A Case Study in More Realistic Retirement Planning

Harold B. Tamule, Providence College
Richard B. Goldstein, Providence College

ABSTRACT

Financial planning entails the projection of expected cash flows compounded at a realistic rate of return to estimate a potential future value. Standard formulae use only simplistic assumptions which may lead to biases, or worse, incorrect estimates. Using more realistic assumptions, we develop a financial model to correct such potential error. To extend this analysis further, we employ our model to develop an understanding of a controversial case of CEO retirement benefits compensation. While our model is limited by mathematical parameters, we show that this case of defined benefits CEO retirement compensation could only be earned by a competing defined contribution plan with unusually high cash flow inputs.

INTRODUCTION

Early in their college educations, business majors engage in thorough study of discounted cash flow analysis, or the time value of money. While the various present value formulae demonstrate the standard valuation process, the future value equations are also useful. In fact, some students may erroneously see more significance in future value operations, possibly due to the entertainment value of seeing modest investments become large from compounding over long holding periods. Nonetheless, future value operations are likely to be important in the modeling of retirement. The primary purpose of this paper is to show that the current basic future value equation that is a standard component of introductory finance courses may mislead those planning for retirement, especially if the periodic cash flow experiences real growth over the investment horizon. A second purpose is to examine a controversial case study of retirement savings.

A REALISTIC FINANCIAL PLANNING MODEL

The standard classroom application for retirement is typically the future value of an ordinary annuity. A traditional example of this type of investment is a whole life insurance policy with cash surrender value. With regard to retirement savings, usually an employee's retirement account receives an employer's end-of-period retirement contribution payment, or the individual deposits their own payment at the end of the period (A). Students see this operation in the future value of an n-period ordinary annuity formula as the end-of-period payment is discretely compounded at the periodic opportunity rate-of-return (r) as follows:

$$FVA_{ORD} = A * \left[\frac{(1+r)^n - 1}{r} \right]$$

This will be in error unless the opportunity rate-of-return is the real rate-of-return and the recurring retirement payment is a constant and real, not nominal amount. For a more realistic retirement example, this analysis must be modified. In the case in which the financial analyst uses nominal values and nominal expected investment rates-of-return, a more accurate retirement planning model would reflect a growing annual base salary to reflect cost-of-living adjustments as well as merit or real raises from a promotion, etc. As long as the employer keeps the percentage contribution of employees' salary constant, the employee (student) will rationally expect a growing series of cash flow being invested for retirement. This would mean that rational newly-hired employees would reference their projected end-of-period payments (A) which grow at an annual rate of g and compound to a retirement account balance as follows:

$$FVA_n = A*(1+g)^0*(1+r)^{n-1} + A*(1+g)^1*(1+r)^{n-2} + ... + A*(1+g)^{n-1}*(1+r)^0 \qquad (1)$$

With somewhat familiar algebraic manipulation, one can develop a more concise version of an effective retirement planning model. First assume that r>g and that the growth in an employee's annual salary and thus retirement payment grows at a constant rate (g). Then define a constant (C):

$$C = \frac{1+r}{1+g}$$

and multiply both sides of equation 1 with the constant to obtain:

$$FVA_n * \frac{1+r}{1+g} = A*(1+g)^{-1}*(1+r)^n + A*(1+g)^0*(1+r)^{n-1} + ... + A*(1+g)^{n-2}*(1+r)^1 \qquad (2)$$

Then factor the A_0 from both equations 1 and 2. Then subtract equation 1 from equation 2 to obtain:

$$FVA_n * \left[\frac{1+r}{1+g}\right] - FVA_n = A*\left[(1+g)^{-1}*(1+r)^n - (1+g)^{n-1}*(1+r)^0\right] \qquad (3)$$

By subtracting and then crossmultiplying, the future value of the n-period growing, but finite annuity, i.e. $FVFBGA_n$ becomes:

$$\mathrm{FVFBGA_n} = \mathrm{A} * \frac{\left[(1+\mathrm{r})^{\mathrm{n}} - (1+\mathrm{g})^{\mathrm{n}}\right]}{\mathrm{r}-\mathrm{g}} \qquad (4)$$

For example, suppose that a number of students have just accepted a job and are sufficiently farsighted to contemplate their retirement. Furthermore assume that the yearly retirement benefit will be 10% of their starting salary of 40,000 and is payable into their account in a lump sum at the end-of-the-year. These students may rationally expect their nominal annual salary to grow at a 5% rate over their 40-year career, hypothetically invest in a 50/50 allocation between bonds [E(ROR) = .06] and equities [E(ROR) = .10] and constantly rebalance to maintain the 50/50 allocation. Then the future expected value of the retirement account balances can be calculated as follows:

$$FVA_{40} = \$4,000 * \frac{\left[(1.08)^{40} - (1.05)^{40}\right]}{0.08-0.05} = \$4,000 * \frac{[21.7245 - 7.0400]}{0.03} = \$1,957,938 \qquad (5)$$

Any sophisticated student will want to inquire into the error in using the standard future value of an annuity instead of this more accurate and realistic equation. To answer this, the instructor can require a spreadsheet assignment that easily produces the comparison. To continue with the above example, Table 1 reflects the growth versus no-growth cases. By subtracting the value of the growing, but finite retirement annuity from the standard fixed annuity, the student can calculate the improvement in their nominal retirement balance as their contribution grows. In contrast to the standard formula, after a forty-year career, the employee who enjoys a growing retirement payment will have an additional $921,712 (+88.95%). At the extreme an employee who contemplates a fifty-year career would plan on accumulating more than twice the retirement balance than the fixed annuity owner. The error for misusing these formulae leads to substantial error. As one can see from Figure 1 the error due to the misused formula is an exponential shaped function.

Another exercise into the difference between these formulae is the consideration of inflation. The Fisher effect states that the nominal interest rate (r) equals the product of the real interest rate, r_{real} and the expected rate of inflation, E(I). If a recent college graduate rationally, but pessimistically, expects to receive only a nominal annual raise, then the financial planning for retirement is simplified. In this case, the future value available upon retirement is a function of the standard future value of an annuity equation. This is most easily seen using the present value formula. The present value of expected retirement payments equals:

$$PVA = \frac{A*(1+g)}{(1+r)} + \frac{A*(1+g)^2}{(1+r)^2} + ... + \frac{A*(1+g)^n}{(1+r)^n} \qquad (6a)$$

As the Fisher effect states that:

$$1+r = (1+r_{real})*(1+E(I))$$

and by substitution:

$$PVA = \frac{A*(1+g)}{(1+r_{real})*(1+E(I))} + \frac{A*(1+g)^2}{(1+r_{real})^2*(1+E(I))^2} + ... + \frac{A*(1+g)^n}{(1+r)^n*(1+E(I))^n} \qquad (6b)$$

If the new employee only receives a nominal raise to keep pace with inflation, then g = E(I) and after canceling terms, equation 6b becomes similar in form to a standard fixed annuity. After multiplying by the compounding factor $(1+r)^n$, the standard future value formula is produced as follows:

$$FV = PV*(1+r_{real})^n = A*\left[\frac{1-\frac{1}{(1+r_{real})^n}}{r_{real}}\right]*(1+r_{real})^n = A*\left[\frac{(1+r_{real})^n - 1}{r_{real}}\right] \qquad (7)$$

Using the data of the previous example, assume that the recent college graduates expect the rate of inflation to equal their expected nominal raise of 5% over their 40-year career. In that case, one can easily solve for the real rate of growth of 2.86% and a real annual return of 4.85%. Then their expected real retirement account balance will be approximately less than half the nominal amount as follows:

$$FVA_{40} = \$4,000*\left[\frac{1.0485^{40}-1}{.0485}\right] = \$4,000*116.6969 = \$466,788 \qquad (8)$$

Of course, most students will look at this projection as unrealistically low because they do expect real increases in their salaries. To complete a sensible example, we calculate the real future value of retirement savings with 3% inflation, 8% nominal portfolio return, and a 5% nominal growth rate of annual contributions as follows:

$$FVA_{40} = 4{,}000 * \left[\frac{1.0485^{40} - 1.0194^{40}}{.0485 - .0194} \right] = \$4{,}000 * 154.3654 = \$617{,}462 \qquad (8a)$$

Part B of Table 1 displays the real, as opposed nominal error of the simulation. Here the forty-year employee who receives compensation that is growing at 5%, but experiences 3% annual inflation is only \$151,589 (+32.54%) better off than the fixed annuitant. The extreme case of the fifty-year employee sees his/her additional real retirement balance at \$1,108,285, or only 38.87% better off.

A more realistic application of Equation 4 is to calculate future value of retirement savings using a continuous algorithm. In other words, the payments into the retirement account are made on a discrete basis, either annually or monthly, but the return and growth are generated continuously. This reflects a global economy in which financial markets are open continuously and assets are traded continuously. To modify Equation 4, the period rate-of-return and the growth rate must be modified to a continuous form.

Taking Equation 1 and modifying it with k subperiods in each discrete interval to the continuous process yields:

$$\mathrm{FVA}_{\mathrm{Re\,tirement}} = \frac{A}{k} * \left(1 + \frac{g}{k}\right)^{0} * \left(1 + \frac{r}{k}\right)^{k*n-1} + \frac{A}{k} * \left(1 + \frac{g}{k}\right)^{1} * \left(1 + \frac{r}{k}\right)^{k*n-2} + \ldots + \frac{A}{k} * \left(1 + \frac{g}{k}\right)^{k*n-1} * \left(1 + \frac{r}{k}\right)^{0} \qquad (9)$$

As the limit of k approaches infinity, and using L'Hôpital's Rule, Equation 9 reduces to:

$$\mathrm{FVA}_{\mathrm{Retirement}} = A \frac{\left(e^{n*r} - e^{n*g}\right)}{r - g} \qquad (10)$$

Table 2 displays the simulation results of a continuous process of earning employee benefits. The realism of this approach is rooted in the firm operating constantly, i.e. generating cash flows constantly that can be allocated to the employee benefits of salary and retirement and the investment assets of the retirement account are trade in continuously operating financial markets. The parameters of the simulation remain constant. With a continually compounding return and increasing annuity payments, the retirement account clearly produces a higher future value. The continuous process results in Table 2 show that the forty-year employee should expect an additional ending balance of \$327,859 (+16.7%). The longest term employee, the fifty-year worker, is \$930,859 (19.7%) better off.

ANALYSIS OF CEO RETIREMENT COMPENSATION

This financial modeling is critical in analyzing important events in the financial markets. For example, a controversy erupted in 2003 subsequent to the public disclosure of the compensation of the Chairman of the New York Stock Exchange. His pay package not only dwarfed that of other chief executives of not-for-profit corporations, but it exceeded the average of many private sector CEOs. In 2002 the NYSE Chair earned \$10 million in salary and bonus, while the CEOs of the 500 largest corporations earned only an average of \$6.2 million in salary, bonus, and intrinsic value of exercised stock options [Ackman 2003]. The revelation of the NYSE Chair's compensation produced widespread reaction in various avenues of the media.

Unfortunately, most of the reaction tended to be very emotional and lacking in analytical objectivity. Moreover, the references to the situation were at a minimum hyperbolic, and at worst hysterical. Some responses described the entire controversy: “a firestorm” [Morgenson and Thomas 2003] ; “startling” [Kelly and Craig 2003]; “pure greed” [Valdmanis 2003]; “Members Mutiny over Chairman’s Bounty” [Anderson 2003]; and, “an embarrassing episode” [White 2003]. Other commentators reported on their own feelings: “shocked,” “outraged,” “privately incredulous,” “revulsion” [Kelly, Craig, and Dugan 2003]. Yet others isolated on the NYSE Chairman himself: “the newest symbol of runaway greed” [McGeehan and Thomas]; “blundering and clueless” [Tharp 2003]; “[NYSE Chair] has succeed at … making Wall Street gasp in astonishment at someone else’s compensation,” [Thomas 2003]; and, “a $188 Million wedding cake with tier upon tier of bonuses and pension enhancements stacked so high they left onlookers gaping” [McGeehan 2003].

An objective analysis would examine the relevant cash flows using an appropriate, or reasonable opportunity rate-of-return. While most of the media outrage occurred in 2003 as a result of the NYSE Chair accumulating a minimum of $139.5 million in pension benefits and deferred compensation and a maximum of $188 million, a complete analysis of the case study must begin earlier. The NYSE Chair began working for the NYSE in April 1968 as a low-level clerk only making $82.50 per week, i.e. $82.50*52 or $4,290 per year. By all reports, he worked very diligently, earned many well deserved promotions, in 1988 became CEO, and eventually in June 1995 rose to NYSE Chairman. At that time he negotiated a pay package that allowed him to withdraw his accumulated defined-benefit retirement balance of $6.5 million and to earn 8% on this withdrawn amount and any other subsequent accumulated savings balances. Thereafter his base salary of $1.4 million was augmented by substantial bonuses which resulted in his total compensation exceeding $10 million in 1999. In 2003 his accumulated balance of his retirement and deferred compensation of $139.5 million became publicly known. The large and controversial amount of the NYSE Chair’s nest egg of retirement and deferred compensation lead to his forced resignation and is a perfect example for our financial modeling. In addition, the financial modeling is entirely objective and does not impart emotions or personal opinions to this situation.

To analyze the reasonableness of the retirement and savings package requires the simple finite, but growing annuity to model the outcome of a defined contribution retirement plan. First, the model calls for practical assumptions. Given that various sources report that the former NYSE Chairman started working earning $4,290 yearly in 1968, received $2,160,000 ($1,260,000 in annual salary and a $900,000 bonus) in 1995 and at the same time negotiated a withdrawal of $6,571,397 from his retirement account and deferred compensation savings balance, one must identify a constant growth of his compensation, an annual rate-of-return, and a contribution percentage of salary. First, one can quickly calculate an approximate 25.65% annual rate of increase (g) in his total compensation using a simple geometric model as follows:

$$\$2{,}160{,}000 = \$4{,}290 * (1+g)^{27.25}$$

Since the NYSE Chair’s subsequent compensation contract guaranteed him an annual 8% rate-of-return on certain account balances, an initial calculation must assume this opportunity rate. The last input is the NYSE’s contribution percentage into his retirement and savings account. This is assumed to be 12% and projected to begin at the inception of his career.[1] Unfortunately,

[1] A subsequent employment contract offered the NYSE Chair a supplemental savings plan in which the NYSE would match his contribution up to 6% of his salary.

the NYSE Chairman had such an unusually successful career whose increases in compensation yield a growth rate that exceeds the assumed opportunity rate-of-return. Since equation 4 cannot be used directly, as an alternative we employ an excel spreadsheet in which the sum function essentially replaces equation 4. Given the three parameters of hypothetical contribution, return and duration we calculate that the NSYE Chair's simulated retirement balance would grow to $1,443,822 after 26 years of employment (Table 3A). Given the inputs of our simulation, clearly the 1995 balance of $6,571,397 was unattainable. Therefore, the financial analysis requires some sensitivity analysis to proceed further.

A second degree of complexity is to consider a supplementary employee savings that augment a primary retirement account. Some qualified employees of tax-exempt corporations may take advantage of a 403(b) Plan or SRA to augment their primary retirement program. The beauty of our financial analysis is that this additional retirement savings can modeled by simply adding a new column of data. Since the amount to be saved is speculative, our analysis takes advantage of Excel's goal seek process. In this manner we calculate the amount of periodic savings necessary to reach a certain goal. Table 3B shows that the NYSE Chair would have needed to save 42.62% percent of his annual salary to supplement his primary hypothetical defined benefit in order to reach $6,571,397. For most years this grossly exceeds the IRS' maximum limit of total 403(b) contribution.

Another option to consider is the realistic possibility that the employee's funds were invested in an equity account over the sample interval. While the NYSE plan offered a guaranteed 8% annual rate-of-return on certain accounts, many retirement programs have equity account choices. To test this possibility, we obtained the total annual rate-of-return on the S&P500 index from the beginning of employment (April 1968) to the end of his CEO contract (June 1995), i.e. the beginning of his Chairman's contract. In this interval the mean annual arithmetic (geometric) rate of return is 11.74% (10.83%). Because the average equity market return exceeded the 8% contractual guaranteed rate of return over this 27 year period, the cumulative year end balance of the retirement and savings account is higher ($1,884,359) than the result of Table 3A ($1,443,822), but substantially less than the amount that was actually withdrawn. We repeat the simulation involving the personal savings rate necessary to accumulate and find that an additional contribution of 27.20% of his salary is necessary to produce a terminal value of $6,571,397. A logical extension to this simulation is the use of small capitalization equity returns, since some retirement plans may offer their members such an investment option. This outcome which is reported in Table 4C yields little difference from Table 4A results of large capitalization equities.

To reflect a more realistic scenario, we investigate the case of monthly compounding as most business professionals should expect twelve paychecks per annum. To simplify matters we assume that the individual earns one-twelfth of the indicated yearly return per period and all funds are invested in an equity account. First Table 5A shows the case of monthly retirement contributions and compounding. Obviously the amount of necessary personal savings is reduced from the annual case, nonetheless, at 19.34% of salary the required personal savings rate is still very high. Table 5B that reflects monthly compounding with small firm stock returns shows an improved condition for the executive as his required personal savings declines to 14.12% of his compensation. For the continuous compounding, the results which are not shown do not differ appreciably from those of Tables 5A and 5B.

CONCLUSION

We investigate a financial planning model that is more precise than the standard formula that is generally used in finance courses. We demonstrate the error by using the wrong model can increase substantially over long intervals. In addition we employ this financial planning model to analyze a controversial case study of retirement benefits using simulated cash flow analysis. While our basic model requires a restrictive relationship of its variables, use of a spreadsheet easily overcomes such a limitation. Thus, we show that this particular retirement benefit can only be earned by employing unusually liberal cash flow inputs. Our result is congruent with Bebchuk and Jackson (2005) who show that CEO pension benefits constitute a large percentage of CEO career compensation, along with rather opaque firm disclosure of the wealth payment. In addition, Sundaram and Yermack (2007) likewise show the high value of CEO retirement obligations as part of their analysis of the CEO pension as an inside debt contract.

Our analysis emphasizes the ad hoc nature of the defined benefit pension as opposed to a defined contribution. Possibly the CEO uses his/her job market power to extract more assets from the firm through their retirement benefit that is above and beyond the wealth from annual salary, bonus and equity-based incentive awards. While the firm’s decision to fund their CEO’s retirement with a defined benefit payment may be greatly influenced by IRS tax policy, the incompatibility between discounted cash flow modeling and common CEO retirement payments may force them to review such a decision. In fact, any organization that typically compensates their employees with a defined benefit retirement may wish to revisit such a policy.

Table 1

Future Value Comparisons

Part A: Nominal Values

Period	ROR	No-Growth, Finite Nominal Annuity FVA	Growth Rate	Growing, Finite Nominal Annuity FVA	Error
1	8.00%	4,000	5.00%	4,000	0.00%
2	8.00%	8,320	5.00%	8,520	2.40%
3	8.00%	12,986	5.00%	13,612	4.82%
4	8.00%	18,024	5.00%	19,331	7.25%
5	8.00%	23,466	5.00%	25,740	9.69%
10	8.00%	57,946	5.00%	70,671	21.96%
15	8.00%	108,608	5.00%	145,765	34.21%
20	8.00%	183,048	5.00%	267,688	46.24%
25	8.00%	292,424	5.00%	461,616	57.86%
30	8.00%	453,133	5.00%	765,429	68.92%
35	8.00%	689,267	5.00%	1,235,911	79.31%
40	8.00%	1,036,226	5.00%	1,957,938	88.95%
45	8.00%	1,546,022	5.00%	3,058,059	97.80%
50	8.00%	2,295,081	5.00%	4,724,562	105.86%

Part B: Real Values (Assumption of 3% Annual Inflation)

Period	ROR	No-Growth, Finite Real Annuity FVA	Growth Rate	Growing, Finite Real Annuity FVA	Error
1	4.85%	4,000	1.94%	4,000	0.00%
2	4.85%	8,194	1.94%	8,272	0.95%
3	4.85%	12,591	1.94%	12,829	1.89%
4	4.85%	17,202	1.94%	17,689	2.83%
5	4.85%	22,036	1.94%	22,867	3.77%
10	4.85%	49,961	1.94%	54,149	8.38%
15	4.85%	85,346	1.94%	96,327	12.87%
20	4.85%	130,186	1.94%	152,570	17.19%
25	4.85%	187,007	1.94%	226,916	21.34%
30	4.85%	259,011	1.94%	324,513	25.29%
35	4.85%	350,252	1.94%	451,915	29.03%
40	4.85%	465,873	1.94%	617,462	32.54%
45	4.85%	612,387	1.94%	831,758	35.82%
50	4.85%	798,047	1.94%	1,108,285	38.87%

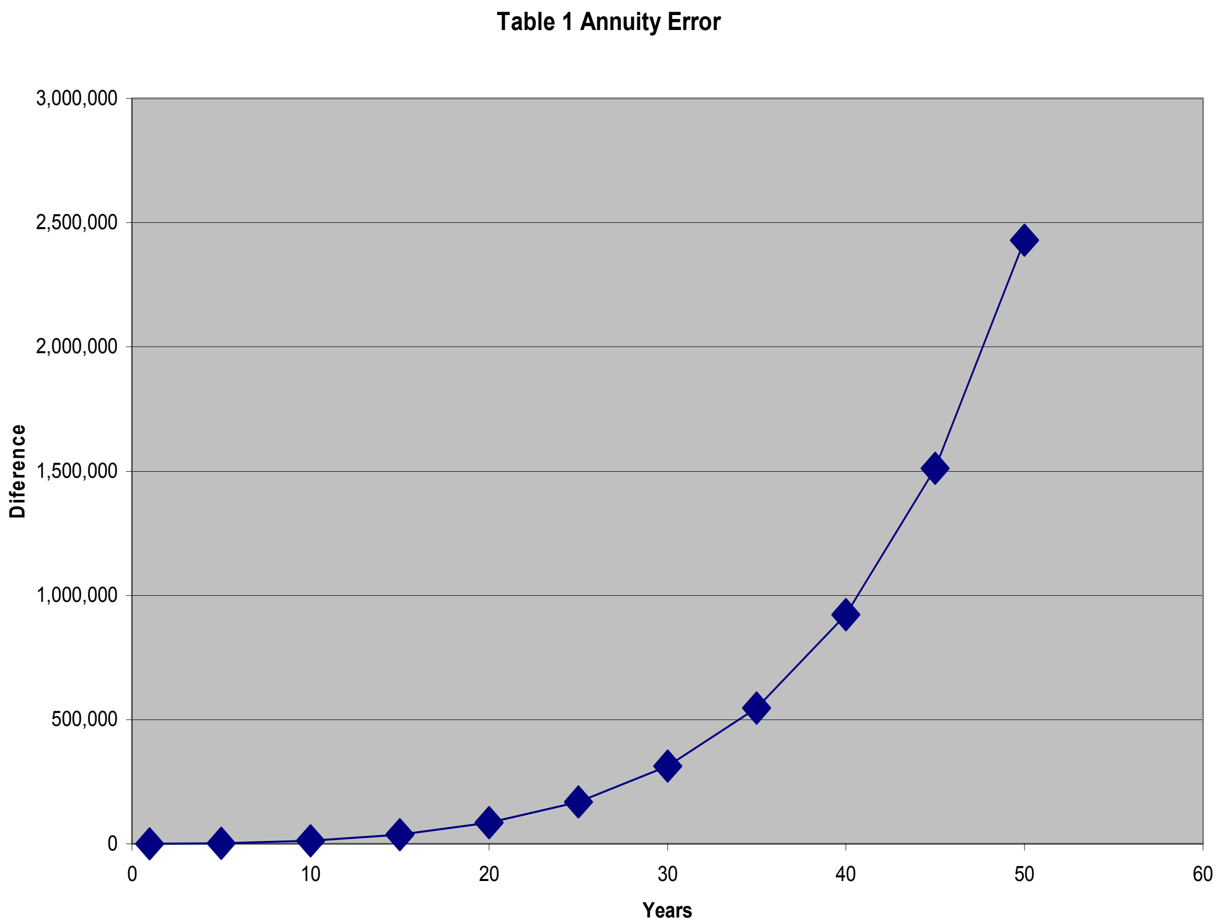
Table 1 Annuity Error
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
Diference
0
10
20
30
40
50
60
Years

Table 2
Future Value Comparisons

Period	ROR	Growth Rate	Discrete Growth and ROR FVA	Continuous Growth and ROR FVA	Error
1	0.08	0.05	4,000	4,269	6.72%
2	0.08	0.05	8,520	9,112	6.95%
3	0.08	0.05	13,612	14,589	7.18%
4	0.08	0.05	19,331	20,763	7.41%
5	0.08	0.05	25,740	27,707	7.64%
10	0.08	0.05	70,671	76,909	8.83%
15	0.08	0.05	145,765	160,416	10.05%
20	0.08	0.05	267,688	297,967	11.31%
25	0.08	0.05	461,616	519,828	12.61%
30	0.08	0.05	765,429	872,198	13.95%
35	0.08	0.05	1,235,911	1,425,339	15.33%
40	0.08	0.05	1,957,938	2,285,797	16.75%
45	0.08	0.05	3,058,059	3,614,733	18.20%
50	0.08	0.05	4,724,562	5,655,421	19.70%

Table 3A
NYSE Simulation Results of 1995 Retirement Balance

Retirement %		12.00%	
Guaranteed ROR			8.00%

B-O-Y Employment Year	E(Annual Compensation)	E-O-Y Retirement Payment	E-O-Y Retirement Balance
1968	4,290	515	515
1969	5,707	685	1,241
1970	7,171	860	2,201
1971	9,010	1,081	3,458
1972	11,321	1,358	5,093
1973	14,224	1,707	7,207
1974	17,872	2,145	9,928
1975	22,456	2,695	13,417
1976	28,216	3,386	17,877
1977	35,453	4,254	23,561
1978	44,546	5,345	30,792
1979	55,971	6,716	39,971
1980	70,326	8,439	51,608
1981	88,363	10,604	66,341
1982	111,027	13,323	84,971
1983	139,503	16,740	108,509
1984	175,283	21,034	138,224
1985	220,240	26,429	175,710
1986	276,727	33,207	222,974
1987	347,702	41,724	282,537
1988	436,881	52,426	357,565
1989	548,932	65,872	452,042
1990	689,723	82,767	570,972
1991	866,623	103,995	720,645
1992	1,088,896	130,667	908,964
1993	1,368,176	164,181	1,145,862
1994	1,719,087	206,290	1,443,822
1995	2,160,000	N/A	N/A
Growth Rate	25.65%		

Table 3B

Financial Model Simulation of 1995 Retirement with Personal Savings

Retirement %		12.00%		
Personal Savings Rate			42.62%	
Guaranteed ROR				8.00%
B-O-Y Employment Year	E(Annual Compensation)	E-O-Y Retirement Payment	E-O-Y Personal Savings	E-O-Y Retirement Balance
1968	4,290	515	1,828	2,343
1969	5,707	685	2,432	5,647
1970	7,171	860	3,056	10,016
1971	9,010	1,081	3,840	15,738
1972	11,321	1,358	4,824	23,180
1973	14,224	1,707	6,062	32,803
1974	17,872	2,145	7,617	45,188
1975	22,456	2,695	9,570	61,068
1976	28,216	3,386	12,025	81,364
1977	35,453	4,254	15,109	107,236
1978	44,546	5,345	18,984	140,145
1979	55,971	6,716	23,853	181,925
1980	70,326	8,439	29,971	234,889
1981	88,363	10,604	37,658	301,942
1982	111,027	13,323	47,316	386,736
1983	139,503	16,740	59,452	493,867
1984	175,283	21,034	74,700	629,110
1985	220,240	26,429	93,859	799,726
1986	276,727	33,207	117,932	1,014,843
1987	347,702	41,724	148,179	1,285,934
1988	436,881	52,426	186,184	1,627,419
1989	548,932	65,872	233,937	2,057,421
1990	689,723	82,767	293,937	2,598,718
1991	866,623	103,995	369,326	3,279,937
1992	1,088,896	130,667	464,051	4,137,050
1993	1,368,176	164,181	583,071	5,215,267
1994	1,719,087	206,290	732,618	6,571,397
1995	2,160,000	N/A	N/A	N/A
Growth Rate	25.65%			

Table 4A
Financial Model Simulation of 1995 Retirement with Annual Equity Returns

Retirement %		12.00%		
Guaranteed ROR				8.00%
Employment Year	E(Annual Compensation)	E-O-Y Retirement Payment	Large Firm Stock Market ROR	E-O-Y Retirement Balance
1968	4,290	515	14.94%	515
1969	5,707	685	-7.53%	1,161
1970	7,171	860	15.86%	2,205
1971	9,010	1,081	11.21%	3,534
1972	11,321	1,358	7.31%	5,151
1973	14,224	1,707	-10.25%	6,330
1974	17,872	2,145	-10.25%	7,826
1975	22,456	2,695	25.08%	12,483
1976	28,216	3,386	3.65%	16,324
1977	35,453	4,254	-6.94%	19,446
1978	44,546	5,345	18.55%	28,398
1979	55,971	6,716	10.39%	38,066
1980	70,326	8,439	33.22%	59,150
1981	88,363	10,604	-11.77%	62,792
1982	111,027	13,323	43.33%	103,323
1983	139,503	16,740	8.35%	128,690
1984	175,283	21,034	18.84%	173,970
1985	220,240	26,429	33.96%	259,478
1986	276,727	33,207	29.50%	369,232
1987	347,702	41,724	-6.10%	388,433
1988	436,881	52,426	13.92%	494,928
1989	548,932	65,872	19.50%	657,311
1990	689,723	82,767	13.57%	829,275
1991	866,623	103,995	12.73%	1,038,837
1992	1,088,896	130,667	13.57%	1,310,474
1993	1,368,176	164,181	2.18%	1,503,224
1994	1,719,087	206,290	20.10%	2,011,662
1995	2,160,000	N/A	N/A	N/A

Table 4B
Financial Model Simulation of 1995 Retirement with Personal Savings and Annual Equity Market Returns

Retirement %		12.00%			
Personal Savings			27.20%		
Guaranteed ROR					8.00%

B-O-Y Employment Year	E(Annual Compensation)	E-O-Y Retirement Payment	E-O-Y Personal Savings	Large Firm Stock Market ROR	E-O-Y Retirement Balance
1968	4,290	515	1,167	14.94%	1,682
1969	5,707	685	1,552	-7.53%	3,792
1970	7,171	860	1,950	15.86%	7,204
1971	9,010	1,081	2,451	11.21%	11,544
1972	11,321	1,358	3,079	7.31%	16,825
1973	14,224	1,707	3,869	-10.25%	20,677
1974	17,872	2,145	4,861	-10.25%	25,563
1975	22,456	2,695	6,108	25.08%	40,777
1976	28,216	3,386	7,675	3.65%	53,326
1977	35,453	4,254	9,643	-6.94%	63,523
1978	44,546	5,345	12,116	18.55%	92,768
1979	55,971	6,716	15,224	10.39%	124,347
1980	70,326	8,439	19,129	33.22%	193,223
1981	88,363	10,604	24,035	-11.77%	205,119
1982	111,027	13,323	30,199	43.33%	337,519
1983	139,503	16,740	37,945	8.35%	420,386
1984	175,283	21,034	47,677	18.84%	568,298
1985	220,240	26,429	59,905	33.96%	847,625
1986	276,727	33,207	75,269	29.50%	1,206,151
1987	347,702	41,724	94,574	-6.10%	1,268,874
1988	436,881	52,426	118,831	13.92%	1,616,758
1989	548,932	65,872	149,308	19.50%	2,147,206
1990	689,723	82,767	187,603	13.57%	2,708,952
1991	866,623	103,995	235,720	12.73%	3,393,516
1992	1,088,896	130,667	296,177	13.57%	4,280,861
1993	1,368,176	164,181	372,141	2.18%	4,910,506
1994	1,719,087	206,290	467,588	20.10%	6,571,397
1995	2,160,000	N/A	N/A	N/A	N/A

Table 4C
Financial Model Simulation of 1995 Retirement with Personal Savings
And Annual Small Firm Equity Market Returns

Retirement %		12.00%			
Personal Savings			31.56%		
Guaranteed ROR					8.00%
B-O-Y Employment Year	E(Annual Compensation)	E-O-Y Retirement Payment	E-O-Y Personal Savings	Small Firm ROR	Retirement Balance
1968	4,290	515	1,354	50.61%	1,869
1969	5,707	685	1,801	-32.27%	3,752
1970	7,171	860	2,263	-16.54%	6,255
1971	9,010	1,081	2,844	18.44%	11,334
1972	11,321	1,358	3,573	-0.62%	16,195
1973	14,224	1,707	4,490	-40.54%	15,826
1974	17,872	2,145	5,641	-29.74%	18,906
1975	22,456	2,695	7,088	69.54%	41,836
1976	28,216	3,386	8,906	54.81%	77,058
1977	35,453	4,254	11,191	22.02%	109,471
1978	44,546	5,345	14,061	22.29%	153,279
1979	55,971	6,716	17,667	43.99%	245,089
1980	70,326	8,439	22,198	35.34%	362,341
1981	88,363	10,604	27,892	7.79%	429,063
1982	111,027	13,323	35,045	27.74%	596,454
1983	139,503	16,740	44,034	34.49%	862,945
1984	175,283	21,034	55,328	-14.02%	818,321
1985	220,240	26,429	69,518	28.21%	1,145,117
1986	276,727	33,207	87,348	3.40%	1,304,606
1987	347,702	41,724	109,751	-13.95%	1,274,089
1988	436,881	52,426	137,900	21.72%	1,741,147
1989	548,932	65,872	173,269	8.37%	2,126,023
1990	689,723	82,767	217,709	-27.08%	1,850,772
1991	866,623	103,995	273,548	50.24%	3,158,142
1992	1,088,896	130,667	343,707	27.84%	4,511,744
1993	1,368,176	164,181	431,862	20.30%	6,023,671
1994	1,719,087	206,290	542,626	-3.34%	6,571,397
1995	2,160,000	N/A	N/A	N/A	N/A

Table 5A
Financial Model Simulation of 1995 Retirement with Personal Savings and Monthly Compounding of Annual Equity Returns

Retirement %		12.00%			
Personal Savings			19.34%		
Guaranteed ROR					8.00%

B-O-Y Employment Year	E(Annual Compensation	E-O-Y Retirement Payment	E-O-Y Personal Savings	Large Firm Stock Market ROR	E-O-Y Retirement Balance
1968	4,290	515	830	11.00%	1,414
1969	5,707	685	1,104	-8.47%	3,299
1970	7,171	860	1,387	3.94%	5,318
1971	9,010	1,081	1,742	14.30%	8,547
1972	11,321	1,358	2,189	-14.69%	13,171
1973	14,224	1,707	2,751	-26.47%	15,316
1974	17,872	2,145	3,456	37.23%	18,382
1975	22,456	2,695	4,343	23.93%	34,386
1976	28,216	3,386	5,456	23.93%	53,459
1977	35,453	4,254	6,856	-7.16%	78,505
1978	44,546	5,345	8,614	6.57%	87,453
1979	55,971	6,716	10,824	18.61%	112,491
1980	70,326	8,439	13,600	32.50%	160,943
1981	88,363	10,604	17,088	-4.92%	248,865
1982	111,027	13,323	21,470	21.55%	275,337
1983	139,503	16,740	26,977	22.56%	389,432
1984	175,283	21,034	33,896	6.27%	543,502
1985	220,240	26,429	42,590	31.73%	658,572
1986	276,727	33,207	53,513	18.67%	995,310
1987	347,702	41,724	67,238	5.25%	1,309,513
1988	436,881	52,426	84,483	16.61%	1,527,769
1989	548,932	65,872	106,152	31.69%	2,001,115
1990	689,723	82,767	133,378	-3.10%	2,949,087
1991	866,623	103,995	167,586	30.46%	3,171,848
1992	1,088,896	130,667	210,569	7.62%	4,638,376
1993	1,368,176	164,181	264,576	10.08%	5,453,560
1994	1,719,087	206,290	332,434	1.32%	6,571,397
1995	2,160,000	N/A	N/A	N/A	N/A

Table 5B
Financial Model Simulation of 1995 Retirement with Monthly Personal Savings and Compounding of Annual Small Firm Equity Returns

Retirement %		12.00%			
Personal Savings			14.12%		
Guaranteed ROR					8.00%

B-O-Y Employment Year	E(Annual Compensation)	E-O-Y Retirement Payment	E-O-Y Personal Savings	Small Firm Stock Market ROR	E-O-Y Retirement Balance
1968	4,290	515	606	50.61%	1,421
1969	5,707	685	806	-32.27%	3,621
1970	7,171	860	1,012	-16.54%	4,348
1971	9,010	1,081	1,272	18.44%	6,243
1972	11,321	1,358	1,598	-0.62%	10,445
1973	14,224	1,707	2,008	-40.54%	13,478
1974	17,872	2,145	2,523	-29.74%	13,004
1975	22,456	2,695	3,170	69.54%	17,770
1976	28,216	3,386	3,983	54.81%	44,470
1977	35,453	4,254	5,005	22.02%	86,255
1978	44,546	5,345	6,289	22.29%	120,188
1979	55,971	6,716	7,902	43.99%	167,849
1980	70,326	8,439	9,929	35.34%	280,206
1981	88,363	10,604	12,475	7.79%	420,875
1982	111,027	13,323	15,675	27.74%	487,841
1983	139,503	16,740	19,695	34.49%	684,556
1984	175,283	21,034	24,746	-14.02%	1,004,750
1985	220,240	26,429	31,093	28.21%	938,167
1986	276,727	33,207	39,068	3.40%	1,313,284
1987	347,702	41,724	49,088	-13.95%	1,443,863
1988	436,881	52,426	61,678	21.72%	1,381,013
1989	548,932	65,872	77,498	8.37%	1,861,707
1990	689,723	82,767	97,374	-27.08%	2,183,032
1991	866,623	103,995	122,349	50.24%	1,946,462
1992	1,088,896	130,667	153,729	27.84%	3,507,780
1993	1,368,176	164,181	193,158	20.30%	5,011,649
1994	1,719,087	206,290	242,699	-3.34%	6,571,397
1995	2,160,000	N/A	N/A	N/A	N/A

APPENDIX

1. An alternate way to derive formula 4 is a two-level process that first looks at the present value of a growing, but finite annuity. Some advanced investments or financial theory texts may cover this subject, i.e. Copeland, Weston and Shastri (2004). Keeping all previous assumptions, the basic present value formula of a constantly growing, but finite stream of cash flow is:

$$PVA = \frac{A*(1+g)^1}{(1+r)^1} + \frac{A*(1+g)^2}{(1+r)^2} + \ldots + \frac{A*(1+g)^n}{(1+r)^n} \qquad (9)$$

For the first step we calculate the present value by first multiplying equation 9 by the constant (1+r)/(1+g):

$$PVA * \frac{(1+r)}{(1+g)} = A + \frac{A*(1+g)}{(1+r)} + \ldots + \frac{A*(1+g)^{n-1}}{(1+r)^{n-1}} \qquad (10)$$

Then subtracting equation 9 from equation 10 yields:

$$PVA * \left[\frac{(1+r)}{(1+g)}\right] - PVA = A - \frac{A*(1+g)^n}{(1+r)^n} \qquad (11)$$

To complete the first step we subtract and crossmultiply to arrive at the present value of a finite and growing annuity equation that will be familiar to advanced students:

$$PVA = \frac{A}{(r-g)} * \left[1 - \frac{(1+g)^n}{(1+r)^n}\right] \qquad (12)$$

As this is the total value now of all projected retirement savings, a new employee can calculate in a second step the future value by simply multiplying by the appropriate compounding factor to reproduce equation 4:

$$FVA = PVA*(1+r)^n = \frac{A}{(r-g)} * \left[(1+r)^n - (1+g)^n\right] \qquad (13)$$

2. The basic formula for the constantly growing infinite annuity is the familiar:

$$PV = \frac{A*(1+g)}{r-g} \qquad (14)$$

Reflecting continuous discounting and again using L'Hôpital's Rule, Equation 14 remains the same.

This leads to the intermediate step in the constantly growing, but finite annuity case:

$$FVA = \frac{A * \left(\left(1 + \frac{r}{k}\right)^{kn} - \left(1 + \frac{g}{k}\right)^{kn} \right)}{r - g} \tag{15}$$

As k →∞, Equation 16 simplifies to:

$$FVA = A * \frac{\left(e^{n*r} - e^{n*g}\right)}{r - g} \tag{16}$$

BIBLIOGRAPHY

Ackman, D., "Dick Grasso and the Company He Keeps," Forbes.com, May 5, 2003.

Anderson, J. "Grasso Clipped – Members Mutiny over Chairman's Bounty," The New York Post, September 2003, p. 39.

Bebchuk, L. and J. Fried, "Pay Without Performance: Overview of the Issues," Journal of Applied Corporate Finance, Fall 2005, pp. 8-23.

Bebchuk, L. and R. Jackson, "Executive Pensions," Journal of Corporate Law, December 2005, pp. 823-855.

Cohen, L. and D. Solomon, "NYSE Feels Heat from Inside and Outside," The Wall Street Journal, September 16, 2003, p. C1.

Copeland, T., J.F. Weston and K. Shastri, Financial Theory and Corporate Policy, Pearson Addison Wesley, 2005.

Core, J. and W. Guay, "Is U.S. CEO Compensation Broken?" Journal of Applied Corporate Finance, Fall 2005, pp. 97-104.

Elkind, P. and J. Levinstein, "The Fall of the House of Grasso," Fortune, October 18, 2004, p. 284.

Gasparino, C., K. Kelly and S. Craig, "Grasso is NYSE's $10 Million Man," The Wall Street Journal, May 5, 2003, p. C1.

George, B. and A. McLean, "Richard Grasso and the NYSE, Inc. (A), Harvard Business School Press, 2005.

Kelly, K. and S. Craig, "Grasso Forgoes Extra $48 Million, Raising New Questions for NYSE," The Wall Street Journal, September 10, 2003, p. A1.

Kelly, K. and S. Craig, "Several NYSE Directors Consider Removing Grasso to Stem Pay Flap," The Wall Street Journal, September 15, 2003, p. A1.

Kelly, S. Craig, and I. Dugan, "Grasso Quits NYSE Amid Pay Furor," The Wall Street Journal, September 18, 2003.

McGeehan, P. "Quick: What's the Boss Making?" New York Times, September 21, 2003, p. 3.1.

McGeehan, P. and L. Thomas, Jr., "Market Chief Holds Firm in Storm Over Pay," New York Times, September 14, 2003, p. 1.1.

Morgenson, G. and L. Thomas, Jr., "Chairman Quits Stock Exchange in Furor over Pay," New York Times, p. A1.

Sundaram, R., and D. Yermack, "Pay Me Later: Inside Debt and Its Role in Managerial Compensation," The Journal of Finance, August 2007, pp. 1551-1588.

Tharp, P., "NYSE Dis-Grasso: Angry Spitzer Offers a 'Clean Team' Wish List," The New York Post, March 25, 2003, p. 35.

Thomas, L., "A Pay Package that Fat Cats Call Excessive," New York Times, August 29, 2003, p. C1.

Valdmanis, T., "NYSE Faces Thursday Without Richard Grasso," USA Today, September 18, 2003.

White, B., "NYSE Ousts Grasso as Chairman," Washington Post, September 18, 2003, p. A1