person retiring at age 65 in 1995, the person's earnings would be indexed to the national average wage index for 1990, or $21,027.98. Earnings in a year before 1990 would be multiplied by the ratio of $21,027.98 to the national average wage index for that year; earnings in 1990 or later enter the AIME computation at their nominal values.

To compute the AIME for a worker attaining age 62, becoming disabled before age 62, or dying before attaining age 62, in 1992, the national average wage index for 1990, $21,027.98, is divided by the national average wage index for each year prior to 1990 in which the worker had earnings. Taxable wages credited for each year are multiplied by the corresponding ratio to obtain the worker's indexed earnings for each year before 1990. Any earnings in 1990 or later are considered at face value, without indexing. From this set of earnings, the best 35 years are selected, added together, and divided by 420 (the number of months in 35 years). The result is the AIME (Meyer and Wolff, 1993; Myers, 1993; Steuerle and Bakija, 1994).

Primary Insurance Amounts (PIA)

The PIA is the basic monthly benefit paid to someone who has stopped working and then begins to collect benefits before adjustments for factors such as early or delayed retirement and spousal benefits. A progressive feature of the Social Security program in the United States is a rate structure in the benefit formula that provides a higher rate of return on the contributions of workers with low earnings than for those with high earnings.

The PIA is the sum of three separate percentages of portions of the AIME. For workers turning 65 in 1995, the formula for determining the PIA is

(1) 90 percent of the first $387 of their AIME, plus

(2) 32 percent of the AIME over $387 and through $2,333, plus

(3) 15 percent of the AIME over $2,333.

The bracket limits in the benefit formula are referred to as "bend points." They are adjusted upward each year by the appropriate wage index. This procedure assures that average benefits paid to successive cohorts will rise each year to keep pace with increases in average earnings, as noted above.

In short, under current law Social security benefits are an earned right in which benefit amounts are determined by the lifetime earnings histories of individuals and their spouses.

Race, Sex, and the Distribution of Total Earnings

It is important to perceive that those comparative results deal only with full-time workers. Although ignoring the effects of unemployment and part-time labor, I make a most conservative evaluation of the differentials in total earnings when the individuals involved are working at full-time jobs.

The order of total earnings was White males, White females, Black males, Black females through the 1950s; but since 1960 the total earnings of full-time employed Black males has exceeded that of similarly employed White females (Winnick,1989). Up to 1991, the order of total earnings was also White males, Black males, Hispanic males, White females, Black females, Hispanic females. While Hispanic males have been catching up to Black males since 1989, the percentage gap between them is the same as it had been back in 1965.

Total Earnings Differentials by Race

Ordinarily, the income from all sources is higher for Whites than for Blacks and Hispanics. Whites also receive higher earnings relative to Blacks and Hispanics, on average (Aquirre, 1990; Horton, Thomas, and Herring, 1995; Winnick, 1989; Wolff, 1987). Table 1 reports mean earnings of workers 18 years old and over by race and sex from 1985 to 1994. The level of total earnings trended upward over time, the exceptions being for Black males between 1990-91 and Hispanic females between 1992-93.

Table 2 deals with Blacks/Whites in columns 1 and 2. Table 3 presents Hispanics/ Whites and Hispanics/ Blacks in columns 1,2,5 and 6, respectively. I intend to examine the

Table 1. Mean earnings of workers 18 years old and over, by race, Hispanic origin, and sex: 1985 to 1994

Year	White Male	White Female	Black Male	Black Female	Hisp Male	Hisp Female
1985	22,604	11,555	14,932	10,904	15,293	9,865
1986	23,892	12,247	15,441	11,571	15,624	10,457
1987	24,898	13,161	16,171	12,106	17,048	11,234
1988	26,184	13,902	17,782	12,916	17,357	11,573
1989	28,013	14,810	18,108	14,122	18,087	12,307
1990	28,105	15,559	18,859	14,449	18,320	12,516
1991	28,516	16,431	18,607	15,065	18,516	13,069
1992	29,515	17,289	19,278	15,605	18,842	13,880
1993	31,719	18,028	21,108	16,336	19,460	13,602
1994	33,292	18,912	22,614	17,200	21,288	14,631

Source: U.S. Bureau of Labor Statistics, Employment and Earnings, January issues; and unpublished data, 1985 to 1994.

Table 2. Earnings ratios (1)

	1	2	3	4	5	6
Year	BM/WM	BF/WF	BF/BM	WF/WM	WF/BM	BF/WM
1985	66.06%	94.37%	73.02%	51.12%	77.38%	48.24%
1986	64.63	94.48	74.94	51.26	79.31	48.43
1987	64.95	91.98	74.86	52.86	81.39	48.62
1988	67.91	92.91	72.64	53.09	78.18	49.33
1989	64.64	95.35	77.99	52.87	81.79	50.41
1990	67.10	92.87	76.62	55.36	82.50	51.41
1991	65.25	91.69	80.96	57.62	88.31	52.83
1992	65.32	90.26	80.95	58.58	89.68	52.87
1993	66.55	90.61	77.39	56.84	85.41	51.50
1994	67.93	90.95	76.06	56.81	83.63	51.66

pattern of racial differentials in total earnings among full-time workers with both tables. The BM/WM ratio stays steadily between 64 percent and 68 percent from 1985 to 1994. The BF/WF ratio remained a little below 93 percent, except in 1985, 1986, and 1989. These group differences in total earnings also show up as differences in poverty rates. Thirty-eight percent of rural Blacks and 29.4 percent of urban Blacks live below the poverty threshold.

Table 3. Earnings ratios (2)

	1	2	3	4	5	6
Year	HM/WM	HF/WF	HF/HM	HF/WM	HM/BM	HF/BF
1985	48.24%	43.64%	64.51%	43.64%	102.42%	90.47%
1986	48.43	43.77	66.93	43.77	101.19	90.37
1987	48.62	45.12	65.90	45.12	105.42	92.80
1988	49.33	44.20	66.68	44.20	97.61	89.60
1989	50.41	43.93	68.04	43.93	99.88	87.15
1990	51.41	44.53	68.32	44.53	97.14	86.62
1991	52.83	45.83	70.58	45.83	99.51	86.75
1992	52.87	47.03	73.67	47.03	97.74	88.95
1993	51.50	42.88	69.90	42.88	92.19	83.26
1994	51.66	43.95	68.73	43.95	94.14	85.06

Note: WM-- White Male BF--Black Female
WF-- White Female HM--Hisp Male
BM-- Black Male HF--Hisp Female

In contrast, 13.1 percent of rural Whites and 8.7 percent of urban Whites live below the poverty line (Horton, Thomas, and Herring, 1995).

The HM/WM, HF/WF, HM/BM, and HF/BF total earnings differentials constantly deteriorate in the relative total earnings of Hispanic full-time workers, compared to Whites and Blacks of the same sex between 1992 and 1994. Among both males and females, the gap between Hispanic and White full-time workers is wider than between Blacks and Whites. From the HM/BM ratio in Table 3, I find Hispanics fall below Blacks in total earnings among full-time workers since 1988. There has been some widening of the differential between Hispanic and Black males since 1992. The relative position of Hispanic females, compared to Black females, varied within a narrow range until 1993, when the relative status of Hispanic females worsened significantly.

In short, the racial differential increased from 1991 to 1994 (BF/WF: 91.69%-90.95%; HM/WM: 52.83%-51.66%; HF/WF: 45.83%-43.95%). Only the ratio of Black male to White male earnings increased, from 65.25% to 67.93%.

Total Earnings Differentials by Sex

The ratio of female-to-male total earnings increased dramatically between 1985 and 1994, though it fluctuated between 1991 and 1994 (WF/WM: 51.12%-56.81%; BF/BM: 73.02%-76.06%; HF/HM: 64.51%-68.73%; WF/BM: 77.38%-83.63%; BF/WM: 48.24%-51.66%; HF/WM: 43.64%-43.95%). However, the BF/BM ratio has fallen since 1991. Because the total earnings of Hispanic females went down by $278 between 1992 and 1993, the HF/HM ratio descended from 73.67 percent to 68.73 percent. There was a modest improvement in the ratios to both males and females with the same race from 1985 to 1986. After 1986, all three ratios, WF/WM, BF/BM, and HF/HM, fluctuated within a narrow range.

In brief, the sexual differential was reduced from 1985 to 1994. But during the 1970s, a meaningful change in the formation of the family was an increase in the number of female-headed households, households in which the woman does not have access to the resources brought in by a male worker. By 1983 about one out of three persons below the poverty level belonged to a family maintained by a woman with no husband present. About two-fifths of the overall increase in the number of poor families since 1980 was attributable to an increase in the number of families maintained by women (Aguirre, 1990).

SOCIOECONOMIC STATUS AND DIFFERENTIALS IN MORTALITY

For many years now, researchers have indicated that socioeconomic status, especially race, sex, and educational attainment, are correlated with an individual's inequality in the face of death. Mortality rates were found to be higher for Nonwhites relative to Whites, for males relative to females, and for the less educated relative to the more educated (Feldman, Mackuc, Kleinaman, and Cornoni-Huntley, 1989; Hadley and Osei, 1982; Kitagawa and Hauser, 1973; Mare, 1990; Nathanson, 1995; Sorlie, Backlund, and Keller, 1995; Wolff, 1987). Mostly it has been presumed that the secular decline in mortality in the currently industrialized countries was accompanied by a reduction in socioeconomic differentials (Pamuk, 1985). In fact, what little empirical evidence exists does not support the notion of a continuous decline in mortality differentials. Recent studies using data from the United States have revealed a deteriorating relationship of socioeconomic differentials to mortality. Results from Kitagawa and Hauser (1973) are based on the 1960 Matched Records study and the special tabulations of 1959-61 deaths for the entire nation compiled by the National Center for Health Statistics. The U.S. National Longitudinal Mortality Study (1992), on the other hand, is based on matching individual records from Census Bureau Samples for 1,281,475 persons to the National Death Index for years 1979-1985. The basic objective of the study is to investigate socioeconomic, demographic and occupational differentials in mortality within the United States.

To summarize, lower mortality was found among Whites than Blacks for persons less than 65 years of age and among persons with higher incomes and with more education. With occasional exceptions, in specific sex and age groups, these relationships were reduced but remained strong and statistically significant when each variable was adjusted for all of the other characteristics. The relationships were generally weaker in individuals 65 years of age or more (Behrman, Sickles, Taubman, and Yazbeck, 1991; Chapman, LaPlante, and Wilensky, 1986; Kestenbaum, 1992; Kitagawa and Hauser, 1973; Sorlie, Backlund, and Keller, 1995; U.S. National Longitudinal Mortality Study, 1992).

Life expectancy, estimating the average number of future years of life remaining at a specific age and year, has varied significantly over this century. The most rapid gain in life expectancy at birth occurred from 1940 to 1954. This gain was somewhat more accelerated for females, resulting in a further widening of the sex differential in life expectancy. From 1954 to 1968, the rate of improvement in life expectancy slowed for both sexes, but more so for males than females. From 1978 to 1982, the annual rate of increase for males was 0.325 years, while that for females was 0.225 years (Chapman, LaPlante, and Wilensky, 1986). From 1990 to 2020, the probability of surviving from age 65 to age 95 is expected to nearly double. From 1990 to 2050, the number of elders aged 85 and over is expected to increase more than fivefold. In all likelihood, by 2050 there will be more than 26 million Americans aged 85 and older and they will represent about 5 percent of the total population. Of that 26 million, more than 2.5 million will be centenarians (Atchley, 1995).

Even though average life expectancy has increased, regardless of race or sex, socioeconomic differentials in mortality have increased. Furthermore, individuals of lower socioeconomic status are at a disadvantage when it comes to many of the psychosocial and environmental risk factors associated with functional limitations, for instances, health behaviors and work-related hazards. These factors may have additive positive effects on mortality (Behrman, Sickles, Taubman, and Yazbeck, 1991; Chapman, LaPlante, and Wilensky, 1986; Dunkle and Lynch, 1995; Kitagawa and Hauser, 1973; Lopez, Caselli, and Valkonen, 1995; Mare, 1990; Sorlie, Backlund, and Keller, 1995; U.S. National Longitudinal Mortality Study, 1992).

Sex

The late twentieth-century movement of women in many developed countries away from an exclusive involvement in the domestic sphere of home and family into the public world of paid employment and political action has led many observers to consider the effect of these changes on women's mortality, and to forecast that women will experience men's mortality risks along with other characteristics conventionally attributed to the masculine role (Nathanson, 1995). In fact, male mortality is still higher than female mortality at all ages, although the sex differential tends to decrease at the oldest ages (Chapman, LaPlante, and Wilensky, 1986; Himes, Preston, and Condran, 1994; Nathanson, 1995; Vallin, 1995).

Himes, Preston, and Condran (1994) constructed a relational model of old age mortality that summarizes the annual deaths and enumerated populations from 16 industrialized countries and covers the period from 1950 to 1985. They showed that the mortality rate is higher for males than for females at every age, with the greatest sex difference occurring between ages 55 and 65. The period life of males and females published by U.S. Social Security Administration, May 28,1997, also shows that females have a lower mortality rate than males for all ages; see the totals in Table 4.

Race

Throughout much of their lifespan, Blacks have a higher age-specific death rate than Whites in the United States, although there may be a crossover at later ages (Behrman, Sickles, Taubman, and Yazbeck, 1991; Chapman, LaPlante, and Wilensky, 1986; Kestenbaum, 1992; Kitagawa and Hauser, 1973; Sorlie, Backlund, and Keller, 1995; U.S. National Longitudinal Mortality Study, 1992). Race crossovers have long been an apparent trait of the U.S. life tables, although the point of crossover is floating upward. In the 1979-1981 the White-Black crossovers occur at ages 84 for males and 85 for females, compared to ages 78 and 80 respectively for the White-Black crossovers in the 1969-1971 and ages 75 and 77 respectively for the White-Nonwhite crossovers in the 1959-1961 (Kestenbaum, 1992).

Kitagawa and Hauser (1973) stated that both the male and the female curves cross at age 75 in the uncorrected rates; that is, Nonwhite death rates are higher than White death rates below age 75 but lower than White rates after age 75.The Nonwhite and white curves do not cross until the last open-ended age interval, 85 and over, when corrected for age reporting. This might be owing to older age of Whites more than Nonwhites, on the average, in this age interval.

Chapman, LaPlante, and Wilensky (1986) revealed that Blacks suffer considerably

Table 4. Period life table, 1994

Exact age	Male Death probability	Male Survival probability	Male Life expectancy	Female Death probability	Female Survival probability	Female Life expectancy
65	0.023662	0.976338000	15.28	0.013657	0.986343000	19.03
66	0.026008	0.950945401	14.63	0.015016	0.971532074	18.29
67	0.028279	0.924053616	14.01	0.016352	0.955645581	17.56
68	0.030398	0.895964234	13.40	0.017622	0.938805195	16.84
69	0.032489	0.866855252	12.81	0.018902	0.921059899	16.14
70	0.034789	0.836698225	12.22	0.020341	0.902324619	15.44
71	0.037455	0.805359693	11.64	0.022027	0.882449115	14.75
72	0.040474	0.772763565	11.08	0.023942	0.861321518	14.07
73	0.043914	0.738828426	10.52	0.026122	0.838822078	13.40
74	0.047794	0.703516860	9.98	0.028596	0.814835121	12.75
75	0.052114	0.666853782	9.46	0.031441	0.789215890	12.11
76	0.056884	0.628920472	8.95	0.034639	0.761878241	11.48
77	0.062152	0.589831807	8.46	0.038121	0.732834681	10.88
78	0.067946	0.549755095	7.99	0.041882	0.702142099	10.29
79	0.074303	0.508906642	7.54	0.046018	0.669830924	9.72
80	0.081277	0.467544237	7.10	0.050716	0.635859778	9.16
81	0.088889	0.425984697	6.69	0.056056	0.600216023	8.62
82	0.097131	0.384608377	6.29	0.061989	0.563009232	8.11
83	0.106017	0.343833351	5.91	0.068552	0.524413823	7.61
84	0.115585	0.304091373	5.55	0.075824	0.484650669	7.13
85	0.125879	0.265812655	5.21	0.083897	0.443989932	6.68
86	0.136935	0.229413599	4.89	0.092852	0.402764579	6.24
87	0.148776	0.195282362	4.59	0.102748	0.361381324	5.83
88	0.161411	0.163761640	4.31	0.113628	0.320318287	5.44
89	0.174838	0.135129883	4.04	0.125510	0.280115139	5.07
90	0.189047	0.109583984	3.79	0.138406	0.241345523	4.73
91	0.204023	0.087226331	3.55	0.152315	0.204584979	4.41
92	0.219745	0.068058781	3.34	0.167230	0.170372233	4.11
93	0.236189	0.051984045	3.13	0.183140	0.139170263	3.84
94	0.253327	0.038815083	2.95	0.200023	0.111333009	3.59
95	0.270566	0.028313041	2.78	0.217175	0.087154263	3.36
96	0.287756	0.020165794	2.63	0.234399	0.066725391	3.15
97	0.304741	0.014020450	2.49	0.251481	0.049945223	2.96
98	0.321353	0.009514936	2.36	0.268189	0.036550463	2.79
99	0.337421	0.006304397	2.23	0.284280	0.026159898	2.63
100	0.354292	0.004070799	2.12	0.301337	0.018276953	2.48

Source: U.S. Social Security Administration, May 28, 1997.

higher mortality than Whites. In 1980, the age-adjusted mortality ratio for Black males compared to White males was 1.18 and for Black females to White females, 1.49. For both Black males and females, mortality ratios are large at younger ages, but decline with increasingly older ages and actually cross below 1 for those over 75 years old.

Behrman, Sickles, Taubman, and Yazbeck (1991) used the males in the Retirement History Survey, started in 1969 with about 11,000 men and women, to see how much of the observed inequality in mortality hazard rates (the age-specific death rate in a year t divided by the survivors in that age cohort up to time t) is eliminated once they control for certain observed variables. They found that the hazard is higher for Blacks at every age covered, 60-66. In their research paper, there is no crossover in hazard rates for Blacks and Whites.

Kestenbaum (1992) employed Medicare enrollment data from the Social Security Administration's Master Beneficiary Record to determine the mortality and size of the extreme aged population. The race crossover was present in his improved enrollment data file. His result provided strong support for the view that race crossover is a matter of fact. According to the death probabilities given in his paper, the crossovers in 1987 occurred at ages 86 for men and 88 for women. Actually, White female mortality exceeds Black female mortality at age 86, but Black female mortality again is higher at ages 87. Allowing some margin for error, he stated positively that White mortality exceeds Black mortality after age 90.

The U.S. National Longitudinal Mortality Study (1992) provided comparison of tabulations that permitted the correction of official death statistics for the seven-year period 1979-1985 for differences in the reporting of race on the death certificate and in the census.

The corrections had significant effect on the mortality indices of Whites and Blacks. For male ages 0-74, Blacks have a relatively high mortality. After ages 74, there is a marked inverse relationship between Black and White males. For females, the race crossover appears after ages 84.

Sorile, Backlund, and Keller (1995) indicated Blacks less than 65 years of age had significantly higher age-adjusted mortality rates than Whites in the same age group. Blacks also in the 25-44 year group showed more than twice the rates of Whites, and those in the 45-64 year group showed 1.5 fold higher rates. After adjustment for the other characteristics, the excess risk among Blacks was reduced but still considerably higher than that of Whites. In the 65+ age group, the multivariable adjusted mortality rates of Blacks were similar to, or even slightly lower than, those of Whites.

Educational Attainment

Higher education level was associated with lower mortality in males and females, with the strongest relationship in persons less than 65 years of age and much weaker association in the older age group (Feldman, Makuc, Kleinman, and Cornoni-Huntley, 1989; Kitagawa and Hauser, 1973; Sorlie, Bucklund, and Keller, 1995; U.S. National Longitudinal Mortality Study, 1992).

Kitagawa and Hauser (1973) interpreted that the range of the education differentials was much larger among persons 25-64 years of age than among older persons, and greater among women than men. For example, among White males 25-64 years old the mortality ratios by education decreased consistently from a high of 1.15 for males with less than 5 years of schooling to a low of 0.70 for males with at least 4 years of college, a differential of 64 percent. In contrast to this, the education differential in mortality for White males 65 and over was only 4 percent (from 1.02 to 0.98). Among White females 25-64 years of age the mortality ratio of 1.60 for women with less than 5 years of schooling was 105 percent higher than the ratio of 0.78 for women with at least 4 years of college. On the other hand, for women aged 65 and over the ratio was only 67 percent (from 1.17 to 0.70). Among Nonwhite 25-64 age years of age, males with less than 5 years of schooling had a mortality ratio (1.14) that was 31 percent higher than the ratio (0.87) for males with at least one year of high school. In this group females with less than 5 years of schooling had a mortality ratio (1.26) that was 70 percent higher than the ratio (0.74) for females who had at least one year of high school.

Feldman, Makuc, Kleinman, and Cornoni-Huntley (1989) explored educational differentials in mortality between 1960 and 1971-1984 for White males and females aged 55-84 years at death. Their analysis was based on two national data sources, the 1960 Matched Records Study, a sample of all death records for 62,405 persons from May through August 1960, and the National Heath and Nutrition Examination Survey (NHANES I) Epidemiologic Follow-up Study (NHEFS), which was used to estimate educational differentials in mortality for the period 1971-1984. They pointed out that there was little difference in mortality by educational level among middle-age and older men in 1960. Since 1960, death rates among men dropped more speedily for the more educated than the less educated, which resulted in meaningful educational differentials in mortality in 1971-1984. However, among women, the inverse relation between education and mortality remained at about the same magnitude between 1960 and 1971-1984.

The National Longitudinal Mortality Study (1992) showed that all-cause mortality levels tended to decline with increasing education for White and Black males ages 25-64. The inverse relationship was also seen for females ages 25-64 years, regardless of race. This relationship at ages 65 or older for males and females was not as strong as in the younger ages.

Sorlie, Backlund, and Keller (1995) found that there were twofold to threefold defferences between the education with the highest (17+) and the lowest (0-4) risks for those less than 65 years of age. After adjustment for age and race, the ratio of the highest to the lowest risk diminished to between 1.5 and 2.

Income

There is evidence of a strong inverse relationship between mortality rates and the scale of income differentials (Kitagawa, Hauser, 1973; Rodgers, 1979; U.S. National Longitudinal Mortality Study, 1992; Wilkinson, 1989).

Kitagawa and Hauser (1973) reported that income was inversely related to mortality and the range of income differentials was much larger and the pattern more consistent among persons 25-64 years of age than among older persons. Among males of age 25-64 the mortality ratio of 1.51 for those from families with less than $2,000 income in 1959 was 80 percent higher than the ratio of 0.84 for those from families with income of $10,000 or more. Comparable indices for White females in the 25-64 age group ranged from 1.20 for those from families with less than $2,000 income to 0.86 for those from families with more than $10,000 income, a differential of 40 percent. After age 65, however, the mortality ratio for men from families with less than $2,000 income was only 15 percent higher than that for men from families with income of $8,000 of more. Among women 65 and over, there was no consistent pattern of declining mortality with increasing family income. Among White unrelated individuals 25-64 years of age, there also was a strong inverse association between mortality and income. Among White unrelated individuals over 65 years of age, there was no indication of an inverse association between mortality and income for men, although women did maintain a differential of 31 percent.

The U.S. National Longitudinal Mortality Study (1992) stated that mortality ratios from all causes of death in White males ages 25-64 with family incomes of less than $5,000 per year were 2.71 times the ratios in men with incomes of $50,000 or more per year. For White females ages 25-64, mortality ratios from all causes of death with family incomes of less than $5,000 per year were more 2.17 times than the ratios in women with incomes of $50,000 or more per year. For Black males ages 25-64, mortality ratios from all causes of death with family incomes of less than $5,000 per year were more 1.91 times than the ratios in men with incomes of $50,000 or more per year. For Black females ages 25-64, mortality ratios from all causes of death with family incomes of less than $5,000 per year were 2.68 times the ratios in women with incomes of $50,000 or more per year. After age 65, all mortality ratios reduced dramatically (2.71-1.44, 2.17-1.10, 1.91-1.23, and 2.68-0.88).

BIAS IN THE CONSUMER PRICE INDEX

Beginning in 1975, automatic benefit increases, also known as a cost-of-living adjustment or COLA, have been in effect in Social Security program. The purpose of the COLA is to maintain a recipient's benefit level at a constant real value, or purchasing power, from age of retirement to age of death. After 1982, the COLA becomes effective with the January benefit payment. It is equal to the percentage increase in the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W) between the third quarter of the previous year and the corresponding third quarter one year earlier. Until 1985 there was a trigger requirement such that the COLA would not be given if the CPI increase is less than 3.0 percent. For example, this provision had been in effect in 1985-87, and the CPI rose by only 1.3 percent from the third quarter of 1985 to the third quarter of 1986, the latter would not be a base quarter. If rise measured from the third quarter of 1985 to the third quarter of 1987 were 5.5 percent, the latter would be the new base quarter, and benefits would be increased by this amount, beginning with December 1987, including those for new eligibles in 1987.

In 1994, the Congressional Budget Office stated that the budgetary effect of any overestimates of changes in the cost of living creates the possibility of a shift in the distribution of wealth. If the CPI has an upward bias, some federal programs would overcompensate for the effect of price changes on living standards, and wealth would be transferred from younger and future generations to current recipients of indexed federal programs. In short, the upward bias programs into the federal budget every year an automatic, real increase in indexed benefits and a real income tax cut. Correction of bias in the CPI, while designed to adjust benefits and taxes for true changes in the cost of living more accurately, would also contribute importantly to reductions in future federal budget deficits and the national debt (Advisory Commission to Study the CPI, 1996). Table 5 displays recent estimates of bias in the U.S. Consumer Price Index.

Table 5. Recent estimates of bias in the U.S. Consumer Price Index

Authors	Point estimate	Interval estimate
Advisory Commission to Study the CPI (1996)	1.1	0.8-1.6
Michael Boskin (1995)	1.5	1.0-2.0
Congressional Budget Office (1994)	-----	0.2-0.8
Michael R. Darby (1995)	1.5	0.5-2.5
W. Erwin Diewert (1995)	-----	1.3-1.7
Federal Reserve Board	-----	0.4-1.5
Robert J. Gordon (1995)	1.7	-----
Alan Greenspan (1995)	-----	0.5-1.5
Ziv Griliches (1995)	1.0	0.4-1.6
Dale W. Jorgenson (1995)	1.0	0.5-1.5
Jim Klumpner (1996)	-----	0.3-0.5
Lebow, Roberts and Stockton (1994)	-----	0.4-1.5
Ariel Pakes (1995)	0.8	-----
Shapiro and Wilcox (1996)	1.0	0.6-1.5
Wynne and Sigalla (1994)	less than 1.0	-----

Source: Brent R. Moulton, Bias in the Consumer Price Index: What Is the Evidence? In Journal of Economic Perspectives, Fall 1996, pp160.

Abraham (1995a) and D'Amato (1995) concluded that a one percent increase in the index produces an increase in outlays and a decline in revenues for the federal government which, jointly, add approximately between $6 billion and $6.5 billion to the federal deficit due to the CPI used to adjust such things as Social Security benefits and income tax brackets.

Boskin (1995) estimated that correcting the overindexation by one percentage point per annum would reduce the federal budget deficit by about $70 billion in the year 2002, and by over $200 billion cumulatively for the next seven years.

Gordon (1995) concluded that the federal budget deficit would be reduced over the next decade by hundreds of billion of dollars if the rate of inflation used to escalate Social Security benefits, tax brackets, exemptions, and the standard deduction were to be reduced by one percent below the forecast growth in the official CPI.

Greenspan (1995) concluded that the annual level of the deficit would be lower by about $55 billion after five years if annual inflation adjustments to indexed programs and taxes were reduced by one percentage point. The cumulative deficit reduction over this period would be nearly $150 billion, and these savings would continue to grow in subsequent years.

Jorgenson (1995) estimated that the bias produced an increase of 3.42 percent in federal outlays of $1.5 trillion in fiscal 1995 or $50 billion between 1968 to 1982.

McLennan (1995) assumed that the CPI overstates the rate of inflation by one percent. Eliminating this bias could result in a savings to the federal government of $150 billion over five years. That would reduce the federal budget deficit currently projected for the year 2000 by $55 billion, about one-quarter of the total.

O'Neill (1995) showed that tax collections would be close to $10 billion higher and spending would be $13 billion lower than the Congressional Budget Office currently projects by the year 2000 if the CPI grew 0.5 percentage points slower than the CBO budget baseline assumes from 1996 through 2000.

Freedman (1996) stated that the cumulative outstanding federal debt would be reduced by an estimated $634.3 billion in the next decade if such a one percent discount were applied.

The Advisory Commission to Study the CPI (1996) reported that this bias would contribute about $148 billion to the deficit in 2006 and $691 billion to the national debt estimated by the CBO if the change in the CPI overstated the change in the cost of living by an average of 1.1 percentage points per year over the next decade. By 2008, these totals reach $202 billion and $1.07 trillion, respectively.

Commodity Substitution Bias

One reason for this upward bias is that the CPI does not reflect changes in buying or consumption patterns that consumers would be expected to make as they adjust to relative price changes, buying more of goods whose relative prices have fallen and less of goods those relative prices have risen (Abraham, 1995b; Advisory Commission to Study the CPI, 1996; Boskin, 1995; Darby, 1995; Diewert, 1995; Fixler, 1993; Freedman, 1996; Gordon, 1995; Marcoot, 1985; McLennan, 1995; Moulton, 1996; Norwood, 1995; O'Neill, 1995; Pakes, 1995; Pollak, 1995). Most estimates cluster around 0.2 to 0.25 percent per year, for example, Boskin (0.2), Gordon (0.25), O'Neill (0.2), and Pakes (0.2). The latest estimate available was about 0.15 percentage point per year adopted by Advisory Commission to Study the CPI in December 1996.

Formula Bias

The base price for the sample item should represent its average price during the expenditure base period. Because the sample item had not yet been selected during the base period, neither the base price nor the base period quantity is observable, and a method is required for estimating the base price. From 1978 until 1996, the BLS took the price of the sample item during the sample replacement, and deflated it to the base period using the overall price index for the stratum. This procedure causes items that are on sale or otherwise have an unusually low price when they are introduced to the sample to receive a disproportionately large weight because the expenditure weight is divided by an atypically low base price for the item on sale. The net effect is that the estimator may apply too much weight to price increases and too little weight to price decreases immediately after the introduction of a new sample or a new sample item (Abraham, 1995b; Advisory Commission to Study the CPI, 1996; Boskin, 1995; Diewert, 1995; Gordon, 1995; Moulton, 1996; Pollak, 1995). A numerical example from Boskin (1995), if the price of a shirt, which was originally \$50, goes on sale at \$40. It is calculated as a 20 percent reduction. Now the sale ends and the price goes back to its original level, \$50. That is calculated as a 25 percent increase. Clearly, over the two periods there has been no price change. But the methodology of the CPI results in an estimate of a +5 percent change in price (-20 percent plus 25 percent equal +5 percent). The upward bias for the total CPI was estimated 0.5 percent by Boskin (1995) and 0.35 percent by Gordon (1995).

Outlet Substitution Bias

The outlet substitution effect can arise because consumers are free to substitute where they buy goods and services as well as what goods they buy. For instance, if consumers do not consider the lower level of customer service provided by a discount store to be of any consequence, they may shift to such stores and experience no loss of well-being. Current CPI procedures would not capture any price decline associated with such a shift (Abraham, 1995b; Advisory Commission to Study the CPI, 1996; Boskin, 1995; Diewert, 1995; Freedman, 1996; Gordon, 1995; Moulton, 1996; Norwood, 1995; O'Neill, 1995; Pakes, 1995; Pollak, 1995). The upward bias for the total CPI was assessed 0.3 percent by Boskin (1995), 0.5 percent by Gordon (1995), and 0.1 percent by O'Neill (1995).

Quality Change

In the real world, goods and services change over time. The BLS uses various techniques to try to capture changes in the characteristics of goods and services and translate these changes into "equivalent" price changes. Not all quality changes are improvements, of course, but surely most changes in the quality of goods and services unrecognized by the BLS have been improvements and the net bias from that source may be upward (Advisory Commission to Study the CPI, 1996; Boskin, 1995; Darby, 1995; Diewert, 1995; Freedman, 1996; Gordon, 1995; Kokoski, 1993; McLennan, 1995; Moulton, 1996; Norwood, 1995; O'Neill, 1995; Pollak, 1995). According to previous evaluations of quality change bias, this bias was estimated 0.5 percent by Boskin (1995), 0.6 percent by Gordon (1995), and 0.2-1.0 percent by O'Neill (1995).

New Goods

In our dynamic economy new goods come into the consumer marketplace virtually continuously. Sometimes new goods provide a service similar to an existing good, but with higher quality or a lower price. In other cases, new goods offer an additional variety of choices but without fundamentally changing the services provided. Finally, some new goods provide entirely new services that were previously unavailable. For the CPI, the appearance of new goods presents at least two important problems: bring new goods into the samples on a timely basis; and accounting for differences in price between new goods and the old goods that provided the same or similar services (Moulton, 1996). New goods bias occurs when new products are not introduced in the market basket, or included only with a long lag (Advisory Commission to Study the CPI, 1996; Armknecht, Lane, and Stewart, 1997; Darby, 1995; Diewert, 1995; Moulton, 1996; Pakes, 1995). Diewert (1995) made a conservative range of estimates, 0.35-0.6 percent, for the linking bias and the new goods bias in the U.S. CPI in recent years. Advisory Commission to Study the CPI (1996) estimated that the bias for quality change and new goods was 0.6 percent per year.

THE EFFECT OF THE ANNUAL COST-OF-LIVING ADJUSTMENT ON SOCIAL SECURITY BENEFITS

Low Earnings, Average Earnings, and High Earnings

Table 6 illustrates the PIA and monthly benefit for someone retiring in 1995. Retirement at age 65 means at exact age 65 and 0 months. Low earnings are defined as earnings equal to 45 percent of the national average wage index. Average earnings are defined as earnings equal to the national average wage index. High earnings are defined as earnings equal to 160 percent of the national average wage index.

Table 6. Illustrative benefit table for workers, retiring in 1995, with low earnings, average earnings, and high earnings

Earnings level	Average Indexed Monthly Earnings	Primary Insurance Amount	Monthly benefit
Low Earnings	796.00	520.30	520.00
Average Earnings	1,770.00	858.90	858.00
High Earnings	2,600.00	1,098.20	1,098.00

Source: Social Security Administration, http://www.ssa.gov

Normal Retirement Age (NRA)

An individual is eligible for a monthly old-age insurance benefit at age 62 or later if fully insured. The amount of this benefit is 100 percent of the primary insurance amount (PIA), except in the case of a worker first claiming benefits before the Normal Retirement Age and except for deferment of retirement beyond the NRA. From U.S. Congress, House Committee on Ways and Means (1992), the scheduled NRA is 65 years old between 1994 and 2002. Table 7 shows the Normal Retirement Age for workers and spouses born after

Table 7. Normal Retirement Age for workers and spouses born after 1928.

Birth date	Year cohort turns 65	Full retirement age
1/2/29-1/1/30	1994	65 years
1/2/30-1/1/31	1995	65 years
1/2/31-1/1/32	1996	65 years
1/2/32-1/1/33	1997	65 years
1/2/33-1/1/34	1998	65 years
1/2/34-1/1/35	1999	65 years
1/2/35-1/1/36	2000	65 years
1/2/36-1/1/37	2001	65 years
1/2/37-1/1/38	2002	65 years
1/2/38-1/1/39	2003	65 years and 2 months
1/2/39-1/1/40	2004	65 years and 4 months
1/2/40-1/1/41	2005	65 years and 6 months
1/2/41-1/1/42	2006	65 years and 8 months
1/2/42-1/1/43	2007	65 years and 10 months
1/2/43-1/1/55	2008-2019	66 years
1/2/55-1/1/56	2020	66 years and 2 months
1/2/56-1/1/57	2021	66 years and 4 months
1/2/57-1/1/58	2022	66 years and 6 months
1/2/58-1/1/59	2023	66 years and 8 months
1/2/59-1/1/60	2024	66 years and 10 months
1/2/60 and later	2025	67 years

Source: Social Security Handbook, Section 723, 1997.

1928.

Benefit Adjustments for Early and Delayed Retirement

Insurance against earnings loss is one of many forms of insurance characterized by "moral hazard," a problem encountered whenever the insured can influence the probability that the insured event will occur. Without proper safeguards, a worker could collect benefits simply by ceasing to work. To counter moral hazard, the OASI system imposes on workers a minimum retirement age of 62, exacts benefit reductions for early retirement, and grants additional benefits for delayed retirement beyond the Normal Retirement Age (Meyer and Wolff, 1993).

A retirement insurance benefit is reduced by 5/9 of 1 percent (or 1/180) for each month of entitlement before age 65. Beginning with the year 2003, the retirement age increases gradually from age 65 until it reaches age 67 in the year 2025. An additional reduction applies to Primary Insurance Benefits based on the additional reduction period. Retirement insurance benefits are reduced by 5/12 of 1 percent for each month of reduction in excess of 36 months. This applies to individuals whose Normal Retirement Age is after age 65.

The Delayed Retirement Credit (DRC) increases the benefit amount for certain individuals who did not receive benefits for months after attainment of age 65. For a person attaining age 65 before 1982, this beneficiary receives an increase equal to 1/12 of 1 percent of the benefit for each increment month. For a person attaining age 65 after 1981 and before 1990, this beneficiary receives an increase equal 1/4 of 1 percent of the benefit for each increment month. For person attaining age 65 after 1989, this beneficiary's benefit amount is increased for each increment month at rate of 1/4 of 1 percent, plus 1/24 of 1 percent for each even-numbered year from 1990 through 2008 in which the beneficiary is NRA or older. Table 8 displays the Delayed Retirement Credit rates.

Table 9 presents scheduled changes in adjustments for early and delayed retirement. In short, for a worker attaining 65 in 1995, the reduction for starting his or her Social Security benefits at age 62 is 20 percent; at age 63, it is 13.33 percent; and at age 64, it is 6.67 percent. In contrast to the benefit reduction for early retirement, his or her Social

Table 8. Delayed Retirement Credit rates

Attain age 65	monthly percentage	Yearly percentage
Prior to 1982	1/12 of 1%	1%
1982-1989	1/4 of 1%	3%
1990-1991	7/24 of 1%	3.5%
1992-1993	1/3 of 1%	4%
1994-1995	3/8 of 1%	4.5%
1996-1997	5/12 of 1%	5%
1998-1999	11/24 of 1%	5.5%
2000-2001	1/2 of 1%	6%
2002-2003	13/24 of 1%	6.5%
2004-2005	7/12 of 1%	7%
2006-2007	5/8 of 1%	7.5%
2008 or later	2/3 of 1%	8%

Source: Social Security Handbook, Section 720, 1997.

Table 9. Scheduled changes in adjustments for early and delayed retirement

Birth date	Benefit as a percentage of PIA, if retirement age is						
	62	63	64	65	66	67	70
1/2/29-1/1/30	80.00%	86.67%	93.33%	100.%	104.5%	109.0%	122.5%
1/2/30-1/1/31	80.00	86.67	93.33	100.0	104.50	109.00	122.50
1/2/31-1/1/32	80.00	86.67	93.33	100.0	105.00	110.00	125.00
1/2/32-1/1/33	80.00	86.67	93.33	100.0	105.00	110.00	125.00
1/2/33-1/1/34	80.00	86.67	93.33	100.0	105.50	111.00	127.50
1/2/34-1/1/35	80.00	86.67	93.33	100.0	105.50	111.00	127.50
1/2/35-1/1/36	80.00	86.67	93.33	100.0	106.00	112.00	130.00
1/2/36-1/1/37	80.00	86.67	93.33	100.0	106.00	112.00	130.00
1/2/37-1/1/38	80.00	86.67	93.33	100.0	106.5	113.00	132.50
1/2/38-1/1/39	79.17	85.56	92.22	98.89	105.42	111.92	131.42
1/2/39-1/1/40	78.33	84.44	91.11	97.78	104.64	111.67	132.67
1/2/40-1/1/41	77.50	83.33	90.00	96.67	103.50	110.50	131.50
1/2/41-1/1/42	76.67	82.22	88.89	95.56	102.50	110.00	132.50
1/2/42-1/1/43	75.83	81.11	87.78	94.44	101.25	108.75	131.25
1/2/43-1/1/55	75.00	80.00	86.67	93.33	100.00	108.00	132.00
1/2/55-1/1/56	74.17	79.17	85.56	92.22	98.89	106.67	130.67
1/2/56-1/1/57	73.33	78.33	84.44	91.11	97.78	105.33	129.33
1/2/57-1/1/58	72.50	77.50	83.33	90.00	96.67	104.00	128.00
1/2/58-1/1/59	71.67	76.67	82.22	88.89	95.56	102.67	126.67
1/2/59-1/1/60	70.83	75.83	81.11	87.78	94.44	101.33	125.33
1/2/60 and later	70.00	75.00	80.00	86.67	93.33	100.00	124.00

Security benefits increases 9 percent if the worker retires at age 67; it is 22.5 percent if the worker retires at age 70.

Spousal and Survivors Benefits

A husband (or wife) of any insured worker is eligible, upon reaching age 65, to receive a "spousal benefit" equal to 50 percent of the worker's PIA. If the insured worker dies, a widowed spouse aged 65 or older may receive a "survivors benefit," which equals 100 percent of the worker's PIA. Spouses and survivors who retire before age 65 are eligible to receive a reduced benefit. The rules governing these benefits apply equally to males and females, but the vast majority of these supplementary benefits currently go to retired wives and widows (Steuerle and Bakija, 1994).

Wife's and husband's insurance benefits are reduced by 25/36 of 1 percent (or 1/144) for each month of entitlement before age 65. In addition, spouse's benefits are reduced by 5/12 of 1 percent for each month of reduction in excess of 36 months. This applies to individuals whose the NRA is after age 65. Table 10 displays scheduled changes in the NRA and adjustments for spousal benefits. For example, for a worker attaining 65 in 1995, his or her spouse begins collecting benefits at 64, the benefit amount would be about 45.84 percent (91.67%*0.5= 45.835%) of the worker's full benefit. At age 63, it would be about 41.67 percent (83.33%*0.5= 41.665%), and 37.5 percent (75%*0.5= 37.5%) at age 62.

The procedure is entirely different for the widow's and widower's benefit because the factor of 71.5 percent for age 60 remains fixed, and the factors for ages at claim between age 60 and the NRA are obtained by linear interpolation (Myers, 1993). For instance, when the

Table 10. Scheduled changes in the NRA and adjustments for spousal benefits

Birth date	the NRA for spouse's benefits	Benefit as a percentage of PIA, if retirement age is			
		62	63	64	65
Before 1/1/38	65 years	75.00%	83.33%	91.67%	100.0%
1/2/38-1/1/39	65 years and 2 months	74.17	81.94	90.28	98.61
1/2/39-1/1/40	65 years and 4 months	73.33	80.56	88.89	97.22
1/2/40-1/1/41	65 years and 6 months	72.50	79.17	87.50	95.83
1/2/41-1/1/42	65 years and 8 months	71.67	77.78	86.11	94.44
1/2/42-1/1/43	65 years and 10 months	70.83	76.39	84.72	93.06
1/2/43-1/1/55	66 years	70.00	75.00	83.33	91.67
1/2/55-1/1/56	66 years and 2 months	69.17	74.17	81.94	90.28
1/2/56-1/1/57	66 years and 4 months	68.33	73.33	80.56	88.89
1/2/57-1/1/58	66 years and 6 months	67.50	72.50	79.17	87.50
1/2/58-1/1/59	66 years and 8 months	66.67	71.67	77.78	86.11
1/2/59-1/1/60	66 years and 10 months	65.83	70.83	76.39	84.72
1/2/60 and later	67 years	65.00	70.00	75.00	83.33

NRA is 66, the factor for exact age 63 is 85.75 percent (three-sixths of the way between 71.5 percent and 100 percent). Similarly, when the NRA is 67, the factor for age 63 is 83.71 percent (three-sevenths of the way between 71.5 percent and 100 percent). In addition, the NRA for the widow's and widower's benefits is determined in a slightly different manner than that for retired workers and spouses (Myers, 1993). Table 11 presents scheduled changes in the NRA and adjustments for survivors benefits.

At retirement, many married and divorced workers become dually entitled to primary benefits. For example, a spouse is often entitled to a benefit based on his or her own earnings record, as well as for being the spouse or survivor of an insured worker. In this case, the spouse can receive an amount equal to the larger of the two available benefits.

Table 11. Scheduled changes in the NRA and adjustments for survivors benefits

Birth date	the NRA for the widow(er)'s benefits	Benefit as a percentage of PIA, if retirement age is			
		62	63	64	65
Before 1/1/41	65 years	82.90%	88.60%	94.30%	100.0%
1/2/40-1/1/41	65 years and 2 months	82.53	88.04	93.56	99.08
1/2/41-1/1/42	65 years and 4 months	82.19	87.53	92.88	98.22
1/2/42-1/1/43	65 years and 6 months	81.86	87.05	92.23	97.41
1/2/43-1/1/44	65 years and 8 months	81.56	86.59	91.62	96.65
1/2/44-1/1/45	65 years and 10 months	81.27	86.16	91.04	95.93
1/2/45-1/1/57	66 years	81.00	85.75	90.50	95.25
1/2/57-1/1/58	66 years and 2 months	80.74	85.36	89.99	94.61
1/2/58-1/1/59	66 years and 4 months	80.50	85.00	89.50	94.00
1/2/59-1/1/60	66 years and 6 months	80.27	84.65	89.04	93.42
1/2/60-1/1/61	66 years and 8 months	80.05	84.33	88.60	92.88
1/2/61-1/1/62	66 years and 10 months	79.84	84.01	88.18	92.35
1/2/62 and later	67 years	79.64	83.71	87.79	91.86

The maximum family benefit restriction is placed on the total amount of benefits that can be paid in any month to a worker and to his or her dependents or survivors based on that worker's earnings record. In 1997, the family maximum ranges from 150 percent of PIA for workers with low earnings to a maximum of 182.12 percent in midrange, decreasing to 175.03 percent of PIA for workers with high earnings. Benefit awards may exceed the family maximum if the worker qualifies for a delayed retirement credit since the credit is excluded from the maximum benefit amount (Meyer and Wolff, 1993).

Simulations

The Expected Consumer Price Index And Average Annual Interest Rate

The data quoted from 1996 OASDI Trustees Report, Table II.D1. are the estimated intermediate level changes for the CPI and the average annual interest rate. The Consumer Price Index is the annual average value for the calendar year of the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W). The average annual interest rate is the average of the nominal interest rates, which, in practice, are compounded semiannually, for special public-debt obligations issuable to the trust funds in each of the 12 months of the year. To adjust for the upward bias of the CPI, I cite an average of 1.1 percentage points reported by Advisory Commission to Study the CPI (1996) as an adjusted factor.

Cumulative rate of the unadjusted CPI (CPI-UA) is

$$(\text{CPI-UA})_t = \prod_{t=1}^{35} (1+A_t)$$

A_t = the percentage change CPI in year t

t =1 $\Rightarrow$ the CPI in 1996

⋮

t=35 $\Rightarrow$ the CPI in 2030

Cumulative rate of the adjusted CPI (CPI-A) is

$$(\text{CPI-A})_t = \prod_{t=1}^{35} (1+A_t-1.1\%)$$

A_t = the percentage change CPI in year t

$t = 1 \Rightarrow$ the CPI in 1996

⋮

$t = 35 \Rightarrow$ the CPI in 2030

Cumulative rate of average annual interest rate (IR-C) is

$$(IR\text{-}C)_t = \prod_{t=1}^{35} (1+B_t)$$

B_t = the average annual interest rate in year t

$t = 1 \Rightarrow$ the average annual interest rate in 1996

⋮

$t = 35 \Rightarrow$ the average annual interest rate in 2030

Table 12 displays the calculation results.

Survival Probability

A unique set of survival probabilities is used for each sex and cohort, based on mortality tables published by the Social Security Administration in 1997; see the totals in Table 4. Unfortunately, mortality tables that differentiate among people with respect to socioeconomic differentials are not available for each cohort although there is evidence that socioeconomic differentials have a significant effect on life expectancy. Survival probability, year t, is given by

$$S_t = \prod_{t=0}^{35} (1-d_t)$$

d_t = the probability of death rate in age t

$t = 0 \Rightarrow$ the probability of death rate in age 65

⋮

$t = 35 \Rightarrow$ the probability of death rate in age 100

Table 12. The calculation results of CPI, CPI-UA, CPI-A, IR, and IR-C

Year	CPI	CPI-UA	CPI-C	CPI-A	IR	IR-C
1995	--------	--------	--------	--------	--------	--------
1996	2.90%	1.02900000	1.80%	1.01800000	6.40%	1.064000000
1997	3.20%	1.06192800	2.10%	1.03937800	6.50%	1.133160000
1998	3.20%	1.09590970	2.10%	1.06120494	6.50%	1.206815400
1999	3.40%	1.13317063	2.30%	1.08561265	6.50%	1.285258401
2000	3.50%	1.17283160	2.40%	1.11166736	6.50%	1.368800197
2001	3.60%	1.21505354	2.50%	1.13945904	6.50%	1.457772210
2002	3.90%	1.26244062	2.80%	1.17136389	6.50%	1.552527404
2003	4.00%	1.31293825	2.90%	1.20533345	6.50%	1.653441685
2004	4.00%	1.36545578	2.90%	1.24028811	6.50%	1.760915394
2005	4.00%	1.42007401	2.90%	1.27625647	6.40%	1.873613979
2006	4.00%	1.47687697	2.90%	1.31326791	6.40%	1.993525274
2007	4.00%	1.53595205	2.90%	1.35135268	6.40%	2.121110892
2008	4.00%	1.59739013	2.90%	1.39054190	6.40%	2.256861989
2009	4.00%	1.66128574	2.90%	1.43086762	6.40%	2.401301156
2010	4.00%	1.72773716	2.90%	1.47236278	6.30%	2.552583129
2011	4.00%	1.79684665	2.90%	1.51506130	6.30%	2.713395866
2012	4.00%	1.86872052	2.90%	1.55899808	6.30%	2.884339806
2013	4.00%	1.94346934	2.90%	1.60420902	6.30%	3.066053213
2014	4.00%	2.02120811	2.90%	1.65073109	6.30%	3.259214566
2015	4.00%	2.10205644	2.90%	1.69860229	6.30%	3.464545083
2016	4.00%	2.18613869	2.90%	1.74786175	6.30%	3.682811424
2017	4.00%	2.27358424	2.90%	1.79854974	6.30%	3.914828543
2018	4.00%	2.36452761	2.90%	1.85070769	6.30%	4.161462742
2019	4.00%	2.45910872	2.90%	1.90437821	6.30%	4.423634894
2020	4.00%	2.55747306	2.90%	1.95960518	6.30%	4.702323893
2021	4.00%	2.65977199	2.90%	2.01643373	6.30%	4.998570298
2022	4.00%	2.76616287	2.90%	2.07491031	6.30%	5.313480227
2023	4.00%	2.87680938	2.90%	2.13508270	6.30%	5.648229481
2024	4.00%	2.99188176	2.90%	2.19700010	6.30%	6.004067938
2025	4.00%	3.11155703	2.90%	2.26071311	6.30%	6.382324218
2026	4.00%	3.23601931	2.90%	2.32627379	6.30%	6.784410644
2027	4.00%	3.36546008	2.90%	2.39373573	6.30%	7.211828515
2028	4.00%	3.50007848	2.90%	2.46315406	6.30%	7.666173711
2029	4.00%	3.64008162	2.90%	2.53458553	6.30%	8.149142655
2030	4.00%	3.78568489	2.90%	2.60808851	6.30%	8.662538642

Source: 1996 OASDI Trustees Report, Table II.D1.

Note: $(CPI)_t$ = the estimated CPI in intermediate level

$(CPI\text{-}C)_t = (CPI)_t - 1.1\%$

$(CPI\text{-}UA)_t$ = cumulative rate of the unadjusted CPI

$(CPI\text{-}A)_t$ = cumulative rate of the adjusted CPI

$(IR)_t$ = the estimated average annual interest rate in intermediate level

$(IR\text{-}C)_t$ = cumulative rate of average annual interest rate

Results

To see how the system treats people of different income level, I examine three levels: low earnings (LE), average earnings (AE), and high earnings (HE). To illustrate the effects of the COLA, I use the CPI-UA and CPI-A to calculate annual benefit for each income level.

Table 13 demonstrates how the expected annual benefit varies for retirement workers turning 65 in 1995. For example, in 2010, for an individual with low earnings, his or her expected annual benefit will be $10,781.08 with the CPI-UA and $9,187.54 with the CPI-A, respectively.

The Social Security beneficiaries receive their benefits paid by SSA monthly. Because it is very difficult to get the mortality rate by month for each age, I use the expected annual benefit instead of the expected monthly benefit to examine the effect of sex differential in mortality. Table 14 and Table 15 present the expected annual benefit values for retirement workers turning 65 in 1995 with male and female survival probabilities by age. For low-earning males surviving to age 80, their expected annual benefit will be $5,040.63 with the CPI-UA and $4,295.58 with the CPI-A, respectively. The expected annual benefit will be reduced by $745.05. For low-earning females surviving to age 80, their expected annual benefit will be $6,855.26 with the CPI-UA and $5,841.99 with the CPI-A, respectively. The expected annual benefit will be reduced by $1013.27. Due to different survival probabilities between males and females, the differences in the expected annual benefit are $1,814.63 with the CPI-UA and $1,546.41 with the CPI-A.

Table 13. Expected annual benefit for retirement workers turning 65 in 1995

Year	LE	LE-65	LE-65C	AE	AE-65	AE-65C	HE	HE-65	HE-65C
1995	6,240.00	6,240.00	6,240.00	10,296.00	10,296.00	10,296.00	13,176.00	13,176.00	13,176.00
1996	6,240.00	6,420.96	6,352.32	10,296.00	10,594.58	10,481.33	13,176.00	13,558.10	13,413.17
1997	6,240.00	6,626.43	6,485.72	10,296.00	10,933.61	10,701.44	13,176.00	13,991.96	13,694.84
1998	6,240.00	6,838.48	6,621.92	10,296.00	11,283.49	10,926.17	13,176.00	14,439.71	13,982.44
1999	6,240.00	7,070.98	6,774.22	10,296.00	11,667.12	11,177.47	13,176.00	14,930.66	14,304.03
2000	6,240.00	7,318.47	6,936.80	10,296.00	12,075.47	11,445.73	13,176.00	15,453.23	14,647.33
2001	6,240.00	7,581.93	7,110.22	10,296.00	12,510.19	11,731.87	13,176.00	16,009.55	15,013.51
2002	6,240.00	7,877.63	7,309.31	10,296.00	12,998.09	12,060.36	13,176.00	16,633.92	15,433.89
2003	6,240.00	8,192.73	7,521.28	10,296.00	13,518.01	12,410.11	13,176.00	17,299.27	15,881.47
2004	6,240.00	8,520.44	7,739.40	10,296.00	14,058.73	12,770.01	13,176.00	17,991.25	16,342.04
2005	6,240.00	8,861.26	7,963.84	10,296.00	14,621.08	13,140.34	13,176.00	18,710.90	16,815.96
2006	6,240.00	9,215.71	8,194.79	10,296.00	15,205.93	13,521.41	13,176.00	19,459.33	17,303.62
2007	6,240.00	9,584.34	8,432.44	10,296.00	15,814.16	13,913.53	13,176.00	20,237.70	17,805.42
2008	6,240.00	9,967.71	8,676.98	10,296.00	16,446.73	14,317.02	13,176.00	21,047.21	18,321.78
2009	6,240.00	10,366.42	8,928.61	10,296.00	17,104.60	14,732.21	13,176.00	21,889.10	18,853.11
2010	6,240.00	10,781.08	9,187.54	10,296.00	17,788.78	15,159.45	13,176.00	22,764.66	19,399.85
2011	6,240.00	11,212.32	9,453.98	10,296.00	18,500.33	15,599.07	13,176.00	23,675.25	19,962.45
2012	6,240.00	11,660.82	9,728.15	10,296.00	19,240.35	16,051.44	13,176.00	24,622.26	20,541.36
2013	6,240.00	12,127.25	10,010.26	10,296.00	20,009.96	16,516.94	13,176.00	25,607.15	21,137.06
2014	6,240.00	12,612.34	10,300.56	10,296.00	20,810.36	16,995.93	13,176.00	26,631.44	21,750.03
2015	6,240.00	13,116.83	10,599.28	10,296.00	21,642.77	17,488.81	13,176.00	27,696.70	22,380.78
2016	6,240.00	13,641.51	10,906.66	10,296.00	22,508.48	17,995.98	13,176.00	28,804.56	23,029.83
2017	6,240.00	14,187.17	11,222.95	10,296.00	23,408.82	18,517.87	13,176.00	29,956.75	23,697.69
2018	6,240.00	14,754.65	11,548.42	10,296.00	24,345.18	19,054.89	13,176.00	31,155.02	24,384.92
2019	6,240.00	15,344.84	11,883.32	10,296.00	25,318.98	19,607.48	13,176.00	32,401.22	25,092.09
2020	6,240.00	15,958.63	12,227.94	10,296.00	26,331.74	20,176.09	13,176.00	33,697.27	25,819.76
2021	6,240.00	16,596.98	12,582.55	10,296.00	27,385.01	20,761.20	13,176.00	35,045.16	26,568.53
2022	6,240.00	17,260.86	12,947.44	10,296.00	28,480.41	21,363.28	13,176.00	36,446.96	27,339.02
2023	6,240.00	17,951.29	13,322.92	10,296.00	29,619.63	21,982.81	13,176.00	37,904.84	28,131.85
2024	6,240.00	18,669.34	13,709.28	10,296.00	30,804.41	22,620.31	13,176.00	39,421.03	28,947.67
2025	6,240.00	19,416.12	14,106.85	10,296.00	32,036.59	23,276.30	13,176.00	40,997.88	29,787.16
2026	6,240.00	20,192.76	14,515.95	10,296.00	33,318.05	23,951.31	13,176.00	42,637.79	30,650.98
2027	6,240.00	21,000.47	14,936.91	10,296.00	34,650.78	24,645.90	13,176.00	44,343.30	31,539.86
2028	6,240.00	21,840.49	15,370.08	10,296.00	36,036.81	25,360.63	13,176.00	46,117.03	32,454.52
2029	6,240.00	22,714.11	15,815.81	10,296.00	37,478.28	26,096.09	13,176.00	47,961.72	33,395.70
2030	6,240.00	23,622.67	16,274.47	10,296.00	38,977.41	26,852.88	13,176.00	49,880.18	34,364.17

Note: 1. $(LE)_t = 520 * 12 = 6240$

2. $(LE\text{-}65)_t = (LE)_t * (CPI\text{-}UA)_t$

3. $(LE\text{-}65C)_t = (LE)_t * (CPI\text{-}A)_t$

4. $(AE)_t = 858 * 12 = 10{,}296$

5. $(AE\text{-}65)_t = (AE)_t * (CPI\text{-}UA)_t$

6. $(AE\text{-}65C)_t = (AE)_t * (CPI\text{-}A)_t$

7. $(HE)_t = 1{,}098 * 12 = 13{,}176$

8. $(HE\text{-}65)_t = (HE)_t * (CPI\text{-}UA)_t$

9. $(HE\text{-}65C)_t = (HE)_t * (CPI\text{-}A)_t$

Table 14. Expected annual benefit for retirement workers turning 65 in 1995 with male survival probability

Year	Male Survival probability	LE-M	LE65-M	LE65C-M	AE-M	Male AE65-M	AE65C-M	HE-M	HE65-M	HE65C-M
1995	0.976338	6,092.35	6,092.35	6,092.35	10,052.38	10,052.38	10,052.38	12,864.23	12,864.23	12,864.23
1996	0.950945401	5,933.90	6,105.98	6,040.71	9,790.93	10,074.87	9,967.17	12,529.66	12,893.02	12,755.19
1997	0.924053616	5,766.09	6,123.18	5,993.15	9,514.06	10,103.24	9,888.70	12,175.33	12,929.32	12,654.77
1998	0.895964234	5,590.82	6,127.03	5,933.00	9,224.85	10,109.60	9,789.45	11,805.22	12,937.46	12,527.76
1999	0.866855252	5,409.18	6,129.52	5,872.27	8,925.14	10,113.71	9,689.25	11,421.68	12,942.72	12,399.53
2000	0.836698225	5,221.00	6,123.35	5,804.01	8,614.64	10,103.53	9,576.62	11,024.34	12,929.69	12,255.39
2001	0.805359693	5,025.44	6,106.18	5,726.29	8,291.98	10,075.20	9,448.38	10,611.42	12,893.44	12,091.28
2002	0.772763565	4,822.04	6,087.55	5,648.37	7,956.37	10,044.45	9,319.81	10,181.93	12,854.09	11,926.75
2003	0.738828426	4,610.29	6,053.03	5,556.94	7,606.98	9,987.49	9,168.94	9,734.80	12,781.20	11,733.68
2004	0.70351686	4,389.95	5,994.28	5,444.80	7,243.41	9,890.56	8,983.91	9,269.54	12,657.14	11,496.90
2005	0.666853782	4,161.17	5,909.17	5,310.72	6,865.93	9,750.12	8,762.68	8,786.47	12,477.43	11,213.78
2006	0.628920472	3,924.46	5,795.95	5,153.87	6,475.37	9,563.32	8,503.89	8,286.66	12,238.37	10,882.60
2007	0.589831807	3,680.55	5,653.15	4,973.72	6,072.91	9,327.70	8,206.64	7,771.62	11,936.84	10,502.20
2008	0.549755095	3,430.47	5,479.80	4,770.21	5,660.28	9,041.67	7,870.85	7,243.57	11,570.81	10,072.49
2009	0.508906642	3,175.58	5,275.54	4,543.83	5,239.70	8,704.64	7,497.32	6,705.35	11,139.51	9,594.47
2010	0.467544237	2,917.48	5,040.63	4,295.58	4,813.84	8,317.04	7,087.71	6,160.36	10,643.49	9,070.29
2011	0.425984697	2,658.14	4,776.28	4,027.25	4,385.94	7,880.86	6,644.97	5,612.77	10,085.29	8,503.70
2012	0.384608377	2,399.96	4,484.85	3,741.53	3,959.93	7,400.00	6,173.52	5,067.60	9,469.93	7,900.38
2013	0.343833351	2,145.52	4,169.75	3,441.86	3,540.11	6,880.09	5,679.07	4,530.35	8,804.59	7,267.63
2014	0.304091373	1,897.53	3,835.30	3,132.31	3,130.92	6,328.25	5,168.31	4,006.71	8,098.39	6,614.00
2015	0.265812655	1,658.67	3,486.62	2,817.42	2,736.81	5,752.92	4,648.75	3,502.35	7,362.13	5,949.10
2016	0.229413599	1,431.54	3,129.55	2,502.14	2,362.04	5,163.75	4,128.52	3,022.75	6,608.16	5,283.36
2017	0.195282362	1,218.56	2,770.50	2,191.64	2,010.63	4,571.33	3,616.21	2,573.04	5,850.02	4,627.74
2018	0.16376164	1,021.87	2,416.25	1,891.19	1,686.09	3,986.81	3,120.46	2,157.72	5,102.00	3,993.32
2019	0.135129883	843.21	2,073.55	1,605.79	1,391.30	3,421.35	2,649.56	1,780.47	4,378.37	3,390.69
2020	0.109583984	683.80	1,748.81	1,339.99	1,128.28	2,885.54	2,210.98	1,443.88	3,692.68	2,829.43
2021	0.087226331	544.29	1,447.69	1,097.53	898.08	2,388.69	1,810.92	1,149.29	3,056.86	2,317.48
2022	0.068058781	424.69	1,174.75	881.19	700.73	1,938.34	1,453.96	896.74	2,480.54	1,860.66
2023	0.051984045	324.38	933.18	692.58	535.23	1,539.75	1,142.76	684.94	1,970.45	1,462.41
2024	0.038815083	242.21	724.65	532.13	399.64	1,195.68	878.01	511.43	1,530.13	1,123.61
2025	0.028313041	176.67	549.73	399.41	291.51	907.05	659.02	373.05	1,160.77	843.36
2026	0.020165794	125.83	407.20	292.73	207.63	671.89	483.00	265.70	859.82	618.10
2027	0.01402045	87.49	294.44	209.42	144.35	485.82	345.55	184.73	621.71	442.20
2028	0.009514936	59.37	207.81	146.25	97.97	342.89	241.30	125.37	438.80	308.80
2029	0.006304397	39.34	143.20	99.71	64.91	236.28	164.52	83.07	302.37	210.54
2030	0.004070799	25.40	96.16	66.25	41.91	158.67	109.31	53.64	203.05	139.89

Note: 1. $(LE\text{-}M)_t = (LE)_t * S_t$ - male

2. $(LE65\text{-}M)_t = (LE\text{-}65)_t * S_t$ - male

3. $(LE65C\text{-}M)_t = (LE\text{-}65C)_t * S_t$ - male

4. $(AE\text{-}M)_t = (AE)_t * S_t$ - male

5. $(AE65\text{-}M)_t = (AE\text{-}65)_t * S_t$ - male

6. $(AE65C\text{-}M)_t = (AE\text{-}65C)_t * S_t$ - male

7. $(HE\text{-}M)_t = (HE)_t * S_t$ - male

8. $(HE65\text{-}M)_t = (HE\text{-}65)_t * S_t$ - male

9. $(HE65C\text{-}M)_t = (HE\text{-}65C)_t * S_t$ - male

Table 15. Expected annual benefit for retirement workers turning 65 in 1995 with female survival probability

Year	Female Survival probability	LE-F	LE65-F	LE65C-F	AE-F	Female AE65-F	AE65C-F	HE-F	HE65-F	HE65C-F
1995	0.986343	6,154.78	6,154.78	6,154.78	10,155.39	10,155.39	10,155.39	12,996.06	12,996.06	12,996.06
1996	0.971532074	6,062.36	6,238.17	6,171.48	10,002.89	10,292.98	10,182.95	12,800.91	13,172.13	13,031.32
1997	0.955645581	5,963.23	6,332.52	6,198.05	9,839.33	10,448.66	10,226.78	12,591.59	13,371.36	13,087.42
1998	0.938805195	5,858.14	6,420.00	6,216.69	9,665.94	10,593.00	10,257.54	12,369.70	13,556.07	13,126.78
1999	0.921059899	5,747.41	6,512.80	6,239.47	9,483.23	10,746.12	10,295.12	12,135.89	13,752.03	13,174.87
2000	0.902324619	5,630.51	6,603.63	6,259.25	9,290.33	10,896.00	10,327.76	11,889.03	13,943.83	13,216.65
2001	0.882449115	5,506.48	6,690.67	6,274.41	9,085.70	11,039.61	10,352.78	11,627.15	14,127.61	13,248.66
2002	0.861321518	5,374.65	6,785.17	6,295.67	8,868.17	11,195.53	10,387.85	11,348.77	14,327.15	13,293.54
2003	0.838822078	5,234.25	6,872.25	6,309.02	8,636.51	11,339.21	10,409.88	11,052.32	14,511.01	13,321.73
2004	0.814835121	5,084.57	6,942.76	6,306.33	8,389.54	11,455.55	10,405.45	10,736.27	14,659.90	13,316.07
2005	0.78921589	4,924.71	6,993.45	6,285.19	8,125.77	11,539.19	10,370.56	10,398.71	14,766.94	13,271.42
2006	0.761878241	4,754.12	7,021.25	6,243.43	7,844.30	11,585.06	10,301.67	10,038.51	14,825.64	13,183.25
2007	0.732834681	4,572.89	7,023.74	6,179.58	7,545.27	11,589.17	10,196.32	9,655.83	14,830.89	13,048.43
2008	0.702142099	4,381.37	6,998.75	6,092.47	7,229.26	11,547.94	10,052.58	9,251.42	14,778.13	12,864.49
2009	0.669830924	4,179.74	6,943.75	5,980.66	6,896.58	11,457.19	9,868.09	8,825.69	14,662.00	12,628.40
2010	0.635859778	3,967.77	6,855.26	5,841.99	6,546.81	11,311.17	9,639.28	8,378.09	14,475.13	12,335.59
2011	0.600216023	3,745.35	6,729.82	5,674.43	6,179.82	11,104.20	9,362.81	7,908.45	14,210.27	11,981.78
2012	0.563009232	3,513.18	6,565.15	5,477.04	5,796.74	10,832.49	9,037.11	7,418.21	13,862.56	11,564.97
2013	0.524413823	3,272.34	6,359.70	5,249.52	5,399.36	10,493.50	8,661.71	6,909.68	13,428.74	11,084.57
2014	0.484650669	3,024.22	6,112.58	4,992.17	4,989.96	10,085.75	8,237.09	6,385.76	12,906.94	10,541.17
2015	0.443989932	2,770.50	5,823.74	4,705.97	4,571.32	9,609.17	7,764.86	5,850.01	12,297.05	9,936.84
2016	0.402764579	2,513.25	5,494.32	4,392.82	4,146.86	9,065.62	7,248.15	5,306.83	11,601.46	9,275.60
2017	0.361381324	2,255.02	5,126.98	4,055.76	3,720.78	8,459.51	6,692.01	4,761.56	10,825.81	8,563.90
2018	0.320318287	1,998.79	4,726.18	3,699.17	3,298.00	7,798.21	6,103.63	4,220.51	9,979.52	7,810.94
2019	0.280115139	1,747.92	4,298.32	3,328.70	2,884.07	7,092.23	5,492.35	3,690.80	9,076.07	7,028.67
2020	0.241345523	1,506.00	3,851.54	2,951.16	2,484.89	6,355.05	4,869.41	3,179.97	8,132.68	6,231.48
2021	0.204584979	1,276.61	3,395.49	2,574.20	2,106.41	5,602.56	4,247.43	2,695.61	7,169.71	5,435.52
2022	0.170372233	1,063.12	2,940.77	2,205.88	1,754.15	4,852.27	3,639.71	2,244.82	6,209.55	4,657.81
2023	0.139170263	868.42	2,498.29	1,854.15	1,432.90	4,122.17	3,059.35	1,833.71	5,275.23	3,915.12
2024	0.111333009	694.72	2,078.51	1,526.30	1,146.28	3,429.55	2,518.39	1,466.92	4,388.86	3,222.83
2025	0.087154263	543.84	1,692.20	1,229.47	897.34	2,792.13	2,028.63	1,148.34	3,573.14	2,596.08
2026	0.066725391	416.37	1,347.37	968.58	687.00	2,223.16	1,598.16	879.17	2,845.02	2,045.20
2027	0.049945223	311.66	1,048.87	746.03	514.24	1,730.64	1,230.95	658.08	2,214.74	1,575.27
2028	0.036550463	228.07	798.28	561.78	376.32	1,317.16	926.94	481.59	1,685.60	1,186.23
2029	0.026159898	163.24	594.20	413.74	269.34	980.43	682.67	344.68	1,254.67	873.63
2030	0.018276953	114.05	431.75	297.45	188.18	712.39	490.79	240.82	911.66	628.07

Note: 1. $(LE\text{-}F)_t = (LE)_t * S_t$ - female
2. $(LE65\text{-}F)_t = (LE\text{-}65)_t * S_t$ - female
3. $(LE65C\text{-}F)_t = (LE\text{-}65C)_t * S_t$ - female
4. $(AE\text{-}F)_t = (AE)_t * S_t$ - female
5. $(AE65\text{-}F)_t = (AE\text{-}65)_t * S_t$ - female
6. $(AE65C\text{-}F)_t = (AE\text{-}65C)_t * S_t$ - female
7. $(HE\text{-}F)_t = (HE)_t * S_t$ - female
8. $(HE65\text{-}F)_t = (HE\text{-}65)_t * S_t$ - female
9. $(HE65C\text{-}F)_t = (HE\text{-}65C)_t * S_t$ - female

Table 16 reveals the present value of the expected annual benefit stream for a retirement worker turning 65 in 1995. With the CPI-UA and IR-C, for an individual with average earnings, his or her expected annual benefit will be $6,968.93 in 2010. With the CPI-A and IR-C, it will be reduced to $5,938.87.

Table 17 and Table 18 show present value of the expected annual benefit stream for retirement workers turning 65 in 1995 adjusted for male and female survival probabilities by age, discounted by the IR-C. For males age 80 with average earnings, their present value of the expected annual benefit will be $3,258.28 with the CPI-UA and IR-C. It will be $4,431.26 for females. With the CPI-A and IR-C, for males surviving age 80 with average earnings, their present value of the expected annual benefit will be $2,776.68. It will be $3,776.29 for females. After using CPI-A instead of CPI-UA, the present value of the expected annual benefit will be reduced by $481.60 for males and by $654.97 for females.

From table 19, if the CPI is reduced by 1.1 percentage points to correct for bias, the percentage difference in absolute annual benefit level will be larger year by year, regardless of different earnings levels. That is, the range of reduction in absolute annual benefit for the retirement workers turning 65 in 1995 will be wider and wider over time. For example, the difference in absolute annual benefit level is only 1.07 percent in 1996 in contrast to 19.19 percent in 2015. Because more than one-third of the elderly depend on Social Security for 90 percent or more their annual income (Melcher), these results imply that the probability of a retirement worker turning 65 in 1995 falling into poverty will increase significantly year by year after the CPI is adjusted for bias. This issue is noteworthy. Coe (1988), examined the poverty experience of persons in their elderly years, utilizing data from the Michigan Panel

Table 16. Present value of the expected annual benefit stream for retirement workers turning 65 in 1995

Year	PV-LE	PV-LE65	PV-LE65C	PV-AE	PV-AE65	PV-AE65C	PV-HE	PV-HE65	PV-HE65C
1995	6,240.00	6,240.00	6,240.00	10,296.00	10,296.00	10,296.00	13,176.00	13,176.00	13,176.00
1996	5,864.66	6,034.74	5,970.23	9,676.69	9,957.32	9,850.87	12,383.46	12,742.58	12,606.36
1997	5,506.72	5,847.74	5,723.57	9,086.10	9,648.78	9,443.89	11,627.66	12,347.74	12,085.53
1998	5,170.63	5,666.55	5,487.10	8,531.55	9,349.80	9,053.72	10,917.99	11,965.13	11,586.23
1999	4,855.05	5,501.61	5,270.71	8,010.84	9,077.65	8,696.67	10,251.63	11,616.85	11,129.30
2000	4,558.74	5,346.63	5,067.80	7,521.92	8,821.94	8,361.87	9,625.95	11,289.62	10,700.85
2001	4,280.50	5,201.04	4,877.46	7,062.83	8,581.72	8,047.81	9,038.45	10,982.20	10,298.94
2002	4,019.25	5,074.07	4,708.01	6,631.77	8,372.21	7,768.21	8,486.81	10,714.09	9,941.14
2003	3,773.95	4,954.96	4,548.86	6,227.01	8,175.68	7,505.62	7,968.83	10,462.59	9,605.10
2004	3,543.61	4,838.64	4,395.10	5,846.96	7,983.76	7,251.91	7,482.47	10,216.98	9,280.42
2005	3,330.46	4,729.50	4,250.52	5,495.26	7,803.68	7,013.36	7,032.40	9,986.53	8,975.14
2006	3,130.13	4,622.82	4,110.70	5,164.72	7,627.66	6,782.66	6,609.40	9,761.27	8,679.91
2007	2,941.85	4,518.55	3,975.48	4,854.06	7,455.60	6,559.55	6,211.84	9,541.09	8,394.39
2008	2,764.90	4,416.63	3,844.71	4,562.09	7,287.43	6,343.77	5,838.19	9,325.87	8,118.25
2009	2,598.59	4,317.00	3,718.24	4,287.68	7,123.05	6,135.10	5,487.03	9,115.52	7,851.21
2010	2,444.58	4,223.60	3,599.31	4,033.56	6,968.93	5,938.87	5,161.83	8,918.29	7,600.09
2011	2,299.70	4,132.21	3,484.19	3,794.51	6,818.15	5,748.91	4,855.91	8,725.32	7,357.00
2012	2,163.41	4,042.80	3,372.75	3,569.62	6,670.62	5,565.03	4,568.12	8,536.53	7,121.68
2013	2,035.19	3,955.33	3,264.87	3,358.06	6,526.29	5,387.04	4,297.38	8,351.83	6,893.90
2014	1,914.57	3,869.75	3,160.44	3,159.04	6,385.08	5,214.73	4,042.69	8,171.12	6,673.40
2015	1,801.10	3,786.02	3,059.36	2,971.82	6,246.93	5,047.94	3,803.10	7,994.32	6,459.95
2016	1,694.36	3,704.10	2,961.50	2,795.69	6,111.77	4,886.48	3,577.70	7,821.35	6,253.33
2017	1,593.94	3,623.96	2,866.78	2,630.00	5,979.53	4,730.19	3,365.66	7,652.12	6,053.32
2018	1,499.47	3,545.54	2,775.09	2,474.13	5,850.15	4,578.89	3,166.19	7,486.55	5,859.70
2019	1,410.60	3,468.83	2,686.32	2,327.50	5,723.57	4,432.44	2,978.55	7,324.57	5,672.28
2020	1,327.00	3,393.78	2,600.40	2,189.56	5,599.73	4,290.66	2,802.02	7,166.09	5,490.85
2021	1,248.36	3,320.34	2,517.23	2,059.79	5,478.57	4,153.43	2,635.95	7,011.04	5,315.23
2022	1,174.37	3,248.50	2,436.72	1,937.71	5,360.03	4,020.58	2,479.73	6,859.34	5,145.22
2023	1,104.77	3,178.22	2,358.78	1,822.87	5,244.06	3,891.98	2,332.77	6,710.92	4,980.65
2024	1,039.30	3,109.45	2,283.33	1,714.84	5,130.59	3,767.50	2,194.51	6,565.72	4,821.34
2025	977.70	3,042.17	2,210.30	1,613.21	5,019.58	3,646.99	2,064.45	6,423.66	4,667.13
2026	919.76	2,976.35	2,139.60	1,517.60	4,910.97	3,530.35	1,942.10	6,284.67	4,517.85
2027	865.25	2,911.95	2,071.17	1,427.65	4,804.71	3,417.43	1,827.00	6,148.69	4,373.35
2028	813.97	2,848.94	2,004.92	1,343.04	4,700.76	3,308.12	1,718.72	6,015.65	4,233.47
2029	765.72	2,787.30	1,940.79	1,263.45	4,599.05	3,202.31	1,616.86	5,885.49	4,098.06
2030	720.34	2,726.99	1,878.72	1,188.57	4,499.54	3,099.89	1,521.03	5,758.15	3,966.99
	92,392.53	149,206.60	127,861.07	152,447.67	246,190.89	210,970.76	195,090.38	315,055.48	269,983.56

Note: 1. $(PV\text{-}LE)_t = (LE)_t / (IR\text{-}C)_t$

2. $(PV\text{-}LE65)_t = (LE\text{-}65)_t / (IR\text{-}C)_t$

3. $(PV\text{-}LE65C)_t = (LE\text{-}65C)_t / (IR\text{-}C)_t$

4. $(PV\text{-}AE)_t = (AE)_t / (IR\text{-}C)_t$

5. $(PV\text{-}AE65)_t = (AE\text{-}65)_t / (IR\text{-}C)_t$

6. $(PV\text{-}AE65C)_t = (AE\text{-}65C)_t / (IR\text{-}C)_t$

7. $(PV\text{-}HE)_t = (HE)_t / (IR\text{-}C)_t$

8. $(PV\text{-}HE65)_t = (HE\text{-}65)_t / (IR\text{-}C)_t$

9. $(PV\text{-}HE65C)_t = (HE\text{-}65C)_t / (IR\text{-}C)_t$

Table 17. Present value of expected annual benefit for retirement workers turning 65 in 1995 with male survival probability

	Male								
Year	PV-LE-M	PV-LE65-M	PV-LE65C-M	PV-AE-M	PV-AE65-M	PV-AE65C-M	PV-HE-M	PV-HE65-M	PV-HE65C-M
1995	6,092.35	6,092.35	6,092.35	10,052.38	10,052.38	10,052.38	12,864.23	12,864.23	12,864.23
1996	5,576.97	5,738.71	5,677.36	9,202.01	9,468.86	9,367.64	11,775.99	12,117.50	11,987.96
1997	5,088.51	5,403.63	5,288.88	8,396.04	8,915.99	8,726.66	10,744.58	11,409.97	11,167.68
1998	4,632.70	5,077.02	4,916.25	7,643.96	8,377.09	8,111.81	9,782.13	10,720.33	10,380.84
1999	4,208.63	4,769.10	4,568.94	6,944.24	7,869.01	7,538.75	8,886.68	10,070.13	9,647.50
2000	3,814.29	4,473.52	4,240.22	6,293.57	7,381.30	6,996.36	8,054.01	9,446.00	8,953.38
2001	3,447.35	4,188.71	3,928.11	5,688.12	6,911.37	6,481.38	7,279.20	8,844.62	8,294.35
2002	3,105.93	3,921.05	3,638.18	5,124.79	6,469.74	6,002.99	6,558.30	8,279.46	7,682.15
2003	2,788.30	3,660.86	3,360.83	4,600.69	6,040.43	5,545.37	5,887.60	7,730.06	7,096.52
2004	2,492.99	3,404.07	3,092.03	4,113.43	5,616.71	5,101.84	5,264.05	7,187.82	6,528.93
2005	2,220.93	3,153.89	2,834.48	3,664.54	5,203.91	4,676.89	4,689.58	6,659.55	5,985.11
2006	1,968.60	2,907.39	2,585.31	3,248.20	4,797.19	4,265.75	4,156.79	6,139.06	5,458.97
2007	1,735.20	2,665.18	2,344.87	2,863.08	4,397.55	3,869.03	3,663.94	5,627.64	4,951.28
2008	1,520.02	2,428.06	2,113.65	2,508.03	4,006.30	3,487.52	3,209.58	5,126.95	4,463.05
2009	1,322.44	2,196.95	1,892.24	2,182.03	3,624.97	3,122.19	2,792.38	4,638.95	3,995.53
2010	1,142.95	1,974.72	1,682.84	1,885.87	3,258.28	2,776.68	2,413.38	4,169.69	3,553.38
2011	979.64	1,760.26	1,484.21	1,616.40	2,904.43	2,448.95	2,068.54	3,716.85	3,133.97
2012	832.06	1,554.90	1,297.19	1,372.91	2,565.58	2,140.36	1,756.94	3,283.22	2,739.06
2013	699.77	1,359.97	1,122.57	1,154.61	2,243.96	1,852.24	1,477.58	2,871.64	2,370.35
2014	582.20	1,176.76	961.06	960.64	1,941.65	1,585.75	1,229.35	2,484.77	2,029.32
2015	478.76	1,006.37	813.22	789.95	1,660.51	1,341.81	1,010.91	2,124.99	1,717.14
2016	388.71	849.77	679.41	641.37	1,402.12	1,121.02	820.77	1,794.32	1,434.60
2017	311.27	707.69	559.83	513.59	1,167.70	923.72	657.25	1,494.32	1,182.11
2018	245.56	580.62	454.45	405.17	958.03	749.85	518.50	1,226.01	959.59
2019	190.61	468.74	363.00	314.51	773.43	598.95	402.49	989.77	766.49
2020	145.42	371.90	284.96	239.94	613.64	470.19	307.06	785.29	601.71
2021	108.89	289.62	219.57	179.67	477.88	362.29	229.92	611.55	463.63
2022	79.93	221.09	165.84	131.88	364.80	273.64	168.77	466.84	350.18
2023	57.43	165.22	122.62	94.76	272.61	202.32	121.27	348.86	258.91
2024	40.34	120.69	88.63	66.56	199.14	146.24	85.18	254.85	187.14
2025	27.68	86.13	62.58	45.67	142.12	103.26	58.45	181.87	132.14
2026	18.55	60.02	43.15	30.60	99.03	71.19	39.16	126.74	91.11
2027	12.13	40.83	29.04	20.02	67.36	47.91	25.62	86.21	61.32
2028	7.74	27.11	19.08	12.78	44.73	31.48	16.35	57.24	40.28
2029	4.83	17.57	12.24	7.97	28.99	20.19	10.19	37.10	25.84
2030	2.93	11.10	7.65	4.84	18.32	12.62	6.19	23.44	16.15
	56,372.61	72,931.58	67,046.80	93,014.80	120,337.11	110,627.22	119,032.93	153,997.84	141,571.90

Note: 1. $(PV\text{-}LE\text{-}M)_t = (PV\text{-}LE)_t * S_t$ - male
2. $(PV\text{-}LE65\text{-}M)_t = (PV\text{-}LE65)_t * S_t$ - male
3. $(PV\text{-}LE65C\text{-}M)_t = (PV\text{-}LE65C)_t * S_t$ - male
4. $(PV\text{-}AE\text{-}M)_t = (PV\text{-}AE)_t * S_t$ - male
5. $(PV\text{-}AE65\text{-}M)_t = (PV\text{-}AE65)_t * S_t$ - male
6. $(PV\text{-}AE65C\text{-}M)_t = (PV\text{-}AE65C)_t * S_t$ - male
7. $(PV\text{-}HE\text{-}M)_t = (PV\text{-}HE)_t * S_t$ - male
8. $(PV\text{-}HE65\text{-}M)_t = (PV\text{-}HE65)_t * S_t$ - male
9. $(PV\text{-}HE65C\text{-}M)_t = (PV\text{-}HE65C)_t * S_t$ - male

Table 18. Present value of expected annual benefit for retirement workers turning 65 in 1995 with female survival probability

	Female								
Year	PV-LE-F	PV-LE65-F	PV-LE65C-F	PV-AE-F	PV-AE65-F	PV-AE65C-F	PV-HE-F	PV-HE65-F	PV-HE65C-F
1995	6,154.78	6,154.78	6,154.78	10,155.39	10,155.39	10,155.39	12,996.06	12,996.06	12,996.06
1996	5,697.71	5,862.94	5,800.27	9,401.22	9,673.85	9,570.44	12,030.93	12,379.82	12,247.48
1997	5,262.48	5,588.37	5,469.70	8,683.09	9,220.81	9,025.01	11,111.92	11,800.06	11,549.49
1998	4,854.22	5,319.78	5,151.32	8,009.46	8,777.64	8,499.68	10,249.87	11,232.93	10,877.21
1999	4,471.80	5,067.31	4,854.64	7,378.46	8,361.06	8,010.15	9,442.37	10,699.82	10,250.76
2000	4,113.46	4,824.40	4,572.80	6,787.21	7,960.25	7,545.12	8,685.73	10,186.90	9,655.64
2001	3,777.33	4,589.65	4,304.11	6,232.59	7,572.93	7,101.78	7,975.97	9,691.23	9,088.29
2002	3,461.87	4,370.40	4,055.11	5,712.08	7,211.17	6,690.93	7,309.87	9,228.28	8,562.52
2003	3,165.67	4,156.33	3,815.69	5,223.35	6,857.94	6,295.88	6,684.43	8,776.25	8,056.97
2004	2,887.46	3,942.70	3,581.28	4,764.31	6,505.45	5,909.11	6,096.98	8,325.16	7,562.01
2005	2,628.45	3,732.60	3,354.58	4,336.95	6,158.79	5,535.06	5,550.08	7,881.53	7,083.33
2006	2,384.78	3,522.03	3,131.86	3,934.89	5,811.35	5,167.56	5,035.56	7,436.90	6,613.03
2007	2,155.89	3,311.35	2,913.37	3,557.22	5,463.72	4,807.06	4,552.25	6,992.04	6,151.70
2008	1,941.35	3,101.10	2,699.53	3,203.23	5,116.81	4,454.23	4,099.24	6,548.09	5,700.17
2009	1,740.62	2,891.66	2,490.59	2,872.02	4,771.24	4,109.48	3,675.38	6,105.85	5,258.98
2010	1,554.41	2,685.61	2,288.66	2,564.78	4,431.26	3,776.29	3,282.20	5,670.78	4,832.59
2011	1,380.32	2,480.22	2,091.27	2,277.52	4,092.36	3,450.59	2,914.59	5,237.08	4,415.79
2012	1,218.02	2,276.14	1,898.89	2,009.73	3,755.62	3,133.16	2,571.89	4,806.15	4,009.57
2013	1,067.28	2,074.23	1,712.14	1,761.01	3,422.48	2,825.04	2,253.61	4,379.81	3,615.26
2014	927.90	1,875.48	1,531.71	1,531.03	3,094.54	2,527.32	1,959.29	3,960.14	3,234.27
2015	799.67	1,680.95	1,358.32	1,319.46	2,773.57	2,241.23	1,688.54	3,549.40	2,868.15
2016	682.43	1,491.88	1,192.79	1,126.01	2,461.60	1,968.10	1,440.97	3,150.16	2,518.62
2017	576.02	1,309.63	1,036.00	950.43	2,160.89	1,709.40	1,216.29	2,765.33	2,187.56
2018	480.31	1,135.70	888.91	792.51	1,873.91	1,466.70	1,014.19	2,398.08	1,876.97
2019	395.13	971.67	752.48	651.97	1,603.26	1,241.59	834.34	2,051.72	1,588.89
2020	320.27	819.07	627.60	528.44	1,351.47	1,035.53	676.25	1,729.50	1,325.19
2021	255.40	679.29	514.99	421.40	1,120.83	849.73	539.28	1,434.35	1,087.42
2022	200.08	553.45	415.15	330.13	913.20	685.00	422.48	1,168.64	876.60
2023	153.75	442.31	328.27	253.69	729.82	541.65	324.65	933.96	693.16
2024	115.71	346.18	254.21	190.92	571.20	419.45	244.32	730.98	536.77
2025	85.21	265.14	192.64	140.60	437.48	317.85	179.93	559.85	406.76
2026	61.37	198.60	142.77	101.26	327.69	235.56	129.59	419.35	301.46
2027	43.21	145.44	103.44	71.30	239.97	170.68	91.25	307.10	218.43
2028	29.75	104.13	73.28	49.09	171.81	120.91	62.82	219.87	154.74
2029	20.03	72.92	50.77	33.05	120.31	83.77	42.30	153.96	107.20
2030	13.17	49.84	34.34	21.72	82.24	56.66	27.80	105.24	72.50
	65,077.29	88,093.29	79,838.25	107,377.53	145,353.93	131,733.11	137,413.20	186,012.37	168,581.53

Note: 1. $(PV\text{-}LE\text{-}F)_t = (PV\text{-}LE)_t * S_t$ - female
2. $(PV\text{-}LE65\text{-}F)_t = (PV\text{-}LE65)_t * S_t$ - female
3. $(PV\text{-}LE65C\text{-}F)_t = (PV\text{-}LE65C)_t * S_t$ - female
4. $(PV\text{-}AE\text{-}F)_t = (PV\text{-}AE)_t * S_t$ - female
5. $(PV\text{-}AE65\text{-}F)_t = (PV\text{-}AE65)_t * S_t$ - female
6. $(PV\text{-}AE65C\text{-}F)_t = (PV\text{-}AE65C)_t * S_t$ - female
7. $(PV\text{-}HE\text{-}F)_t = (PV\text{-}HE)_t * S_t$ - female
8. $(PV\text{-}HE65\text{-}F)_t = (PV\text{-}HE65)_t * S_t$ - female
9. $(PV\text{-}HE65C\text{-}F)_t = (PV\text{-}HE65C)_t * S_t$ - female

Table 19. Percentage difference in absolute annual benefit level using the CPI-UA and CPI-A

Year	LE-Difference	AE-Difference	HE-Difference
1995	0.00%	0.00%	0.00%
1996	1.07%	1.07%	1.07%
1997	2.12%	2.12%	2.12%
1998	3.17%	3.17%	3.17%
1999	4.20%	4.20%	4.20%
2000	5.22%	5.22%	5.22%
2001	6.22%	6.22%	6.22%
2002	7.21%	7.21%	7.21%
2003	8.20%	8.20%	8.20%
2004	9.17%	9.17%	9.17%
2005	10.13%	10.13%	10.13%
2006	11.08%	11.08%	11.08%
2007	12.02%	12.02%	12.02%
2008	12.95%	12.95%	12.95%
2009	13.87%	13.87%	13.87%
2010	14.78%	14.78%	14.78%
2011	15.68%	15.68%	15.68%
2012	16.57%	16.57%	16.57%
2013	17.46%	17.46%	17.46%
2014	18.33%	18.33%	18.33%
2015	19.19%	19.19%	19.19%
2016	20.05%	20.05%	20.05%
2017	20.89%	20.89%	20.89%
2018	21.73%	21.73%	21.73%
2019	22.56%	22.56%	22.56%
2020	23.38%	23.38%	23.38%
2021	24.19%	24.19%	24.19%
2022	24.99%	24.99%	24.99%
2023	25.78%	25.78%	25.78%
2024	26.57%	26.57%	26.57%
2025	27.34%	27.34%	27.34%
2026	28.11%	28.11%	28.11%
2027	28.87%	28.87%	28.87%
2028	29.63%	29.63%	29.63%
2029	30.37%	30.37%	30.37%
2030	31.11%	31.11%	31.11%

Note: 1. $(\text{LE-Difference})_t = [(\text{LE-65})_t - (\text{LE-65C})_t] / (\text{LE-65})_t$

2. $(\text{AE-Difference})_t = [(\text{AE-65})_t - (\text{AE-65C})_t] / (\text{AE-65})_t$

3. $(\text{HE-Difference})_t = [(\text{HE-65})_t - (\text{HE-65C})_t] / (\text{HE-65})_t$

Study of Income Dynamics (PSID) from 1970 to 1982. He concluded that the exit probabilities for an elderly person defined to begin at age 65 in the first 3 elderly years of a poverty spell are relatively high; 42.3 percent, 23.1 percent, and 21.5 percent, respectively. The results were virtually equivalent to those which have been reported for non-elderly persons. After these first 3 years, however, exit probabilities fall dramatically for elderly persons. Implied is that if an elderly person is unable to escape poverty after the first 3 elderly years of being poor, it is highly likely that the persons will remain poor.

Those among the elderly most likely to be poor are elderly widows, many of who depend on survivors benefits based on the earnings of deceased workers with a history of low earnings. Furthermore, if the worker accepted a benefit cut for early retirement, this benefit reduction is inherited by a surviving spouse. A reduction in the annual COLA to correct for alleged CPI bias is likely to have its greatest impact on this group of beneficiaries owing to the compounding of benefit cuts that occur over time, as shown in table 19.

Supplemental Security Income (SSI) provides a safety net for Social Security beneficiaries with inadequate benefits, but it is likely that any correction in the CPI will also cause SSI benefits to fall over time, weakening this part of the safety net.

INDEXING SOCIAL SECURITY BENEFITS

Each year, price inflation adjustments are made for various Federal, State, and local programs in the United States. According to the Congressional Research Service, 1996, nearly 80 benefit programs provide cash and noncash aid, primarily to persons with limited incomes. The combined cost of these programs in fiscal year 1994 was almost $345 billion, up 11 percent from the previous fiscal year. Federal funds accounted for approximately 72 percent of total spending. Thus, all of price inflation adjustments can result in meaningful changes in eligibility requirements for the receipt of government benefits and in increases or decreases in benefit levels, thereby directly influencing government budgets (Garner, Johnson, and Kokoski, 1996). For instance, a one percentage point COLA cost the federal government $3.41 billion in 1996.

Bridges and Hambor (1982) used an experimental index (known as CPI-X1), developed by the Bureau of Labor Statistics with the rental equivalence approach, to make a comparison of annual percentage changes in the CPI-X1 with annual percentage changes in the CPI-W during the period 1967-1981. If CPI-X1 had been used as the basis for inflation adjustment to OASDI and Supplemental Security Income (SSI) benefits when such adjustment began, benefits would now be lower and the OASDI Trust Fund reverses would be larger. Table 20 shows how the actual calendar year totals for both OASDI and SSI benefit payments would have been reduced had the CPI-X1 rather than the CPI-W been used to adjust for inflation.

Clearly, Social Security benefits are guaranteed to an eligible person for the remainder of his or her life, and survivor benefits are available for surviving spouses. More than one-

Table 20. OASDI and Federal SSI cash benefit payment: actual amounts and reductions due to indexing by CPI-X1 [in billions]

	OASDI benefits		Federal SSI benefits	
Calendar year	Actual	Reduction	Actual	Reduction
1975	$66.9	$0.3	$4.314	$0.020
1976	75.7	0.8	4.512	0.045
1977	84.6	1.0	4.703	0.050
1978	92.9	1.3	4.881	0.065
1979	104.3	2.2	5.279	0.110
1980	120.5	4.7	5.866	0.225
1981	141.0	7.5	6.518	0.360

Source: Benjamin Bridges, and John C. Hambor. Notes and brief reports, Social Security Bulletin, August 1982, Vol. 45:17.

third of the elderly depend on Social Security for 90 percent or more of their annual income (Melcher, 1988). Current legislation provides for automatic cost-of-living increases so that the real value of this asset is unaffected by inflation. By assisting older Americans in keeping pace with the actual increase in the cost of living, the CPI-W plays a major role in the determination of the well-being of most older persons.

The Need for a Separate Consumer Price Index for Elderly

Several previous studies have attempted to develop a separate price index for the elderly to test the hypothesis that the elderly have been adversely affected by inflation relative to the general population at large. Most of them conclude the inflation experience of the elderly was not significantly different from the general population (Amble and Stewart, 1994; Boskin and Hurd, 1985; Bridges and Packard, 1981; Clark, Maddox, Schrimper, and Sumner, 1984; Cobb, 1991).

The CPI-U and CPI-W are designed to measure the change in the cost of purchasing a fixed market basket of goods and services representing average consumption patterns during some base period (Moulton, 1996). Population subgroups-- such as the elderly-- may on average consume a different enough market basket that if the goods they consume in greater proportion experience significantly different price changes than the average, then the overall CPI might be a poor measure of the true change in their cost of living (Boskin, 1995). For instance, within the medical care component, the elderly had larger out-of-packet costs relative to the nonelderly (Amble and Stewart, 1994; Borzilleri, 1978; Boskin and Hurd, 1985; Bridges and Packard, 1981; Clark, Maddox, Schrimper, and Sumner, 1984; Cobb, 1991; Melcher, 1988). The different spending patterns imply possible differential effects of relative price changes. In addition, the CPI-W covers only wage earners and clerical workers, who present roughly 32 percent of the U.S. population. The survey does not include retired people. The CPI-U, which tracks costs for all urban consumers, who represent nearly 80 percent of the U.S. population, includes retirees (Abraham, 1995b; Amble and Stewart, 1994; Melcher,1988). The CPI-W may not be the most appropriate index for use in indexing Social Security benefits because it excludes retired people-- especially those 62 years old and over.

Borzilleri (1978) employed data from the 1972-1973 Consumer Expenditure Survey. The average budget shares were derived for 15 categories of consumer expense reported by all urban and rural families and single consumers 65 years of age or older. These shares were then used to weight the month-to-month price changes reported for these items from January 1970 through March 1977. He pointed out that the measured increase in the OPI was greater than that measured by the CPI in 18 out of 26 quarters. He concluded the prices of goods and services increased approximately 4 percent faster for older people than indicated by the CPI currently in use over this period.

Bridges and Packard (1981) fashioned an annual Consumer Price Index for older consumers (CPI-O), using BLS price indexes for the seven major expenditure classes for the period 1967-1979. The seven weights for older consumers were derived from the 1972-1973 Consumer Expenditure Surveys. These weights were for all consumer units headed by persons aged 65 or older and are used in computing the CPI-O for each year of the 1967-1979 period. Since the published CPI-W for the period 1967-77 used major expenditure class weights derived from the 1960-61 Consumer Expenditure Surveys, it was necessary to construct a Consumer Price Index for urban wage earners and clerical workers (CPI-W_c) using the 1972-73 Consumer Expenditure Surveys data. All differences between the CPI-O and the CPI-W_c are due to the use of different major expenditure class weights. Table 21 describes annual indexes and percentage changes for the CPI-O and CPI-W_c from 1967 to 1979. During this period, the CPI-O increased slightly faster than the CPI-W_c. The slightly faster increase of the CPI-O was fairly persistent. For 7 of the 12 years, the percentage increase of the CPI-O was slightly greater than that of the CPI-W_c. Only in 1979 was the percentage increase of the CPI-O slightly less than that of the CPI-W_c.

Boskin and Hurd (1985) dealt with the 1972-1973 interview portion of the Consumer Expenditure Survey (CES). In this survey, conducted by the BLS, 19,975 households were interviewed, each over a 15-month period, to determine out their expenditures in detail. They calculated Laspeyres indices by age group, taking the expenditure share weights from the CES. The price changes were taken from the CPI Detailed Report. They divided the

Table 21. Constructed consumer price indexes: annual indexes and percentage changes, 1967-1979. [1967=100.0]

	CPI-O		$CPI-W_c$	
Year	Index	Percentage change	Index	Percentage change
1967	100.0	------	100.0	------
1968	104.2	4.2	104.2	4.2
1969	109.9	5.5	109.9	5.5
1970	116.5	6.0	116.2	5.7
1971	121.7	4.5	121.2	4.3
1972	125.7	3.3	125.1	3.2
1973	133.1	5.9	132.3	5.8
1974	147.9	11.1	147.0	11.1
1975	162.0	9.5	160.7	9.3
1976	172.0	6.2	170.6	6.2
1977	183.5	6.7	181.7	6.5
1978	197.6	7.7	195.2	7.4
1979	219.9	11.3	217.7	11.5

Source: Benjamin Bridges and Michael D. Packard. Price and Income Changes for the Elderly, Social Security Bulletin, Jan. 1981, Vol. 44: 4

population into six age groups: 21-54, 55-59, 60-64, 65-69, 70-74, and 75 and older. They defined those aged 60 and over as elderly. Because a house purchase has an investment component as well as a consumption component, its treatment in the official CPI has been controversial. Their calculation was based on the rental equivalence concept: the annual expenditure on housing is said to be the amount the house would rent for. They concluded that, conditional on a housing adjustment, the cost-of-living indices and annual inflation rates for the elderly population from 1961-1981 were similar to that of the general population. For example, in 1981, the largest difference was that between 21-54 and 60-64, a difference of 2 points, less than 1 percent of the cumulative cost of living. The nonelderly inflation rate was measured at 9.58 percent, within three-tenths of 1 percentage point of that for any of the elderly age groups. In addition, they found that the official Consumer Price Index substantially overstated the cost of living; this overstatement was about 22 basis points or approximately 10 percent in 1981. The difference was due almost exclusively to the treatment of housing.

Cobb (1991) used cross-section individual household expenditure data from the 1972-1973 Consumer Expenditure Survey to estimate his expenditure system. The price data used to establish all indexes were taken from 1967-1984 CPI data for the U.S. and six U.S. cities, including Atlanta, Baltimore, Boston, Chicago, Minneapolis, and San Francisco. His subsample contained roughly 4,100 households which are divided into 24 demographic groups according to age of family head (>64 and <64 years) , and family size (single /couple /couple with own children only). Finally, he chose ten household groups with at least 100 households to limit his analysis. All indexes were calculated for several city price series and at several expenditure levels for each household group. He discovered both substantial differences in how they allocate expenditure and in their ability to substitute among the expenditure groups within the ten household groups. Though poor and elderly households inclined to display higher cost of living increases during the period 1967-1984, the differences from the other groups were small. Therefore, he concluded that group-specific fixed-weight indexes are better cost-of-living approximations than a general Consumer Price Index even though all substitution bias estimates, by income and household type, are quite small.

Amble and Stewart (1994) indicated that the Bureau of Labor Statistics developed an experimental Consumer Prince Index, reweighted to incorporate the spending patterns of those 62 years of age and older. BLS observed that from December 1982 to December 1987, the experimental Consumer Price Index for older Americans rose slightly faster than the CPI-U and CPI-W. They updated the experimental Consumer Price Index for the period from December 1987 through December 1993. They showed the experimental Consumer Price Index rose 28.7 percent, slightly more than the increases of 26.3 percent for the CPI-U and 25.5 percent for the CPI-W; see the totals in Table 22. Although there were various limitations (expenditure weights, areas and outlets priced, item priced, and prices collected) inherent in the methodology, they concluded the medical care component accounted for most of the difference between the experimental Consumer Price Index and either the CPI-U or the CPI-W. In the experimental Consumer Price Index, this component increased 59.4 percent from 1988 to 1993. By contrast, inflation for the medical care component of the CPI-U was 54.2 percent and that for the CPI-W was 53.3 percent.

Table 22. Percent change in alternative Consumer Price Index, all items, 12 months ended December, 1988-1993.

Year	CPI-U	CPI-W	Experimental Index for older Americans
1988	4.4	4.4	4.5
1989	4.6	4.5	5.2
1990	6.1	6.1	6.6
1991	3.1	2.8	3.4
1992	2.9	2.9	3.0
1993	2.7	2.5	3.1
Cumulative change, Dec.1987-Dec.1993	26.3	25.5	28.7

Source: Nathan Amble and Ken Stewart, 1994. Experimental price index for elderly consumers, Monthly Labor Review, May, 1994: 15.

CONCLUSION

Earnings are found to be higher for Whites relative to Nonwhites, for males relative to females. OASDI, with its formula based on earnings history, tends to compound the benefit differences, although the structure does provide proportionately larger returns for those at lower earnings levels. But the disparity between the Social Security benefits of Whites and Blacks, and between males and females, remains large. In addition, mortality rates were found to be higher for Nonwhites relative to Whites, for males relative to females, and for the less educated relative to the more educated. Some of researchers pointed out that differential mortality rates may have a significant influence on the distributional character of the Social Security program. Therefore, the redistribution effect of the progressive benefit formula, intended to provide a higher rate of return on the contributions of workers with low earnings than for those with high earnings, may not be as strong as expected.

Since needs tend to increase and abilities trend to decrease at older ages, one would expect that a progressive, need-oriented system like Social Security would attempt to increase real benefit levels over the aging process. Social Security benefits are guaranteed to an eligible person for the remainder of her or his life, and survivor benefits are available for surviving spouses. This lifetime flow of benefits can be viewed as a form of wealth, and its value will depend on the individual's life expectancy. For many elderly, Social Security benefits are their largest asset at retirement. As life expectancy has been increasing, the age structure of the elderly has also been shifting toward higher ages.

If the bias for the CPI is empirical, we must consider whether an escalator intended for a specific demographic group, such as Social Security beneficiaries, should reflect the expenditure patterns of that group. Furthermore, the index number biases themselves could have differing impacts across different demographic groups. Therefore, it is important to discover how measured annual inflation rates and cumulative cost of living differed among specific demographic groups.

As a final note, I note several limitations in my thesis. First, I focus on three prominent socioeconomic characteristics,, race, sex, and the distribution of earnings. Actually, many other factors, such as educational attainment and urban-rural differentials are also relevant to understanding the causes for and the pattern of the distribution of earnings in the United States. Second, I use a single set of survival probabilities for each sex and cohort as the calculation base. The reason is mortality tables that differentiate among people with different socioeconomic characteristics are not available for each cohort, although there is evidence that socioeconomic differentials have a significant effect on life expectancy. Third, the Social Security beneficiaries receive their benefits paid by SSA monthly. Because it is very difficult to get the mortality rate by month for each age, I use the expected annual benefit instead of the expected monthly benefit to examine the effect of the sex differential in mortality.

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