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Social Security's Five OASI Inflation Indexing Problems

Michael C. Lovell

Wesleyan University

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Abstract

This paper examines five problems with the inflation indexing procedures used by the Social Security Administration of the United States in taking inflation into account when calculating Old Age and Survivors Insurance (OASI) Benefits. Because of Problem #1, the commingling of unindexed with indexed earnings, a retiree born in 1930 who continued in a high earning career until age 75 receives an annual benefit more than $1,800 larger than would have been generated with full indexing. As a result of Problems #2 and #4 your OASI check will be larger if wage inflation happens to be extra high in your 60th year or if price inflation is exceptionally low in your 61st year. Because of the indexing problems, the percentage increase in your inflation (CPI-W) adjusted benefit if you elect to postpone retirement and the start of OASI benefits will depend in part on the pace of inflation. While inflation indexing problems do not attract much attention in normal times, they can contribute to serious short-run financial instability for the OASI trust fund in periods of substantial inflation or deflation.

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Correspondence: *Michael C. Lovell, Chester D. Hubbard Professor of Economics and Social Sciences, Emeritus, Wesleyan University. e-mail: mlovell@wesleyan.edu*

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1. Introduction

This paper examines five problems with the inflation indexing procedures used by the Social Security Administration in calculating Old Age and Survivors Insurance (OASI) Benefits. Because of these indexing problems, a proper evaluation of how progressive OASI actually is – who benefits the most – requires that the pace of inflation be explicitly taken into account. These problems also mean that inflation can have a substantial effect on the incentives provided for delaying retirement and the start of OASI benefits. Although indexing problems do not attract much attention in normal times, they will generate serious short-run financial instability for the OASI trust fund if our economy again experiences stagflation like that generated during the OPEC oil price surges a quarter of a century ago.

This paper shows that how an index is used or misused may be just as important as which index or combination of indexes is used in adjusting OASI benefits for inflation. The most serious problem involves the commingling of the worker's earnings adjusted for wage inflation up through age 60 with unadjusted earnings from age 61 to retirement. As a result, a successful lawyer born in 1930 who earned at or above the taxable maximum cap on earnings subject to OASI taxes ($90,000 in 2005) and postponed full retirement until her 75th birthday might enjoy an annual benefit of $25,812 instead of the $24,000 that would be received if the earnings were fully adjusted for wage inflation in calculating benefits. This $1,812 annual bonus is 7.0% of the annual benefit. In contrast to this $1,812 annual bonus, a worker who always earned the minimum wage over an equally long career receives a benefit of $10,296 instead of $10,164 with full wage indexing – a $132 annual bonus amounting to only 1.3% of the annual benefit. These bonuses, adjusted for inflation with the CPI-W, are received in every year of retirement, and beyond if claimed by the worker's surviving spouse.

Social Security has evolved over the years since President Roosevelt signed it into law in 1935 into a program that must be judged to be in many ways a tremendous success: It has contributed to the dramatic reduction in the rate of poverty among the elderly. And it is remarkably efficient — OASI administrative expenses in FY 2007 were only 0.6% of benefit payments. But it also has serious problems. As everyone knows, it is underfunded and its trust funds are threatened with eventual exhaustion. But there are also serious problems with the way in which the program indexes for inflation.

Attempting to modify the way in which Social Security Benefits are adjusted for inflation can turn into a political minefield. A case in point is provided by the serious political controversy generated in the 1970s when Social Security was first indexed for inflation. The initial attempt at indexing, signed into law in 1972, was flawed – it overcompensated for inflation to such an extent that it is said to have threatened to exhaust the trust funds. After the indexing procedure was revised in 1978, those born between 1917 and 1921 become known as the "Notch Generation" because their benefits were reduced below those of both the immediately preceding and following birth cohorts (Duggan et.al., 1996). In response to their protests, over the years more than 100 legislative bills attempting to redress the problems of the Notch Generation were introduced in both houses of Congress. A bipartisan Commission on the Social Security 'Notch Issue' (1994) concluded after extensive hearings that no remedial action should be taken. That report may have put the Notch Issue more or less to rest, but serious underlying problems with the indexing procedures are still not resolved.

The next section of this paper reviews how OASI benefits are calculated. Section 3 investigates five indexing problems and recommends steps that would contribute to their resolution. Computer experiments in Section 4 test how well alternative indexing procedures respond to accelerated inflation or deflation. Section 5 explains how the price and wage indices used by the SSA are constructed. Section 6 examines the task of phasing in reform, and Section 7 concludes. The Appendix presents a more extended discussion of how benefits are calculated that is illustrated with tables from *AnyPIA*, the SSA personal computer benefit calculating program.

Throughout we shall be focusing on the wage earnings and OASI benefits of workers but will not consider how the financial wellbeing of workers and retirees may be influenced by the income taxes, the Earned Income Tax Credit, Supplementary Social Security payments, pensions, inheritances, personal saving and investments.

2. Calculating OASI Benefits

Before we can appreciate OASI indexing problems we must examine the procedure for calculating a retiree's benefits. First we will calculate the worker's Average Indexed Monthly Earnings (AIME), then we will show how the Primary Insurance Amount (PIA) is derived from the AIME, and finally we will explain how the benefits are calculated from the PIA.

Calculating a Worker's Average Indexed Monthly Earnings (AIME)

The OASI benefit is based on earnings reported on the worker's W-2 forms, E_t^{w-2}, but only up to the Taxable Maximum (aka the *Contribution and Benefit Base*) ceiling C_t on earnings subject to the OASI payroll tax; e.g., C_{2008} = \$102,000. Earnings above C_t are not subject to the payroll tax and are nor tabulated in computing OASI benefits. These capped earnings,

$$E_t = \min(E_t^{w\text{-}2}, C_t), \tag{1}$$

are adjusted for wage inflation with w_t, the Average Wage Index. This index, plotted on Figure 1, is based on $\overline{E}_t^{w-2}$, the average of all workers' W-2 income, and is normalized to equal 100 in the workers 60th year,

$$w_t = \overline{E}_t^{w-2} / \overline{E}_{t^b+60}^{w-2}, \tag{2}$$

where t^b is the year of birth. But our worker's "indexed earnings", ${}^I E_t$, are in fact only indexed up through the year of the worker's 60th birthday; subsequent earnings are not adjusted for inflation:

$${}^I E_t = E_t / w_t^*, \text{ where } w_t^* = w_t \text{ if } t \le t^b + 60, \text{ else } 1. \tag{3}$$

Next the worker's indexed earnings in the highest 35 years prior to date t are summed:

$${}^I E_t^{35} = \sum_{R({}^I E_\tau) \le 35,\ \tau < t} {}^I E_\tau, \tag{4}$$

$$\text{where } R(E_\tau) = \text{the descending rank of earnings up to year t.}$$

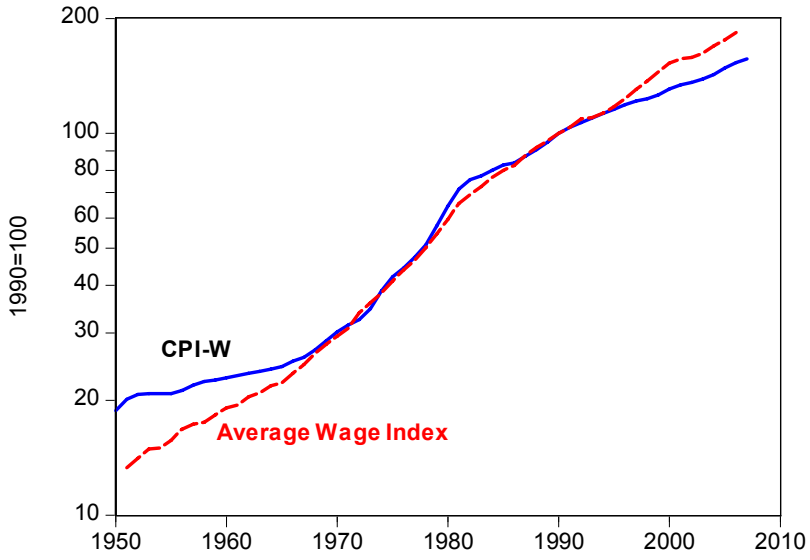
Earnings that are too small to be included in the top 35, although subject to the OASI wage tax, do not count in computing OASI benefits.

The worker's Average Indexed Monthly Earnings (AIME) is this 35 year sum divided by 35×12:

$$\overline{E}_t = {}^I E_t^{35} / (35 \times 12). \tag{5}$$

If there are fewer than 35 years of employment, the sum is still divided by 35x12.

Figure 1: Alternative Inflation Indexes: AWI versus the CPI-W



Calculating the Primary Insurance Amount (PIA)

Workers become eligible to receive OASI benefits at age 62. The Primary Insurance Amount, a piecewise linear function of Average Indexed Monthly Earnings ($\overline{E}_t$), is plotted on Figure 2 for a 62 year old worker born in year t^b = 1930. For any t^b, the PIA is

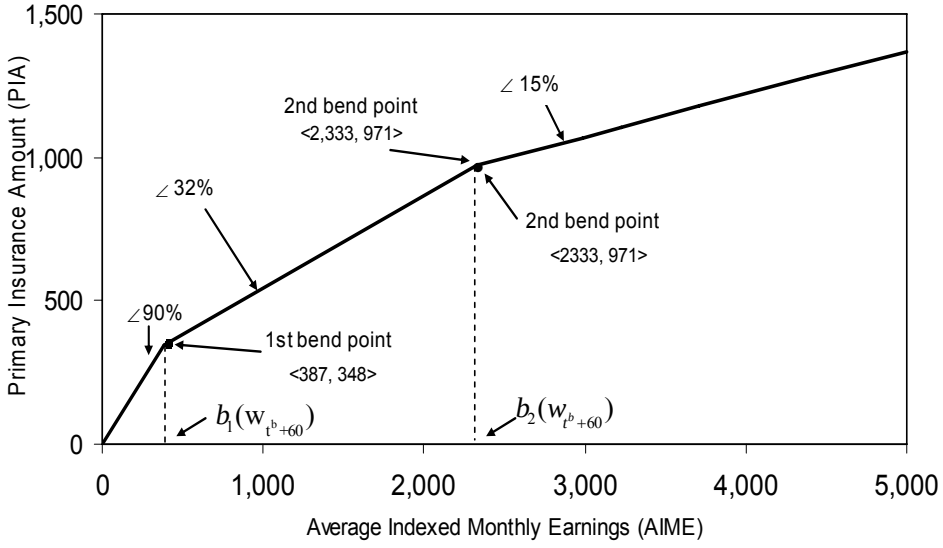
$$P_t(\bar{E}_t, b_1, b_2, t^b) = (p_{t-1} / p_{t^b+61})\{0.9\min(\bar{E}_t, b_1) + \\ + 0.32\max[0, \min(\bar{E}_t - b_1, b_2 - b_1)] + 0.15\max(0, \bar{E}_t - b_2)\},\ t \geq t^b + 62. \quad (6)$$

Here p_t is the CPI-W price index and the ratio p_{t-1} / p_{t^b+61} is introduced to adjust benefits for inflation. The bend points in the graph have coordinates $<b_1, 0.9b_1>$ and $<b_2, 0.9b_1 + 0.35(b_2 - b_1)>$. The bend point coefficients b_1 and b_2 are adjusted for inflation with the wage index in the year of the worker's 60th birthday; i.e., $b_1(w_{t^b+60})$ and $b_2(w_{t^b+60})$.

Observe from Figure 2 that the ratio of benefits to earnings declines with AIME, making the PIA a progressive function of earnings. However, the progressive feature of the function linking annual benefits to AIME is more or less offset because life expectancy increases with socioeconomic status and is sensitive to both race and life style.[1]

Note that the worker's PIA will increase over time for two reasons: First, it is adjusted for price inflation by the ratio p_{t-1} / p_{t^b+61}. Second, the PIA^e increases with the passage of time if the beneficiary continues to work after the 62nd birthday, but only if the earnings are large enough to increase the AIME, which means they must count among the top 35 years.

Figure 2: Primary Insurance Amount (PIA) - DOB 1930, Age 62, t = 1992



Benefit Calculation

The monthly benefit that a worker born in year t^b will receive at age a depends partly on that year's PIA, but subject to an adjustment factor $A(t^b, a^s)$ that penalizes workers if the age a^s at which they

[1] Gustman and Steinmeier (2001) report that there is significant income redistribution when only own benefits are taken into account; but progressivity is substantially reduced when spouse and survivor benefits are included and redistribution is measured among families. A Congressional Budget Office (2006) study reports that the degree of progressivity is strengthened when OASI and Disability Insurance benefits are combined and when benefits are measured net of the personal income tax.

initially claimed benefits is before the normal retirement age and rewards those who delay the start of benefits beyond the normal retirement age:

$$B(t^b, a, a^s, p_{t-1}, p_{t^b+61}, \bar{E}, b_1(w_{t^b+60}), b_2(w_{t^b+60})) = A(t^b, a^s)P(t^b, t, p_{t-1}, p_{t^b+61}, \bar{E}, w_{t^b+60}) \quad (7)$$
$$\text{for } a \geq 62, \text{ 0 otherwise.}$$

For example, a worker born in 1960 who starts benefits when first becoming eligible at age 62 will receive only 70% of the benefit that would be received if the start of benefits were postponed until the normal retirement age, which is 67 for that age cohort. But the adjustment factor would be 122.5% if the worker refrains from drawing benefits until age 70. As indicated by Table 1, the adjustment factor has been modified over time, in part to reflect the increased longevity of the population.

The Average Indexed Monthly Earnings, the Primary Insurance Amount and the benefit are updated in each year after age 62 in which our worker has W-2 earnings, but the PIA function bend points do not change and the wage index remains normalized at 100 in the worker's 60th year. The maximum benefit that can be received by anyone who always earned at or above the taxable maximum depends on the year of retirement, for that limits the sum of the capped earnings that is used in calculating the AIME. For a worker born in 1930 who retires at 62, the maximum AIME is $2,985 and the resulting cap on the PIA is $1,069.

Married workers have the option of claiming ½ of their spouses benefit if it is larger than the benefit based on their own earnings. Dependent children may also receive a benefit based on the retiree's earnings record. Surviving marital partners may choose to continue receiving their deceased spouse's benefit if it is larger than their own.[2]

Table 1: $A(t^b, a^s)$ ~ Benefit Adjustment Factors

Year of birth (t^b)	Normal Retirement Age	Benefit, as a percentage of PIA, beginning at age (a^s)			
		62	65	67	70 & above
1924	65	80	100	106	115
1930	65	80	100	109	122 1/2
1937	65	80	100	113	132 1/2
1939	65, 4 mo.	78 1/3	97 7/9	111 2/3	132 2/3
1940	65, 6 mo.	77 1/2	96 2/3	110 1/2	131 1/2
1941	65, 8 mo.	76 2/3	95 5/9	110	132 1/2
1943-54	66	75	93 1/3	108	132
≥ 1960	67	70	86 2/3	100	124

Source: http://www.socialsecurity.gov/OACT/ProgData/ar_drc.html

3. Indexing Problems

We will illustrate the effects of various indexing problems by considering how they affect the OASI benefits received by four quite differently situated hypothetical workers:[3]

[2] A divorced spouse who does not remarry before age 60 may still elect the survivor benefit, provided the marriage had lasted at least 10 years. A divorced spouse who remarried after age 60 could still collect survivor benefits on the former spouse's record or choose instead to receive retirement benefits based on the record of the new spouse. Several former wives of a serially marrying spouse may be able to claim benefits on the basis of that former spouse's earning history, provided each marriage lasted at least 10 years. The Social Security Administration accepts common law marriages if recognized by the state where the couple resides. Gay Marriages are not accepted even if recognized in the state of residence (e.g., Massachusetts or California).

[3] It is assumed that workers earned the specified amounts in their 35 highest real earning years. In practice, workers' relative position in the income distribution tends to change over the years, rising early in their careers as they develop skills and obtain seniority and dropping in later years if they suffer a decline in physical stamina or their human capital

- Maximum Wage Earners always earned at or above the taxable maximum cap. This category includes successful accountants, lawyers, physicians, business school professors, and many other professionals and business leaders. Some may continue to earn above the taxable maximum cap even in part-time retirement.
  (http://www.socialsecurity.gov/cgi-bin/netcomp.cgi?year=2006)

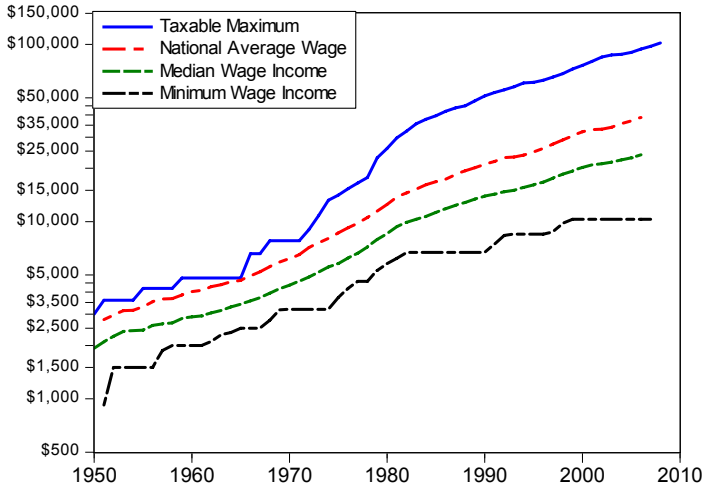
- Average Wage Earners enjoyed the average (mean) W-2 income of all workers subject to the Social Security tax throughout their careers.

- Median Wage Earners always earned the median of the W-2 earnings distribution. Because the distribution of income is skewed, the average wage is substantially above the median. In 1990 the mean was $21,028 while the median was $14,499. From 1990 to 2007 the mean increased from 45% above to 54% above the median.[4]

- Minimum Wage Earners always earned the Federal minimum wage while working a 40 hour week 50 weeks of the year. They are the least advantaged.

The income histories of these four classes of workers are reported on Table 2 and plotted on Figure 3. Their incomes are deflated with the CPI-W (1990=100) on Figure 4 and with the Average Wage Index on Figure 5.

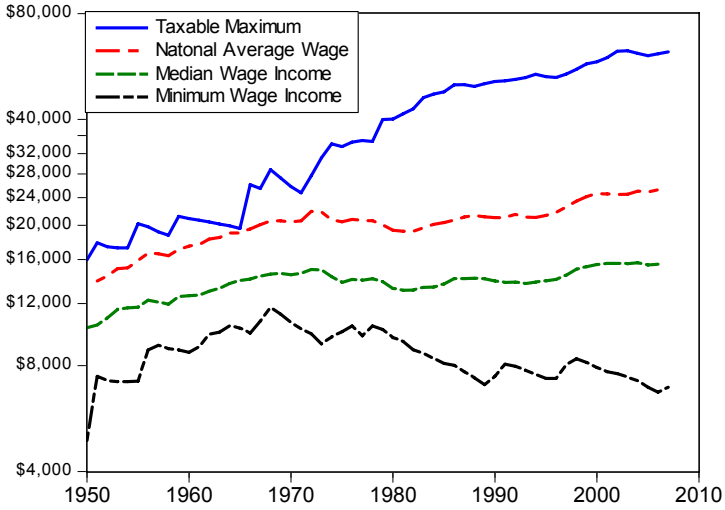
Figure 3: Income History



suffers from obsolescence. A Social Security Administration study suggests that earnings typically peak at age 48 or 49. See Clingman and Nichols (2006). They have developed "scaled factors" to take this complication into account, but only through age 64, which is too short for this study.

[4] Three alternative measures of median income are examined in detail by L. Scott Muller (2006). The median figures referred to in the text are from www.socialsecurity.gov/OACT/COLA/central.htm, but this series only goes back to 1990. Elsewhere this study uses the series compiled by Muller from back issues of the *Annual Statistical Supplements, Social Security Bulletin* because it is the only one covering the entire historical period of interest. While not fully comparable to the Average Wage Index, it is close enough for the purposes of this study.

Figure 4: CPI-W Deflated Incomes (1990 = 100)



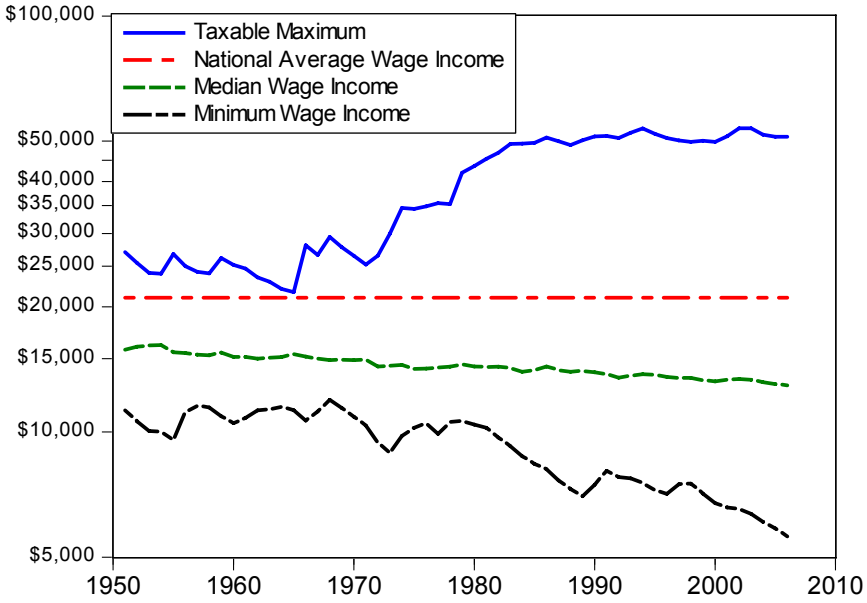
In 2006 our minimum wage worker's W-2 income was in the 35th percentile of all workers, including part timers. The median worker was, by definition, at the 50th percentile, our average worker was in the 73rd percentile and the maximum in the 95th percentile, and only about 6% of W-2 earners had income at or above the taxable maximum cap. In 1979, the earliest year for which data are readily available, 13.4 percent of hourly workers were paid at or below the minimum wage; by 2006 that percentage had declined to 2.3%.[5]

[5] http://www.bls.gov/cps/minwage2007tbls.htm#10

Table 2: Earnings, Inflation and Interest Rates

	Earnings				Inflation					Trust fund interest rates		
	MinWage	Median	Average	TaxMax	CPI-W	AWI	Annual Inflation Rates			nominal	real	
Year	Income	Wage	Wage		1990=100		CPI-W	AWI	difference	r	r – CPI	r - AWI
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1950	920	1,926		3,000	18.8							
1951	1,500	2,097	2,799	3,600	20.1	13.3	7.24			0.3	-6.9	
1952	1,500	2,258	2,973	3,600	20.7	14.1	2.80	6.22	-3.4	1.3	-1.5	-4.9
1953	1,500	2,400	3,139	3,600	20.8	14.9	0.62	5.59	-5.0	2.3	1.7	-3.3
1954	1,500	2,425	3,156	3,600	20.8	15.0	0.00	0.52	-0.5	2.3	2.3	1.8
1955	1,500	2,438	3,301	4,200	20.8	15.7	-0.37	4.62	-5.0	2.2	2.6	-2.4
1956	1,875	2,599	3,532	4,200	21.2	16.8	1.98	6.99	-5.0	2.4	0.4	-4.6
1971	2,000	2,651	3,642	4,200	21.9	17.3	3.52	3.10	0.4	2.5	-1.0	-0.6
1958	2,000	2,674	3,674	4,200	22.4	17.5	2.22	0.88	1.3	2.5	0.3	1.6
1959	2,000	2,837	3,856	4,800	22.6	18.3	0.92	4.95	-4.0	2.6	1.7	-2.4
1960	2,000	2,894	4,007	4,800	22.9	19.1	1.48	3.92	-2.4	2.6	1.1	-1.3
1961	2,100	2,938	4,087	4,800	23.2	19.4	1.12	1.99	-0.9	2.7	1.6	0.7
1962	2,300	3,058	4,291	4,800	23.5	20.4	1.11	5.01	-3.9	2.8	1.7	-2.2
1963	2,367	3,149	4,397	4,800	23.8	20.9	1.42	2.45	-1.0	2.9	1.5	0.4
1964	2,500	3,298	4,576	4,800	24.1	21.8	1.19	4.09	-2.9	3.1	1.9	-1.0
1965	2,500	3,414	4,659	4,800	24.5	22.2	1.71	1.80	-0.1	3.2	1.5	1.4
1966	2,500	3,566	4,938	6,600	25.3	23.5	3.25	6.00	-2.8	3.5	0.3	-2.5
1967	2,775	3,716	5,213	6,600	25.9	24.8	2.64	5.57	-2.9	3.7	1.1	-1.9
1968	3,167	3,945	5,572	7,800	27.1	26.5	4.45	6.87	-2.4	3.9	-0.6	-3.0
1969	3,200	4,173	5,894	7,800	28.6	28.0	5.59	5.78	-0.2	4.4	-1.2	-1.4
1970	3,200	4,375	6,186	7,800	30.2	29.4	5.65	4.96	0.7	5.0	-0.7	0.0
1971	3,200	4,605	6,497	7,800	31.5	30.9	4.33	5.02	-0.7	5.2	0.9	0.2
1972	3,200	4,870	7,134	9,000	32.5	33.9	3.09	9.80	-6.7	5.3	2.2	-4.5
1973	3,200	5,184	7,580	10,800	34.7	36.0	6.87	6.26	0.6	5.7	-1.2	-0.6
1974	3,733	5,536	8,031	13,200	38.7	38.2	11.45	5.94	5.5	6.2	-5.2	0.3
1975	4,200	5,803	8,631	14,100	42.1	41.0	8.75	7.47	1.3	6.6	-2.1	-0.9
1976	4,600	6,235	9,226	15,300	44.4	43.9	5.42	6.90	-1.5	6.7	1.3	-0.2
1977	4,600	6,630	9,779	16,500	47.4	46.5	6.71	5.99	0.7	6.9	0.2	0.9
1978	5,300	7,204	10,556	17,700	51.1	50.2	7.91	7.94	0.0	7.2	-0.7	-0.7
1979	5,800	7,930	11,479	22,900	57.3	54.6	12.05	8.75	3.3	7.4	-4.6	-1.3
1980	6,200	8,549	12,513	25,900	64.6	59.5	12.77	9.01	3.8	8.5	-4.3	-0.5
1981	6,700	9,361	13,773	29,700	71.5	65.5	10.73	10.07	0.7	9.9	-0.8	-0.2
1982	6,700	9,914	14,531	32,400	75.6	69.1	5.67	5.51	0.2	10.9	5.2	5.4
1983	6,700	10,318	15,239	35,700	77.4	72.5	2.41	4.87	-2.5	10.9	8.5	6.0
1984	6,700	10,704	16,135	37,800	80.1	76.7	3.51	5.88	-2.4	11.8	8.3	5.9
1985	6,700	11,265	16,823	39,600	82.6	80.0	3.14	4.26	-1.1	11.3	8.2	7.0
1986	6,700	11,831	17,322	42,000	83.7	82.4	1.27	2.97	-1.7	11.3	10.0	8.3
1987	6,700	12,327	18,427	43,800	87.2	87.6	4.20	6.38	-2.2	10.1	5.9	3.7
1988	6,700	12,824	19,334	45,000	90.7	91.9	4.00	4.93	-0.9	9.8	5.8	4.9
1989	6,700	13,392	20,100	48,000	94.9	95.6	4.70	3.96	0.7	9.6	4.9	5.6
1990	7,460	13,910	21,028	51,300	100.0	100.0	5.32	4.62	0.7	9.3	4.0	4.7
1991	8,360	14,278	21,812	53,400	103.7	103.7	3.70	3.73	0.0	9.1	5.4	5.4
1992	8,500	14,739	22,935	55,500	106.8	109.1	3.02	5.15	-2.1	8.7	5.7	3.5
1993	8,500	15,000	23,133	57,600	109.6	110.0	2.59	0.86	1.7	8.3	5.7	7.4
1994	8,500	15,560	23,754	60,600	112.7	113.0	2.83	2.68	0.1	8.0	5.2	5.3
1995	8,500	16,108	24,706	61,200	115.7	117.5	2.62	4.01	-1.4	7.9	5.3	3.9
1996	8,750	16,712	25,914	62,700	119.0	123.2	2.93	4.89	-2.0	7.7	4.8	2.8
1997	9,767	17,562	27,426	65,400	121.5	130.4	2.09	5.84	-3.7	7.6	5.5	1.8
1998	10,300	18,513	28,861	68,400	123.2	137.3	1.35	5.23	-3.9	7.3	5.9	2.1
1999	10,300	19,265	30,470	72,600	126.2	144.9	2.46	5.57	-3.1	7.0	4.5	1.4
2000	10,300	20,225	32,155	76,200	130.6	152.9	3.52	5.53	-2.0	6.9	3.4	1.4
2001	10,300	20,905	32,922	80,400	134.1	156.6	2.61	2.39	0.2	6.7	4.1	4.3
2002	10,300	21,194	33,252	84,900	135.9	158.1	1.40	1.00	0.4	6.4	5.0	5.4
2003	10,300	21,622	34,065	87,000	138.8	162.0	2.11	2.44	-0.3	6.0	3.9	3.6
2004	10,300	22,308	35,649	87,900	142.5	169.5	2.66	4.65	-2.0	5.7	3.0	1.1
2005	10,300	22,887	36,953	90,000	148.3	175.7	4.11	3.66	0.4	5.4	1.3	1.7
2006	10,300	23,775	38,651	94,200	153.2	183.8	3.30	4.60	-1.3	5.3	2.0	0.7
2007	10,883		-	97,500	156.7		2.28			5.2	2.9	5.2
Summary statistics, 1952 to 2006												
Minimum	1,500	2,258	2,973	3,600	20.7	14.1	-0.4	0.5	-6.7	1.3	-5.2	-4.9
Maximum	10,300	23,775	38,651	94,200	153.2	183.8	12.8	10.1	5.5	11.8	10.0	8.3
Average	5,597	9,779	14,871	32,987	68.4	70.7	3.8	4.9	-1.1	6.2	2.4	1.3
s	3,177	6,801	11,065	30,405	45.3	52.2	2.9	2.1	2.3	2.9	3.3	3.3
Median	5,800	7,930	11,479	22,900	57.3	54.6	3.0	5.0	-1.0	6.4	1.9	0.9

Figure 5: Average Wage Index deflated incomes (1990 = 100)



Indexing Problem #1: The Undeflated Earnings Bonus

Because earnings adjusted for inflation up through the 60th year are commingled with undeflated earnings in subsequent years, as shown by equation (3), many workers are credited with exaggerated Average Index Monthly Earnings. This results in an enlarged Primary Insurance Amount, leading to a larger OASI benefit than would be awarded if the entire earning history were wage indexed.

As an extreme example, consider a maximum wage earner who continued working until age 75. With wage indexing only until age 60, the maximum wage earner's annual benefit is $25,812 per year (See Table 3). If, however, full wage indexing were extended to W-2 income earned after age 60, this worker would receive $24,000. Thus our worker enjoys an undeflated earnings bonus of $1,812 in the first year of retirement. Or to put it another way, the adoption of full wage indexing would save the Social Security Administration $1,812 in the first year of retirement. The bonus continues, indexed for inflation with the CPI-W, throughout the retirement years. If the spousal benefit is also claimed during retirement, the combined benefit for worker and spouse would be $38,718 with incomplete indexing versus $36,000 with full wage indexing, a difference of $2,718. This annual undeflated earnings bonus will continue until one or the other of the marital partners dies – at age 65 the life expectancy of the first to die is 80. More than this, surviving partners may continue to claim the bonus because they have a choice of either a benefit based on their own earning history or a survival benefit equal to their deceased spouse's retirement benefit – the life expectancy of the second to die at age 65 is 91.[6]

The top four rows of Table 3 contrasts the benefit of the Maximum Wage Earner under the current incomplete indexing procedure with three alternatives: indexing earnings after age 60 with the Average Wage Index, mixed indexing with the earnings wage indexed to age 60 and the CPI-W in subsequent years, and indexing all earnings with the CPI-W. The experience of the Average Wage Earner, the Median Wage Earner and the Minimum Wage Earner are presented in subsequent rows of this table. Note that the maximum wage earner's case is extreme. The mini-

[6] Life expectancy estimates for 2nd to die from Mahaney and Carlson (2007), p 39.

mum wage earner would lose only $132 per year from a shift from incomplete wage indexing to either mixed earnings/CPI-W indexing or full earnings indexing. However, a shift from the current incomplete indexing procedure to full CPI-W indexing would result in a $672 reduction in the minimum wage earner's annual benefit, which in percentage terms looms larger than the reduction for the maximum income worker.

Table 3: Effect of full indexing on the annual benefits of workers retiring at age 75

DofB: 1930; postponed benefits until age 70; worked until 75 birthday

		SSA Bonus		Spouse	Primary +	SSA
	Benefit	$	%	Benefit	Spouse Benefit	Bonus
Maximum Wage Earner						
SSA: Incomplete Wage Indexing	25,812	0	0%	12,906	38,718	0
With Full earnings indexing	24,000	1,812	7.0%	12,000	36,000	2,718
With earnings/CPI-W indexing	24,468	1,344	5.2%	12,234	36,702	2,016
With full CPI-W indexing	24,312	1,500	5.8%	12,156	36,468	2,250
Average Wage Earner						
SSA: Incomplete Wage Indexing	17,424	0	0.0%	8,712	26,136	0
With Full earnings indexing	15,852	1,572	9.0%	7,926	23,778	2,358
With earnings/CPI-W indexing	16,260	1,164	6.7%	8,130	24,390	1,746
With full CPI-W indexing	16,164	1,260	7.2%	8,082	24,246	1,890
Median Wage Earner						
SSA: Incomplete Wage Indexing	13,392	0	0%	6,696	20,088	0
With Full earnings indexing	12,564	828	6.2%	6,282	18,846	1,242
With earnings/CPI-W indexing	12,696	696	5.2%	6,348	19,044	1,044
With full CPI-W indexing	12,288	1,104	8.2%	6,144	18,432	1,656
Minimum Wage Earner						
SSA: Incomplete Wage Indexing	10,296	0	0%	5,148	15,444	0
With Full earnings indexing	10,164	132	1.3%	5,082	15,246	198
With earnings/CPI-W indexing	10,164	132	1.3%	5,082	15,246	198
With full CPI-W indexing	9,624	672	6.5%	4,812	14,436	1,008

As was reported on Table 1, workers who retire before the normal retirement age are penalized by a reduction in OASI benefits while those working later in life are rewarded. Thus a worker born in 1930 who elects to retire at age 62 is scheduled to receive only 80% of the PIA. According to the schedule on Table 1, that worker could receive a 122.5% of the PIA by postponing the start of retirement benefits until age 70. But the worker's PIA itself may be affected by how late in life our worker continues to earn W-2 income. Extra large benefits result from postponing retirement until age 75, provided those extra current dollar earnings are large enough to count among the highest 35 years.

Table 4 shows in successive columns how the benefits depend on how late in life our worker continued to work and when she started to receive benefits. In all cases, benefits after the first year of retirement continue to be indexed by the CPI-W to the initial benefit. Panel A reports benefits when W-2 income is indexed only through age 60, the current procedure. Thus the first three entries in the top row show the benefits with partial wage indexing for the first year of retirement for maximum wage earners who began receiving benefits at age 62, at age 65 or at age 70; and the fourth entry reports the benefit for a worker who continued working to age 75 but started benefits at age 70. Panel B shows what the benefits for these workers would be with complete wage indexing. The columns of Panel C are wage indexed until 60 and then indexed with the CPI-W while those of Panel D are fully indexed by the CPI-W.

Table 4: Annual OASI Benefits – Earned Income Indexing Alternatives

	A. SSA: Wage indexed only until 60				B. Wage Indexed Earnings			
Age of Retiree:	62	65	70	75	62	65	70	75
Age Benefits Started:	62	65	70	70	62	65	70	70
Nominal (at age benefit started)								
Maximum Wage Earner	10,260	14,400	21,048	25,812	10,248	14,316	20,436	24,000
Average Wage Earner	7,536	10,308	14,568	17,424	7,536	10,236	14,040	15,852
Median Wage Earner	5,964	8,136	11,388	13,392	5,964	8,112	11,124	12,564
Minimum Wage Earner	4,824	6,564	9,060	10,296	4,824	6,564	9,000	10,164
Real, CPI-W, year 2005 = 100	72.0	77.9	88.1	100.0				
Maximum Wage Earner	14,244	18,475	23,901	25,812	14,228	18,367	23,206	24,000
Average Wage Earner	10,462	13,225	16,542	17,424	10,462	13,132	15,943	15,852
Median Wage Earner	8,280	10,438	12,931	13,392	8,280	10,407	12,632	12,564
Minimum Wage Earner	6,697	8,421	10,288	10,296	6,697	8,421	10,220	10,164
Real, relative to benefit at age of entitlement (62)								
Maximum Wage Earner	1.00	1.30	1.68	1.81	1.00	1.29	1.63	1.68
Average Wage Earner	1.00	1.26	1.58	1.67	1.00	1.26	1.52	1.52
Median Wage Earner	1.00	1.26	1.56	1.62	1.00	1.26	1.53	1.52
Minimum Wage Earner	1.00	1.26	1.54	1.54	1.00	1.26	1.53	1.52
	C. Wage Indexed to 60, then CPI				D. CPI indexed Earnings			
Age of Retiree:	62	65	70	75	62	65	70	75
Age Benefits Started:	62	65	70	75	62	65	70	75
Nominal (at age benefit started)								
Maximum Wage Earner	10,248	14,328	20,568	24,468	10,008	14,052	20,364	24,312
Average Wage Earner	7,536	10,236	14,160	16,260	7,224	9,948	13,944	16,164
Median Wage Earner	5,964	8,112	11,148	12,696	5,664	7,740	10,728	12,288
Minimum Wage Earner	4,824	6,564	9,000	10,164	4,560	6,192	8,520	9,624
Real, CPI-W, year 2005 = 100								
Maximum Wage Earner	14,228	18,382	23,356	24,468	13,894	18,028	23,124	24,312
Average Wage Earner	10,462	13,132	16,079	16,260	10,029	12,763	15,834	16,164
Median Wage Earner	8,280	10,407	12,659	12,696	7,863	9,930	12,182	12,288
Minimum Wage Earner	6,697	8,421	10,220	10,164	6,331	7,944	9,675	9,624
Real, relative to benefit at age of entitlement (62)								
Maximum Wage Earner	1.00	1.29	1.64	1.72	1.00	1.30	1.66	1.75
Average Wage Earner	1.00	1.26	1.54	1.55	1.00	1.27	1.58	1.61
Median Wage Earner	1.00	1.26	1.53	1.53	1.00	1.26	1.55	1.56
Minimum Wage Earner	1.00	1.26	1.53	1.52	1.00	1.25	1.53	1.52

The increase in nominal benefits for workers who delay retirement results in part from the additional earnings after age 62, provided they are large enough to be counted among the 35 highest income years. But as is clear from the real benefit figures on Panel A of Table 4, the reward for postponing retirement is far from uniform. Why is it that under the current SSA procedure of wage indexing only until age 60, the maximum wage earner receives an 81% increase in real benefits for delaying retirement and continuing to work until 75, the average wage earner a 67% gain, the median earner a 62% gain and the minimum wage earner only 54%? Surely this is not the result of intelligent design. And why is the incentive to delay retirement less with complete wage indexing, particularly for high income workers? Why do late working high income workers fair better with CPI than with wage indexed earnings (Panel B versus Panel D)? To answer such questions we will have to look closely at the earning history of our representative workers.

Maximum Wage Earner

Column 1 of Table 5, reports the partially indexed earnings of a worker who always earned at the taxable maximum cap as calculated with equation (3) in accordance with the OASI procedure by indexing the earnings at the cap (column 4 of) with the Average Wage Index (column 6 of) only through the worker's 60th birthday. Thus the sum of earnings of the best 35 years involves the commingling of indexed and unindexed data. Columns 3 through 5 on Table 5 show that which years are included among the highest 35 that count in determining benefits depends upon when the worker retires. The number of unindexed years that are counted among the top 35 obviously depends upon how late in life the worker earns substantial income. And the contribution of earnings in the later years to the OASI benefit would be more important for workers entering the labor force when they were older.

The two rows after the age 74 row decompose the sum of the best 35 years into earnings through age 60 and earnings from age 61 to retirement. Observe from columns (5), (7) and (9) that the sum through age 60 is the same for the first three indexing procedures. The second half of the

sum in the next row, age 61 to retirement, depends upon whether these observations are not indexed, are wage indexed, or are CPI-W indexed. That explains why the benefits of long career workers are more sensitive to the choice of index than shorter career workers whose post 60 earnings make up a smaller share of their 35 highest earning years.

Table 5: The Maximum Wage Earners 35 best years, alternative indexing procedures

date of birth: 1930

		A. SSA: Wage indexed earnings until 60; then not					B. Wage Indexed		C. Wage Indexed until 60; then CPI		D. CPI indexed	
								Retire at 75		Retire at 75		Retire at 75
age	year	partly indexed earnings (1)	rank (2)	Retire at 62 high 35 earnings (3)	Retire at 65 high 35 earnings (4)	Retire at 75 high 35 earnings (5)	indexed earnings (6)	high 35 earnings (7)	indexed earnings (8)	high 35 earnings (9)	indexed earnings (10)	high 35 earnings (11)
21	1951	27,044	23	27,044	27,044		27,044		27,044		17,849	
22	1952	25,460	29	25,460	25,460		25,460		25,460		17,384	
23	1953	24,113	35	24,113			24,113		24,113		17,256	
24	1954	23,989	37				23,989		23,989		17,256	
25	1955	26,751	24	26,751	26,751		26,751		26,751		20,207	
26	1956	25,002	32	25,002	25,002		25,002		25,002		19,839	
27	1957	24,252	34	24,252			24,252		24,252		19,143	
28	1958	24,040	36				24,040		24,040		18,748	
29	1959	26,177	28	26,177	26,177		26,177		26,177		21,208	
30	1960	25,189	31	25,189	25,189		25,189		25,189		20,923	
31	1961	24,698	33	24,698			24,698		24,698		20,715	
32	1962	23,520	38				23,520		23,520		20,443	
33	1963	22,957	39				22,957		22,957		20,179	
34	1964	22,056	40				22,056		22,056		19,921	
35	1965	21,666	41				21,666		21,666		19,608	
36	1966	28,103	21	28,103	28,103	28,103	28,103	28,103	28,103	28,103	26,138	
37	1967	26,621	25	26,621	26,621		26,621		26,621		25,440	
38	1968	29,437	20	29,437	29,437	29,437	29,437	29,437	29,437	29,437	28,785	28,785
39	1969	27,829	22	27,829	27,829	27,829	27,829	27,829	27,829	27,829	27,237	27,237
40	1970	26,513	27	26,513	26,513		26,513		26,513		25,782	
41	1971	25,245	30	25,245	25,245		25,245		25,245		24,713	
42	1972	26,529	26	26,529	26,529		26,529		26,529		27,704	27,704
43	1973	29,960	19	29,960	29,960	29,960	29,960	29,960	29,960	29,960	31,107	31,107
44	1974	34,563	17	34,563	34,563	34,563	34,563	34,563	34,563	34,563	34,089	34,089
45	1975	34,353	18	34,353	34,353	34,353	34,353	34,353	34,353	34,353	33,484	33,484
46	1976	34,870	16	34,870	34,870	34,870	34,870	34,870	34,870	34,870	34,445	34,445
47	1977	35,479	14	35,479	35,479	35,479	35,479	35,479	35,479	35,479	34,851	34,851
48	1978	35,259	15	35,259	35,259	35,259	35,259	35,259	35,259	35,259	34,627	34,627
49	1979	41,948	13	41,948	41,948	41,948	41,948	41,948	41,948	41,948	39,983	39,983
50	1980	43,523	12	43,523	43,523	43,523	43,523	43,523	43,523	43,523	40,100	40,100
51	1981	45,344	11	45,344	45,344	45,344	45,344	45,344	45,344	45,344	41,529	41,529
52	1982	46,885	10	46,885	46,885	46,885	46,885	46,885	46,885	46,885	42,859	42,859
53	1983	49,261	8	49,261	49,261	49,261	49,261	49,261	49,261	49,261	46,144	46,144
54	1984	49,263	7	49,263	49,263	49,263	49,263	49,263	49,263	49,263	47,168	47,168
55	1985	49,500	6	49,500	49,500	49,500	49,500	49,500	49,500	49,500	47,941	47,941
56	1986	50,986	3	50,986	50,986	50,986	50,986	50,986	50,986	50,986	50,191	50,191
57	1987	49,984	5	49,984	49,984	49,984	49,984	49,984	49,984	49,984	50,217	50,217
58	1988	48,943	9	48,943	48,943	48,943	48,943	48,943	48,943	48,943	49,622	49,622
59	1989	50,217	4	50,217	50,217	50,217	50,217	50,217	50,217	50,217	50,569	50,569
60	1990	51,300	2	51,300	51,300	51,300	51,300	51,300	51,300	51,300	51,300	51,300
61	1991	53,400	1	53,400	53,400	53,400	51,482	51,482	51,497	51,497	51,497	51,497
62	1992	55,500			55,500	55,500	50,884	50,884	51,941	51,941	51,941	51,941
63	1993	57,600			57,600	57,600	52,359	52,359	52,544	52,544	52,544	52,544
64	1994	60,600			60,600	60,600	53,647	53,647	53,770	53,770	53,770	53,770
65	1995	61,200				61,200	52,090	52,090	52,929	52,929	52,929	52,929
66	1996	62,700				62,700	50,878	50,878	52,683	52,683	52,683	52,683
67	1997	65,400		**Not**		65,400	50,143	50,143	53,803	53,803	53,803	53,803
68	1998	68,400		**Indexed**		68,400	49,835	49,835	55,532	55,532	55,532	55,532
69	1999	72,600				72,600	50,103	50,103	57,540	57,540	57,540	57,540
70	2000	76,200				76,200	49,832	49,832	58,329	58,329	58,329	58,329
71	2001	80,400				80,400	51,353	51,353	59,988	59,988	59,988	59,988
72	2002	84,900				84,900	53,689	53,689	62,449	62,449	62,449	62,449
73	2003	87,000				87,000	53,704	53,704	62,681	62,681	62,681	62,681
74	2004	87,900				87,900	51,849	51,849	61,687	61,687	61,687	61,687
Sum through age 60				1,200,601	1,127,539	867,007		867,007		867,007		843,952
Sum from age 61 to retirement				53,400	227,100	973,800		721,849		787,371		787,371
TOTAL (Best 35 years)				1,254,001	1,354,639	1,840,807		1,588,857		1,654,379		1,631,324
AIME (Total/35*12)				2,985	3,225	4,382		3,782		3,938		3,884
PIA at eligibility				1,069	1,105	1,278		1,188		1,212		1,204
Annual benefit				10,260	14,400	25,812		24,000		24,468		24,312

The bottom row on Table 5 reports the resulting OASI benefit. Comparing column 5 with column 3 reveals that working to age 75 instead of to 62 replaces thirteen low earning years in the 1950s, 1960s and early 1970's with high unindexed earnings from 1991 on.

As a result of the partial indexing procedure, less than half of the total earnings for the worker who continues to earn the cap to age 75, column 5, are indexed. The PIA at eligibility, used in calculating the worker's benefits, is 7.6% higher with incomplete wage indexing than would be generated by the case of full wage indexing of column 7. Columns 9 and 11 show how the PIA and hence the benefit for a worker retiring at 75 would be affected by the adoption of alternative full indexing procedures.

Table 6: Selecting the 35 best years for Minimum and Average Wage Workers

date of bireth: 1930

		Minimum Wage Worker										Average Income	
		A. SSA: Wage indexed earnings until 60, then not ……..……				B. Wage Indexed …….		C. Wage Indexed until 60; then CPI		D. CPI indexed ……..		A. SSA: Wage Indexed until 60, then not	
		partly	Retire at 62	Retire at 65	Retire at 75		Retire at 75		Retire at 75		Retire at 75		Retire at 75
year	earnings	indexed earnings	high 35 earnings	high 35 earnings	high 35 earnings	indexed earnings	high 35 earnings	indexed earnings	high 35 earnings	indexed earnings	high 35 earnings	indexed earnings	high 35 earnings
		(1)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1951	1,500	11,268	11,268	11,268	11,268	11,268	11,268	11,268	11,268	7,437		21,028	21,028
1952	1,500	10,608	10,608	10,608	10,608	10,608	10,608	10,608	10,608	7,243		21,028	
1953	1,500	10,047	10,047	10,047	10,047	10,047	10,047	10,047	10,047	7,190		21,028	21,028
1954	1,500	9,995	9,995	9,995	9,995	9,995	9,995	9,995	9,995	7,190		21,028	21,028
1955	1,500	9,554	9,554	9,554		9,554	9,554	9,554	9,554	7,217		21,028	
1956	1,917	11,410	11,410	11,410	11,410	11,410	11,410	11,410	11,410	9,054	9,054	21,028	
1957	2,000	11,548	11,548	11,548	11,548	11,548	11,548	11,548	11,548	9,116	9,116	21,028	
1958	2,000	11,448	11,448	11,448	11,448	11,448	11,448	11,448	11,448	8,928	8,928	21,028	
1959	2,000	10,907	10,907	10,907	10,907	10,907	10,907	10,907	10,907	8,837	8,837	21,028	
1960	2,000	10,495	10,495	10,495	10,495	10,495	10,495	10,495	10,495	8,718	8,718	21,028	
1961	2,100	10,805	10,805	10,805	10,805	10,805	10,805	10,805	10,805	9,063	9,063	21,028	21,028
1962	2,300	11,270	11,270	11,270	11,270	11,270	11,270	11,270	11,270	9,796	9,796	21,028	
1963	2,367	11,319	11,319	11,319	11,319	11,319	11,319	11,319	11,319	9,949	9,949	21,028	21,028
1964	2,500	11,487	11,487	11,487	11,487	11,487	11,487	11,487	11,487	10,375	10,375	21,028	
1965	2,500	11,284	11,284	11,284	11,284	11,284	11,284	11,284	11,284	10,212	10,212	21,028	21,028
1966	2,500	10,645	10,645	10,645	10,645	10,645	10,645	10,645	10,645	9,901	9,901	21,028	21,028
1967	2,775	11,193	11,193	11,193	11,193	11,193	11,193	11,193	11,193	10,697	10,697	21,028	
1968	3,167	11,951	11,951	11,951	11,951	11,951	11,951	11,951	11,951	11,686	11,686	21,028	21,028
1969	3,200	11,417	11,417	11,417	11,417	11,417	11,417	11,417	11,417	11,174	11,174	21,028	21,028
1970	3,200	10,877	10,877	10,877	10,877	10,877	10,877	10,877	10,877	10,577	10,577	21,028	21,028
1971	3,200	10,357	10,357	10,357	10,357	10,357	10,357	10,357	10,357	10,139	10,139	21,028	
1972	3,200	9,432	9,432	9,432		9,432	9,432	9,432	9,432	9,850	9,850	21,028	21,028
1973	3,200	8,877	8,877	8,877		8,877	8,877	8,877	8,877	9,217	9,217	21,028	21,028
1974	3,733	9,775	9,775	9,775	9,775	9,775	9,775	9,775	9,775	9,641	9,641	21,028	21,028
1975	4,200	10,233	10,233	10,233	10,233	10,233	10,233	10,233	10,233	9,974	9,974	21,028	21,028
1976	4,600	10,484	10,484	10,484	10,484	10,484	10,484	10,484	10,484	10,356	10,356	21,028	
1977	4,600	9,891	9,891	9,891	9,891	9,891	9,891	9,891	9,891	9,716	9,716	21,028	21,028
1978	5,300	10,558	10,558	10,558	10,558	10,558	10,558	10,558	10,558	10,369	10,369	21,028	
1979	5,800	10,624	10,624	10,624	10,624	10,624	10,624	10,624	10,624	10,127	10,127	21,028	
1980	6,200	10,419	10,419	10,419	10,419	10,419	10,419	10,419	10,419	9,599	9,599	21,028	
1981	6,700	10,229	10,229	10,229	10,229	10,229	10,229	10,229	10,229	9,368	9,368	21,028	21,028
1982	6,700	9,695	9,695	9,695		9,695	9,695	9,695	9,695	8,863	8,863	21,028	
1983	6,700	9,245	9,245	9,245		9,245	9,245	9,245	9,245	8,660	8,660	21,028	21,028
1984	6,700	8,732	8,732	8,732		8,732	8,732	8,732	8,732	8,361	8,361	21,028	21,028
1985	6,700	8,375	8,375			8,375	8,375	8,375	8,375	8,111	8,111	21,028	
1986	6,700	8,134				8,134		8,134		8,007	8,007	21,028	
1987	6,700	7,646				7,646		7,646		7,682		21,028	21,028
1988	6,700	7,287				7,287		7,287		7,388		21,028	
1989	6,700	7,009				7,009		7,009		7,059		21,028	21,028
1990	7,375	7,375				7,375		7,375		7,375		21,028	21,028
1991	8,275	8,275				7,978		7,980		7,980	7,980	21,812	21,812
1992	8,500	8,500		8,500		7,793		7,955		7,955		22,935	22,935
1993	8,500	8,500				7,727		7,754		7,754		23,133	23,133
1994	8,500	8,500				7,525		7,542		7,542		23,754	23,754
1995	8,500	8,500				7,235		7,351		7,351		24,706	24,706
1996	8,750	8,750				7,100		7,352		7,352		25,914	25,914
1997	9,767	9,767	**Not**			7,488		8,035		8,035	8,035	27,426	27,426
1998	10,300	10,300	**Indexed**		10,300	7,504		8,362		8,362	8,362	28,861	28,861
1999	10,300	10,300			10,300	7,108		8,163		8,163	8,163	30,470	30,470
2000	10,300	10,300			10,300	6,736		7,884		7,884		32,155	32,155
2001	10,300	10,300			10,300	6,579		7,685		7,685		32,922	32,922
2002	10,300	10,300			10,300	6,514		7,576		7,576		33,252	33,252
2003	10,300	10,300			10,300	6,358		7,421		7,421		34,065	34,065
2004	10,300	10,300			10,300	6,076		7,228		7,228		35,649	35,649
Sum through age 60			366,457	358,082	302,547		366,457		366,457		298,439		441,587
Sum from age 61 to retirem			0	8,500	72,100		0		0		32,541		397,052
TOTAL (Best 35 years)			366,457	366,582	374,647		366,457		366,457		330,980		838,640
AIME (Total/35*12)			872	872	892		872		872		788		1,996
PIA at eligibility			504	504	510		504		504		477		863
Annual benefit			4,824	6,564	10,296		10,164		10,164		9,624		17,424

Minimum Wage Earner

A worker who earned only the minimum wage throughout an equally long career has a quite different outcome. As can be seen by comparing the maximum and minimum wage rows of Table 4, this least advantaged worker's benefits are not affected as much by the undeflated earnings problem. Why? As can be seen from Table 6, our worker's earnings after age 60, with or without indexing, do not count as strongly among the 35 highest earning years of equation (4) because the minimum wage was allowed to fall so far behind inflation. Indeed, the real minimum wage, indexed with CPI-W in column 10, was lower in 2004 than it was in 1951.

Average income earner

The average workers indexed income is recorded in column (12) of Table 6. It is a constant $21,028 through our worker's 60th birthday because it is deflated with the wage index constructed with the same nominal series. After the 60th birthday the undeflated wage data is used by the SSA. Because of the wage inflation, the income for all years worked after age 60 is included among the 35 highest. None the less, the gain in benefits from postponing retirement is not as great as that of the maximum income worker because of the increased skewness of the income distribution.

Recommendation

Partial indexing is indefensible. It obviously contributes to Social Security's financial problems, although a precise estimate of its total impact must be left for future research based on a detailed analysis of micro data sets.[7] As shown on Table 3, in some cases it awards the largest benefit bonus to the highest income earners. Correcting this problem would probably not affect a worker's decision as to when to retire because it is doubtful that many contemplating delayed retirement know about the bonus.

Indexing Problem #2: Skipped 61st Year Inflation Adjustment

In computing benefits, a worker's earnings are adjusted for wage inflation with an index normalized to equal 100 in the year of the workers 60th birthday ($t = t^b+60$). But the inflation adjustment ratio p_{t-1} / p_{t^b+61} in (6) starts in the year of the 61st birthday. Hence the inflation from age 60 to age 61 is skipped and as a result the Primary Insurance Amount determined by that equation is understated by the ratio p_{t^b+61} / p_{t^b+60}.

Skipping the 61st year inflation means that our worker's OASI is less not only in that year but in every year of retirement. More than this, the spousal and survivor benefits, if exercised are reduced by the same percentage. It is a Social Security lottery, for how much a worker loses from the skipped inflation of the 61st year depends entirely on what the rate of CPI-W inflation happens to be in that year. Those born in 1930 should consider themselves lucky, for prices increased only 3.7% in the year of their 61st birthday, just below the long-run 1952-2006 average of 3.8%. Those born a year earlier were not so fortunate, for their 61st year inflation rate was 5.32%. If in the future we encounter an inflation rate on the order of 12.77%, such as the U.S. experienced in 1980, workers 61 years of age will suffer a 12.77% reduction in the purchasing power of their benefits in every year of their retirement.[8]

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[7] Diamond and Orszag briefly mention the incomplete indexing problem (2005: 274, fn 24), but its budget implications were not evaluated by either the Social Security Administration or the Congressional Budget Office(2004) in estimating the long run financial implications of the program changes they proposed.

[8] Workers who were 61 in 1980 did not suffer this big a reduction in real benefits because the 1977 Amendments to the Social Security Act to correct the original indexing procedures included a special "Transitional Guarantee Method" for calculating benefits for workers born in 1917-21 (Steven F. McKay: 1980). Nevertheless, the reductions were substantial, leading to the formation of the politically active "Notch Generation."

Recommendation

The obvious remedy is to make the calculation include the CPI-W inflation that is experienced in the 61st year. Historically, inflation as measured by the SSA has averaged about 3.8% over the years. This suggests that the omission of the 61st year in computing OASI benefits saves 3.8% of the OASI benefit budget on average, which it can ill afford to lose. Given the financial pressures on the SSA, it might be most appropriate to maintain budget neutrality when making the correction by coupling the "reform" with a proportional reduction of benefits across the board, as has been suggested by Diamond and Orszag (2005:112). Essentially, this replaces the skipped 61st year inflation lottery with an estimate of average inflation, which is an obvious benefit for the risk adverse.

Indexing Problem #3: The One Year Indexing Lag

As can be seen from equation (6), there is a one year lag in adjusting benefits for price inflation because inflation is missed in the benefit year for the obvious reason that it has yet to be experienced – the current year p_t will not be known until near the end of that year.[9]

Because the one year inflation indexing lag treats equally every age cohort of those currently receiving OASI benefits, the erratic year-to-year fluctuation in the purchasing power of OASI benefits is not nearly as serious as the Skipped 61st year problem, which penalizes those who had the misfortune to experience particularly severe inflation in their 61st year. Furthermore, since retirees generally have expenditures with sticky prices, such as real estate taxes or rents, the skipped benefit year problem is not too serious as long as the inflation does not become intense.

Recommendation:

The problem is that benefits must be determined in advance when obviously the rate of inflation that will prevail is not known. It might be possible to use a predicted rate of inflation together with a simple fine-tuning error-correction adjustment to allow for the prediction error of the preceding year, such as

$$B_t = (\hat{p}_t / p_{t-1})B_{t-1} - (\hat{p}_{t-1} - p_{t-1} / p_{t-2})B_{t-2}\,, \tag{8}$$

where B_t is the benefit in year t, $\hat{p}_t$ is anticipated price level, and p_t the actual price level. With the simplest forecast, same as last year ($\hat{p}_t = p_{t-1}$), this reduces to

$$B_t = B_{t-1} + (p_{t-1} - p_{t-2} / p_{t-2})B_{t-2}\,. \tag{9}$$

It might be better to use a Box-Jenkins forecast of $\hat{p}_t$ instead of p_{t-1} or, alternatively, a forecast provided by an accepted authority, such as the Chairman of the Federal Reserve Board or the Commissioner of Labor Statistics. The same revision procedure might also be used to avoid the two year lag involved in the adjustment of the PIA function bend points, equation (6), for changes in the Average Wage Index.

The adoption of a revision procedure, such as equation (8), has an additional benefit: It would allow the fixed weight CPI-W index, which has as its primary advantage that it is seldom revised, to be replaced with a more appropriate superlative index recognizing that in response to price changes consumers change the composition of their market basket of purchases, substituting away from commodities that increase most in price. The National Research Council's Panel on Conceptual, Measurement, and Other Statistical Issues in Developing Cost-of-Living Indexes, proposed in *At What Price* (2002, Conclusion #7.1:194):

[9] More precisely, the 3rd quarter to 3rd quarter change in the CPI-W, as will be explained in Section 5.Wage and Price Indices.

"It would be feasible and appropriate to calculate cost-of-living allowances provided for by social security and other programs from an advance estimate of the BLS published superlative index. Any divergence between that estimate and the superlative that appears 2 years later could be incorporated as a correction to the cost-of-living allowance provided for that year."

However, it would not be possible to correct divergences occurring during the last two years of life.

Indexing Problem #4: The 60th year Wage Index Bounce

It may seem counterintuitive, but OASI benefits are hypersensitive to what the level of average wage income happens to be in the worker's 60th year. To see why, recall that as one of the very first steps in calculating OASI benefits, annual earnings up to the worker's 60th year are indexed with the Average Wage Index, which is normalized to equal 100 in the workers 60th year. Differentiating equation (2) defining the wage index with respect to the average wage in the worker's 60th year, yields

$$\frac{\partial w_t}{\partial \bar{E}^{w-2}_{t_b+60}} = -\bar{E}_t / \bar{E}^2_{t_b+60} = -w_t / \bar{E}_{t_b+60} < 0 \tag{10}$$

and elasticity

$$\eta = -\frac{\partial w_t}{\partial \bar{E}^{w-2}_{t_b+60}} \frac{\bar{E}^{w-2}_{t_b+60}}{w_t} = 1. \tag{11}$$

Consequently, the percentage change in indexed earnings up to year 60 is also equal to the percentage change in $\bar{E}^{w-2}_{t^b+60}$. However, indexed earnings in year t^b+60 do not change because by construction $w_{t^b+60} = 1$. Further, post age 60 earnings are not affected by the wage index bounce because earnings after age 60 are not deflated. Therefore, a worker's AIME will not change by as large a percentage as the increase in the average wage in the 60th year. However, benefits derived from the new AIME will increase because the bend points defining the function plotted on Figure 2 will shift upwards in proportion to the wage inflation.

To illustrate the index bounce problem, consider an experimental shift of $480 from the National Average Wage income of 1991 to 1990; i.e., we increase the 1990 average wage from $21,028 to $21,508 (2.3%) and decrease the 1991 level from $21,812 to $21,332, as illustrated on column E1 of Table 7. This perturbation is equal to the standard deviation of annual changes in the NAW. It is small relative to the $1,208 jump in the NAW from 1995 to 1996. It does not affect the total undeflated lifetime income or the total OASI tax payments of the Average Worker born in 1930. And there is no change in either the income or the taxes of the Maximum Income or the Minimum Wage Worker. Nevertheless, the perturbation does make quite a difference to the worker's OASI benefit throughout retirement.

Table 7 shows how the wage index used for calculating the benefits for this and all other workers of the same age, because they are normalized to equal 100 in the 60th year, will be lower in all the other working years (Compare columns E6 with C6). When the worker's nominal earnings for all years prior to the 60th are divided by the revised index, the indexed earnings will be about 2.3% higher than if the shift had not occurred (column E10). Also, the change in the National Average Wage in 1990 increases the bend points of the PIA function, which provides a further push to benefits. As can be seen from the bottom line of Table 7, the income shift plus the Bend Point adjustments increases our maximum income workers annual benefit by $432, or 1.7%, if she continues working to age 75.

Table 7: Experiment ~ Shift $480 of Average Worker's annual income from 1991 to 1990

Effect on Maximum Wage Earner who retires at 75; Wage Indexed only until age 60, then not

				CONTROL (See Table 1)……				EXPERIMENT: Shift $480 from 1991 to 1990				DIFFERENCE
					partly	Retire at 75		Purturbed		partly	Retire at 75	
		CPI	Max	Wage index	indexed		high 35	National	Wage index	indexed		high 35	
age	year	1990=100	earnings	1990=100	earnings	rank	index earn	Average Wage	1990=100	earnings	rank	index earn	percent
			(C1)	(C6)	(C7)	(C8)	(C9)	(E1)	(E6)	(E7)	(E8)	(E9)	(E10)
21	1951	20.2	3,600	13.3	27,044	36		2,799	13.0	27,661	36		2.3%
22	1952	20.7	3,600	14.1	25,460	42		2,973	13.8	26,041	42		2.3%
23	1953	20.9	3,600	14.9	24,113	48		3,139	14.6	24,663	48		2.3%
24	1954	20.9	3,600	15.0	23,989	50		3,156	14.7	24,537	50		2.3%
25	1955	20.8	4,200	15.7	26,751	37		3,301	15.3	27,362	37		2.3%
26	1956	21.2	4,200	16.8	25,002	45		3,532	16.4	25,573	45		2.3%
27	1957	21.9	4,200	17.3	24,252	47		3,642	16.9	24,805	47		2.3%
28	1958	22.4	4,200	17.5	24,040	49		3,674	17.1	24,589	49		2.3%
29	1959	22.6	4,800	18.3	26,177	41		3,856	17.9	26,775	41		2.3%
30	1960	22.9	4,800	19.1	25,189	44		4,007	18.6	25,764	44		2.3%
31	1961	23.2	4,800	19.4	24,698	46		4,087	19.0	25,262	46		2.3%
32	1962	23.5	4,800	20.4	23,520	51		4,291	20.0	24,057	51		2.3%
33	1963	23.8	4,800	20.9	22,957	52		4,397	20.4	23,481	52		2.3%
34	1964	24.1	4,800	21.8	22,056	53		4,576	21.3	22,559	53		2.3%
35	1965	24.5	4,800	22.2	21,666	54		4,659	21.7	22,160	54		2.3%
36	1966	25.3	6,600	23.5	28,103	34	28,103	4,938	23.0	28,745	34	28,745	2.3%
37	1967	25.9	6,600	24.8	26,621	38		5,213	24.2	27,228	38		2.3%
38	1968	27.1	7,800	26.5	29,437	33	29,437	5,572	25.9	30,109	33	30,109	2.3%
39	1969	28.6	7,800	28.0	27,829	35	27,829	5,894	27.4	28,464	35	28,464	2.3%
40	1970	30.3	7,800	29.4	26,513	40		6,186	28.8	27,119	40		2.3%
41	1971	31.6	7,800	30.9	25,245	43		6,497	30.2	25,821	43		2.3%
42	1972	32.5	9,000	33.9	26,529	39		7,134	33.2	27,134	39		2.3%
43	1973	34.7	10,800	36.0	29,960	32	29,960	7,580	35.2	30,644	32	30,644	2.3%
44	1974	38.7	13,200	38.2	34,563	30	34,563	8,031	37.3	35,352	30	35,352	2.3%
45	1975	42.1	14,100	41.0	34,353	31	34,353	8,631	40.1	35,137	31	35,137	2.3%
46	1976	44.4	15,300	43.9	34,870	29	34,870	9,226	42.9	35,666	29	35,666	2.3%
47	1977	47.3	16,500	46.5	35,479	27	35,479	9,779	45.5	36,289	27	36,289	2.3%
48	1978	51.1	17,700	50.2	35,259	28	35,259	10,556	49.1	36,064	28	36,064	2.3%
49	1979	57.3	22,900	54.6	41,948	26	41,948	11,479	53.4	42,906	26	42,906	2.3%
50	1980	64.6	25,900	59.5	43,523	25	43,523	12,513	58.2	44,517	25	44,517	2.3%
51	1981	71.5	29,700	65.5	45,344	24	45,344	13,773	64.0	46,379	24	46,379	2.3%
52	1982	75.6	32,400	69.1	46,885	23	46,885	14,531	67.6	47,956	23	47,956	2.3%
53	1983	77.4	35,700	72.5	49,261	21	49,261	15,239	70.9	50,385	21	50,385	2.3%
54	1984	80.1	37,800	76.7	49,263	20	49,263	16,135	75.0	50,387	20	50,387	2.3%
55	1985	82.6	39,600	80.0	49,500	19	49,500	16,823	78.2	50,630	19	50,630	2.3%
56	1986	83.7	42,000	82.4	50,986	16	50,986	17,322	80.5	52,150	15	52,150	2.3%
57	1987	87.2	43,800	87.6	49,984	18	49,984	18,427	85.7	51,125	18	51,125	2.3%
58	1988	90.7	45,000	91.9	48,943	22	48,943	19,334	89.9	50,060	22	50,060	2.3%
59	1989	94.9	48,000	95.6	50,217	17	50,217	20,100	93.5	51,363	16	51,363	2.3%
60	1990	100.0	51,300	100.0	51,300	15	51,300	**21,508**	100.0	51,300	17	51,300	0.0%
61	1991	103.7	53,400	103.7	53,400	14	53,400	**21,332**	99.2	53,400	14	53,400	0.0%
62	1992	106.9	55,500	109.1	55,500	13	55,500	22,935	106.6	55,500	13	55,500	0.0%
63	1993	109.6	57,600	110.0	57,600	12	57,600	23,133	107.6	57,600	12	57,600	0.0%
64	1994	112.7	60,600	113.0	60,600	11	60,600	23,754	110.4	60,600	11	60,600	0.0%
65	1995	115.6	61,200	117.5	61,200	10	61,200	24,706	114.9	61,200	10	61,200	0.0%
66	1996	119.0	62,700	123.2	62,700	9	62,700	25,914	120.5	62,700	9	62,700	0.0%
67	1997	121.6	65,400	130.4	65,400	8	65,400	27,426	127.5	65,400	8	65,400	0.0%
68	1998	123.2	68,400	137.3	68,400	7	68,400	28,861	134.2	68,400	7	68,400	0.0%
69	1999	126.2	72,600	144.9	72,600	6	72,600	30,470	141.7	72,600	6	72,600	0.0%
70	2000	130.6	76,200	152.9	76,200	5	76,200	32,155	149.5	76,200	5	76,200	0.0%
71	2001	134.0	80,400	156.6	80,400	4	80,400	32,922	153.1	80,400	4	80,400	0.0%
72	2002	136.0	84,900	158.1	84,900	3	84,900	33,252	154.6	84,900	3	84,900	0.0%
73	2003	138.8	87,000	162.0	87,000	2	87,000	34,065	158.4	87,000	2	87,000	0.0%
74	2004	142.5	87,900	169.5	87,900	1	87,900	35,649	165.7	87,900	1	87,900	0.0%
Sum through computation year (age 60)							867,007					885,627	2.1%
Sum post indexing year (age 61 to retirement)							973,800					973,800	0.0%
TOTAL (Best 35 years)							1,840,807					1,859,427	1.0%
Average Indexed Monthly Earnings (Total/35*12)							4,382.80					4,427.20	1.0%
Annual Benefit							25,812.00					26,244.00	1.7%

Table 8 shows that the magnitude of the effect of the wage index bounce on retirement benefits depends on the age of retirement, the indexing procedure used in computing benefits, and the income history of the worker. The bounce has a larger percentage effect on the benefits of workers whose income is below the top break point on the piecewise linear PIA function plotted on Figure 2. If wages are fully CPI indexed, the bounce will be small as it reflects only the shift in the bend points because the CPI index is not affected by the bounce in the average worker's 60th year income (it would be affected by revisions of the CPI in the 60th year).

Table 8: Experiment ~ Summary of the Effect of a $480 Pip in Year 1990 Income

	A. SSA: Wage indexed only until 60				B. Wage Indexed Earnings			
Age of Retiree:	62	65	70	75	62	65	70	75
Age Benefits Started:	62	65	70	70	62	65	70	70
Nominal (at age benefit started)								
Maximum Wage Earner	10,488	14,700	21,444	26,244	10,488	14,640	20,904	24,552
Average Wage Earner	7,704	10,512	14,832	17,688	7,704	10,464	14,364	16,212
Median Wage Earner	6,108	8,292	11,376	12,852	6,108	8,292	11,388	12,948
Minimum Wage Earner	4,944	6,708	9,264	10,500	4,944	6,708	9,204	10,404
Real, CPI-W, year 2005 = 100	72.0	77.9	88.1	100.0				
Maximum Wage Earner	14,561	18,859	24,350	26,244	14,561	18,782	23,737	24,552
Average Wage Earner	10,696	13,486	16,842	17,688	10,696	13,425	16,311	16,212
Median Wage Earner	8,480	10,638	12,918	12,852	8,480	10,638	12,931	12,948
Minimum Wage Earner	6,864	8,606	10,520	10,500	6,864	8,606	10,451	10,404
DIFFERENCE ~ Experiment Results less Control Results from Table 4								
Nominal (at age benefit started)								
Maximum Wage Earner	228	300	396	432	240	324	468	552
Average Wage Earner	168	204	264	264	168	228	324	360
Median Wage Earner	144	180	252	288	144	180	240	252
Minimum Wage Earner	120	144	204	204	120	144	204	240
Real, CPI-W, year 2005 = 100								
Maximum Wage Earner	317	385	450	432	333	416	531	552
Average Wage Earner	233	262	300	264	233	293	368	360
Median Wage Earner	200	231	286	288	200	231	273	252
Minimum Wage Earner	167	185	232	204	167	185	232	240
Percent								
Maximum Wage Earner	2.2%	2.0%	1.8%	1.6%	2.3%	2.2%	2.2%	2.2%
Average Wage Earner	2.2%	1.9%	1.8%	1.5%	2.2%	2.2%	2.3%	2.2%
Median Wage Earner	2.4%	2.2%	2.2%	2.2%	2.4%	2.2%	2.1%	1.9%
Minimum Wage Earner	2.4%	2.1%	2.2%	1.9%	2.4%	2.1%	2.2%	2.3%

	C. Wage Indexed to 60, then CPI				D. CPI indexed Earnings			
Age of Retiree:	62	65	70	75	62	65	70	75
Age Benefits Started:	62	65	70	75	62	65	70	75
Nominal (at age benefit started)								
Maximum Wage Earner	10,476	14,628	20,964	24,900	10,140	14,244	20,616	24,600
Average Wage Earner	7,704	10,464	14,436	16,548	7,272	10,008	14,040	16,272
Median Wage Earner	6,108	8,292	11,388	12,948	5,712	7,812	10,824	12,396
Minimum Wage Earner	4,944	6,708	9,204	10,404	4,608	6,264	8,616	9,732
Real, CPI-W, year 2005 = 100	72.0	77.9	88.1	100.0				
Maximum Wage Earner	14,544	18,767	23,805	24,900	14,078	18,274	23,410	24,600
Average Wage Earner	10,696	13,425	16,393	16,548	10,096	12,840	15,943	16,272
Median Wage Earner	8,480	10,638	12,931	12,948	7,930	10,022	12,291	12,396
Minimum Wage Earner	6,864	8,606	10,451	10,404	6,397	8,036	9,784	9,732
DIFFERENCE ~ Experiment Results less Control Results from Table 4								
Nominal (at age benefit started)								
Maximum Wage Earner	228	300	396	432	132	192	252	288
Average Wage Earner	168	228	276	288	48	60	96	108
Median Wage Earner	144	180	240	252	48	72	96	108
Minimum Wage Earner	120	144	204	240	48	72	96	108
Real, CPI-W, year 2005 = 100								
Maximum Wage Earner	317	385	450	432	183	246	286	288
Average Wage Earner	233	293	313	288	67	77	109	108
Median Wage Earner	200	231	273	252	67	92	109	108
Minimum Wage Earner	167	185	232	240	67	92	109	108
Percent								
Maximum Wage Earner	0.9%	1.2%	1.6%	1.7%	0.5%	0.8%	1.0%	1.2%
Average Wage Earner	0.7%	0.9%	1.1%	1.2%	0.2%	0.2%	0.4%	0.4%
Median Wage Earner	0.6%	0.7%	1.0%	1.0%	0.2%	0.3%	0.4%	0.4%
Minimum Wage Earner	0.5%	0.6%	0.8%	1.0%	0.2%	0.3%	0.4%	0.4%

This bounce would cause an increase in OASI expenditures for year 1990. In subsequent years, the higher payments to workers of the 1930 birth cohort would be approximately offset by the lower payments to workers in the 1931 birth cohort, and assuming roughly equal mortality rates, in the long run it would approximately cancel out. The problem is that it is manifestly unfair to have benefits vary between different birth cohorts of workers because the calculation procedure is hypersensitive to movements in income in the year of one's 60th birthday. In our experiment the bounce in annual benefits with partial wage indexing ranges from 1.3% to 1.9%. This would not be deemed insignificant, at least by the minimum wage earner. And its size is roughly proportional to the size of the shift.

Recommendation

It is not easy to devise a remedy for the 60th year bounce, but it would mitigate the problem somewhat if the SSA, instead of indexing to just age 60, would smooth the wage index, perhaps by using a three year average (ages 59 through 61) as is the practice of the BLS in constructing CPI indexes.[10] Also, employing a Median Wage Index instead of the Average (arithmetic mean) Wage Index might help because it may be more stable than the average.[11]

Indexing Problem #5: Taxing OASI Benefits

The IRS has collected income taxes on OASI benefits since 1983. Initially, only 50% of OASI benefits were counted in taxable income by the IRS, and then only if the married couple's combined income was more then $32,000; for single tax payers the income threshold was $25,000. In 1993, the tax rate was imposed on 85% of OASI benefits for joint-filers with combined income above $44,000; for single taxpayers this second threshold is $34,000.

Because the OASI tax paid by a worker from after-tax income is matched by the employer, which is before-tax income, the tax on 50% of OASI benefits that was imposed in 1983 is roughly comparable to the tax imposed on a worker who places equal amounts in a Roth IRA purchased with after tax money and a traditional IRA financed with before-tax money. In this sense, taxing 85% of OASI benefits appears to involve less favorable tax treatment than is currently available with an even mix of Roth and traditional IRA's.

Although tax bracket thresholds for the personal income tax have been indexed since 1985, the thresholds for the tax on OASI benefits have not been adjusted for inflation. This means that the income tax imposed on OASI benefits has gradually reached further and further down the income distribution. If the $32,000, $25,000 brackets established in 1983 had been indexed to the CPI, by 2008 they would have been adjusted to $64,805 for married and $50,629 for single tax fillers for the CPI-W slightly more than doubled during that 25 year time span. Burman and Saleem(2004) estimate that the percentage of households paying taxes on their OASI benefits will increase from 36% in 2004 to 40% in 2014. See also Munnell and Muldoon (2008).

Recommendation

The failure to index tax brackets for inflation has allowed rising prices to impose what amounts to a new tax on middle income retirees. The fact that the income tax revenue collected from taxing OASI benefits is dedicated to the Medicare Trust Fund does not justify failing to index the exemption thresholds.

4. Inflation Experiments

Compared to many countries, the United States has enjoyed fairly stable prices over the years. But suppose the long run rate of inflation were to accelerate? How would this affect different income groups? And how would it affect the financial viability of the Old Age and Survivor Trust Funds? Incomplete indexing of OASI benefits means that the system is exposed to financial disruption from fluctuations in the rate of inflation. Three experiments will show how the

[10] A three-year centered moving average would have reduced the variance of the Average Wage Index over the years 1961-2004 by 19% and of the CPI-W by 10%.

[11] The median is that value which minimizes the Mean Absolute Deviation = $\sum |x_t - x_{median}| / n$ while the mean is that value that minimizes the variance = $\sum (x_i - \bar{x})^2 / n$. The variance may be more sensitive to extreme values because the deviations from the mean are squared. It might also be argued that the median is a better measure of wellbeing because maximizing the median is the same as maximizing average utility *if* income is approximately log normally distributed and utility(x_i) = log(x_i).

choice of deflator affects the sensitivity of real benefits to changes in the trend inflation rate. For comparison, the results for counterfactual inflation trends will be contrasted with the control provided by historical inflation experience reported on Table 4.

Experiment #1: 5% more inflation

The first experiment, reported on Table 9, involves tilting both the CPI-W and the AWI by an extra 5% of inflation per annum, starting in 1991. This superimposes a steeper trend on the two series but preserves the historical fluctuations in the gap between them. To preserve comparability, the series were normalized so as to be at the original historical level in 1990, which meant that precisely the same bend points could be utilized as before and Figure 2 still presents the relationship between the PIA and AIME. In this experiment the CPI-W (1990 = 100) had increased to 308 by 2005, substantially above the control level of 148 for that year. As a result, the deflated data are more revealing, particularly when they are compared with the real outcomes of the control.

Table 9: Replaying History: Control versus 5% higher inflation rate

	A. SSA: Wage indexed only until 60				B. Wage Indexed Earnings			
Age of Retiree:	62	65	70	75	62	65	70	75
Age Benefits Started:	62	65	70	70	62	65	70	70
Nominal (at age benefit started)								
Maximum Wage Earner	10,260	16,836	32,700	55,536	10,248	16,572	30,204	45,252
Average Wage Earner	7,548	12,072	22,944	37,836	7,536	11,844	20,736	29,904
Median Wage Earner	5,964	9,384	16,440	23,688	5,964	9,384	16,476	23,940
Minimum Wage Earner	4,836	7,632	13,776	21,108	4,824	7,596	13,296	19,176
Real, CPI-W, actual year 2005 = 100	79.4	99.5	143.4	207.9				
Maximum Wage Earner	12,920	16,924	22,796	26,714	12,905	16,659	21,056	21,767
Average Wage Earner	9,505	12,135	15,995	18,200	9,490	11,906	14,456	14,384
Median Wage Earner	7,510	9,433	11,461	11,394	7,510	9,433	11,486	11,516
Minimum Wage Earner	6,090	7,672	9,604	10,153	6,075	7,636	9,269	9,224
Real, relative to benefit at age of entitlement (62)								
Maximum Wage Earner	1.00	1.31	1.76	2.07	1.00	1.29	1.63	1.69
Average Wage Earner	1.00	1.28	1.68	1.91	1.00	1.25	1.52	1.52
Median Wage Earner	1.00	1.26	1.53	1.52	1.00	1.26	1.53	1.53
Minimum Wage Earner	1.00	1.26	1.58	1.67	1.00	1.26	1.53	1.52
Real comparison: 5% higher inflation relative to control								
Maximum Wage Earner	91%	92%	95%	103%	91%	91%	91%	91%
Average Wage Earner	91%	92%	97%	104%	91%	91%	91%	91%
Median Wage Earner	91%	91%	91%	91%	91%	91%	91%	91%
Minimum Wage Earner	91%	91%	93%	99%	91%	91%	91%	91%

	C. Wage Indexed to 60, then CPI				D. CPI indexed Earnings			
Age of Retiree:	62	65	70	75	62	65	70	75
Age Benefits Started:	62	65	70	75	62	65	70	75
Nominal (at age benefit started)								
Maximum Wage Earner	10,248	16,584	30,396	46,152	10,008	16,272	30,084	45,840
Average Wage Earner	7,536	11,856	20,916	30,672	7,224	11,508	20,604	30,480
Median Wage Earner	5,964	9,384	16,476	23,940	5,664	8,952	15,840	23,172
Minimum Wage Earner	4,824	7,596	13,296	19,176	4,560	7,176	12,588	18,144
Real, CPI-W, actual year 2005 = 100								
Maximum Wage Earner	12,905	16,671	21,190	22,200	12,603	16,357	20,972	22,050
Average Wage Earner	9,490	11,918	14,581	14,754	9,097	11,568	14,363	14,661
Median Wage Earner	7,510	9,433	11,486	11,516	7,132	8,999	11,042	11,146
Minimum Wage Earner	6,075	7,636	9,269	9,224	5,742	7,214	8,775	8,728
Real, relative to benefit at age of entitlement (62)								
Maximum Wage Earner	1.00	1.29	1.64	1.72	1.00	1.30	1.66	1.75
Average Wage Earner	1.00	1.26	1.54	1.55	1.00	1.27	1.58	1.61
Median Wage Earner	1.00	1.26	1.53	1.53	1.00	1.26	1.55	1.56
Minimum Wage Earner	1.00	1.26	1.53	1.52	1.00	1.26	1.53	1.52
Real comparison: 5% higher inflation relative to control								
Maximum Wage Earner	91%	91%	91%	91%	91%	91%	91%	91%
Average Wage Earner	91%	91%	91%	91%	91%	91%	91%	91%
Median Wage Earner	91%	91%	91%	91%	91%	91%	91%	91%
Minimum Wage Earner	91%	91%	91%	91%	91%	91%	91%	91%

Almost everybody loses from the higher inflationary trend. The primary exceptions are maximum, average and median earners who continue working to age 75 while their earnings, under current SSA procedures, are indexed only through age 60 – their increased incomplete indexing bonus more than offsets their loss from the skipped 61st year and the one year indexing lag. Further, the reward for postponing retirement from 62 to 75 is magnified, as can be seen by

comparing the results on Panel A with those of Table 4 With any of the three alternatives to the SSA's incomplete indexing procedure, everyone's real benefit is reduced to 91% of the control benefit.

Experiment #2: 10% more inflation

Table 10 reports that with 10% inflation the maximum wage earner who continues to receive the cap through to age 75 is the big winner, gaining 13% per annum under incomplete indexing; the average earner gains 6%, the median 14% and the minimum wage earner 2%. With any of the three complete indexing procedure, real income is reduced by 17%.

Table 10: Replaying History: 10% higher Inflation Rate

	A. SSA: Wage indexed only until 60				B. Wage Indexed Earnings			
Age of Retiree:	62	65	70	75	62	65	70	75
Age Benefits Started:	62	65	70	70	62	65	70	70
Nominal (at age benefit started)								
Maximum Wage Earner	10,272	19,572	50,460	121,524	10,248	19,056	43,824	82,860
Average Wage Earner	7,548	14,064	35,964	77,328	7,536	13,620	30,096	54,744
Median Wage Earner	5,964	10,800	23,856	43,380	5,964	10,800	23,916	43,836
Minimum Wage Earner	4,836	8,844	20,904	44,004	4,824	8,736	19,296	35,112
Real, CPI-W, actual year 2005 = 100	87.2	125.5	228.4	417.7				
Maximum Wage Earner	11,786	15,591	22,091	29,092	11,758	15,180	19,186	19,836
Average Wage Earner	8,660	11,204	15,745	18,512	8,647	10,850	13,176	13,105
Median Wage Earner	6,843	8,603	10,444	10,385	6,843	8,603	10,470	10,494
Minimum Wage Earner	5,549	7,045	9,152	10,534	5,535	6,959	8,448	8,406
Real, relative to benefit at age of entitlement (62)								
Maximum Wage Earner	1.00	1.32	1.87	2.47	1.00	1.29	1.63	1.69
Average Wage Earner	1.00	1.29	1.82	2.14	1.00	1.25	1.52	1.52
Median Wage Earner	1.00	1.26	1.53	1.52	1.00	1.26	1.53	1.53
Minimum Wage Earner	1.00	1.27	1.65	1.90	1.00	1.26	1.53	1.52
Real comparison: 10% higher inflation relative to control								
Maximum Wage Earner	83%	84%	92%	113%	83%	83%	83%	83%
Average Wage Earner	83%	85%	95%	106%	83%	83%	83%	83%
Median Wage Earner	83%	83%	83%	83%	83%	83%	83%	83%
Minimum Wage Earner	83%	84%	89%	102%	83%	83%	83%	83%

	C. Wage Indexed to 60, then CPI				D. CPI indexed Earnings			
Age of Retiree:	62	65	70	75	62	65	70	75
Age Benefits Started:	62	65	70	75	62	65	70	75
Nominal (at age benefit started)								
Maximum Wage Earner	10,248	19,068	44,112	84,492	10,008	18,708	43,656	83,928
Average Wage Earner	7,536	13,632	30,348	56,172	7,224	13,236	29,892	55,812
Median Wage Earner	5,964	10,800	23,916	43,836	5,664	10,296	22,992	42,420
Minimum Wage Earner	4,824	8,736	19,296	35,112	4,560	8,256	18,264	33,228
Real, CPI-W, actual year 2005 = 100								
Maximum Wage Earner	11,758	15,190	19,312	20,227	11,483	14,903	19,113	20,092
Average Wage Earner	8,647	10,859	13,286	13,447	8,289	10,544	13,087	13,361
Median Wage Earner	6,843	8,603	10,470	10,494	6,499	8,202	10,066	10,155
Minimum Wage Earner	5,535	6,959	8,448	8,406	5,232	6,577	7,996	7,955
Real, relative to benefit at age of entitlement (62)								
Maximum Wage Earner	1.00	1.29	1.64	1.72	1.00	1.30	1.66	1.75
Average Wage Earner	1.00	1.26	1.54	1.56	1.00	1.27	1.58	1.61
Median Wage Earner	1.00	1.26	1.53	1.53	1.00	1.26	1.55	1.56
Minimum Wage Earner	1.00	1.26	1.53	1.52	1.00	1.26	1.53	1.52
Real comparison: 10% higher inflation relative to control								
Maximum Wage Earner	83%	83%	83%	83%	83%	83%	83%	83%
Average Wage Earner	83%	83%	83%	83%	83%	83%	83%	83%
Median Wage Earner	83%	83%	83%	83%	83%	83%	83%	83%
Minimum Wage Earner	83%	83%	83%	83%	83%	83%	83%	83%

Experiment #3: Deflation

With a reduction in the inflation rate to 5% below its historic value, every thing is reversed: the undeflated earnings bonus turns negative while the skipped 61st year and one year indexing lag contribute to an increase in benefits. As a result, every OASI recipient gains from the deflation, as reported on Table 11. This time the maximum wage earner who continues working until age 75 experiences the smallest real gain, only one percent, because falling wages yield a sizable

undeflated earnings *penalty* that counters the gain workers enjoy from the skipped 61st year and the one year indexing lag.

Table 11: Replaying History: 5% reduction in the inflation rate

	A. SSA: Wage indexed only until 60				B. Wage Indexed Earnings			
Age of Retiree:	62	65	70	75	62	65	70	75
Age Benefits Started:	62	65	70	70	62	65	70	70
Nominal (at age benefit started)								
Maximum Wage Earner	10,248	12,240	13,428	12,072	10,248	12,276	13,560	12,312
Average Wage Earner	7,536	8,772	9,312	8,136	7,536	8,772	9,312	8,136
Median Wage Earner	5,964	6,948	7,380	6,444	5,964	6,948	7,392	6,516
Minimum Wage Earner	4,824	5,628	5,964	5,220	4,824	5,628	5,964	5,220
Real, CPI-W, actual year 2005 = 100	65.0	60.3	52.7	46.3				
Maximum Wage Earner	15,765	20,294	25,467	26,057	15,765	20,354	25,717	26,575
Average Wage Earner	11,593	14,544	17,661	17,561	11,593	14,544	17,661	17,561
Median Wage Earner	9,175	11,520	13,997	13,909	9,175	11,520	14,019	14,065
Minimum Wage Earner	7,421	9,331	11,311	11,267	7,421	9,331	11,311	11,267
Real, relative to benefit at age of entitlement (62)								
Maximum Wage Earner	1.00	1.29	1.62	1.65	1.00	1.29	1.63	1.69
Average Wage Earner	1.00	1.25	1.52	1.51	1.00	1.25	1.52	1.51
Median Wage Earner	1.00	1.26	1.53	1.52	1.00	1.26	1.53	1.53
Minimum Wage Earner	1.00	1.26	1.52	1.52	1.00	1.26	1.52	1.52
Real comparison: 5% deflation relative to control								
Maximum Wage Earner	111%	110%	107%	101%	111%	111%	111%	111%
Average Wage Earner	111%	110%	107%	101%	111%	111%	111%	111%
Median Wage Earner	111%	111%	111%	111%	111%	111%	111%	111%
Minimum Wage Earner	111%	111%	110%	109%	111%	111%	111%	111%

	C. Wage Indexed to 60, then CPI				D. CPI indexed Earnings			
Age of Retiree:	62	65	70	75	62	65	70	75
Age Benefits Started:	62	65	70	75	62	65	70	75
Nominal (at age benefit started)								
Maximum Wage Earner	10,248	12,276	13,644	12,564	10,008	12,048	13,512	12,480
Average Wage Earner	7,536	8,772	9,384	8,352	7,224	8,520	9,252	8,292
Median Wage Earner	5,964	6,948	7,392	6,516	5,664	6,636	7,116	6,300
Minimum Wage Earner	4,824	5,628	5,964	5,220	4,560	5,316	5,652	4,932
Real, CPI-W, actual year 2005 = 100								
Maximum Wage Earner	15,765	20,354	25,877	27,119	15,395	19,976	25,626	26,938
Average Wage Earner	11,593	14,544	17,797	18,028	11,113	14,127	17,547	17,898
Median Wage Earner	9,175	11,520	14,019	14,065	8,713	11,003	13,496	13,598
Minimum Wage Earner	7,421	9,331	11,311	11,267	7,015	8,814	10,719	10,646
Real, relative to benefit at age of entitlement (62)								
Maximum Wage Earner	1.00	1.29	1.64	1.72	1.00	1.30	1.66	1.75
Average Wage Earner	1.00	1.25	1.54	1.56	1.00	1.27	1.58	1.61
Median Wage Earner	1.00	1.26	1.53	1.53	1.00	1.26	1.55	1.56
Minimum Wage Earner	1.00	1.26	1.52	1.52	1.00	1.26	1.53	1.52
Real comparison: 5% deflation relative to control								
Maximum Wage Earner	111%	111%	111%	111%	111%	111%	111%	111%
Average Wage Earner	111%	111%	111%	111%	111%	111%	111%	111%
Median Wage Earner	111%	111%	111%	111%	111%	111%	111%	111%
Minimum Wage Earner	111%	111%	111%	111%	111%	111%	111%	111%

Summary

The uniform nature of the real benefit changes with the three alternatives to SSA's partial indexing is easily explained by looking back to equation (6) on page 3. The price ratio in that equation describing the indexing procedure for a retiree of age a is p_{t^b+a-1} / p_{t^b+61} for a worker of age a born in year t^b, which results in the skipped 61st year and the one year under-indexing problems. Full indexing requires p_{t^b+a} / p_{t^b+60} throughout retirement. With uniform inflation at rate $\dot{p}$, the resulting effect of under-indexing at age *a* is

$$\frac{p_{t^b+a-1}}{p_{t^b+a}} \times \frac{p_{t^b+60}}{p_{t^b+61}} = (1+\dot{p})^{-2}. \qquad (12)$$

With 5% inflation this equation yields a reduction in real benefits to 90.2%; 10% yields 83% and 5% deflation results in a benefit increase to 111%, as reported on the tables. These under-indexing effects could be avoided by using a predicted rate of inflation together with the error correction procedure of equation (8) to eliminate the use of lagged values of CPI-W.

Unanticipated Inflation

While the resolution of the five indexing problems discussed in this paper would help insulate the real value of OASI benefit payout from inflation, that does not mean that the inflation would not have other consequences for the OASI trust funds. Those funds are invested with an average maturity of 7.3 years, which means that a bout of inflation, unless it is anticipated, would have a substantial impact on the real rate of interest earned on those investments.

Recommendation:

These experiments strengthen the case for changing from the current incomplete wage indexing procedure to full indexing. Only with full indexing – whether with the wage index, the CPI or a blend – do inflationary trends impose a proportional reduction in the benefits received by all beneficiaries. And this is true regardless of whether the CPI-W, the wage index, or a mixture of the two is employed. Full indexing can be achieved if, in addition, the skipped 61st year and current year indexing problems are corrected.

5. Wage and Price Indices

The two indexes used by the Social Security Administration (SSA) in adjusting nominal figures for inflation are recorded on the first two columns of. The Average Wage Index (AWI) is used to index earnings up to the year of the worker's 60th birthday and a modified version of the Bureau of Labor Statistics CPI-W price index is used to adjust benefits for workers from the year of the 61st birthday through retirement.[12] Both were plotted on. Figure 1.

On we have the level and annual inflation rates for both indexes from 1960 to 2007. also reports the effective interest rate r earned on Social Security's OASI trust fund and two implied *ex post* real rates of interest, defined as $r - \dot{p}$ where $\dot{p}$ is the rate of change in either the CPI-W or AWI.[13] The OASI procedure for computing the sum of indexed earnings in the highest years implicitly uses a zero *real* AWI interest rate, while in practice the trust funds have earned a real rate of about 1.3% relative to the AWI or 2.4% relative to the CPI-W, as indicated on. In contrast to Social Security, when individuals place some of their retirement funds in a private savings account or purchase bonds, their savings in earlier years make a larger contribution toward retirement, cumulating more interest earnings because they are invested for a longer period of time.

Index Construction

Consumer Price Index (CPI-W):

The *Consumer Price Index for Urban Wage Earners and Clerical Workers* (CPI-W), compiled by the Bureau of Labor Statistics, is used in slightly modified form by the SSA to annually adjust benefit figures for changes in the cost of living (COLA). The annual CPI-W index cannot be used without modification because of the need to have the figure available before the end of the year. Instead, the SSA compiles an index based on the average of the index in the 3rd quarter – July, August and September.

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[12] *At What Price* (2002, ch. 7), a study produced by an expert panel chaired by Charles L. Schultze for the National Research Council, presents a comprehensive analysis of the issues involved in the construction of wage and price indexes appropriate for adjusting Social Security benefits for inflation. That study emphasized the advantage of using a superlative index recognizing that consumers substitute away from commodities that have the largest price increases. In contrast, the primary focus of this study is on the way in which the indexes are used.

[13] The effective interest rate on OASI trust funds was downloaded from http://www.socialsecurity.gov/OACT/ProgData/effectiveRates.html

Average Wage Index (AWI):

The wage index used in calculating Social Security benefits is based on the average income reported on W-2 forms for workers subject to Social Security Taxes. The Social Security web site explains:

> "In keeping with the legal term 'average wage index' (AWI), we often loosely refer to the basis for the index as average wages. To be more precise, however, the index is based on compensation (wages, tips, and the like) subject to Federal income taxes, as reported by employers on Form W-2. Beginning with the AWI for 1991, compensation includes contributions to deferred compensation plans, but excludes certain distributions from plans where the distributions are included in the reported compensation subject to income taxes. We call the result of including contributions, and excluding certain distributions, net compensation."[14]

While the AWI now incorporates employer contributions to retirement plans, it excludes many forms of worker compensation, including employer provided health benefits. And it does not include the income sole proprietors report to the IRS on Schedule C, although such income is subject to OASI taxes (IRS Schedule SE). Needless to say, it also excludes the compensation of hedge fund managers (who are taxed at the 15% capital gains rate by the IRS even though they do not have their own capital at risk) and the "carried interest" of private placement specialists.

Employers do not have to submit the W-2 tax forms used by the SSA in calculating the average wage index until as late as March 31 of the following year, provided they file electronically. As a result, there is a lag in the availability of the average earnings index used in calculating bend points. Thus the National Average Wage for 2006 of $38,651.41 from which the average earnings index is calculated was not posted on the SSA website until October 17, 2007.

A number of non-inflationary factors can influence the path of the Average Wage Index. For example, the index would be boosted by a decline in the proportion of the work force composed of part-time workers, which might occur as a result of the aging of the population or a decline in the labor-force participation rate of teenagers. And indeed, the teenage fraction of total employment declined from a peak of 8.6% in 1974 to 4% in 2007. The index will have a downward bias in recession because the cutback of workers to a shorter work week will reduce the numerator of the index but will cause a corresponding reduction in the denominator only to the extent that laid off workers are unemployed throughout a full calendar year. It will climb if there is an increase in W-2 incomes of high earning workers that is not matched by similar increases among the majority of the work force. In fact, mean income has risen much more rapidly then the median in the last decade and a half, resulting at least in part from the increased skewness of the income distribution, the ratio of median to mean income declining between 1990 and 2006 from 72% to 67%. The OASI benefits might be lower today if a *Median* Wage Index instead of the Average Wage Index had been used, but that could be a temporary effect if the trend toward a more highly skewed income distribution were to reverse.

Comparisons

Figure 1 compared the time path of the Average Wage Index (AWI), used in inflating wages up to the worker's 60th birthday, with the CPI-W, which is used to inflate benefits in step with rising prices during the retirement years. Observe that the upward trend in wages has averaged out above that of

[14] http://www.ssa.gov/OACT/COLA/netcomp.html The growing popularity of deferred compensation pension plans in the 1980s meant that the wage index, because it excluded this expanding component, did not grow as fast as Social Security tax revenue, which did reflect it (Michael Clingman and Kunkel, 2008). The inclusion of deferred compensation plans after 1991 may partly explain the rapid rise in the wage index after that date.

prices, yielding an upward trend in the standard of living that reflects the rise in worker productivity. The primary exception is the productivity slowdown of the 1970's, when real wages declined.

The use of the wage index up to the 60th year allows each generation of workers to enjoy in retirement the fruits of rising productivity that occurred during the bulk of the time they were in the work force. It helps to stabilize the replacement ratio – the ratio of retirement income to the worker's average income. [15]

Evidence that the choice of deflator makes a difference is provided by a comparison of Figure 3 with Figure 4 and Figure 5. Figure 3 reported the income streams for a taxable maximum earner, an average wage earner, a median wage earner, and a worker who always earned at the federal minimum wage. Figure 4, utilizing the CPI-W deflator, indicates that workers earning the Taxable Maximum enjoyed a substantial increase in real income, that the Average Wage earner had only a moderate gain since the 1970s, and that workers who earned only the federal minimum wage throughout their careers have suffered a decline in purchasing power since peaking in the late 1960s. Note on Figure 5 that the wage deflated earnings of a worker receiving the National Average Wage are represented by a horizontal line, as must be the case by construction because the Average Wage Index is the deflator.

The Taxable Maximum, adjusted by the wage deflator, increased dramatically in the 1970s and 80s. The immediate effect of an increase in the Taxable Maximum is to raise OASI tax revenue. The Congressional Budget Office (2004, Appendix A) has commented as follows:

> "Since 1982, the taxable maximum – the level above which earnings are not subject to the Social Security payroll tax – has been indexed to overall wage growth. However, due to increasing earnings inequality, the portion of covered wages that are subject to tax has declined since then, from about 89 percent to about 83 percent."

Even with indexing, the Taxable Maximum has been subject to considerable variation since 1982, in part because the indexation is executed with a two year lag necessitated by the delay involved in the construction of the wage index, which is based on W-2 tax information.

Be that as it may, the fall in covered wages that are subject to the OASI tax to 83% implies that if the payroll cap were removed, as is already the case for Medicare, OASI tax revenue might increase by 17%/83% = 20.5%! This would be a gain in the short run, but it would be at least partially offset when the high income workers paying the tax on their full W-2 earnings retired because their benefit payments are also based on their taxable earnings, and this effect is compounded because of the longer expected lifespan of higher income workers. If the Taxable Maximum cap remained on employee contributions but was removed from employer contribution, the revenue gain would be cut to 10.25%, but there would be no offsetting increase in benefit payments down the road if they were still based on the unmodified Taxable Maximum.

Which Index?

Because this paper focuses on data for the single cohort of retirees born in 1930, it leaves for subsequent research the task of determining the most appropriate index or combination of indexes to use in adjusting OASI for inflation. The choice should not be limited to the Average Wage Index versus the CPI-W. The primary advantage of CPI-W is that it is seldom revised, but

[15] Age 60 provides a convenient base for calculations because it allows time for the compilation of relevant data about wage inflation before the worker turns 62, which is the earliest age at which workers can claim OASI benefits. A case can be made for indexing to the year in which the worker first claims OASI benefits, although this would introduce the complication of correcting initial payments that had to be made on the basis of preliminary data.

equation (8), page 15, provides a procedure for coping with revisions. Because the median rather than the mean is likely to be less subject to erratic year to year movements and less sensitive to the growing income inequality that has contributed to the upward surge in the taxable maximum, consideration should also be given to shifting from using the National Average Wage to a National Median Wage in the construction of the wage index, in adjusting bend points, and in calculating the taxable maximum. Whether based on the average (mean) or median, it would also be somewhat more stable – and hence reduce the seriousness of Problem #4, the 60th year bounce – to have the wage index normalized to equal 100 not in the worker's 60th year, but on the average of wages in the adjacent years (ages 59-61= 100), just as the Bureau of Labor Statistics CPI is normalized: (1982-84 = 100).

6. Phasing in Reform

Easing the transition into a reform is not easy. When SS indexing procedures were revised in 1978, a special Transition Benefit procedure was included to protect workers who attained the age of 62 between the years 1979-83. It did not work, giving rise to the famous Notch Generation conroversy. When President George W. Bush promulgated his Social Security reform, he stressed that there would be no changes for those already over 55[16] – implicit in this pronouncement was a warning to those under 55, the majority of voters, that they should look out.

Using an index that gradually reduces benefits over time might minimize political repercussions if the slippage is so slow as to fall below the representative voter's horizon – so much for transparency.[17] This is the argument for replacing wage indexing with CPI-W price indexing in dealing with the serious longrun financial problems of OASI.

Shifting from wage to price indexing during the working years might reduce financial pressure on the trust funds, provided that on average the CPI continues to rise less rapidly than wages. But the adjustment toward financial viability might well be by fits and starts, judging by the historical comparison of the CPI-W and the AWI on Figure 1 and. Further, Biggs, Brown and Springsteed (2005) point out that a switch to price-indexing in computing benefits might be destabilizing, leading to a divergence over time between the path of expenditures and revenue, because benefits would depend on price movements while the OASI tax revenue is based on wage income. Biggs et.al. (2005:29) explain that "the same level of expected cost savings could be achieved without decreasing stability by simply choosing a predetermined path by which PIA factors are reduced that is not conditional on ex post realizations of wage and price growth."

A predetermined schedule for phasing in adjustments has several advantages. It will minimize the disruption of the financial plans that workers may have developed based on the good faith assumption that scheduled benefits would be received while at the same time facilitating adjustments that might contribute to financial equilibrium. Furthermore, the primary effect will be upon younger voters at a stage of life when they will be less certain about what their health and marital status will be when they reach retirement age, which means that they will be

[16] President George W. Bush State of the Union Address, February 2, 2005, http://www.whitehouse.gov/stateoftheunion/2005/

[17] It would also be possible to use indexes indirectly to gradually slow the growth of benefits generated by wage-indexing, as in the PIA Factor Indexing procedure considered by Biggs, Brown and Springstead (2005). This procedure would adjust the 90%, 32% and 15% parameters of the equation plotted on Figure 2 from the value in the preceding year by the ratio $(p_t / p_{t-1})/(w_t / w_{t-1})$ in the beneficiary's 60th year; bend points would still be adjusted by current procedures. This would adjust the benefits of all workers in the same birth cohort by the same percentage, but it could make benefits for workers with similar wage histories vary rather erratically from one year to the next. For example, the ratio was 100% in 1991, 99.0% in 1992 but 101.7% in 1993. During the OPEC disruptions of the 1970s, the ratio switched from 93.9% in 1972 to 105.2% in 1974.

able to make a judgment that will not be dominated by their own personal situation on eve of retirement. They will be closer to making an impartial judgment based on probabilities, operating closer to John Rawls' "veil of ignorance," rather than making a judgment clouded by their own personal situation. And older voters, because they will not feel the full thrust of the change, will also be able to reach a judgment that will be less clouded by their own position in life.

Here is one way of generating a predetermined schedule that would gently phase in an OASI "reform." Each worker's benefit would be calculated twice: Let $B_{i,t}^{a}$ denote the benefit calculated with the pre-reform procedure and $B_{i,t}^{b}$ the benefit computed with the post reform procedure. Then a weighted average of the two could be calculated based on the proportion of the ith worker's career that had been pre-reform versus post-reform. For example, if 18 were the normal starting age, 62 the year of first entitlement, and a_i^r is the worker's age when the reform was introduced, we might calculate the ith worker's benefit as follows:

$$B_{i,t} = w_i B_{i,t}^{b} + (1 - w_i) B_{i,t}^{a},$$
$$\text{where } w_i = \begin{cases} 0 \quad \text{if } a^r \le 18 \\ \left(\dfrac{a_i^r - 18}{44} \right)^{\rho} \text{ if } 18 \le a_i^r \le 62 \\ 1 \quad \text{otherwise.} \end{cases} \tag{13}$$

The parameter ρ affects the speed of adjustment: with ρ = 1, the case of linear interpolation, weighting is proportional to the years spent before and after reform; for example, w_i = ½ for a worker who was 40 when the reform measure was instituted. The reform is phased in more rapidly with ρ > 1; for example, with ρ = 2, a worker who was aged 49 when the reform was passed would have w_i = ½. While this equation takes 44 years fully to complete the adjustment process, it can easily be modified to shorten the adjustment period.

7. Conclusions

This paper demonstrates that full wage, mixed wage/CPI and full CPI indexing are all better at avoiding the distortions of inflation than the incomplete wage indexing procedure currently used in computing OASI benefits. And it recommends in Section 3 strategies for addressing the other indexing problems with the procedure currently used to calculate OASI benefits.

How would resolving the five indexing problems examined in this paper affect the financial viability of OASI? A precise estimate must be left for future study because it will require the examination of detailed micro data sets instead of just the experiences of the four representative workers considered in this paper. But examination of Table 7 does reveal that resolving Indexing Problem #1, undeflated earnings after 60, would reduce the retirement benefits of practically all categories of workers we have considered. The exception is workers retiring at 62, who would be held harmless. Thus switching from incomplete to the full indexing of earnings would help resolve OASI's financial problems. We also saw that Problem #2, the skipped 61st year inflation adjustment, and #3, the one year indexing lag, could be resolved in a financially neutral way. And mitigating Problem #4, the 60th year wage index bounce, would reduce the variance of benefits among different age cohorts but not the mean of benefit expenditures. Indexing for inflation the brackets of the income tax imposed

on OASI benefits would resolve Problem #5 without affecting OASI's budget.[18] Thus it seems reasonable to conclude, pending further study, that correcting these five indexing problems could help resolve OASI's financial problems.

Adopting CPI-W indexing instead of wage indexing might help resolve OASI's longrun financial problem by gradually reducing most benefits over time. But the adjustment would not be smooth, judging by the rather erratic historical movement in the gap between the CPI-W and the wage index reported on Figure 1. While the majority of retirees would find their benefits reduced as a result of CPI instead of wage indexing, Table 4 revealed that high income workers who postponed retirement well into their seventies might actually gain higher benefits from the switch. Instead, a predetermined schedule, generated perhaps with (13), could be used to provide a smooth phasing in of reform while retaining the advantages of wage indexing.

The various experiments presented in this paper provide ample reason for making the procedure for calculating OASI benefits inflation neutral by resolving the five indexing problems. Not only will the resolution of these five problems eliminate certain capricious and regressive effects of inflation on the distribution of retiree benefits. It will make it easier for workers to evaluate more accurately the effect of delaying retirement on their OASI benefits. It will also help insulate the financial viability of the trust funds from the vicissitudes of inflation.

Appendix: Calculating Benefits with *AnyPIA*

AnyPIA, a program on the SSA website, calculates OASI benefits on the basis of actual or experimental earnings data entered by the user: *http://www.ssa.gov/OACT/anypia/download.html*. Working step-by-step through the tables produced by *AnyPIA* will reveal the details of the procedure by which benefits are calculated and confirm the validity of the equations presented in Section 2: Calculating OASI Benefits. The *AnyPIA* program was used to test the validity of the spreadsheet benefit calculations presented in this paper.

Let us consider the extreme case of a worker born on January 2, 1930, who did not retire until his 75th birthday and whose W-2 income was always at or above the taxable maximum ceiling on earnings subject to the OASI tax.

Step #1: Tabulating Earnings Data (Page 4 of *AnyPIA* output)

Each year the SSA records each worker's earnings as reported by employers on W-2 forms, but capped at the taxable maximum (aka the *Contribution and Benefit Base*) ceiling on earnings subject to the OASI tax. The capped earnings of a high income worker are reported in column 1 of Table 12, which reproduces the output of page 4 of *AnyPIA* in columns 1 through 4. The text in italics has been added to the *AnyPIA* output.

Step #2: Adjusting earnings for Inflation

The worker's W-2 earnings for each year are adjusted for inflation to the level of wages prevailing in the year in which the worker attains age 60, or 1990 for our hypothetical worker. *AnyPIA* uses an especially constructed wage index called the Average Wage Indexing Series, which is based on average earnings of all workers. Column 2 of Table 12 is used by *AnyPIA* in calculating the indexed earnings that are recorded in column 3.[19]

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[18] Because the revenue from this tax is allocated to Medicare, it would prevent inflation from gradually increasing Medicare's funding by reaching further down the income distribution.

[19] Column 2 is the product $E_t \overline{E}_{t^b+60}$, where E_t is the worker's capped earnings in column 1, t^b is the year of birth, and $\overline{E}_{t^b+60}$ is the value of the Average Wage Indexing Series (the average of all incomes reported for year t on Internal

Table 12: *AnyPIA* output, Page 4

		Social Security partially indexed earnings				*Fully Wage Indexed Earnings*				
age	year	earnings	* earnings 21027.98	indexed earnings	high n years	Average wage Indexing series	Wage index 1990=100	indexed earnings	rank	highest 35 indexed earnings
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
21	1951	3,600.00	75,700,728.00	27,044.09		2,799.16	13.3	27,044	36	
22	1952	3,600.00	75,700,728.00	25,460.00		2,973.32	14.1	25,460	42	
23	1953	3,600.00	75,700,728.00	24,112.81		3,139.44	14.9	24,113	48	
24	1954	3,600.00	75,700,728.00	23,989.03		3,155.64	15.0	23,989	50	
25	1955	4,200.00	88,317,516.00	26,751.21		3,301.44	15.7	26,751	37	
26	1956	4,200.00	88,317,516.00	25,002.41		3,532.36	16.8	25,002	45	
27	1957	4,200.00	88,317,516.00	24,251.59		3,641.72	17.3	24,252	47	
28	1958	4,200.00	88,317,516.00	24,039.83		3,673.80	17.5	24,040	49	
29	1959	4,800.00	100,934,304.00	26,177.27		3,855.80	18.3	26,177	41	
30	1960	4,800.00	100,934,304.00	25,188.74		4,007.12	19.1	25,189	44	
31	1961	4,800.00	100,934,304.00	24,697.88		4,086.76	19.4	24,698	46	
32	1962	4,800.00	100,934,304.00	23,520.13		4,291.40	20.4	23,520	51	
33	1963	4,800.00	100,934,304.00	22,957.15		4,396.64	20.9	22,957	52	
34	1964	4,800.00	100,934,304.00	22,055.78		4,576.32	21.8	22,056	53	
35	1965	4,800.00	100,934,304.00	21,665.67		4,658.72	22.2	21,666	54	
36	1966	6,600.00	138,784,668.00	28,103.39	28,103.39	4,938.36	23.5	28,103	34	28,103.39
37	1967	6,600.00	138,784,668.00	26,620.56		5,213.44	24.8	26,621	38	
38	1968	7,800.00	164,018,244.00	29,437.42	29,437.42	5,571.76	26.5	29,437	33	29,437.42
39	1969	7,800.00	164,018,244.00	27,829.14	27,829.14	5,893.76	28.0	27,829	35	27,829.14
40	1970	7,800.00	164,018,244.00	26,513.40		6,186.24	29.4	26,513	40	
41	1971	7,800.00	164,018,244.00	25,244.92		6,497.08	30.9	25,245	43	
42	1972	9,000.00	189,251,820.00	26,528.89		7,133.80	33.9	26,529	39	
43	1973	10,800.00	227,102,184.00	29,960.08	29,960.08	7,580.16	36.0	29,960	32	29,960.08
44	1974	13,200.00	277,569,336.00	34,563.27	34,563.27	8,030.76	38.2	34,563	30	34,563.27
45	1975	14,100.00	296,494,518.00	34,352.60	34,352.60	8,630.92	41.0	34,353	31	34,352.60
46	1976	15,300.00	321,728,094.00	34,870.08	34,870.08	9,226.48	43.9	34,870	29	34,870.08
47	1977	16,500.00	346,961,670.00	35,478.68	35,478.68	9,779.44	46.5	35,479	27	35,478.68
48	1978	17,700.00	372,195,246.00	35,259.02	35,259.02	10,556.03	50.2	35,259	28	35,259.02
49	1979	22,900.00	481,540,742.00	41,948.03	41,948.03	11,479.46	54.6	41,948	26	41,948.03
50	1980	25,900.00	544,624,682.00	43,523.11	43,523.11	12,513.46	59.5	43,523	25	43,523.11
51	1981	29,700.00	624,531,006.00	45,344.26	45,344.26	13,773.10	65.5	45,344	24	45,344.26
52	1982	32,400.00	681,306,552.00	46,885.32	46,885.32	14,531.34	69.1	46,885	23	46,885.32
53	1983	35,700.00	750,698,886.00	49,260.91	49,260.91	15,239.24	72.5	49,261	21	49,260.91
54	1984	37,800.00	794,857,644.00	49,262.73	49,262.73	16,135.07	76.7	49,263	20	49,262.73
55	1985	39,600.00	832,708,008.00	49,499.63	49,499.63	16,822.51	80.0	49,500	19	49,499.63
56	1986	42,000.00	883,175,160.00	50,986.28	50,986.28	17,321.82	82.4	50,986	10	50,986.28
57	1987	43,800.00	921,025,524.00	49,983.72	49,983.72	18,426.51	87.6	49,984	16	49,983.72
58	1988	45,000.00	946,259,100.00	48,942.65	48,942.65	19,334.04	91.9	48,943	22	48,942.65
59	1989	48,000.00	1,009,343,040.00	50,217.20	50,217.20	20,099.55	95.6	50,217	13	50,217.20
60	**1990**	**51,300.00**	**0**	**51,300.00**	**51,300.00**	**21,027.98**	**100.0**	**51,300**	**9**	**51,300.00**
61	1991	53,400.00		53,400.00	53,400.00	21,811.60	103.7	51,482	7	51,481.51
62	**1992**	**55,500.00**		**55,500.00**	**55,500.00**	**22,935.42**	**109.1**	**50,884**	**11**	**50,884.30**
63	1993	57,600.00		57,600.00	57,600.00	23,132.67	110.0	52,359	4	52,359.35
64	1994	60,600.00		60,600.00	60,600.00	23,753.53	113.0	53,647	3	53,646.58
65	**1995**	**61,200.00**		**61,200.00**	**61,200.00**	**24,705.66**	**117.5**	**52,090**	**5**	**52,089.78**
66	1996	62,700.00		62,700.00	62,700.00	25,913.90	123.2	50,878	12	50,878.27
67	1997	65,400.00		65,400.00	65,400.00	27,426.00	130.4	50,143	14	50,143.29
68	1998	68,400.00		68,400.00	68,400.00	28,861.44	137.3	49,835	17	49,835.14
69	1999	72,600.00		72,600.00	72,600.00	30,469.84	144.9	50,103	15	50,103.03
70	2000	76,200.00		76,200.00	76,200.00	32,154.82	152.9	49,832	18	49,831.78
71	2001	80,400.00		80,400.00	80,400.00	32,921.92	156.6	51,353	8	51,353.31
72	2002	84,900.00		84,900.00	84,900.00	33,252.09	158.1	53,689	2	53,689.12
73	2003	87,000.00		87,000.00	87,000.00	34,064.95	162.0	53,704	1	53,704.30
74	2004	87,900.00		87,900.00	87,900.00	35,648.55	169.5	51,849	6	51,849.50

Wage Indexed

	Sum: Age 21 through Age 60, wage indexed	***867,007.52***	*Sum: Age 21 through Age 60*	***867,007.52***
	Sum: Age 61 to retirement, not indexed	***+ 973,800.00***	*Sum: Age 61 through to retirement*	***+ 721,849.27***
TOTAL	*Sum: Age 21 to retirement*	***∑ 1,840,807.52***	*Sum: Age 21 through to retirement*	***∑ 1,588,856.78***
	SSA Mixed Indexed Sum		**Not indexed**	**Wage Indexed Sum**

Step #3: Summing the 35 best years

The Social Security benefit is calculated from the sum of indexed earnings for the 35 highest years; earnings in remaining years do not count. Column 4 of the AnyPIA output selects the highest 35 years from column 3. The sum of this column, $1,840,807.52, will be carried over to

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Revenue Service W-2 forms) in the worker's 60th year. Column 3 is this product divided by $\overline{E}_t$. This is equivalent to calculating indexed earnings ${}^{I}E_t = E_t / w_t$, where $w_t = \overline{E}_t / \overline{E}_{t^b+60}$ is the Average Wage Index based on average W-2 income of all workers, with $w_t = 100$ in the year of the worker's 60th birthday (t^b+60). The average wage indexing series and the wage index have been added as columns 5 and 6 to the *AnyPIA* table.

the next table for the subsequent steps in calculating our worker's retirement benefit. As indicated by the bottom italicized rows that have been added to the AnyPIA output, more than half this sum for this late retiring worker has not been indexed for inflation. The fully indexed best 35 year sum reported at the bottom of column 9 is only $1,588,856.78, which would yield substantially lower retirement benefits for our high income worker.

Step #4: Calculating Average Indexed Monthly Earnings (Page 5 of *AnyPIA* output)

Next, near the upper left-hand corner of Table 13, *AnyPIA* calculates the worker's Average Indexed Monthly Earnings (AIME) by dividing the sum of indexed earnings for the best 35 years from the preceding step by 35x12: AIME = $1,840,807.52/(35x12) = $4,382. The columns added to the right of the dashed line show the effects of full indexing. As shown near the top of the rightmost column, full wage indexing of earnings yields AIME = $3,782, or only 86% of the figure obtained with incomplete indexing.

Table 13: Primary Insurance Amount (Page 5 of *AnyPIA* Output)

page 5

(1)	(2)	(3)	(4)
Base year for indexing = 1990	*Mixed sum from column 4 of AnyPIA output (Table 4)*	*Fully wage indexed sum from column 9 of AnyPIA output (Table 4)*	
		SSA recalculated	***Full Wage Indexing***
Number of computation years = 40 - 5 = 35		*1,840,807.52*	***1,588,856.78***
AIME = 1,840,807.52/(35*12) = 4,382		*4,382*	***3,782***
PIA formula bend points = 387 and 2,333			
PIA at eligibility =			
0.90 * 387 +		*348.30*	*348.30*
0.32 * 1,946 +		*622.72*	*622.72*
0.15 * 2,049 = 1,278.30		*307.35*	*217.35*
(PIA Rounds down to nearest 10 cents)		***1,278.30***	***1,188.30***
CPI increases applied:	p_t / p_{t-1}		
3.0 % for December 1992: 1,316.60	*1.0302*	*1,316.89*	*1,224.18*
2.6 % for December 1993: 1,350.80	*1.0259*	*1,351.06*	*1,255.93*
2.8 % for December 1994: 1,388.60	*1.0283*	*1,389.33*	*1,291.52*
2.6 % for December 1995: 1,424.70	*1.0262*	*1,425.71*	*1,325.33*
2.9 % for December 1996: 1,466.00	*1.0293*	*1,467.47*	*1,364.15*
2.1 % for December 1997: 1,496.70	*1.0209*	*1,498.15*	*1,392.67*
1.3 % for December 1998: 1,516.10	*1.01351*	*1,518.40*	*1,411.49*
2.4 % for December 1999: 1,554.00	*1.02458*	*1,555.72*	*1,446.19*
3.5 % for December 2000: 1,608.30	*1.0352*	*1,610.45*	*1,497.06*
2.6 % for December 2001: 1,650.10	*1.0261*	*1,652.52*	*1,536.17*
1.4 % for December 2002: 1,673.20	*1.0140*	*1,675.61*	*1,557.64*
2.1 % for December 2003: 1,708.30	*1.0211*	*1,711.04*	*1,590.58*
2.7 % for December 2004: 1,754.40	*1.0266*	*1,756.59*	*1,632.92*
PIA at benefit date = 1,754.40		***1,756.50***	***1,632.90***
Alternative Calculation of the PIA at benefit date:			
The CPI-W was 134.7 in 1991 and 185.1 in 2004 (1982-84=100, 3rd quarter ave); therefore, the PIA at benefit date is (185.1/134.7) ×1,278.30 =		***1,756.50***	***1,632.90***

PIA at benefit date figures are rounded off to the nearest 10 cents.
The SSA Recalc column figure of 1,756.50 for the PIA at benefit date differs slightly from AnyPIA's PIA because of rounding and differences for the 1998 and 1999 inflation factors.

Step #5: Calculating the Primary Insurance Amount at Eligibility (Page 5 of *AnyPIA* output)

Age 62, the first year one may elect to start receiving OASI benefits, is called the year of eligibility. The PIA at eligibility is a piecewise linear function of the AIME, as graphed on Figure 2 for a worker born in 1930. The PIA function is the same for all workers born in the same year, but it shifts from

birth cohort to birth cohort because the bend points shift in response to changes in the Average Wage Index.

As indicated about a quarter of the way down column 3 of Table 13, our worker's PIA at eligibility as calculated by the SSA, is $1,278.30. Column 4 reveals that with fully wage indexed earnings, it would have been $1,188.30, or about 7% less.

Step #6: Calculating the PIA at a Benefit Date (e.g., 2005)

The Consumer Price Index, CPI-W, is used to determine the Primary Insurance Amount (PIA) at a benefit date (age 75 for this example) from the PIA at age of eligibility by an iterative year-to-year procedure recorded on successive lines of the *AnyPIA* output. As shown halfway down the left side of Table 13, each successive year's inflation adjusted PIA is obtained by multiplying the preceding year's inflation adjusted figure by p_t / p_{t-1}, where p_t is the Bureau of Labor Statistics' Consumer Price Index for Urban Wage Earners and Clerical Workers, seasonally unadjusted (CPI-W). *AnyPIA* reports that if our worker continued working until his 75th birthday, the PIA at age 75 would be

$$PIA = 1,278.30 \times (p_{2004} / p_{2003}) \times (p_{2003} / p_{2002}) \times \ldots \times (p_{1992} / p_{1991}) = \$1754.40. \quad (1)$$

Because of rounding to the nearest 10 cents at each stage of this iterative process, a slightly different number is obtained (column 3) with the simple algebraic equivalent

$$PIA = 1,278.30 \times (p_{2004} / p_{1991}) = \$1,756.50. \quad (2)$$

With full wage indexing (column 4), the PIA at benefit date 2005 would be $1,632.90, or 7% less than with incomplete indexing.

Step #7: Determining the Benefit (Page 1 of *AnyPIA* output)

How our maximum earner's monthly benefit is affected by the choice of when to retire from work and when to start claiming OASI benefits is revealed by Table 14. Thanks to the delayed increment factor, workers who delay starting benefits until age 70 enjoy benefits that are 22.5% higher than they would have been if they had started taking benefits at age 65. Working beyond age 70 will involve enjoying a higher benefit as a result of paying more taxes, but the delayed increment factor will remain at 22.5%.

Table 14: OASI Benefits for Maximum Wage Earner (page 1 of *AnyPIA* Output)

Date of birth: January 02, 1930 Retired in January 2005 at age 75 and 0 months	*Alternative Indexing Strategies*		
	(1) *SSA recalculated: wage indexing to age 60; then not*	*(2)* *Full Wage Indexing*	*(3)* *Difference*
Average Indexed Monthly Earnings = 4,382	*4,382.00*	*3,782.00*	*600.00*
Primary Insurance Amount = 1,754.40	*1,756.50*	*1,632.90*	*123.60*
Number of months increment = 60	*60.00*	*60.00*	-
Delayed increment factor = 1.225	*1.225*	*1.225*	-
Monthly Benefit after rounding = 2,149.00	*2,151.00*	*2,000.00*	*151.00*
Annual Benefit	*25,812.00*	*24,000.00*	*1,812.00*

Table 15: Review: OASI Benefit Calculation

t, a, t^b, a^s	Subscripts for year, age, birth year, age when worker first claims OASI benefits	Note: $t = a + t^b$
Step 1: Tabulating Earnings Data		
E_t^{w-2}	Earnings reported on worker's W-2 form	
C_t	Taxable Maximum Earnings; aka the Contribution and Benefit Base or Cap	e.g., $102,000 in 2008
E_t	E_t = min(E_t^{w-2} , C_t)	Earnings above C_t are ignored
Step 2: Adjusting Earnings for Inflation		
w_t	National Average Wage Index at date t $w_t = \bar{E}_t^{w-2} / \bar{E}_{t^b+60}^{w-2}$	Index based on $\bar{E}_t^{w-2}$, the average of all workers' W-2 income; w_t is normalized to equal = 100 in worker's 60th year.
${}^I E_t$	${}^I E_i = E_t / w_t *,\ w_t^* = w_t$ if $t \le 60 + t^b$, else 1.	Indexed earnings; actually indexed only to year of the 60th birthday; then current dollar earnings.
Step 3: Summing the 35 Best Years (other years are discarded)		
$R_a({}^I E_a)$	Rank of indexed earnings at age a	Identifies 35 top earning years
${}^I E^{35}$	${}^I E^{35} = \sum_{R_a(E_a) \le 35} {}^I E_a$	Only the best 35 years of the worker's entire career are counted in computing benefits
Step 4: Calculating Average Indexed Monthly Earnings		
$\bar{E}$	$\bar{E}$ = ${}^I E^{35}$ /(35x12)	Average Indexed Monthly Earnings (AIME)
Step 5: Calculating the Primary Insured Amount (PIA) at age of eligibility		
$P^{62}(t^b, \bar{E})$	PIA at Age of Eligibility P^{62} is a piecewise linear function of $\bar{E}$; see Figure 2.	62, the earliest age at which a worker qualifies to receive OASI benefits, is called the age of eligibility
Step 6: Calculating the Primary Insured Amount for a Benefit Year t ≥ 62 + t^b		
p_t	Price index at date t	Bureau of Labor Statistics CPI-W (3rd quarter average)
P_{t^b}	$P_{t^b} = (p_{t^b-1} / p_{b+61}) P^{62}(t^b, \bar{E})$	Primary insurance amount for benefit at date $t^b + a$
Step 7: Calculating the Benefit at date t ≥ t^b + 62		
$A(a^s)$	Adjustment factor (actuarial reduction or delayed retirement credit) reduces benefits for early start or augments benefits for the late start of benefits:	*A(62)* = 80%*; A(65)* = 100%*; A(70)* = 122.5% for *b* = 1930 . See Table 1
$B(t^b, a, a^s)$	$= \begin{cases} A(a^s)(p_{t^b+a-1} / p_{t^b+61}) P^{62}(t^b, \bar{E}) \text{ for } a \ge 62, \\ 0 \text{ otherwise} \end{cases}$	Benefit at age *a* for a worker born in year t^b who starts benefits at age a^s.

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