

## **MBA Teaching Note 08-03**

### **Net Present Value Analysis of Social Security**

One of the most common complaints about the Social Security system in the United States is that many people believe they will put in a certain amount of money and get out far less. It should be understood that Social Security is not an investment in a retirement plan such as a 401(k) or IRA. Social security is a pay-as-you-go system, meaning that those who are working generate the money that is paid to those who are retired. To view Social Security as an investment is, therefore, somewhat misleading, but that does not mean that it is invalid to wonder about whether what you pay out is anywhere near what you receive.

To answer this question, we can do a net present value analysis of expected Social Security taxes paid during one's working years and expected Social Security benefits received during one's retirement years. Obviously some critical assumptions must be made, but all financial analyses are dependent on assumptions. The more tenuous are the assumptions, the higher the discount rate you should use.

While the assumptions can be difficult to make, the procedure for determining Social Security taxes and benefits is fairly simple. The procedure for calculating your benefits is covered in the document <http://www.ssa.gov/pubs/10070.html>. To determine your payments into the system, you simply calculate (presently) 6.2% of your earnings up to \$102,000 (in 2009). That is, you pay 6.2% on the first \$102,000 and nothing on any amount thereafter in that year. This figure, \$102,000, is called your "maximum Social Security earnings" and refers to the largest amount you can earn on which Social Security taxes are paid in a given year. This figure usually increases at around the rate of inflation.

If you retire at age 65, your benefits are calculated by identifying the 35 years in which you had the highest earnings. For most people, this will be ages 30 through 65. You simply add up those earnings and determine your average monthly earnings. The system recognizes inflation, however, by allowing for a certain indexing of your earnings. For example, if you earned \$50,000 in a year and got a 10% raise to \$55,000 the next year, you are allowed to adjust the \$50,000 by an inflation factor so that both figures are expressed in the equivalent of second-year dollars. To project into the future, we have to index in that manner, but in practice, the procedure is slightly different. Typically you want to calculate your Social Security benefit upon retirement, whereupon you have a history of past earnings. The procedure is to index them to adjust them up to current dollars. The Social Security Administration publishes tables of indexing factors. As an example and to keep it simple, let's assume you worked only two years and made \$50,000 and \$55,000 and inflation was 3%. Then your first year figure would be bumped up to \$51,500. You did not actually make \$51,500 but in terms of year 2 dollars, that is the equivalent first-year salary. In the example we will do, we are going to project forward so we will index to the current year looking ahead and that will require an adjustment that is the opposite from what happens when you look back.

When you have obtained these adjusted earnings for the 35 years in which you had the highest earnings, you add them up and divide by 420, the number of months in 35 years. This is your average monthly salary. Your benefit is found as follows:

- (a) The first \$711 is multiplied by 90%
- (b) Any amount in excess of \$711 but less than \$4,288 is multiplied by 32%
- (c) Any excess over \$4,288 is multiplied by 15%

The sum of these figures is your monthly benefit, assuming retirement at 65. If you retire at 62, you get 75% of this amount.

If you can make a reasonable forecast of your future earnings, you can then forecast your expected retirement benefits. You should also index those to inflation as well, as the system usually grants increases in benefits at about the inflation rate.

To take an example, assume that a person is expected to start work in 2009 at a salary of \$50,000, which is projected to grow at a 5% rate for 40 years. The maximum Social Security earnings in 2009 is \$102,000, and this figure is projected to grow at the inflation rate. In this example, at a \$50,000 annual salary this person will pay Social Security taxes on all earnings every year.

The spreadsheet below shows the projected annual earnings, Social Security taxes, Social Security benefits, and the present values of both. To obtain present values, we must have an investment opportunity cost, for which I use 5%.

In the third column the salary is raised each year by 5%. The fourth column is the inflation-indexed salary, which increases the salary by the inflation factor, as described above. For example, the first-year salary of \$50,000 grows at 5% to \$52,500 the second year. This figure is then indexed to the inflation rate of 4% to obtain  $\$52,500(1.04) = \$54,600$ . That means this person did not earn \$54,600 but would have needed to earn that much to net out to a 5% raise with the same purchasing power. These calculations continue down the column in that manner. The maximum Social Security earnings of \$102,000 is indexed each year at the inflation rate. This figure is well above the person's salary so 6.2% of the salary is paid in taxes each year. Then you must find the present value of each of these figures. Note how the present value of each figure is the same, which is because the figures are growing at 5% and being discounted by 5%. Of course, there may be good reasons for using a higher discount rate.

The Social Security benefit in year 41 is shown as \$39,386, which is found as follows. The 35 highest-earning years are years 6 through 40. The sum of the earnings in years 6-40 is \$5,994,255. There are 420 months in that period, so the monthly average salary is \$14,272. The monthly benefit is found as follows:

- (a) The first \$711 is multiplied by 90%  
 $\$711(0.90) = \$639.90$
- (b) Any amount in excess of \$711 but less than \$4,288 is multiplied by 32%  
 $(\$4,288 - \$711)(0.32) = \$1,144.64$
- (c) Any excess over \$4,288 is multiplied by 15%  
 $(\$14,272 - \$4,288)(0.15) = \$1,497.60$

The monthly benefit is the sum of these three numbers,  $\$639.90 + \$1,144.64 + \$1,497.60 = \$3,282.14$ , rounded to \$3,282. For 12 months, this adds up to \$39,386, rounded off. This number is then indexed to inflation. The last column is its present value. Note that this figure is not the same every year because it is increasing at the inflation rate and being discounted at the investment opportunity cost.

The next page from the spreadsheet shows that the sum of the present values of the Social Security taxes paid is \$118,095, while the sum of Social Security benefits is \$97,451 for a net loss of \$20,644. This figure is effectively the projected net cost today to this individual of the Social Security system. If the inputs are reliable, an individual should be indifferent between the Social Security system and putting in \$20,644 now with an understanding that he would pay no more Social Security taxes or receive any Social Security benefits in the future.<sup>1</sup>

Changing the inputs can be done to evaluate how the results change. At a starting salary of around \$132,000, the net benefit is close to zero. Going back to a \$50,000 starting salary, a salary growth rate of a little under 7.9% would also result in breakeven. Of course, not living 20 years after retirement would lower the net benefit. If you believe the uncertainty in these numbers is much greater than would be justified for a 5% opportunity cost, you might want to change the discount rate to something closer to a long-run expected return on the stock market, say 9%. In that case, the net cost is \$44,855. Another factor that is quite uncertain and could

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<sup>1</sup>Such choices make a lot of economic sense but would be difficult and politically unpopular to implement. A person opting completely out of the system might have a perverse incentive to become indigent in his old-age, whereupon a compassionate government would probably start paying him benefits.

change is the 6.2% tax rate and the rate at which the maximum Social Security earnings level increases.

What if this person decides to retire at age 62? That means he will get Social Security earnings at ages 63, 64, and 65 instead of starting at 66. Social Security rules state that the benefit is reduced to 70% of what it would be for retirement at 65. Thus, assuming the same life expectancy, it would seem he would get 70% of the present value of the earnings calculated in the above example, but his monthly benefit should be lower because retiring early reduces the average monthly salary for most people. In addition, he would receive three more years of benefits and would have three fewer years of costs. It would be virtually impossible to do the calculations without modifying the spreadsheet. When I do that, I get a net cost of \$27,629. So in this case, it looks more costly to retire early. Of course, unrelated to these calculations is the fact that you lose three years of working income as well. Hence, early retirement is probably a bad idea.

What about continuing to work past retirement age? Social security rules say that for every additional year you work past the age of 65 but not past 70, your Social Security benefit goes up by 8% a year. Again, we would have to create a new spreadsheet, but in this example I find that the net cost is even greater at \$31,972. Of course, the primary reason for that is that we have to assume the same life expectancy. Thus, this person will pay into the system for five more years but receive benefits for five fewer years. Of course, that is more than offset, however, by the additional working income for five more years.

Retiring early, late, or right on schedule is, however, more than just a financial decision. Quality of life and health considerations are major factors. But for sure, the financial implications of retirement are extremely important as well. Net present value analysis, which is really just finding the value in today's dollars of money paid out and money taken in, is the right way to analyze the problem. If you care about this issue for you, you should consider building a spreadsheet to track your past contributions and project your future contributions and benefits.

	Year	Salary	Inflation Indexed Salary	Maximum Social Security Earnings	Social Security Taxes Paid	Present Value of Social Security Taxes Paid	Social Security Benefit	Present Value of Social Security Benefit
0								
1	2009	\$50,000	\$50,000	\$102,000	\$3,100	\$2,952		
2	2010	\$52,500	\$54,600	\$106,080	\$3,255	\$2,952		
3	2011	\$55,125	\$57,330	\$110,323	\$3,418	\$2,952		
4	2012	\$57,881	\$60,197	\$114,736	\$3,589	\$2,952		
5	2013	\$60,775	\$63,206	\$119,326	\$3,768	\$2,952		
6	2014	\$63,814	\$66,367	\$124,099	\$3,956	\$2,952		
7	2015	\$67,005	\$69,685	\$129,063	\$4,154	\$2,952		
8	2016	\$70,355	\$73,169	\$134,225	\$4,362	\$2,952		
9	2017	\$73,873	\$76,828	\$139,594	\$4,580	\$2,952		
10	2018	\$77,566	\$80,669	\$145,178	\$4,809	\$2,952		
11	2019	\$81,445	\$84,703	\$150,985	\$5,050	\$2,952		
12	2020	\$85,517	\$88,938	\$157,024	\$5,302	\$2,952		
13	2021	\$89,793	\$93,385	\$163,305	\$5,567	\$2,952		
14	2022	\$94,282	\$98,054	\$169,837	\$5,846	\$2,952		
15	2023	\$98,997	\$102,956	\$176,631	\$6,138	\$2,952		
16	2024	\$103,946	\$108,104	\$183,696	\$6,445	\$2,952		
17	2025	\$109,144	\$113,509	\$191,044	\$6,767	\$2,952		
18	2026	\$114,601	\$119,185	\$198,686	\$7,105	\$2,952		
19	2027	\$120,331	\$125,144	\$206,633	\$7,461	\$2,952		
20	2028	\$126,348	\$131,401	\$214,899	\$7,834	\$2,952		
21	2029	\$132,665	\$137,971	\$223,495	\$8,225	\$2,952		
22	2030	\$139,298	\$144,870	\$232,434	\$8,636	\$2,952		
23	2031	\$146,263	\$152,114	\$241,732	\$9,068	\$2,952		
24	2032	\$153,576	\$159,719	\$251,401	\$9,522	\$2,952		
25	2033	\$161,255	\$167,705	\$261,457	\$9,998	\$2,952		
26	2034	\$169,318	\$176,090	\$271,915	\$10,498	\$2,952		
27	2035	\$177,784	\$184,895	\$282,792	\$11,023	\$2,952		
28	2036	\$186,673	\$194,140	\$294,104	\$11,574	\$2,952		
29	2037	\$196,006	\$203,847	\$305,868	\$12,152	\$2,952		
30	2038	\$205,807	\$214,039	\$318,102	\$12,760	\$2,952		
31	2039	\$216,097	\$224,741	\$330,827	\$13,398	\$2,952		
32	2040	\$226,902	\$235,978	\$344,060	\$14,068	\$2,952		
33	2041	\$238,247	\$247,777	\$357,822	\$14,771	\$2,952		
34	2042	\$250,159	\$260,166	\$372,135	\$15,510	\$2,952		
35	2043	\$262,667	\$273,174	\$387,020	\$16,285	\$2,952		
36	2044	\$275,801	\$286,833	\$402,501	\$17,100	\$2,952		
37	2045	\$289,591	\$301,174	\$418,601	\$17,955	\$2,952		
38	2046	\$304,070	\$316,233	\$435,345	\$18,852	\$2,952		
39	2047	\$319,274	\$332,045	\$452,759	\$19,795	\$2,952		
40	2048	\$335,238	\$348,647	\$470,869	\$20,785	\$2,952		
41	2049						\$39,386	\$5,328
42	2050						\$40,961	\$5,277
43	2051						\$42,600	\$5,227
44	2052						\$44,304	\$5,177
45	2053						\$46,076	\$5,128
46	2054						\$47,919	\$5,079
47	2055						\$49,836	\$5,031
48	2056						\$51,829	\$4,983
49	2057						\$53,902	\$4,935
50	2058						\$56,058	\$4,888
51	2059						\$58,301	\$4,842
52	2060						\$60,633	\$4,796
53	2061						\$63,058	\$4,750
54	2062						\$65,580	\$4,705
55	2063						\$68,203	\$4,660
56	2064						\$70,932	\$4,616
57	2065						\$73,769	\$4,572
58	2066						\$76,720	\$4,528
59	2067						\$79,788	\$4,485
60	2068						\$82,980	\$4,442

This model assumes you work 40 years, retire, and live 20 years thereafter								
Inputs			Results					
Year you start work	2009							
Starting salary	\$50,000							
Expected annual salary growth rate	5.00%		PV of social security taxes paid	\$118,095	Monthly social security benefit	\$3,282	Overall net cost of social security	-\$20,644
Maximum social security earnings	\$102,000		Income in highest 35 years	\$5,994,255	PV of social security benefit	\$97,451		
Expected inflation rate	4.00%		Average monthly income	\$14,272				
Social security tax rate	6.20%							
Investment opportunity cost	5.00%							