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Financial Analysis on Retirement Implications for Women

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Abstract

This study addresses some aspects of the financial impact on women under the Social Security benefits reform or redistribution. This paper presents a preliminary result of the study. A multiple decrement model (LL Model) is developed based on a proxy population of U.S. women and its demographic projection. Social Security benefits under current policy rules are then assigned to each sample unit in the resulting proxy population. The authors then compare aggregate benefit entitlement figures under current policies to figures obtained when potential policy change is implemented.

For example, one potential policy change is the proposed "de-coupled allocation" policy, which involves changing the current benefit loss (ranging from 33–50%) upon spousal death to 40% in order to redistribute wealth and to help alleviate poverty in elderly widows. The analysis of the authors shows that this redistribution is more equitable for "de-coupled allocation", of which the gross effect would not significantly increase Social Security payments. The redistribution also seeks to improve the financial condition of the American senior citizens who live below the poverty line.

1. Introduction

The primary objective of this research is to study the financial impact on women under the Social Security benefits reform or redistribution by building a sample of sufficiently representative women population demographics from the U.S. population.

Retirement and family patterns have dramatically changed since the Social Security system was instituted, and further change is likely. A significant number of women have since entered the workforce. Furthermore, the proportion of divorced and single people in the population has increased and the median length of marriage before divorce has gone down. While some revisions have been made to the social insurance systems to handle the new patterns, several issues still remain.

Many issues in the current retirement system are of concern for women. For instance, dual-earner families whose earnings are nearly evenly divided (for example, one spouse earns $30,000 and the other earns $20,000) almost always fare worse than those whose earnings are more lopsided ($40,000 versus $10,000, for example) (see Stanfield and Nicolaou, 2000 and Rappaport, 1997 and 1999). Since spousal benefits are greater for those married to higher earners, higher-income households in general get more for raising their children than lower-income households. This produces the perplexing result that child-raising in high-income households is more valued by society—at least from a benefit perspective.

There is a lack of recognition for nontraditional families (for example, single-parent households and domestic relationships that do not involve marriage). There is a 10-year marriage requirement for divorced spouse benefits in the U.S. even though a high level of divorces fall under that mark.

In 1990, marriages that ended in divorce averaged only seven years. Half the marriages of divorced women ages 25–29 lasted less than 3.4 years (see Williamson and Rix, 1999). Moreover, some of the reform solutions being discussed that are geared towards strengthening the solvency of social insurance systems may worsen the problems presented by new retirement and family structures (see Shirley & Spiegler, 1998, Shaw, Zuckerman & Hartmann, 1998, and Munnell, 1999).

According to the Social Security Administration (SSA) Accountability Report for Fiscal Year 1998, one of their goals was to improve the SSA's retirement modeling capacity. In an effort to enhance the projection of demographic changes including marriage and divorce trends and mortality rates, the SSA issued a task order contract with the Urban Institute in collaboration with the Brookings Institution to develop a model (CORSIM). CORSIM is a dynamic micro simulation model based on the 1960 decennial census. SSASIM2 is a statistical model designed to evaluate the distributional effects of proposed solvency reforms. RAND Corporation added to this endeavor (see Lillard and Panis, 1998).

These researchers appear to have had some success in drawing samples and projecting retirement income from them in order to address the actuarial questions associated with funding levels for Social Security. This study was built on these previous researchers' approaches, which were extended and enhancements were added, including the projection of the employment history for each person.

This paper proposes a change referred to as "de-coupled allocation" that targets the problem of inequities associated with an equal versus a lopsided earnings structure. A model was developed to investigate the impact of this type of change.

In the following section, the paper introduces a multiple decrement model for the U.S. women population. It models women workers' behavioral changes in activities and characterizes the population of women by segmenting them into subgroups or categories, running the gamut from single and working to permanently retired. Section three discusses the "de-coupled allocation" principle and the impact of the proposed change. Comparative analyses are given of payout distributions that occur when benefit accrual rules are altered. Validation of the model is discussed in section four. Section five summarizes the paper and offers insights into further alternatives on policy changes and their implications.

2. Multiple Decrement Model

In this section, a multiple decrement model is developed for the analysis of retirement benefit valuation of U.S. women.

There are many random events in a lifetime that affect retirement income, including Social Security benefits for women. The most important events in the calculation of benefit payoffs are death, marriage, divorce, disability and employment. Based on this consideration, the demographic model was built with five decrements.

2.1 Women Population

The model started by securing a seeding sample of the U.S. population. In order to include young disabled persons as well as retirees in the projections for Social Security entitlements, the study needed women sample units from 1960, 1970, 1980 and 1990. It chose to employ the University of Minnesota's sample set generator called IPUMS.

The IPUMS is a data extraction tool that consists of twenty-five high-precision samples of the American population drawn from thirteen federal censuses. Some of these samples have existed for years, and others were created specifically for this database. The twenty-five samples spanned the censuses of 1850–1990 (see Ruggles and Sobek, 1997). By using the Census data, actual persons' data trails began in 1960, 1970, 1980 and 1990, and thus reduced inaccuracies that were introduced by simulating life events for these persons.

In the following, the process of generating this seeding sample along with the initial and imputed variable values is discussed in detail.

The IPUMS allows for differing density of samples. For the 1960 data, a sample was drawn based on 21,000 households, which found 18,526 women 30 years of age or older. Note that these women will be 90 and older in the year 2020. The study accumulated younger factions in 1970, 1980 and 1990 by securing a sample of women aged 30–39. The next wave will be 80 and older in 2020, with the next being 70 and older, and the final sample will be 60 and older in 2020.

Some types of women will be missed; for example, a 32-year-old who immigrates to the U.S. in 1981 cannot be included in the proxy population. With approximately 44 million women 30 years of age and older in the U.S. in 1960 (see 1995 Statistical Abstract), this sample of 18,526 represents about 1 in every 2,500 women. The extractions for 1970 generated 3,831 from a population of 11.5 million for a 1 in 3,000 sampling with 4,171 of 15.9 million for 1 in 3,800 for 1980. The 1990 sample was trickier to work with due to the fact it was weighted, but the study extracted 7,234 from the 21 million for a 1 in 2,900 sampling.

Remark: In future work the study will include extraction code edits to ensure a more equal sampling from each of the years. The size of the data could also be expanded in the subsequent work.

The study settled on the sample unit's age at the time of the Census taking and sex, race, marital status, educational level, current employment status and income for the year. Key variables were summarized, distilled and imputed from these answers in order to create input for the multi-decrement model. Everyone except women in the specified age bracket was deleted from the sample set. From these remaining women sample units these additional needed values were derived: birth year, an indicator for which marriage the woman is presently experiencing, the duration she has most recently been single, the number of years in the current or most recent marriage, an accumulating variable tracking the number of years a woman sample unit (and a husband, as appropriate) has been employed.

Note that half of the above variables were imputed. What follows is a discussion of each of those variables, and the rationale behind the assumptions made along with some of the consequences of those assumptions.

To derive the number of times a woman has been married, if the Census data reported a non-single status (i.e. currently married, widowed or divorced), it was assumed that this was her first marriage. For the 1960 sample draw, this approach underestimated the number of marriages since the women contained in this set are aged 30 and older. The impact is less noticeable since the divorce rate is lower for that age and calendar time.

As matter of fact, many of these woman sample units will be deceased during the projecting period (2001–2020). For later year draws, with women in the age bracket of 30–39, the number of marriages will only be slightly underestimated. As a partial remedy to this approximation the study set the

number of credit years of this first marriage to the woman sample unit's age past 23 divided by 1.5 rather than just 1.0. The commencement of marriage at age 23 was selected after reviewing median ages of first marriage for women (see Almanac, p. 838).

In addition to the above consideration, the duration of being single was set to one if a woman was unmarried. Note that another variable which might affect marriage probability is ethnic origin—in particular, Hispanic origin. A meaningful extraction of this indicator via IPUMS had not yet been attempted.

2.2 Decrement in Mortality

In order to simulate death for each of the woman sample units it is necessary to generate yearly probabilities of death. A regression analysis of death rates was applied for females in 1960, 1970, 1980 and 1990 by various age brackets with midpoints at 30, 40, 50, 60, 70, 80 and 95. The regression analysis on this data (from Almanac, p. 847) provided a predictive equation and this, along with an adjustment for race (black versus other) coming from the RAND work is used to discern female mortality.

The regression model derived from this data is as follows:

$$q'^{f,d}_{x,t} = e^{(-8.795 - .013458*(t-1900) + .08546x)}$$

Where $q'^{f}_{x,t}$ is the probability of death at age x for the female mortality decrement in a particular year, t. The R-square on this model was .996. Notice that the influence of the year variable intends to capture advances in medical technology and other socioeconomic aspects of life, such as fewer on-the-job accidents, better nutrition, etc.. For a detailed discussion on this factor, see Panis and Lillard, 1999. According to the RAND study, there is a significant factor that increases death rates in black women. Here is the adjustment to the regression equation:

$$q'^{f,d}_{x,t} = e^{(-8.795 - .013458*(t-1900) + .08546x + .3325I_r)}$$

Where I_r is an indicator variable for race:

$$I_r = \begin{cases} 1 & \textit{if black} \\ 0 & \textit{otherwise} \end{cases}.$$

For calibration 1900 was changed to 1950. This had the effect of essentially doubling the overall death rates but seemed to work best in the simulation. Presently, a woman sample unit is not allowed to live beyond 100. Table 1 is the actual death rate data used to generate the mortality probabilities.

Table 1.
Death Rate per 1,000 for White Females

Year	Age						
	30	40	50	60	70	80	95
1960	.9	1.9	4.6	10.8	27.8	77	194.8
1970	.8	1.9	4.6	10.1	24.7	67	159.8
1980	.7	1.2	3.7	8.8	20.7	54	149.8
1990	.6	1.2	3.1	8.2	19.2	48.4	144.0

For the male mortality, a piecewise linear function was used to model the force of mortality function. The choices of parameters were taken from the RAND model.

At the current year, t, the male mortality rates were derived from:

$$q'^{m,d}_{x,t} = e^{(-8.3597 + a - .0081(t-1968) + .2851I_r)} ,$$

Where a describes an increment value for age x:

$$a = \begin{cases} .0721(x-30) & if\ 30 \leq x < 65 \\ 2.5235 + .0821*(x-65) & if\ x \geq 65 \end{cases}$$

and I_r again, is an indicator variable as previously defined.

The primary use of the male mortality model is to determine the probability of widowhood occurrence for a married woman sample unit.

2.3 Decrement in Marriage

The study used the RAND model for probability of a wedding in a certain year. The probability of marriage in year t is

$$q'^{f,m}_{x,t} = e^{(-21.9557 + a_m + s - .0036(t-1940) + marry - R + E - .3813 I_w)} ;$$

Where a_m is a piecewise linear function that represents the increment of age:

$$a_m = \begin{cases} 1.1783x & if & x < 16 \\ 18.8528 + .3855(x-16) & if & 16 \le x < 20 \\ 20.3948 - .0545(x-20) & if & 20 \le x < 25 \\ 20.1768 - .0751*(x-25) & if & x \ge 25 \end{cases} ,$$

s is an incrementing of the years spent single, s_y ($s_y \ge 8$ if remain married for more than 8 years, for example):

$$s = \begin{cases} .0789 s_y & if & 0 \le s_y < 3 \\ .2367 - .0726 s_y & if & 3 \le s_y < 8 \\ -.1263 - .0223 s_y & if & s_y \ge 8 \end{cases} ,$$

marry is an incrementing of number of previous marital experience, m_y, (whether the person was married once, twice or three times previously):

$$marry = \begin{cases} .359 & if & m_y = 1 \\ .6248 & if & m_y = 2 \\ 1.2017 & if & m_y \ge 3 \end{cases} ,$$

Also incorporated into the equation is the race/ethnicity variable, R:

$$R = \begin{cases} .5179 & if & black \\ .0543 & if & indian \\ .2276 & if & asian \\ .3009 & if & hispanic \end{cases} ,$$

E represents the educational level:

$$E = \begin{cases} .1284 & \text{if high school drop out} \\ -.4313 & \text{if college graduate} \end{cases},$$

and finally, I_w is an indicator of whether currently widowed or not:

$$I_w = \begin{cases} 1 & \text{if currently widowed} \\ 0 & \text{otherwise} \end{cases}.$$

2.4 Decrement in Divorce

For the projection of divorce probability, the RAND model is adopted. Assume that the probability of marriage dissolution in a given year, t, follows:

$$q'^{f,d}_{x,t} = e^{(-1.7268 - a_d + ym + trend + marry_d + R_d - E_d)};$$

Where a_d is a piecewise linear function that represents the increment of the age factor:

$$a_d = \begin{cases} .1021x & \text{if } x < 30 \\ 3.063 + .0523 * (x - 30) & \text{if } x \geq 30 \end{cases},$$

ym is an indicator variable for the duration of the marriage:

$$ym = \begin{cases} .735 & \text{if } m = 1 \\ .735 + .1526(m - 1) & \text{if } 1 \leq m < 4 \\ 1.1928 - .0156(m - 4) & \text{if } 4 \leq m < 15 \\ 1.0212 - .0275(m - 15) & \text{if } 15 \leq m < 25 \\ .7462 - .0832(m - 25) & \text{if } m \geq 25 \end{cases},$$

$trend$ is a component, which reflects the divorce trend that allows for rising rates until the year 1980 (trend1=1980 - year for years 1980 and prior and 40 beyond that) and more level divorce probabilities after 1980:

$$trend = \begin{cases} .0429(1980 - t) & \text{if } t \leq 1980 \\ 1.716 + .0058(t - 1980) & \text{if } t > 1980 \end{cases},$$

marry_d is an incrementing of number of previous marital experience, m_y, (whether the person was married once, twice or three times previously):

$$marry_d = \begin{cases} 0 & if \quad m_y = 1 \\ .6368 & if \quad m_y = 2 \\ 1.3584 & if \quad m_y = 3 \end{cases},$$

Also incorporated into the equation is the race/ethnicity variable, R_d:

$$R_d = \begin{cases} .1736 & if \quad black \\ .3237 & if \quad indian \\ -.6378 & if \quad asian \\ -.2067 & if \quad hispanic \end{cases}.$$

Note that *hispanic*=0 currently since ethnicity was not included in the woman sample unit data.

Finally, E_d represents the educational level:

$$E_d = \begin{cases} .0085 & if \, high \; school \; drop \, out \\ .1068 & if \, college \; graduate \end{cases}.$$

2.5 Decrement in Disability

Assuming that once disabled, a worker will be permanently unable to return to gainful employment. Also assume the probability of being disabled is zero once one reaches age 65. The simple model is adopted for the probability of disability at current year t:

$$q'^{f,dsb}_{x,t} = e^{(-7.376 + a_{dsb} + R_{dsb} - E_{dsb})};$$

Where a_{dsb} is a linear function that represents the increment of age factor:

$$a_{dsb} = \begin{cases} .0526(x-30) & if \; 30 \le x < 45 \\ .789 + .1746*(x-45) & if \; x \ge 45 \end{cases}.$$

Also incorporated into the equation is the race/ethnicity variable, R_{dsb}:

$$R_{dsb} = \begin{cases} .2779 & if & black \\ .5446 & if & indian \\ -.5249 & if & asian \\ -.1647 & if & hispanic \end{cases}.$$

Finally, E_{dsb} represents the educational level:

$$E_{dsb} = \begin{cases} .7321 & if\ high\ school\ drop\ out \\ -.6668 & if\ college\ graduate \end{cases}.$$

2.6 Model for Employment

Now, the study introduces a new model for employment history and earnings. Since Social Security retirement, disability and survivor payments are based on average earnings over years worked, it is necessary to establish a mechanism for ascertaining the number of working years of a woman and that of her husband. In order to simulate the year-to-year employment activity, it is necessary to calculate the probability distribution of employment in a woman's lifetime.

To begin, the study models a regression analysis based on the data from the Statistical Abstract. The data used appears in table No. 636 Labor Force Participation Rates, by Marital Status, Sex and Age: 1960–1994 as quoted in Table 2 with the age being the mid-point of the age bracket listed in the Abstract.

The regression analysis shows that at age x, in the current year t, between 1960 and 2000, the labor participating rate for women is as follows:

$$p'^{f,em}_{x,t} = -1396.33 + .7044t + 32.84x - 17.052 + 3.1928I_s - .014xt - .06589x^2,$$

Where I_s is an indicator for single status:

$$I_s = \begin{cases} 0 & if\ married \\ 1 & otherwise \end{cases}.$$

The fit was good with an R-square of .901. For the valuation years beyond the year 2000 the study used the probabilities associated with the year 2000.

Table 2. Labor Force Participation Rates: 1960–1994

				MALE				FEMALE		
	Age	29.5	39.5	54.5	70.0		29.5	39.5	54.5	70.0
Year										
					SINGLE					
1960		91.5	88.6	80.1	31.2		83.4	82.9	79.8	24.3
1970		87.9	86.2	57.1	25.2		81.4	78.6	73	19.7
1975		86.7	83.2	69.9	21.0		80.8	78.6	68.3	15.8
1980		89.2	82.2	66.9	15.8		83.3	76.9	65.6	13.9
1985		89.4	84.6	67.1	15.7		82.4	80.8	67.9	9.8
1990		89.9	84.6	67.1	15.7		81.2	81.0	66.1	12.2
1994		88.4	83.1	67.8	17.8		78.9	78.7	68.8	12.7
					MARRIED					
1960		98.8	98.6	93.7	36.6		28.8	37.2	36.0	6.7
1970		98.0	98.1	91.2	29.9		38.8	46.8	44.0	7.3
1975		97.4	97.1	88.8	23.3		48.4	52.0	43.8	7.0
1980		97.5	97.2	84.3	20.5		58.8	61.8	46.9	7.3
1985		97.4	96.8	81.7	16.8		65.8	68.1	49.4	6.6
1990		96.9	94.4	83.2	22.7		63.1	70.0	60.0	11.4
1994		95.9	85.6	81.9	18.1		71.6	75.8	61.9	9.4
					OTHER					
1960		95.2	94.4	83.2	22.7		63.1	70.0	60.0	11.4
1970		93.7	91.1	78.5	19.3		64.6	68.8	61.9	10.0
1975		92.4	89.4	73.4	15.0		68.6	69.2	59.0	8.3
1980		94.1	91.9	73.3	13.7		76.5	77.1	60.2	8.2
1985		93.7	91.8	72.8	11.4		76.9	81.6	61.0	7.5
1990		93.0	90.8	74.6	12.0		77.3	82.3	65.0	8.5
1994		90.3	88.6	72.6	11.9		74.3	80.4	67.6	8.7

Notice that $p'^{f,em}_{x,t}$ only represents the participation percentage for varying marital statuses, ages and calendar year. Using the above regression equation can simulate $p'^{f,em}_{x}$, the probability of women being employed during the given year of interest. Recall that this activity is simulated year-by-year until she is age 65.

Based on the analysis on the Bureau of Labor Statistics (series ID LFU21000010 and LFU21001731: UNEMPLOYMENT RATES), race is a very important contributor to the employment probability. Therefore, the model was developed to incorporate a component related to race next. The data used is described in Table 3.

Notice that over the available years, the average unemployment rate for blacks was about 10.7% whereas for non-blacks it was 4.4%. The ratio of unemployed blacks to others is 10.7/4.4 = 2.43 and the paper assumes 10% blacks in the population versus 90% non-blacks; calculating $q'^{f,em,nb}_x$ —the probability of unemployment for non-blacks— by solving this equation:

$$1 - p'^{f,em}_x = .1 * 2.43 \, q'^{f,em,nb}_x + .9 \, q'^{f,em,nb}_x .$$

The probability of unemployment for blacks $q'^{f,em,b}_x$ is then $2.43 \, q'^{f,em,nb}_x$. A bound is enforced on percentages at 100 above and 5 below.

Finally, another important factor in the modeling consideration is employment duration. Again data was obtained from the Bureau of Labor Statistics Web site (http://stats.bls.gov/emplt986.htm) to acquire statistics related to this phenomenon. This data was separated into men versus women, blacks versus whites and others and identifies numbers of "stayers" (those who remain in the work force from year to year). Cumulative numbers for the years 1988–1998 appear.

This finding indicated that the probability of being employed for a woman next year given that she is working this year is .86, regardless of race. To ascertain the chance of employment next year for an identical (except that she is unemployed) woman sample unit, this study adopted the following approach. Let P be the participating labor force in current year,

$$P = \begin{cases} 100(1 - q'^{f,em,b}_x) & \text{for blacks} \\ 100(1 - q'^{f,em,nb}_x) & \text{for non-blacks} \end{cases} .$$

By assuming that there will also be P number in the labor force next year, .86*P will be "stayers" so the number of new entrants must be P-.86*P out of the remaining work force of 100-P. So that the probability of being employed now that she is unemployed will be .14P/(1-P). Note that P depends on a woman sample unit's age, the current year, her marital status and her race.

Table 3. Unemployment Rates, by Sex and Race: 1954–1994

		Non-Blacks			Blacks	
	Gender	Men	Women		Men	Women
Year						
1954		4.4	5.1			
1955		3.3	3.9			
1956		3.0	3.7			
1957		3.2	3.8			
1958		5.5	5.6			
1959		4.1	4.7			
1960		4.2	4.6			
1961		5.1	5.7			
1962		4.0	4.7			
1963		3.9	4.8			
1964		3.4	4.6			
1965		2.9	4.0			
1966		2.2	3.3			
1967		2.1	3.8			
1968		2.0	3.4			
1969		1.9	3.4			
1970		3.2	4.4			
1971		4.0	5.3			
1972		3.6	4.9		7.0	9.0
1973		3.0	4.3		6.0	8.6
1974		3.5	5.1		7.4	8.8
1975		6.2	7.5		12.5	12.2
1976		5.4	6.8		11.4	11.7
1977		4.7	6.2		10.7	12.3
1978		3.7	5.2		9.3	11.2
1979		3.6	5.0		9.3	10.9
1980		5.3	5.6		12.4	11.9
1981		5.6	5.9		13.5	13.4
1982		7.8	7.3		17.8	15.4
1983		7.9	6.9		18.1	16.5
1984		5.7	5.8		14.3	13.5
1985		5.4	5.7		13.2	13.1
1986		5.3	5.4		12.9	12.4
1987		4.8	4.6		11.1	11.6
1988		4.1	4.1		10.1	10.4
1989		3.9	4.0		10.0	9.8
1990		4.3	4.1		10.4	9.7
1991		5.8	5.0		11.5	10.6
1992		6.4	5.5		13.5	11.8
1993		5.7	5.2		12.1	10.7

	Gender	Non-Blacks			Blacks	
		Men	Women		Men	Women
Year						
1994		4.8	4.6		10.3	9.8
1995		4.3	4.3		8.8	8.6
1996		4.1	4.1		9.4	8.7
1997		3.6	3.7		8.5	8.8
1998		3.2	3.4		7.4	7.9
1999		3.0	3.3		6.7	6.8
2000		2.8	3.1		7.0	6.3
Averages		**4.25**	**4.79**		**10.78**	**10.77**

In summary, the model predicts the probability of employment next year for a woman with a certain age, race, marital status and whether she is currently employed or currently unemployed. The male employment probability model is developed following a similar process.

After extracting the samples from the 1960, 1970, 1980 and 1990 Census, women sampling units the study intended to simulate year by year each of their life events. Each year, based on the probability formulas derived above, the study generated a uniform random variable, and if it exceeded the probability assigned to that event (marriage, employment, etc.) then the woman sampling unit took on that demographic. Each sampling unit was followed until death (also simulated by considering mortality on a yearly basis for a woman with the simulated life event stream). This entire procedure is executed via SAS code. Then, Social Security benefits were calculated based on this multiple decrement model.

3. Financial Impacts on Women

Based on the projected women population demographics, the Social Security benefit payoff was analyzed for the woman population according to the current rule, and some alternative rules in this section.

At present, our model only looks at retirement, survivor and disability benefits for workers which in 1999 comprised 88.4% (39.4 million) of those eligible to draw on Social Security, the remaining 11.6% (5.2 million) being children and parent benefits (see Table 3.C6, page 126, of the Social Security Bulletin in the Annual Statistical Supplement, 2000, http://www.ssa.gov/statistics/Supplement/2000/supp2000.pdf). In order to

compute benefits the average indexed monthly earnings (AIME) of a woman sample unit is needed, along with items related to her marital status. Then, the rules set forth in the Social Security Handbook (http://www.ssa.gov/) are used to determine the amount of payment. Outlined below are the six categories to which women recipients were relegated.

Average Indexed Monthly Earnings

The average indexed monthly earnings (AIME) is an indexed earning used as a base to calculate the Social Security benefits. The average is the result of dividing the sum of the 35 highest amounts by the number of months in 35 years.

To calculate AIME, the study used Census files that contain information on earnings. In 1960 about 30% of women reported zero income. In 1990 that figure dropped to nearly 10%. Many of these women were not employed that year and the model will tend to leave those women unemployed (see Section 2.6), but it is still necessary to have a monetary figure available for the few years that these women were in the work force. In this case, RAND's model was used to determine income, I_x^w in 1990 for a woman based on factors such as age, marital status and household size.

$$I_x^w = e^{(9.3733+a\ +marry+h)} \ ,$$

where a represents the increment of age (i.e. x):

$$a = \begin{cases} .0110(x-25) & if\ 25 \le x < 50 \\ .275+.0156*(x-50) & if\ x \ge 50 \end{cases} ,$$

and *marry* depends on the marital status of the woman:

$$marry = \begin{cases} -.3486 & if\ never\ married \\ -.4963 & if\ divorced \\ -.3876 & if\ widowed \end{cases} ,$$

and

$$h = .7541 \ln(n) ,$$

where n is the number in the household:

$$n = \begin{cases} 2.3 & \text{if married} \\ 1 & \text{otherwise} \end{cases}.$$

Based on the consumer price indices (CPI) for 1960, 1970, 1980 and 1990 of 18.22, 24.33, 52.76 and 81.81, respectively, each of these income numbers were anchored to the woman at age 30. When working with the woman sample unit, five was subtracted from the number of years she worked as stipulated for AIME calculations allowing up to a maximum of 35 years. It was decided that those years would be centered on the age of 48. Using the 30-year-age income each working year's salary was indexed by relying on a 4% year-to-year general population salary growth. This percentage was determined by referring to the national average wage indexing series provided by SSA office (see the SSA Web site http://www.ssa.gov/OACT/COLA/AWI.html#Series). The AIME for a woman was then computed by taking her lifetime-indexed earnings and dividing by 420 months. Her husband's (as appropriate) AIME was calculated in the same manner but with his 30-year-age income equal to his wife's income divided by .7.

The basic Social Security benefit is called the primary insurance amount (PIA). Typically the PIA is a function of AIME. PIA is the sum of three separate percentages of portions of the average indexed monthly earnings. The portions depend on the year in which a worker attains age 62, becomes disabled before age 62, or dies before attaining age 62. The formula changes annually. For 2001 these portions are the first $561, the amount between $561 and $3,381 and the amount over $3,381. The 2001 computations for Social Security benefits are based on 90 percent of the first $561 of AIME plus 32 percent of AIME of $561 through $3,381 plus 15 percent over $3,381 up to a maximum for an individual at age 65 of $1,536. For ease of computation the PIA was approximated by a quadratic curve:

$$PIA = 140.3317 + .493367\,AIME - .000391\,AIME^2.$$

The fit is good with an R-square of .991. The above formula was used to generate benefits for the woman and her spouse, if married, in the proxy population.

Benefits Allocations

Social Security benefits vary with health, employment and marital situations. Now it is necessary to classify the proxy population and assign each woman to one of the following six classes:

1) divorced where no marriage lasted 10 or more years,
2) divorced where a marriage lasted at least 10 years,
3) currently married,
4) widowed,
5) single or
6) disabled.

Each of these classifications receives a different benefit allocation: Those in the first class receive benefits based solely on her own earnings. The second category of woman draws the maximum of hers and the divorced husband's benefit. To a currently married woman, the study apportioned either half of the sum of the couple's benefits or half of 1.5 multiplied by the maximum of each of the couple's Social Security stipend, which ever was larger. For women who are widowed, the maximum of hers or her deceased husband's benefits were allocated.

Finally, to the single or disabled woman, benefits were assigned based only on her earnings. Benefits were assigned to a disabled woman only if she was employed at least half of the years preceding her disability. Also, we have assigned full benefits to persons 64 and older rather than deal with the two-tiered allocations to those aged 62–64 and those 65 and older. Additionally, the paper has not yet accounted for the recent policy changes that delay the age for full retirement.

Financial Impacts of De-coupled Allocation

As indicated in the beginning of the paper there are several inequities in Social Security allocations. One problem lies in the reduction of a couple's income when a spouse dies. Social Security policy works to the disadvantage of working couples who have comparable levels of earnings. When one person in the couple dies, the remaining spouse will lose one-third to one-half of his or her joint benefits. When earnings are more lopsided the reduction is limited to one-third.

In the following, the LL model is used to show that those earners with more equal levels of benefits are most likely to be the poorer persons in the U.S. Thus the survivor of the poorest couples is most likely to suffer when the spouse dies, and due to lower female mortality this is also likely to be a surviving woman.

Let S be the amount of smaller benefit, and L be the amount of larger benefit for a working couple. Under the current policy, the couple will draw the maximum of 1.5L and S+L, while the survivor will only draw the maximum of S and L.

Define:
$$r = \frac{S}{L}.$$

When r is smaller than one-half, then the benefit that the living couple draws is 1.5L while the benefit for the survivor (if one of the couple dies) is only L. The result is a one-third reduction in the benefit payoff. In the case when r is larger or equal to one-half, S+L will be larger than 1.5L and possibly as big as 2L. Paying L to the survivor reduces the benefit amount by at least one-third, and as much as one-half.

Now look at married couple recipients in the year 2001 and examine the correlation between their current benefit amount and the ratio r. The finding shows a correlation coefficient of -.73. This indicates that those with a higher value of r (i.e. having more equal AIMEs) tend to have lower overall Social Security benefits.

The above analysis supports the study's statement that the survivor, most likely a woman, of poorer couples will tend to see a larger proportional reduction of her Social Security benefits upon the death of her spouse.

Now examine some possible changes of policy in the computation of the survivor benefit, and assess the cost and distributional consequences and antipoverty impact of the change. Consider the de-coupled allocation policy, which involves changing the current benefit loss ranging from 33–50% upon spousal death to 40% in order to redistribute wealth and to help alleviate poverty of elderly widows.

Under current law, there is a notable difference between the poverty rates of non-married versus married women that holds across all age groups. For all benefit categories, married women are much less likely to reside in poor families than are non-married women. The poverty rate of female divorced-spouse beneficiaries is also markedly higher than for all other beneficiary subgroups except for non-married retired workers aged 62–64.

The de-coupled allocation policy change would be an attempt to redistribute the benefits paid to surviving spouses. Since in 2001 those drawing the largest payments were those who received the smaller proportional reduction, a flat 40% reduction seems to be a reasonable policy change. To ascertain the overall impact to the Social Security entitlement program it is necessary to compare several facets: the change in the median expenditures for the entire program, the change to the survivors' median payments and the manner of the redistribution.

The median monthly expenditure based on the LL model for all recipients is $707 in the year 2001. The median for widows was $675. Under the proposed de-coupled allocation policy, the median monthly expenditure for widows increased by $3. However, since the proportion of the widows is small in the group, the monthly median for all recipients remained the same.

Figure 1 shows our analysis in benefit changes due to the proposed de-coupled allocation in year 2001. It displays how changes in Social Security benefit rules affects widows in different parts of the income distribution.

Figure 1. Benefits Under De-coupled Allocation in the Year 2001
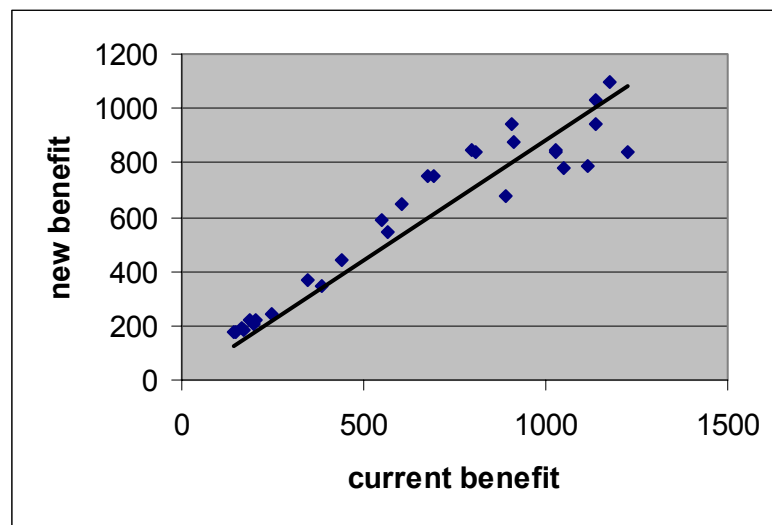
Viewing figure 1 the paper notes that there has been an actual alteration in individual allocations while maintaining aggregate benefit amounts. In Figure 1, the solid line represents no change of benefits. One can see that the lower amount recipients would have some increase to their monthly income since they lie above the line. For the most part, those receiving more than $900 monthly would have a reduced amount allocated under the de-coupled allocation policy. The analysis reveals the effectiveness of the de-coupled allocation in improving the economic well-being of women of lower-income status.

Now the model is used to project benefit allocations beyond the year 2001. As explained above the study used earnings inflation of 4%. To compute Social Security payments the 2001 approximating quadratic equation was relied on with the alteration of an inflationary shift using a 3% per year increase. This 3% increase reflects the historical Consumer Price Index from 1984 through 1999.

The median monthly expenditures based on the LL model for 2020 for all recipients were $1,251. The median for widows was $1,483. Under the de-coupled allocation policy, the group would see a slight $2 decrease in the monthly median due to the overall drop of $53 in median payments to widows. Figure 2 shows the projection of benefit changes due to the proposed de-coupling allocation in the year 2020.   Viewing Figure 2, again there has been a redistribution of benefits among widows.

Figure 2. Benefits Under De-coupled Allocation in the Year 2020
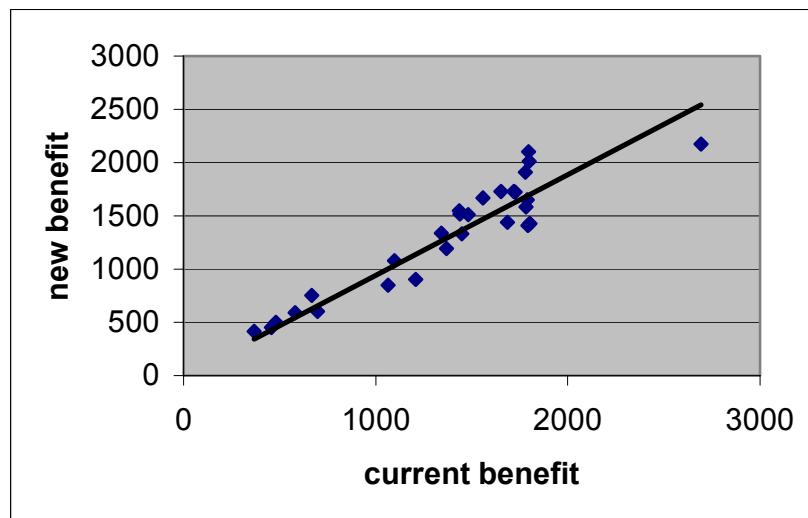
The year 2020 projection indicates that most of the lower earners will receive some relief. The middle-income widows, those who receive Social Security payments near the median, are allocated with certain increases in benefit payout. This occurs mainly because of the substantially demographic change of the U.S. women population from 2001–2020. For the analysis of demographic change, the subcategories of women were examined and compared in the years 2001 and 2020.

The most notable difference was in the percentages of the group of married couples and the group of divorced women.   In 2001 the retired/married group constitutes 62% of the Social Security recipients with the divorced/retired women being 15%. By the year 2020, the retired/married group decreases to 50% while the divorced/retired women group increases to 22%, respectively.

The above percentages lead the study to infer that marriages last for a shorter duration and women will be working for relatively more years out into the future. This means that the lopsided earnings structure observed in 2001 will not be as prevalent in 2020. The correlation between their current benefit amount and the ratio between the minimum and maximum earnings will no longer be negative. By 2020 the equality in earnings will no longer be an indicator of a couple being in a lower income bracket. So the de-coupled allocation policy will not serve as well to redistribute an inequitable allocation.

In summary, the results show that the proposed de-coupled allocation improves the economic circumstances of the poor at the present time but might have less impact on women in the future due to changing demographics.

4. Model Validation

For model validation purposes, a 10% sample of proxy woman population was used. The validation figures reported here are for the 3,376 data vectors. The validity must be checked in two manners: the proxy population must adequately represent the entirety of U.S. women and the monetary Social Security benefits must match the actual expenditures.

4.1 Proxy Population Representativeness

Due to the availability of comparative figures, the study settled on projecting life events for each woman sample unit through the year 1995. The youngest woman in the data vectors then would be 35. Using data from the 1995 Statistical Abstract (Table 14: Resident Population, by Age and Sex: 1970–1994) there were 66.86 million women of these ages in the U.S.. Out of the 3,376 women sample units, 1,979 were alive in 1995. According to the discussion in section 2.1, this was designed as a 1 in 30,000 sample. That means the number of women of this age was 1,979*30,000 = 59.4 million. This was close (about a 10% error) to the actual population. Table 4 summarizes the percentages by age bracket. It shows that the proxy population mimics very closely the real population.

Table 4
Comparing Percentage of Population of U.S. Women

Age	Proxy	1995 Actual Data
35-39	19	16
40-49	29	28
50-59	18	19
60-74	24	24
75+	10	13

Also, the racial proportion was checked, specifically the number of black women in this 1995 proxy population. Of the 1979 women still alive from the extraction, it was noted that 10.9% of them were black. This is close to the 10.5% reported by the CDC via its WONDER data inquiry system (see http://wonder.cdc.gov).

Next, the mortality ratio was examined. Of the 1,764 non-black women alive in our 1994 proxy population, the simulation reveals a rate of .0198 per thousand. And the death rate for non-black women in this age range was .0161 per thousand according to the WONDER data.

Finally, the study looked at marriage rate statistics and found that the rate was 9.1 per thousand in 1994 (Monthly Vital Statistic Report, Vol. 43 No. 13, October 23, 1995, published by the Centers for Disease Control) and the study's 1995 rate was 9.6.

Based on these checks, the proxy population mimics the U.S. women population with enough accuracy to conduct benefits projection of the future years.

4.2 Verifying Benefits Matching

The most recent data accessible from the Social Security Administration is their Social Security Bulletin, Annual Statistical Supplement, 2000. Tables 3C.6-8 contain data that were used to verify the model's benefit assignment methodology. In March 1999, 21.5 million women were receiving Social Security benefits. Among them, about 9.5% of the recipients were disabled and under age 65, and 5.9% of the recipients were widows and widowers. The median annual benefit amount for each recipient was $8,170 (a 1998 figure).

A benefit analysis for 2001 determined that out of 3,376 women sample units 597 were drawing Social Security. This is a good match since 597*30,000 is 17.9 million (but this does not account for those with child or parent benefits and thus not all 21.5 million recipients will be accounted for). Of the 597 recipients 41 are disabled (6.8%) and 29, or 4.9%, are widows. The entire group of recipients had a median annual benefit amount of $8,484. Since this is a 2001 figure from the LL model it should be reduced by COLA percentages (which are figured at three percent per year) so that $8,484 in 1998 dollars would be $7,764, also underestimating expenditures a bit.

These figures were close to actual values when employing the LL model. Particularly, the study primarily wanted to analyze comparisons of dollar allocations under proposed policy changes.

5. Summary and Discussion

This paper presented a preliminary result of a scientific analysis on the impact of changing Social Security's benefit structure on women's economic condition. This was accomplished by building a multiple decrement model for a proxy population of U.S. women. Evaluating policy proposals for women's Social Security benefits is a complicated process because those benefits depend

on complex interactions among women's lifetime earnings patterns, marital histories, and the correlation between the earnings histories of married women and those of their husbands.

Many simplifying assumptions were made in order to handle efficiently differing life event situations during the simulation. Based on the model, the effect of changing some of the current SSA policy was studied, such as the de-coupled allocation. Then model outcomes were validated via the actual population and the Social Security benefits payoff. In spite of adopting many gross aggregating characterizations of individual women sample units, the LL model worked well and matched both population numbers and benefit amounts.

One of the examples of future study using the LL model is to analyze the spousal credit sharing for a working couple proposed by Greenspan (1983). It combines a couple's earnings and divides the credits between them. If they divorce, each half of the shared earnings or benefit is portable, so many of the inequities faced by two-earner couples are removed along with the arbitrary 10-year rule.

During the past several decades, there have been striking changes to the factors that affect women's retirement income. For example, women's wages (relative to men's) have been steadily increasing due to various causes. The trend in the labor force activity of women suggests that in the future a higher proportion of women reaching retirement age will be eligible for their own Social Security retired-worker benefits. Therefore, the fraction of women entitled as spouse-only beneficiaries will decline.

Marriage patterns have also been changing. The increased incidence of divorce and the lower propensity of women to enter marriage would lead to a smaller proportion of women near retirement age qualifying for secondary Social Security benefits of any type. Additionally, the average wife/husband earnings ratio within couples, which determines the type and level of Social Security benefit a woman will eventually receive, has also been redistributed.

The analysis explored the economic impact of potential Social Security benefits policy alteration due to the changing demographics in our society. For further study, the LL model can be used to evaluate all potential Social Security policy. De-coupled allocation example indicates the urgent need for dynamic change in the Social Security Benefit policy.

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