

# The Link between the Stock Market and Retirement Income

Christian E. Weller  
*Economic Policy Institute*

## **Abstract**

This paper analyzes the effect of wealth fluctuations on retirement income adequacy between 1992 and 2000. In addition, the paper estimates how financial wealth relative to income may develop in the medium to long-term. If a fixed real level of consumption is considered for retirement income adequacy, the average household was more likely to be inadequately prepared for retirement, even after wealth increased dramatically in the late 1990s. Moreover, on average, households can expect to reach their peak wealth to income levels only after a period of 30–50 years. To address the likely shortfalls in retirement income adequacy for many households, public policy choices that could help to raise private savings should be considered.

## **Introduction**

Beginning in March 2000, the stock market fell precipitously. With the slide in stock prices, household financial wealth declined by 16 percent, and the combined housing and financial wealth dropped by 13 percent—the largest nominal decline since 1952—by March 2001.

While stock prices and housing wealth declined, public policy debates focused on increasing the reliance of households on private markets in saving for retirement. As more private accounts, either as add-ons or carve-outs to Social Security, may become more popular, the question arises whether and how the recent stock market gyrations affect retirement income security. Consequently, this paper analyzes the link between stock market fluctuations and retirement income, and its adequacy, since 1992.

## **The Stock Market and Household Wealth in the 1990s**

Within one year, from March 2000 to March 2001, direct equity holdings declined by \$3.5 trillion, financial assets fell by \$4.3 trillion, and financial wealth

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Author's address: Economic Policy Institute, 1660 L. Street NW, Washington, DC 20036

dropped by \$4.9 trillion (Board of Governors 2001). Moreover, by March 2001, financial wealth to income fell to 281 percent, the same level as in March 1997. What did this mean for retirement income security?

To see how the adequacy of retirement wealth changed during the stock market rise and fall, a target wealth-to-income ratio is estimated and then compared to the actual average wealth-to-income ratio. It is important to keep in mind, though, that this paper's focus is on the average, rather than the median, household; however, because retirement wealth is increasingly unequally distributed (Wolff 2002), the median household's retirement income adequacy has also fallen further behind that of the average household.

Several studies have focused on adequate retirement wealth. Two general conclusions can be drawn from the prior research (Weller 2001). First, households had, on average, inadequate savings in 1992. Second, the distribution of household wealth differs widely, so a large minority of households fell far short of adequate retirement savings.

To calculate a target ratio of adequate retirement savings, this paper uses the estimates from Gustman and Steinmeier (1999). Thus, both a nominal and a real replacement ratio are used. In particular, Gustman and Steinmeier (1999) calculate a nominal replacement ratio of 86 percent and a real replacement ratio of 60 percent for 1992. These ratios are increased by one-fifth, to account for the fact that retirees have lower consumption needs than workers (Gustman and Steinmeier 1999), resulting in an effective nominal replacement ratio of 103 percent and an effective real replacement ratio of 72 percent. Further, the original replacement ratios included housing and Social Security wealth. Housing wealth amounted to 16 percent of total wealth, and Social Security wealth to another 23.7 percent. Assuming that the shortfall of 28 percent of the real replacement ratio would have to be covered by financial savings only, financial wealth was 47 percent of what it should have been. If it is assumed that the shortfall should have been covered by financial and housing wealth, wealth was 67 percent of what it should have been in 1992. Hence, the effective wealth-to-income ratio for 1992 was either 100 percent, 67 percent (for the real ratio, including housing wealth), or 53 percent (for the real ratio, excluding housing wealth) of its target.

To calculate the target values after 1992, the ratio for 1992 is adjusted for demographic changes, such as average age, life expectancy at 65, and the share of the population over 65.

The target wealth-to-income ratio,  $W/T$ , is equal to the adjusted wealth-to-income ratio of the previous period. It is adjusted for the percent increase in the age of the average worker,  $age$ , which itself is adjusted by an interest factor,  $\pm$ . A higher age means that fewer years are left to retirement, therefore requiring more wealth relative to income. Not only does the worker have

$$(1) \quad \frac{\hat{W}_t}{Y_t} = \frac{W_{t-1}}{Y_{t-1}} * (1 + (age_{t-1}) * \alpha + \frac{P_{t-1}}{\beta} - 65plus_{t-1})$$

$$(1)' \quad \alpha = (1 + r_{LT})^{(AGE_t - AGE_{t-1})}$$

$$(1)'' \quad \beta = (1 + r_{LT})^{(LEB5_t - LEB5_{t-1})}$$

to compensate for fewer working years, but also for the loss of compounded interest over those years. Equation (1)' shows that *age* is adjusted for the loss of long-term interest,  $r_{LT}$  compounded for the number of years that the average age of workers, *AGE*, has changed. Also, the target wealth-to-income ratio increase with life expectancy at age 65, *65plus<sub>t</sub>*, because a longer life expectancy requires more wealth to maintain the same retirement income. But a household can increase its wealth partially due to compounded interest. Thus, the increase in the wealth-to-income ratio is reduced by a discount factor. Equation (1)'' shows that the adjustment is the long-term interest rate compounded over the additional years, *LE65*. Another adjustment is the change in the share of population over 65, *65plus<sub>t</sub>*, because, by definition, retirees are dissavers and thus a larger share of the elderly would imply fewer aggregate savings relative to income.

For the calculations, actual changes of the average age of workers, of life expectancy at age 65 (Social Security Administration 2000, 2001), and of the share of the population over 65 (International Database 2001) are chosen. Table 1 shows that the financial wealth-to-income ratio was 24 percent above its target in 2000 and that the financial and housing wealth-to-income ratio was 16 percent above its target in 2000, starting from 100 percent adequacy, or at the same levels as in 1997. Starting from adequacy ratios of less than 100 percent, the average household never reached its target and the average household was 22–34 percentage points below its target in 2000 (Table 1).

To evaluate what the future may hold, this paper uses a regression-based simulation. The regression model considers empirically relevant determinants of household wealth-to-income. Wealth relative to income rose annually by 3.3 percent from 1992 to 2000, although the stock market grew by 13.9 percent and income by 5.2 percent. Most household assets were not allocated in corporate equities, because households' direct and indirect equity holdings never amounted to more than 50 percent of financial assets (Board of Governors 2001). Also, as wealth grew, so did income. Faster income growth required faster wealth growth to maintain the same level of retirement savings adequacy, and more wealth also provided households with more collateral to borrow. Moreover, more wealth provided households with more resources to increase

TABLE 1  
Comparison of Actual Wealth-to-Income Ratios with Projected Adequate Ratios

Year	Financial Wealth-to-Income	Financial and Housing Wealth-to-Income		Financial Wealth-to-Income		Financial and Housing Wealth-to-Income		Financial Wealth-to-Income		Financial and Housing Wealth-to-Income	
		100% Adequacy in 1992		100% Adequacy in 1992		53% Adequacy in 1992		53% Adequacy in 1992		67% Adequacy in 1992	
		Target at Year End	Actual-to-Target Levels	Target at Year End	Actual-to-Target Levels	Target at Year End	Actual-to-Target Levels	Target at Year End	Actual-to-Target Levels	Target at Year End	Actual-to-Target Levels
1992	236.17	361.54	100	236.17	361.54	100	445.61	53	539.62	67	
1993	243.89	367.47	102	238.72	365.44	101	450.42	53	545.43	67	
1994	238.03	358.52	99	240.17	367.66	98	453.17	53	548.75	65	
1995	264.03	385.06	107	241.42	369.57	104	455.51	58	551.59	70	
1996	279.47	399.42	115	242.70	371.53	108	457.94	61	554.52	72	
1997	305.17	425.82	125	243.23	372.34	114	458.95	66	555.73	77	
1998	320.72	442.80	131	244.31	374.00	118	461.00	70	558.21	79	
1999	354.11	479.28	144	245.21	375.37	128	462.71	77	560.26	86	
2000	306.18	438.18	124	246.82	377.84	116	465.77	66	563.94	78	

their consumption, thereby reducing savings. On average, households contributed about 8 percent of personal disposable income (PDI) to their financial assets in the 1990s, below the averages of all previous postwar business cycles. Also, the wealth effect seems asymmetric. When holding gains were positive, households added on average 8.5 percent of their PDI to their financial assets, and when holding gains were negative they added only 6.5 percent (Board of Governors 2001, Table F.100).

To study the relative importance of each factor determining the wealth-to-income ratio, the following equation is estimated

$$(2) \ln \frac{W}{Y}_t \beta_0 + \beta_1 \ln \left( \frac{S\&P\ 500}{CPI} \right)_t + \beta_2 \ln \left( -\frac{Y}{CPI} \right)_t + \beta_3 \ln \left( -\frac{E}{A} \right)_t + \beta_4 \ln \left( -\frac{L}{Y} \right)_t + \\ \beta_5 \ln \left( -\frac{S}{PDI} \right)_t + \beta_6 \ln (LE65)_t + \beta_7 \ln AGE_t + \beta_8 \ln 65plus_t + \varepsilon_t$$

where the wealth-to-income ratio,  $W/Y$ , depends on the real value of the S&P 500, on real income (both deflated by the consumer price index, CPI), on the share of equities out of financial assets,  $E/A$ , on the ratio of debt relative to income,  $L/Y$ , and on the savings rate out of personal disposable income,  $S/PDI$ . To control for demographic changes, the life expectancy at age 65, the average age of workers, and the share of the population over 65 are included. Also,  $\mu$  is a normally distributed random error term. A logarithmic specification is used for each variable.

The expected signs of the explanatory variables are straightforward. The S&P 500, the savings rate, the equity share in households' portfolios, average age of workers, and longevity at 65 should all be positively related to the wealth-to-income ratio. By contrast, real income, liabilities, and the population over the age of 65 should have negative signs.

All economic variables are compiled from the *Flow of Funds Statistics for the United States* (Board of Governors 2001), except the (seasonally adjusted) CPI, which is from the Bureau of Labor Statistics. The data for life expectancy are from the National Center for Health *Statistics' Life Expectancy by Race, Sex, 1970 to 1998 (at Birth, Age 65 and Age 85)*, and the *2001 Social Securities Trustees' Report* (Social Security Administration 2001). Average age is calculated as a weighted average of workers covered by Social Security (Social Security Administration 2000). Missing demographic data are interpolated.

For the regression, a few adjustments are made. The ratio of liabilities to income is nonstationary and hence differenced once. As the savings rate may be endogenously related to the dependent variable, it is instrumented by re-

gressing it on itself lagged once and on all other explanatory variables. To correct for autocorrelation, a Corchran-Orcutt regression is used.

The estimated coefficients have the expected signs or are insignificant (Table 2). The determinants of financial wealth-to-income may vary over time. Thus, the sample is separated in 1982, which marks the beginning of 401(k) plans. The results show a significant effect of the stock market in the later period, but not in the earlier period. The regression results seem robust, however, and all explanatory variables are significant determinants at one time or another. The estimated coefficients are consequently used to simulate future wealth-to-income ratios.

TABLE 2  
Regression Estimates for Financial Wealth-to-Income Ratio

Explanatory Variable	Full Sample	1952–1982	1983–2000
$\ln(S\&P500/CPI)_t$	0.05 (0.03)	-0.01 (0.03)	0.21*** (0.06)
$\ln(E/A)_t$	0.42*** (0.04)	0.46*** (0.04)	0.33*** (0.08)
$\Delta\ln(L/Y)_t$	-0.09 (0.06)	-0.15*** (0.05)	0.15 (0.17)
$\ln(S/PDI)_{t-1}$	0.03*** (0.01)	0.01 (0.01)	0.02** (0.01)
$\ln(Y/CPI)_t$	-0.38*** (0.09)	-0.54*** (0.07)	0.30 (0.24)
$\ln(LE65)_t$	0.97* (0.52)	0.32 (0.50)	0.30 (0.72)
$\ln age_t$	0.96** (0.48)	-1.25* (0.74)	-1.89* (1.11)
$\ln 65plus_t$	0.60 (0.40)	0.60 (0.38)	-1.47*** (0.38)
Constant	1.69 (2.19)	14.14*** (3.83)	8.27*** (1.88)
N	193	119	72
Adjusted $R^2$	0.84	0.93	0.96
rho	0.94	0.86	0.51
Durbin-Watson	1.94	1.78	1.88

Note: Standard deviations in parentheses.

\*Significant at the 10% level.

\*\*Significant at the 5% level.

\*\*\*Significant at the 1% level.

The target levels for the wealth-to-income ratios are simulated using equation (1) as the basis for Monte Carlo simulations. The target levels are calculated for the period from 2000 to 2050 using Monte Carlo simulations, using 1,000 random observations for each input variable, based on historic distributions. Also, there are two separate starting points for each of two wealth-to-income ratios for the relative adequacy levels in 1992: 100 percent and 53 percent for the financial wealth-to-income rate, and 67 percent and 100 percent for the financial wealth plus net housing wealth-to-income rate.

To simulate the actual levels, the estimated coefficients for the full sample from Table 2 are inserted in Equation (2). Monte Carlo simulations are used to simulate actual wealth-to-income ratios based on 1,000 random values, which in turn are based on historic distributions, for each variable for each of the next 50 years. The results are used to calculate the chance of reaching the last peak wealth-to-income ratio or of falling below the target level in any given year.

The results in Table 3 illustrate the risks associated with using private wealth as a vehicle of retirement income provision. The chance of remaining below the peak levels of March 2000 stays above 50 percent for the next 30 years. Further, if the starting adequacy levels are lower, the chance of staying below the target level is above 90 percent. The fact that the average household has no discernible possibility to reach its target level should not be surprising in light of the recent experience. Despite an unprecedented increase in the stock market, the average household did not reach adequate wealth-to-income ratios in the late 1990s.

It may be that the parameter estimates for the wealth-to-income ratios for the full sample may not adequately reflect the determinants of household wealth. Instead, the coefficient estimates for the period after 1982 may more accurately reflect the importance of each variable. Using the parameter estimates for the period after 1982, however, the results in Table 4 suggest a similar future. The chance of not reaching peak levels remains above 60 percent for the financial wealth-to-income ratio and close to 100 percent for the financial and housing wealth-to-income ratio. Similarly, when starting points of 53 percent and 67 percent of adequate wealth-to-income are assumed, the chances of staying below adequate levels stay above 90 percent and 100 percent, respectively.

## Conclusion

This paper studies the consequences of the stock market ups and downs for retirement income adequacy. The results suggest that the average household's wealth-to-income ratio was 22–34 percentage points below its target by the end of 2000. Further, the chances for the average household to recover the lost wealth and to reach adequate retirement savings are very low. It will

TABLE 3  
Summary of Simulation Results, 2005–2050, Based on Full Sample

Year	Financial Wealth-to-Income Ratio		Financial and Housing Wealth-to-Income Ratio	
	Probability of Falling below Past Peak	Probability of Falling below Target Levels	Probability of Falling below Past Peak	Probability of Falling below Target Levels
	Peak: 356.3% in March 2000	100% Adequacy in 1992	Peak: 482.6% in March 2000	100% Adequacy in 1992
2010	99	54	100	99
2020	86	57	100	99
2030	55	65	99	100
2040	22	67	86	100
2050	8	71	52	100

Note: All figures are in percent.



TABLE 4  
 Summary of Simulation Results, 2005–2025, Based on Sample after 1980

Year	Financial Wealth-to-Income Ratio			Financial and Housing Wealth-to-Income Ratio		
	Probability of Falling below Past Peak	Probability of Falling below Target Levels	Probability of Falling below Target Levels	Probability of Falling below Past Peak	Probability of Falling below Target Levels	Probability of Falling below Target Levels
	Peak: 356.3% in March 2000	100% Adequacy in 1992	53% Adequacy in 1992	Peak: 482.6% in March 2000	100% Adequacy in 1992	67% Adequacy in 1992
2010	68	54	90	94	87	100
2020	64	59	90	94	95	100
2030	65	66	95	99	100	100
2040	63	71	96	99	100	100
2050	62	74	97	100	100	100

Note: All figures are in percent.

take the average household more than 30 years, in the best-case scenario, to have a greater than 50 percent chance of reaching its previous peak wealth-to-income level again. Moreover, for the average household, the chances of reaching its target wealth-to-income ratio remain below 50 percent, and often close to 100 percent, for the next 50 years. This should not come as a surprise. The past years saw an unprecedented boom on the stock market combined with a proliferation of indirect stock ownership of households. Yet, households on average fell short of adequate retirement savings.

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