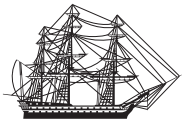
Implications of a Bear Market for Retirement Security

Vanguard Investment Counseling & Research



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Executive summary. As global stock markets fell during 2008 and into 2009, it was widely reported that investors had lost well over $2 trillion in retirement savings.[1] Indeed, from the most recent market high at the end of October 2007 through January 31, 2009, the broad U.S. stock market lost –47%; European markets lost –56%; Asian markets, –47%; and emerging stock markets, –60%.[2] An important question arises: Has the "average" retiree (or worker) suffered irreparable loss? And perhaps just as critical: Is the notion of saving and investing in this market tantamount to throwing good money after bad?

This paper examines several hypothetical scenarios over the past 138 years in which investors would have faced historically similar poor markets. We show the impact of a significant market decline on a retiree who followed a "life-cycle" approach to investing—that is, moving from an initially high allocation to equities to less-volatile fixed income investments over time. To be sure, whether such an investor retired in 1928, 1972, or 1999 in the United States, or in 1989 in Japan, portfolio balances would have declined as a result of the major downturns during those times. However, we also show that if investors focus on areas that they can control—saving rates, spending, asset allocation, costs, and (limiting) market-timing—they can measurably improve their long-term prospects for weathering such negative environments, even those investors who are already retired. It is also critical for investors to understand that they should not rely solely on the markets to provide for them. Failure in one or more of these areas markedly increases the risk of running out of private sources of money early in retirement.

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1 According to an October 2008 study by the U.S. Congressional Budget Office (Orszag, 2008), public and private pension funds and employees' private retirement savings accounts lost about –10% from mid-2007 to mid-2008, and another 10% through September 2008. As of this writing, an update through fourth-quarter 2008 was not yet available.

2 Sources for these returns: U.S. stock market—MSCI Broad Market Index; European stock market—MSCI Europe Index; Asian stock market—MSCI Pacific Index; and emerging markets—MSCI Emerging Markets Index.

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Introduction

Investors have come to expect the stock market to reward them over time. However, as two bear markets since the U.S. stock market's peak in early 2000 have shown, the price of higher expected returns is potentially significant market volatility and downside risk. Historically, U.S. stocks have realized negative returns in 40 of the past 138 years (dating back to 1871), or 29% of the time. Seven of those 40 years (5% of the time) witnessed declines greater than –20%. Of course, the flip side is that the stock market has enjoyed positive returns 71% of the time. However, because retirement security tends to be an exercise in capital preservation, what happens if the market turns significantly downward at the worst possible moment—that is, just as a worker decides to retire and live off some portion of an investment portfolio?

Evaluating an 'average' retiree

In a worst-case scenario, a retiree would have 100% of their portfolio in equities, resulting in a substantial drawdown due to spending and market losses, as well as potentially big changes in portfolio income. Fortunately, most investors approaching retirement do not maintain a 100% exposure to equities. Surveys by Vanguard have shown that investors aged 65-plus allocate, on average, 55% of their portfolios to equities.[3] So how has a balanced, diversified retiree fared in such an environment?

Figure 1 plots the hypothetical performance of a $100,000 portfolio allocated evenly between stocks and bonds.[4] The retirees in question spend 4% of the initial balance, which subsequently grows by inflation to supplement pension and/or Social Security income.[5] We plot four different scenarios, representing four unique, but similarly adverse, market and economic environments, three occurring in the United States. We show the portfolio balances for investors who retire just before: the market crash and Great Depression of 1929,[6] the bear market and inflationary period of 1973–74, the bear market of 2000–2002 (which includes the current bear market) and the market crash and extended bear market in Japan in 1990 (also including the two bear markets observed in the 2000s).[7]

In Figure 1, the scenario of the 1989 Japanese retiree projects the worst result of the four depicted, as they are on track to run out of money by age 86—a direct result of 19 years of poor market performance combined with the retiree's spending of about $83,000 in retirement (the sum of the actual annual withdrawals). The U.S. retiree in 1999 has seen their portfolio decline to approximately $80,000 by the end of 2008, the result of cumulative spending of $40,000 on top of two significant bear markets. Because the future is uncertain, and a portfolio depletion of –20% in only 8 years is significant, such a situation may call for a reevaluation of spending priorities to reduce the speed of the drawdown. On the other hand, the

Notes on risk: Past performance is not a guarantee of future results. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index. All investments are subject to risk. Investments in bonds are subject to interest rate, credit, and inflation risk. Foreign investing involves additional risks, including currency fluctuations and political uncertainty. Diversification does not ensure a profit or protect against a loss in a declining market.

3 See Utkus and Young (2008) for details.

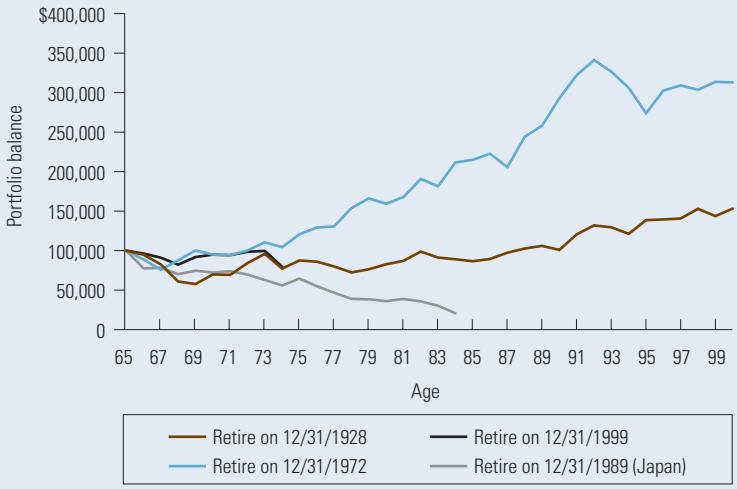
4 All portfolio values are in today's (that is, 2009) U.S. dollars or Yen. For example, we do not assume that an investor retires with $100,000 in 1929 dollars, but in 2009 dollars.

5 All scenarios in this paper ignore any potential taxes on distributions. In addition, we use index returns. When evaluating investment returns, adjustments for costs must be made.

6 For our analysis using the period following the 1929 crash, we looked past the economic environment and focused only on market performance. That said, unemployment rates of 25% during the Great Depression would not materially affect our analysis, in that we assumed the worker retired at the market peak and remained in retirement thereafter.

7 Each of the scenarios examined in this paper implicitly assumes that investors across time had access to the same retirement and investment vehicles as they do today (401(k)s, index funds with low costs, etc.). Although this was obviously not the case, we used these time periods for their return series and not for purposes of plotting how actual retirees fared in the 1920s and so on.

Figure 1. Hypothetical performance of a diversified, balanced investor during actual "worst" periods in U.S. and Japanese financial history*



Assumptions:

- $100,000 portfolio balance at retirement.
- Retire at market peak at age 65.
- Maintain a 50% stock/50% bond portfolio in retirement.
- All investments are domestic.
- All bonds are nominal, not inflation-adjusted.
- Spend $4,000 on January 1 of year one, grow by inflation thereafter.
- All portfolio values are shown in today's (2009) values.
- Japan performance is denominated in Yen.

*The actual worse-case scenario for a Japanese investor would be the –100% decline as a result of World War II. Thus, we evaluate *post* World War II history for Japan.

Note: Refer to the Appendix for a summary of return data used in these scenarios.

Source: Vanguard.

This hypothetical illustration does not represent returns on any particular investment.

1928 retiree, while enduring a significant initial drawdown of about 42% over the first 3 years, saw their portfolio grow over time to a value of $153,000 by age 100 (in 1963), despite spending a total of $170,000 from age 66 through age 100. Finally, the 1972 retiree actually fares best. After enduring a 2-year drawdown of over 24%, their portfolio tripled in value to over $312,000 by age 100 (in 2007), all while spending a total of $407,000 (primarily the result of high inflation in the 1970s and early 1980s).

Of course, these results can change significantly, depending on shifts in spending. If, for example, spending is increased at a rate that exceeds inflation by 1%, the 1928 retiree would spend a total of $208,000, but would draw their portfolio down to $47,000 by age 100. Similarly, the 1972 retiree would boost spending to $498,000 with their portfolio declining to $25,000 by age 100. The 1999 retiree would not see significant change so far, increasing cumulative withdrawals by only $1,700. However, the 1989 Japanese retiree would see their portfolio decline to $13,000 by 2008 after spending a total of $91,000 over the prior 19 years. Obviously, once in retirement, the spending rate *significantly* affects the sustainability of a diversified, balanced portfolio.[8]

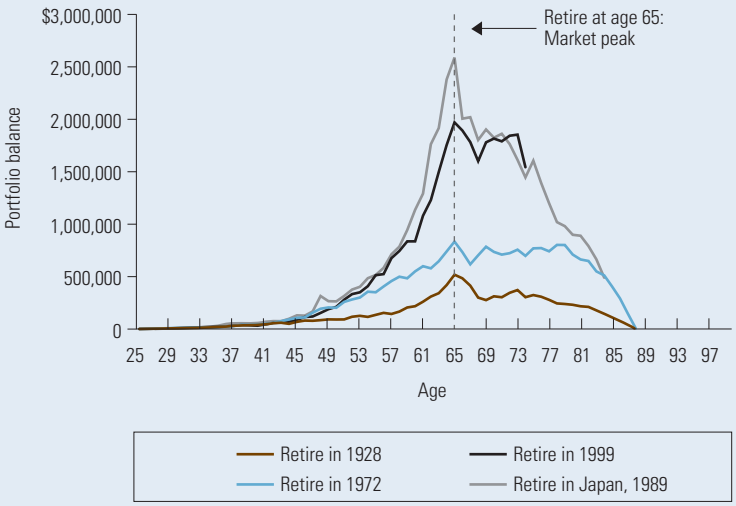
The value of savings

For investors who diligently saved over time and remained committed to their investment plan, even being unlucky enough to retire at the market's peak may not be fatal. For example, **Figure 2**, on page 4, shows the same four market environments, but with the time-series window expanded to capture the potential growth of the hypothetical portfolio *before* retirement. For this example, we used relatively conservative assumptions for saving (3% initial annual employee contributions, increasing by 1% every 10 years,[9] plus 3% annual employer match) and wage growth (1% *real* growth from a starting wage of $20,000), and above-average assumptions for portfolio spending (replace 50% of preretirement wages, grown by inflation). In these scenarios, we assumed the retirees supplemented this income with Social Security or other income sources, resulting in a total-replacement ratio higher

8 For additional analysis on saving and spending in retirement, see Bruno (2009); Jaconetti (2007, 2008); and Jaconetti and Bruno (2008).

9 In Figure 2, from ages 25 through 30, we assumed that the employee contributes 3%; from 31 through 40, 4%; from 41 through 50, 5%; from 51 through 60, 6%; and from 61 through 65, 7%. The employer match remains at 3% throughout.

Figure 2. Hypothetical performance of a diversified saver



Assumptions:

- Start saving at age 25.
- Retire at age 65.
- $20,000 starting salary.
- Annual raise at rate of inflation (previous year's CPI) plus 1%.
- Employee contribution added on December 31:
  —Initial contribution rate of 3%; increased by 1% every ten years starting at age 30.
- 3% employer match on December 31.
- All investments are domestic.
- All bonds are nominal, not inflation-adjusted.
- Replace 50% of terminal salary in retirement.
- Grow spending at inflation rate (previous year's CPI).

Note: Refer to the Appendix for a summary of return data used in these scenarios.

Source: Vanguard.

This hypothetical illustration does not represent returns on any particular investment.

than 50%.[10] We also assumed that the investors' retirement savings followed a "life-cycle" path of investing and asset allocation (that is, we used a generic path that shifts from 90% stocks to 30% stocks in 10% increments every ten years starting at age 25) containing only domestic stocks and domestic bonds represented by broad-market indexes. And perhaps, most important, we assumed that the investors stuck to their investment plan for the duration of their working careers.

Ultimately, assuming reasonable and regular savings and a disciplined investment plan, Figure 2 suggests that even participants of modest means can fund a lengthy retirement while drawing down their portfolio amid some of history's poorest market and economic environments. And although the 1928 and 1972 scenarios still result in the retirees running out of money, they were able to withdraw 50% of their preretirement salaries—adjusted for inflation—each year until they reached 88 years old, while only contributing 3% of their salaries initially and 7% by age 65. The remaining scenarios in this paper provide other hypothetical examples of investors who are able to significantly increase their portfolios' longevity by focusing on saving more, controlling costs, and staying committed to their investment plans.

Given short-term equity market risk, what can investors do?

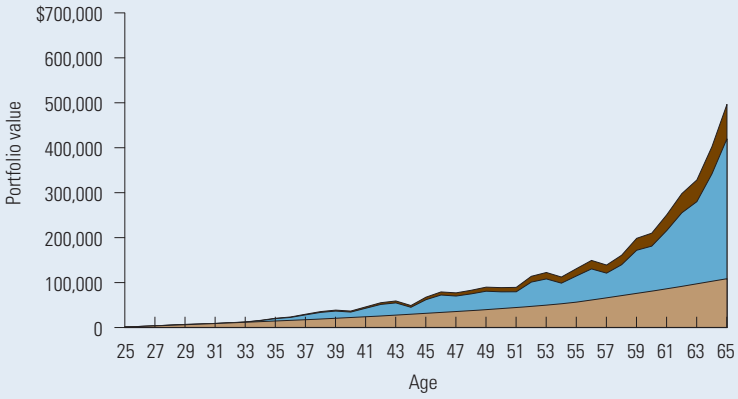
For the most part, investors cannot control their time horizon or market performance[11]—they are relegated to investing over one finite time series. Obviously, the scenarios in Figures 1 and 2 represent difficult time series for an investor to retire into. So what could an investor have done to decrease the odds of running out of money? **Figure 3** illustrates the relationship between savings, market returns, and costs over time. Here we dissect the portfolio of the 1928

10 This also assumes that the retirees do not require full replacement of their preretirement income, because of potentially lower fixed and discretionary expenses. For example, few retirees have a mortgage, which represents a significant portion of nondiscretionary spending before retirement. Most studies suggest that approximately 80% of preretirement income is reasonable. In addition, an oft-cited 2008 study by Aon Consulting found that private sources (401(k), IRA, etc.) would need to account for between 30% and 42%, on average, of age-65 salary. We elected to use a replacement ratio of 50% to account for the greater uncertainty regarding Social Security, defined benefit pension plans, and certain costs such as health care.

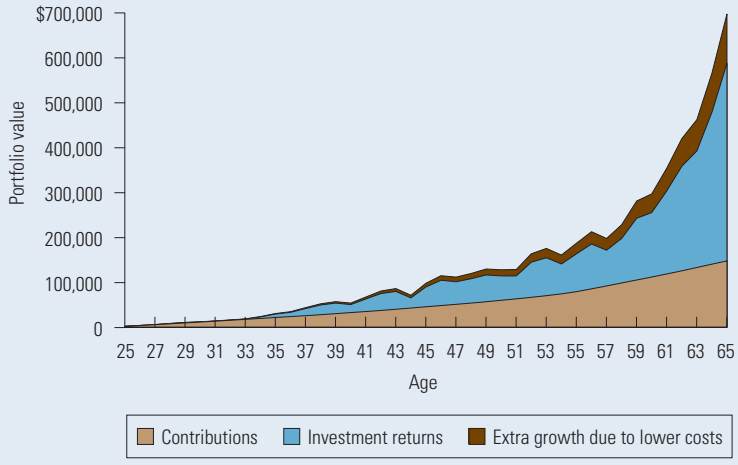
11 Certain investors may be able to delay a life event, such as retirement, for several years. Similarly, certain investors can alter their market exposure through tools such as options, but these tools are beyond the scope of most investors' portfolios.

Figure 3. The role of savings, returns, and costs: 1888 through 1928

Growth of hypothetical retirement portfolio by source: 3% initial employee contributions



Growth of hypothetical retirement portfolio by source: 6% initial employee contributions



			Expense ratio	
			1.00%	0.20%
Starting contribution level	Sum of all contributions	Investment returns on contributions	Total value at retirement	Total value at retirement
3%	$108,599	$311,403	$420,002	$496,591
6%	147,328	439,434	586,763	696,761

Note: Refer to the Appendix for a summary of return data used in these scenarios.

Source: Vanguard.

This hypothetical illustration does not represent returns on any particular investment.

retiree (from Figure 2) into its primary growth components: contributions, investment returns, and costs. *Contributions* represent the total accumulated value of all employee and employer contributions over time. For the saver starting at 3% (plus an annual 3% employer match) in the top panel of Figure 3, this value reached $108,599 over a 40-year career. For the saver starting at 6% (plus a 3% match) in the figure's bottom panel, this value reached $147,328. So saving 6% instead of 3% added approximately $39,000 to the final portfolio value over 40 years.

As shown in Figure 3, the largest growth component for the 1928 retiree was the *investment returns* on those savings. Although the 3% saver was able to put aside $108,599 in savings, by maintaining steady investment in a well-diversified, balanced plan, the portfolio grew by an additional $311,403, for a total value of $420,002. For the 6% saver, this growth was even more robust, at $439,434, for a total portfolio value of $586,763. It is this interaction between savings and investment returns that investors must focus on. Clearly, due to compounding, the more you save, the better off you'll be, even if your particular path results in a market downturn around the anticipated retirement date.[12]

12 It should be understood that by saving more now, less is available for discretionary spending today. As a result, investors must weigh the trade-off between spending today and spending in retirement.

In addition to controlling their savings rate, investors can also control costs, which can help improve their portfolios' future outcomes. To demonstrate this lever, Figure 3 compares low-cost (0.20% annual expense ratio) funds with high-cost (1.00%) funds. For the 3% hypothetical saver, the $420,002 portfolio represents the growth over time of a portfolio delivered at a total cost of 1%. However, if the retiree had instead selected funds with a total cost of 0.20%, that portfolio would have grown to $496,591. In other words, by selecting low-cost funds, the retiree would have accumulated an extra $76,589 over the course of 40 years, an amount almost equal to their total paycheck contributions. We found similar results for the 6% saver, who would have realized a portfolio value of $696,671 by using low-cost funds—an "extra" growth of $109,998 over time (again, almost as large as the total accumulated value of the retiree's contributions). And, interestingly, this extra $109,998 means that the 6% saver paying only 20 basis points could have increased spending to 65% of preretirement income and the portfolio would have lasted until age 89—the same age at which the portfolio with 100-basis-point expenses would have run out of money while spending at a 50% spending rate. (For the 3% saver spending 65% of preretirement salary, the terminal age of the portfolio would be 81).

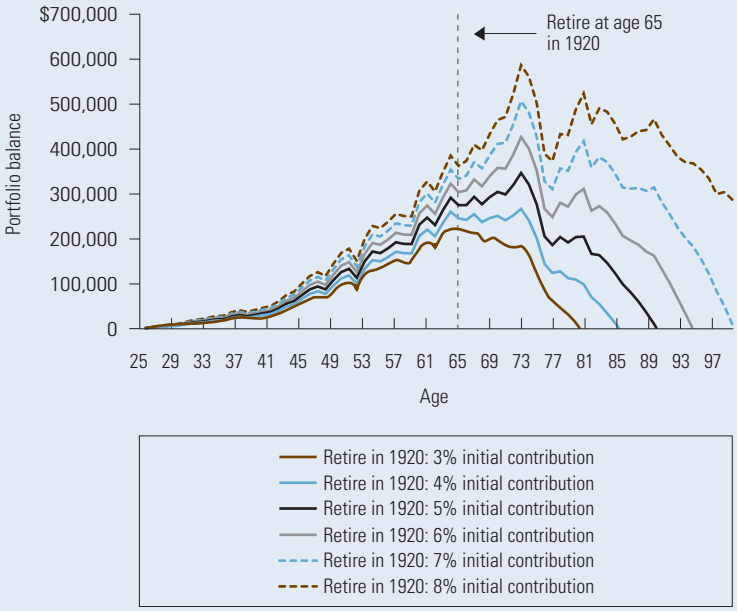
Because of these relationships, and the power of compounded growth over time, investors need to understand and be comfortable with the partnership that exists between their retirement savings and the investment markets. As such, an appropriate balance must be struck between the two to ensure a secure retirement during any market or economic environment. On the one hand, this means that workers should not rely too heavily on the financial markets to "make up" for a real or perceived lack of savings due to the short- and intermediate-term risks in the equity markets. For example, if we again take the 40 years ended 1928, but evaluate a hypothetical employee who maintained a heavy static equity allocation throughout their career (80% stocks/20% bonds), we find that this retiree would have retired with a larger balance than the life-cycle investor (because the retiree captured more of the equity risk premium over time). However, assuming the retiree didn't change their asset allocation upon retiring, their portfolio would have also seen a much more significant drawdown over the first 4 years of retirement (returning –61% versus –46%) than would the investor who reduced equity exposure over time.

Similarly, investors cannot afford to be too risk averse throughout their working career. For example, an investor who instead maintained a risk-averse portfolio throughout their career (20% stocks/80% bonds) would have realized significantly less volatility and downside risk, but would have required an initial savings rate of 9% (plus the 3% match) increased by 1% every ten years to retire with the same balance as the investor who contributed 3% initially and followed a life-cycle path (again assuming retirement in 1928). And if a worker can contribute at this increased rate and utilize low-cost funds, their retirement balance when following the life-cycle path (instead of the 20%/80% static portfolio) would have been $896,750 (up from $496,592 for the 3% saver), and at age 100, the portfolio would have reached $869,351, even under the identical spending assumptions as in Figure 2. In other words, by initially saving 9% of compensation instead of 3%, a retiree in 1928 would have endured the worst economic and financial crisis the United States has faced, all the while spending from their portfolio, *and* would have been able to bequeath a substantial portfolio to heirs.

What about a low-return environment?

While it is helpful to evaluate the situations of individuals who retired only to confront significant bear markets (given the current market environment), it's also important to consider that the particular 40-year working career of a retiree may not be as financially robust as those experienced in recent history. This may be especially relevant for younger investors today. For example, for the 40 years ended 2008, U.S. stocks returned 9.1% annually, while U.S. bonds returned 8.2% annually. And leading up to the Great Depression, the 40 years ended 1929 saw an 8.7% return for stocks and a 3.5% return for bonds. Further, U.S. investors haven't seen a 40-year period

Figure 4. Hypothetical performance of a retirement portfolio during a low-return environment



Assumptions:

- Start saving at age 25.
- Retire at age 65.
- $20,000 starting salary.
- Annual raise at rate of inflation (previous year's CPI) plus 1%.
- Employee contribution added on December 31:
  —Contribution rate increased by 1% every ten years starting at age 30.
- 3% employer match on December 31.
- All investments are domestic.
- All bonds are nominal, not inflation-adjusted.
- Replace 50% of terminal salary in retirement.
- Grow spending at inflation rate (previous year's CPI).

Note: Refer to the Appendix for a summary of return data used in these scenarios.

Source: Vanguard.

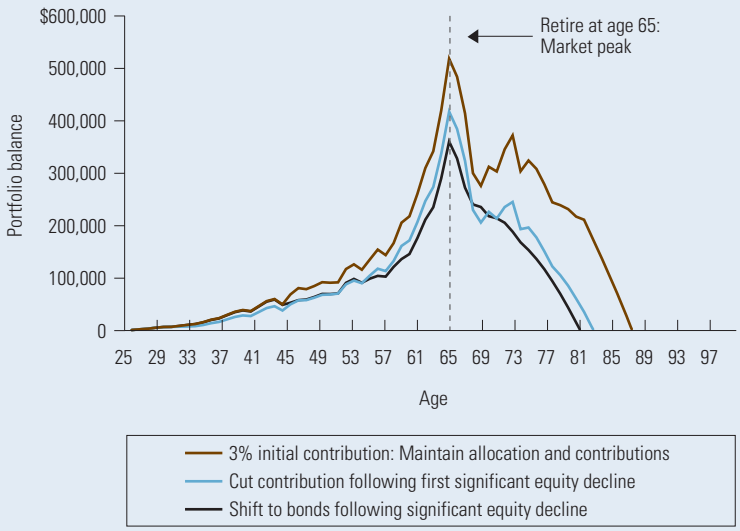
This hypothetical illustration does not represent returns on any particular investment.

with average stock returns below 7% since the 40 years ended 1946 (which returned an annual average of +6.86%). As a result, investors have become accustomed to high, long-term nominal equity returns. But what if, going forward, long-term returns fail to match those since 1947?

In such a scenario, savings become even more important. For example, the worst 40-year period for returns in U.S. history ended in 1920, with stocks returning only 5.4% annually and bonds returning 3.1% annually. To add insult to injury, while equity markets accelerated upward through the 1920s, retirees in this period then endured the crash and subsequent bear market of 1929 through the early 1930s. Investors unlucky enough to experience this particular market over their working careers would have built up enough savings only by contributing more than the 3% initial savings rate used in our examples so far.

We demonstrate this in **Figure 4**, which shows that because the markets contributed less to portfolio growth leading up to retirement, an investor retiring in 1920 who contributed a minimal initial amount (even factoring in the 1% increases over time) would have run out of money by age 81. Only by boosting the initial savings rate to 5% or more (along with subsequent 1% increases over time), could the retiree maintain a positive balance past age 90 (while also enduring the 1929 market crash—at age 73—and the subsequent Depression). And for higher savers, even this low-return environment coupled with the market crash during retirement would not have proved disastrous, as the 8% saver actually ended up with a sizable portfolio at age 100. Clearly, then, instead of focusing on the near-term movements in the markets, investors should ensure they are doing as much as they can to maximize their retirement contributions and control costs while allowing the financial markets to operate in the background of a well-thought-out, balanced plan.

Figure 5. Reacting to a negative event may not pay off



Assumptions:

- Start saving at age 25.
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- 3% employer match on December 31.
- All investments are domestic.
- All bonds are nominal, not inflation-adjusted.
- Replace 50% of terminal salary in retirement.
- Grow spending at inflation rate (previous year's CPI).

Notes: Refer to the Appendix for a summary of return data used in these scenarios. For the scenario evaluating the impact of cutting contributions, we assumed that the company match was also cut in lockstep. When contributions increased from 0% to 1%, we assumed that the company match also rose from 0% to 1%.

Source: Vanguard's Investment Strategy Group.

This hypothetical illustration does not represent the returns on any particular investment.

similarly foreboding periods in U.S. history, individuals who followed a disciplined investment plan, saved a reasonable amount consistently, and took advantage of low costs managed to not only survive the bad times but to fund a retirement with reasonable financial security.

That said, investors may be tempted going forward to alter their savings rate or portfolio allocation in reaction to this dismal ten-year period. **Figure 5** (again we use the 1928 retiree scenario), illustrates two different possible reactions to a sharp downturn in the equity markets.[13] The first example shows the impact of cutting contributions in reaction to a severe market drop. The thinking here is that as the retirement portfolio shrinks, new contributions may be synonymous with throwing good money after bad. So the worker cuts new contributions. As the market rebounds, contributions are incrementally increased back to prior levels. In our example, the worker cuts contributions from 3% to 0% at age 31 in reaction to a –20% loss in the stock market the previous year. Contributions remain at 0% for 2 years, after which they are increased by 1% per year to the target rate (see the blue line in Figure 5). This reaction, while seemingly not significant, results in a dramatic reduction in both retirement wealth and the portfolio's sustainability.

What about today's environment?

Following the global equity market collapse of 2008, both workers and retirees in the United States are understandably shaken. With trailing ten-year total returns for U.S. stocks at –0.62% per year (through December 2008), many may question whether a large allocation to stocks is worth the volatility and near-term risks. Yet, as this paper has shown, during other

Figure 5 also includes an example of the investor who reacts to significant downside risk by shifting their asset allocation into bonds. When the equity markets rebound, the investor incrementally moves back into equities (in 20% shifts). For our 1928 retiree, this action occurs 3 times—at ages 31, 45, and 55. Finally, reacting to the 1929 market crash, and because the investor is retired, their portfolio is

13 Although not shown, we found similar results for the 1972 retiree and the 1989 Japanese retiree.

shifted out of equities and remains 100% in bonds without shifting back into equities, meaning that the portfolio escaped most of the damage of the Depression. However, as seen in Figure 5, the retiree's prior reactions to equity market volatility lead to a significant reduction in retirement wealth and in the portfolio's sustainability. The net result is a portfolio that runs out of money 6 years earlier than that of the worker who stuck to an asset allocation and saving plan.

Finally, although we obviously cannot evaluate every possible scenario, another "at-risk" group would be those who are in their prime earning years, but who may not have been able to build up a significant portfolio even with retirement just around the corner. For our example, we evaluate a worker who turned 50 at the start of the 1929 bear market (overlooking the increased risk of job loss due to the poor economy). We assume this worker has an average salary of $50,000 and a retirement portfolio equaling three times their salary ($150,000) at the start of the bear market (2.5 times at the trough). For this individual, savings are extremely important. Maintaining our assumptions regarding wage growth, portfolio allocations, and spending, and using the same 1928 return series, we found that to build a sustainable portfolio for retirement, this investor would have to save, on average, 21% of their salary until retirement. At age 50 this could mean a contribution rate of 11%, an employer match of 3%, and extra contributions to an IRA of $3,000 ($250 per month). Such a savings rate would likely permit the retiree to draw down the portfolio through age 90, similar to the 1928 scenario in Figure 2.

Conclusion

Although bear markets are difficult to endure "in the moment," the reality is that to participate in the equity markets, investors must expect periodic downside volatility or even protracted periods of below-average returns to justify an expectation of long-term growth beyond that achievable by bonds, cash, or other less risky investments. And although the 2000s, a period characterized by two severe bear markets, have certainly been a challenge for investors, we have shown that by following a diligent savings and investing plan, most retirees have been able to rely on their portfolios to meet a significant portion of their spending needs in retirement. In contrast, those investors who did not remain committed to a savings and investment plan over time were worse off in retirement. Going forward, because the performance of the markets is beyond anyone's control, reacting to market volatility by substantially repositioning a portfolio offers little in the way of positive long-term impact. Instead, focusing on costs and savings rates while also ignoring the urge to alter an asset allocation may offer the best opportunities for long-term success.

References

Aon Consulting/Georgia State University, 2008. *Replacement Ratio Study. A Measurement Tool for Retirement Planning*. Chicago: Aon Consulting.

Bruno, Maria A., 2009. *Income in Retirement: Common Investment Strategies*. Valley Forge, Pa.: Investment Counseling & Research, The Vanguard Group.

Jaconetti, Colleen M., 2007. *Spending from a Portfolio: Implications of a Total-Return Approach Versus an Income Approach for Taxable Investors*. Valley Forge, Pa.: Investment Counseling & Research, The Vanguard Group.

Jaconetti, Colleen M., 2008. *Investing for Retirement: Strategies for Taxable Investors*. Valley Forge, Pa.: Investment Counseling & Research, The Vanguard Group.

Jaconetti, Colleen M., and Maria A. Bruno, 2008. *Spending from a Portfolio: Implications of Withdrawal Order for Taxable Investors*. Valley Forge, Pa.: Investment Counseling & Research, The Vanguard Group.

Orszag, Peter R., 2008 (October 7). *The Effects of Recent Turmoil in Financial Markets on Retirement Security*. Testimony before the Committee on Education and Labor, U.S. House of Representatives. Washington, D.C.: U.S. Congressional Budget Office.

Utkus, Stephen, and Jean Young, 2008. *How America Saves: A Report on Vanguard 2007 Defined Contribution Plan Data*. Valley Forge, Pa.: Center for Retirement Research, The Vanguard Group.

Wilson, Jack W., and Charles P. Jones, 2002. An Analysis of the S&P 500 Index and Cowles's Extensions: Price Indexes and Stock Returns, 1870–1999. *Journal of Business* 75(3): 505–33.

Appendix: Data sources

Following are sources for the return data used in this paper's scenarios.

- **U.S. equity market returns:** From 1871 through 1925, we used data provided by Wilson and Jones (2002). From 1926 through 1970, we used the Standard & Poor's 500 Index. From 1971 through 2005, we used the Dow Jones Wilshire 5000 Index. Thereafter, we used the MSCI US Broad Market Index.
- **U.S. bond market returns:** From 1871 through 1925, we used total return data for U.S. Treasury bonds provided by Global Financial Data. From 1926 through 1968, we used the S&P High Grade Corporate Index. From 1969 through 1972, we used the Citigroup High Grade Index. From 1973 through 1975, we used the Barclays Capital U.S. Long Credit Aa Bond Index. Thereafter, we used the Barclays Capital U.S. Aggregate Bond Index.
- **U.S. cash returns:** Since 1926, we used the Citigroup 3-Month Treasury Bill Index
- **U.S. inflation statistics:** From 1871 through 1912, we used estimated inflation provided by the Federal Reserve Bank of Minneapolis (Consumer Price Index [Estimate], 1800–2005). Thereafter, we used the consumer price index (CPI) provided by the Bureau of Labor Statistics, U.S. Department of Labor.
- **Japanese equity returns:** From 1951 through 1969, we used the Nikkei 225 Index (in Yen). Thereafter, we used the MSCI Japan Index (in Yen).
- **Japanese bond returns:** From 1951 through 1965, we used the discount rate of commercial bills (converted to total returns) provided by the Bank of Japan. From 1966 through 1984, we used the 10-year constant maturity bond (converted to total returns) provided by the Bank of Japan. From 1985 through 2000, we used the Citigroup World Government Bond Index—Japan Index (in Yen). Thereafter, we used the Barclays Capital Japan Aggregate Index (in Yen).
- **Japanese cash returns:** From 1951 through 1985, we used the National Discount Rate provided by the Bank of Japan. Thereafter, we used the JPMorgan Japan 3-Month Cash Index.
- **Japanese inflation statistics:** From 1951 through 1955, we used CPI numbers from the Japan Ministry of Internal Affairs and Communications: Statistics Bureau. Thereafter, we used CPI statistics from the Bank of Japan.

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