What does the crisis of 2008 imply for 2009 and beyond?

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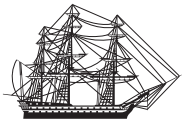

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Executive summary. The financial crisis of 2008 engendered severe declines in equity markets and economic activity around the world. Underscoring the severity of the crisis and the rising uncertainty about the future economic and financial landscape, the daily volatility of the U.S. stock market over the year approached levels last seen during the Great Depression.

The events of 2008 raise important questions about the markets and the economy in 2009:

- Given that the stock market is a leading economic indicator, what do its returns and volatility last year imply about the severity of the U.S. economic recession this year? In other words, how much economic "bad news" has already been discounted by the market?
- Do the exceptional levels of volatility witnessed during 2008 imply anything about the market's performance in 2009 and beyond? Similarly, how strong is the tendency for stock returns to "mean-revert"? Can investors learn anything from the past?

In this paper, we consult historical U.S. data as far back as the 1870s to examine the predictive relationship of annual stock market returns and their within-year volatility on future real economic growth. Specifically, we show that the returns and volatility of the stock market in any one year explain more than 50% of the pattern in real GDP growth the following year. Looking ahead, our analysis implies that the stock market's performance in 2008 has priced in an extremely harsh U.S. recession for 2009, one that would be approximately twice as severe as the deep recessions of 1974 and 1982.

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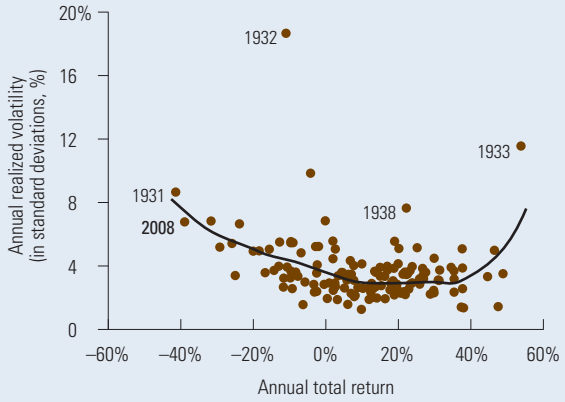
We also evaluate whether trailing stock returns or volatility levels have any correlation with future stock returns over 1-, 3-, 5-, and 10-year horizons. Overall, we show that the level of market volatility in any one year has effectively *zero correlation* with future stock returns over both short- and longer-term horizons. We do find some evidence that stock returns tend to revert to their long-term mean over 3-year and 5-year horizons, although the correlation is low. A more significant (and long-recognized) relationship is found between current stock valuation metrics (i.e., price/earnings ratios or dividend yields) and future long-term returns.

Given end-of-2008 valuation levels, our analysis suggests that a reasonable "central tendency estimate" for the return of the U.S. stock market over the next ten years should be near the long-term average of 8%–10%. How the stock market may perform in 2009 is obviously much less clear and depends on a number of factors, including the success of various monetary and fiscal policies aimed at stunting the severity of the recession, the degree of risk-aversion among various market participants, and the expected future earnings growth of companies around the world. The profound uncertainty with respect to the timing and magnitude of a future stock market rebound underscores the time-tested benefit of maintaining a strategic and well-diversified portfolio allocation.

Figure1. Annual returns and volatility of the S&P 500 Index: 1871–2008

Volatility reflects the within-year standard deviations of monthly S&P 500 returns



Note: The "J-shaped" curve corresponds to a nonparametric fit based on an Epanechnikov kernel with a bandwidth of 0.20.

Soures: S&P, Shiller, and Vanguard.

Introduction

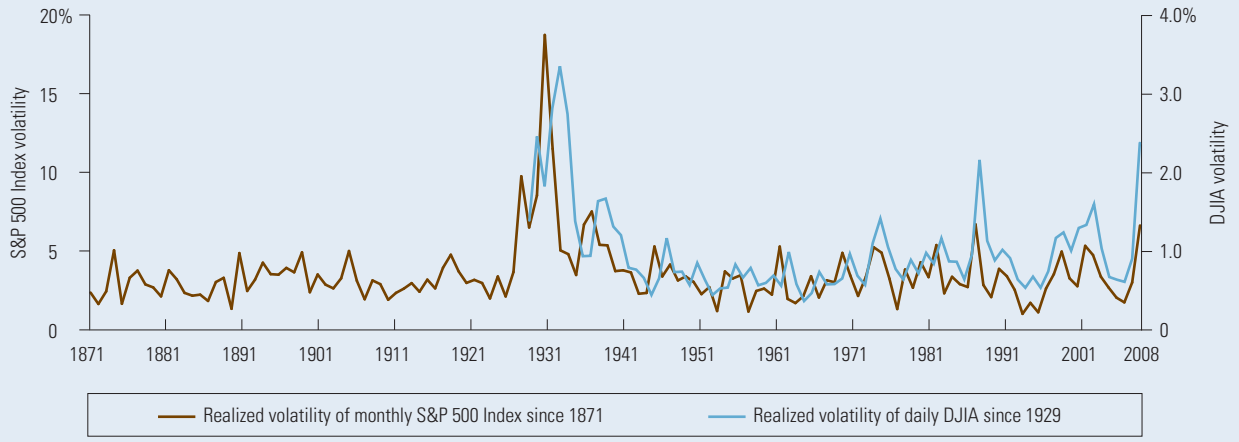
The year 2008 was one of the most vicious—and volatile—years for the U.S. stock market in its long history, as illustrated in **Figure 1**. The financial crisis engendered severe declines in equity markets and economic activity around the world. An index of the largest U.S. stocks—the Standard & Poor's 500 Index—posted a –37% return for the 12 months. Returns across all market capitalizations and styles were markedly negative, with all stock sectors down more than 20% for the fourth quarter.

Stock market volatility in 2008 approached levels last seen during the Great Depression, as further illustrated in **Figure 2**. Historically, stock volatility has tended to persist, with high volatility in one year typically followed by high volatility the following year. Such periods tend to occur during (and often preceding) recessions.[1] This is one reason that the

1 See Krainer (2002) for a brief discussion.

Figure 2. Historical realized volatility of the U.S. stock market: 1871–2008

Annual standard deviation of monthly S&P 500 Index returns and daily Dow Jones Industrial Average (DJIA) returns



Sources: S&P, Shiller, Dow Jones, Datastream, and Vanguard.

extreme volatility witnessed during 2008 has contributed to widespread alarm about the severity of the crisis and what it could mean to the global economic and financial landscape.

Major questions for the near term are: What do the negative returns and high volatility of the stock market in 2008 imply for the severity of the U.S. recession in 2009? And, for U.S. equity investors: Does the extreme volatility witnessed during 2008 imply *anything* about the stock market's performance in 2009 and beyond? As shown by the fitted line in Figure 1, periods of high volatility have been associated with *both* negative stock returns (i.e., 1931 and 2008) and positive stock returns (i.e., 1933). In the latter case, volatility is high because stock prices, which are a leading economic indicator, rise sharply in anticipation of an economic recovery. Below we examine the average link between stock market volatility in a given calendar year and future market returns at various investment horizons.

Similarly, with the trailing returns of the U.S. stock market now negative over 1-, 3-, 5-, and 10-year horizons, how strong is the tendency for stock returns to "mean-revert," returning toward their long-term trend? Can investors learn anything from high-volatility periods of the past?

In this paper, we consult historical U.S. data as far back as the 1870s to gain perspective on the relationship of past stock market volatility and performance to future economic growth and future stock returns.

Notes on risk: All investments are subject to 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.

Alternative measures of stock market volatility

To build the longest possible annual data series on stock market volatility, this paper focuses on the realized intra-year volatility of *monthly* total returns in the S&P 500 Index. Figure 2 illustrates that this annual volatility series, which extends back to 1871, is very highly correlated (at 90%) with a similar annual intra-year volatility series based on *daily* returns of the Dow Jones Industrial Average (daily data available since 1929).

Figure 3 shows that measures of *realized* volatility are also highly correlated with measures of *implied* market volatility, such as the Chicago Board Options Exchange's Volatility Index, or VIX. For further details on the pros and cons of alternative volatility measures, see Ambrosio and Kinniry (2008).

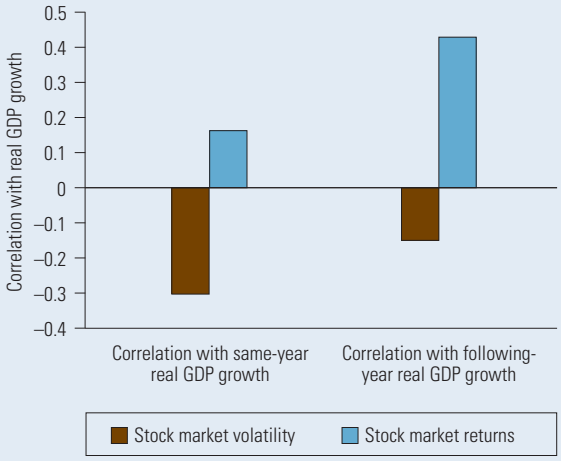
Figure 3. Correlation among alternative volatility measures

	Monthly Volatility Series		Annual Volatiltiy Series
	Based on daily S&P 500 Index returns	Based on daily DJIA returns	Based on monthly S&P 500 Index returns
Realized volatility (daily DJIA data)	0.98	—	0.90
Implied volatility (VIX)	0.87	0.88	—

Sources: S&P, Shiller, Chicago Board Options Exchange, Dow Jones, Datastream, and Vanguard calculations.

Figure 4. Simple correlation between the U.S. stock market and real GDP growth

Correlations based on annual data: 1871–2008



Sources: See Figure 7 and the Appendix for data sources.

What does the stock market of 2008 say about the U.S. economy in 2009?

Historically, higher annual stock returns have been positively correlated with higher current and year-ahead real (inflation-adjusted) growth in gross domestic product (see **Figure 4**). One obvious reason for the positive correlation is that the aggregate value of a market-capitalization-weighted stock index reflects the current and expected future corporate earnings growth of publicly traded companies. In addition, changes in the value of the stock market can influence the pace of consumption and business investment in the economy. As an example, estimates of the so-called "wealth effect" stipulate that U.S. consumer spending rises 5 cents for every $1 increase in household wealth, which, in the aggregate, is highly sensitive to changes in stock prices.

Conversely, Figure 4 shows that current and future real GDP growth is, on average, negatively correlated with the level of stock market volatility. Explanations for this negative relationship include the association of volatility with investment risk, recessions, and the countercyclical pattern in risk-aversion.[2]

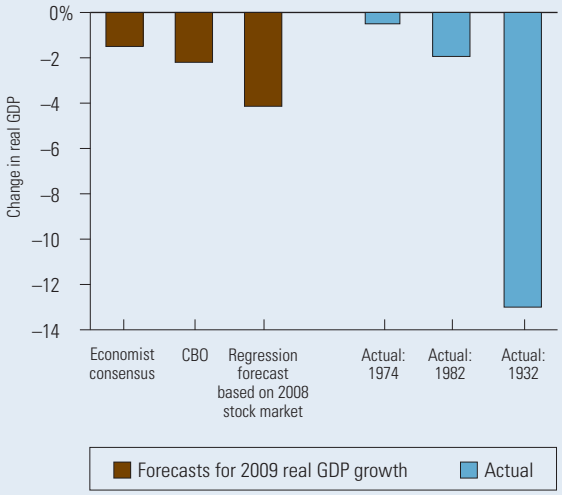
Given the simple correlations in Figure 4, it is obvious that the steep market declines and high volatility experienced in 2008 point to a significant decrease in economic activity in 2009. But just how extensive is the contraction implied by the market's behavior?

We answer this question by estimating a regression model using annual data beginning in 1871. The model predicts future real GDP growth in any year based on the previous calendar year's stock market returns and volatility. In this model, the market's returns and volatility in any one year explain more than 50% of the pattern in real GDP growth the following year. Further details of the model are provided in the Appendix.

Based on this regression model, **Figure 5** shows that the stock market has priced in an extremely severe U.S. recession for 2009 that would be approximately twice as deep as the recessions of 1974 and 1982. The model's central-tendency forecast for U.S. real GDP growth in 2009 is –4%, notably below the –1% to –2% consensus estimate of most economists. If the model's forecast is correct, 2009 would see the worst one-year decline in U.S. real GDP since the end of World War II, though it would not approach the economic contraction witnessed during the Great Depression of the 1930s.

Figure 5. The U.S. stock market anticipates a severe recession (but not a depression) in 2009

Projected annual change in real GDP for 2009 from various sources, along with actual values for prior years



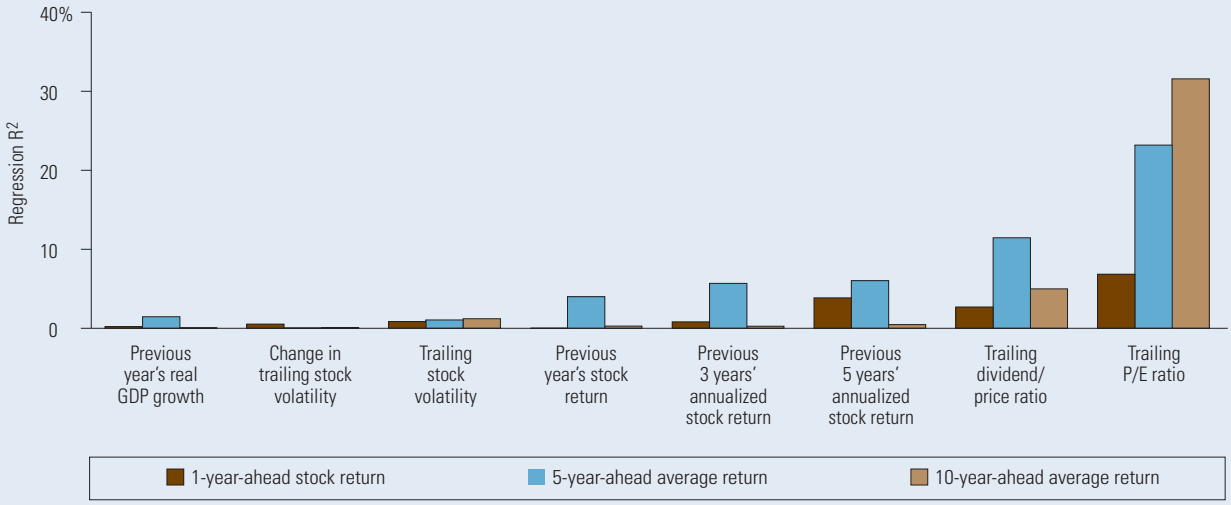
Sources: Bloomberg, Congressional Budget Office (CBO), U.S. Bureau of Economic Analysis, and Vanguard calculations.

What does 2008 imply for future stock returns?

Given the dismal economic conditions forecast by the stock market, what does the market's extreme volatility in 2008 imply about stock performance in 2009 and beyond? Similarly, how strong is the tendency for stock returns to mean-revert following bear markets? More broadly, what do the conditions prevailing at the end of 2008 imply for future stock returns?

2 Schwert (1990) and Campbell, et al. (2001), among others, have shown that economic recessions are the single most important factor explaining stock market volatility.

Figure 6. Association of future stock returns with various initial market conditions: 1871–2008



Note: Trailing P/E ratio reflects the so-called Graham P/E ratio as used by Shiller, calculated as the "End of previous year price" divided by 10-year average earnings. Slopes of both fitting lines are statistically different from zero. See Figure 7 for more details.

Sources: S&P, Shiller, Dow Jones, Datastream, and Vanguard.

To help investors form a reasonable forward-looking range of estimates for future returns, we evaluate whether trailing stock returns or volatility levels have had any correlation with future stock returns over 1-, 3-, 5-, and 10-year horizons. We also compare these historical correlations with other well-known and well-researched "predictors" of future stock returns—fundamental valuation metrics.[3] Here, we focus on two popular metrics with a long time series: (1) dividend-price ratios and (2) P/E ratios.

Figure 6 shows the *association* (defined here as simply the R^2 from a simple predictive regression) between various initial conditions and future stock returns at various horizons. Figure 7 summarizes the actual regression results in more detail and shows the simple correlation coefficients for the future stock return regression over 1-, 3-, and 5-year horizons.

The results in Figure 6 have several important—and fairly intuitive—implications. First, Figure 6 shows that trailing economic conditions (i.e., the prior year's real GDP growth) have had effectively *zero correlation* with future stock returns over both short- and longer-term horizons. This observation is consistent with previous Vanguard research showing that the stock market tends to anticipate economic shifts rather than lag them (Davis, 2008).

Similarly, trailing market volatility has had little correlation with future stock returns over either short- or longer-term horizons. To put this another way, the historical relationships estimated in Figure 6 suggest that the high level of volatility observed in 2008 does not offer any meaningful insight into whether the market in 2009 will outperform or underperform its long-term average annual return.

3 The academic literature on the relationship between valuations and future stock returns is immense. For an overview of research on stock-return predictability, see Campbell, et al. (1997), Cochrane (2004), Campbell and Thompson (2005), and Goyal and Welch (2008).

Figure 7. Historical relationship of future U.S. stock returns with various trailing statistics: 1871–2008

Independent/predictor variable		Average future annualized U.S. stock returns over . . . Next year	Next 3 years	Next 5 years
Trailing economic conditions				
Previous year's real GDP growth	Regression beta	*Statistically zero*	*Statistically zero*	*Statistically zero*
	Beta t-statistic	–0.48	0.03	–1.22
	R^2	0%	0%	1%
	Simple correlation	*Statistically zero*	*Statistically zero*	*Statistically zero*
Trailing volatility				
Previous year's realized volatility of S&P 500 Index, in logs	Regression beta	*Statistically zero*	*Statistically zero*	*Statistically zero*
	Beta t-statistic	0.90	0.14	0.94
	R^2	1%	0%	1%
	Simple correlation	*Statistically zero*	*Statistically zero*	*Statistically zero*
Change in previous year's realized volatility of S&P 500 Index, in logs	Regression beta	*Statistically zero*	*Statistically zero*	*Statistically zero*
	Beta t-statistic	0.99	0.27	0.32
	R^2	1%	0%	0%
	Simple correlation	*Statistically zero*	*Statistically zero*	*Statistically zero*
Trailing returns ("mean reversion")				
Previous year's nominal stock return	Regression beta	*Statistically zero*	*Statistically zero*	**–0.08**
	Beta t-statistic	0.10	–1.56	**–3.00**
	R^2	0%	1%	**4%**
	Simple correlation	*Statistically zero*	*Statistically zero*	**–20%**
Previous 3 years' annualized stock return	Regression beta	*Statistically zero*	**–0.21**	**–0.17**
	Beta t-statistic	–1.29	**–1.87**	**–1.93**
	R^2	1%	**4%**	**6%**
	Simple correlation	*Statistically zero*	**–21%**	**–24%**
Previous 5 years' annualized stock return	Regression beta	**–0.51**	**–0.33**	**–0.24**
	Beta t-statistic	**–2.39**	**–1.66**	**–1.80**
	R^2	**4%**	**6%**	**6%**
	Simple correlation	**–20%**	**–24%**	**–25%**
Previous 10 years' annualized stock return	Regression beta	*Statistically zero*	*Statistically zero*	*Statistically zero*
	Beta t-statistic	–0.24	–0.19	–0.43
	R^2	0%	0%	0%
	Simple correlation	*Statistically zero*	*Statistically zero*	*Statistically zero*
Trailing valuations				
Previous year's dividend/price ratio	Regression beta	**1.80**	**1.35**	**1.49**
	Beta t-statistic	**1.94**	**2.19**	**3.30**
	R^2	**3%**	**5%**	**11%**
	Simple correlation	**16%**	**23%**	**34%**
End of previous year's P/E ratio (Earnings averaged over trailing 10 years)	Regression beta	**–0.008**	**–0.006**	**–0.006**
	Beta t-statistic	**–2.60**	**–3.27**	**–4.01**
	R^2	**7%**	**18%**	**23%**
	Simple correlation	**–26%**	**–42%**	**–48%**

Notes: Statistically significant beta coefficients, R^2 terms, and correlation coefficients are shown in bold. Regressions were estimated using Newey-West HAC robust standard errors given overlapping data. Log volatility is calculated using standard deviation of the monthly total returns within each year. Dividend/price ratio is the ratio between the average dividend of January–November of a given year and the stock price in December. Prices and 10-year average earnings are available from 1881 through 2008 and were downloaded from Shiller's website. The annual stock total return series reflects several sources: Shiller's S&P 500 Index return from 1871 through 1925; the S&P 500 Index monthly reinvested return from 1926 through 1970, the Dow Jones Wilshire 5000 Index from 1971 through 2005, and the MSCI Broad Market Index from 2005 through 2008.

Sources: S&P, Shiller, Dow Jones, Datastream, and Vanguard.

However, we do find some evidence that stock returns tend to mean-revert over 3-year and 5-year horizons. As described in Figure 7, trailing returns over a 3-year or 5-year period that were higher than their historical averages have tended to be succeeded by lower returns over the next several years; similarly, lower trailing returns have been followed by higher ones. It is important to recognize, however, that the inverse correlations for mean reversion are still rather low, consistent with the low R^2s in Figure 6. The length of economic business cycles (which can range from 3 to 7 years) may be an explanation for the (weak) tendency for mean reversion in stock returns.

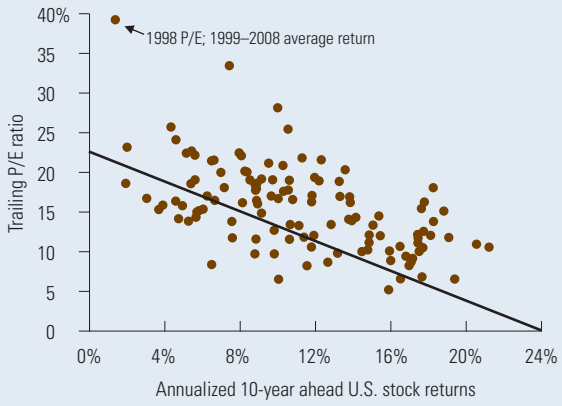
Most notably, Figure 6 shows the more significant (and long-recognized) relationship between current stock valuation metrics (i.e., P/E ratios or dividend yields) and future long-term returns. Given the trailing P/E ratios that existed at the end of 2008, the expected 10-year annualized total return for the 2009–2018 period is centered in the 9%–10% range, close to the historical average.

However, it is important to underscore that much less than 50% of future stock return volatility (i.e., R^2) is explained by valuation metrics alone. This is perhaps best illustrated by the wide range of future 10-year returns in **Figure 8** when compared with trailing P/E ratios. The relationship is even weaker for year-ahead returns.

The bottom line: Implications for expected long-run returns

Given early 2009 stock valuation levels, our analysis, as shown in **Figure 9**, suggests that a reasonable central-tendency estimate for the U.S. stock market's expected return over the next 10 years should be near the long-term average of 8%–10%. However, our modeling also underscores that a wide range of outcomes is possible, given the inherent difficulty of predicting future stock returns.

Figure 8. Valuations and future long-term stock returns: 1881–2008



Notes: Trailing P/E ratio reflects the so-called Graham P/E ratio as used by Shiller, calculated as the "End of previous year price" divided by 10-year average earnings. Slopes of both fitting lines are statistically different from zero. See Figure 7 for more details. The 10-year annualized returns were computed from annual returns. Based on this methodology, the stock market return from 1999 through 2008 is slightly positive. However, if one calculated the 10-year annualized return using a *monthly* return index from December 1999 to December 2008, the average return would be slightly negative.

Sources: Shiller, S&P, and Vanguard.

How the stock market may perform in 2009 is obviously much less clear and depends on a number of factors, including the success of various monetary and fiscal policies aimed at stunting the severity of the U.S. recession, the degree of risk-aversion among various market participants, and the expected future earnings growth of companies around the world. The uncertainty with respect to the timing and magnitude of a future stock market rebound underscores the time-tested benefit of maintaining a strategic and well-diversified portfolio allocation.

Figure 9. Projected future distribution of average annualized stock returns for 2009–2018

	Percentiles from Vanguard Capital Markets Model™							
	5	10	25	50 (median)	75	90	95	Annual median time-series volatility
U.S. equities	0.7%	2.8%	6.2%	10.1%	14.4%	18.4%	20.9%	20.7%
International equities	–1.3	1.2	5.4	10.0	14.8	19.3	22.1	20.8

Note: The figure represents the returns for domestic equities (MSCI US Broad Market Index) and international equities (MSCI EAFE + EM Index Gross). The model uses expected asset class returns, volatility, correlations, and economic and financial market variables to simulate hypothetical investment results through time. At the core of the model are estimates of the dynamic statistical relationship between risk factors and asset returns, obtained from statistical analysis based on available monthly financial and economic data from as early as 1960. Using a system of estimated equations, the model then applies a Monte Carlo simulation method to project the estimated interrelationships among risk factors and asset classes as well as uncertainty and randomness over time. The model generates a large set of simulated outcomes for each asset class over several time horizons. Forecasts are obtained by computing measures of central tendency in these simulations. Results may vary with each use and over time.

IMPORTANT: The projections or other information generated by the VCMM regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results.

Sources: Vanguard, as of December 31, 2008.

Conclusions

In this paper we have analyzed more than a century's worth of market and economic data to gain perspective on what the financial crisis of 2008 may mean for the U.S. economy and the market itself in 2009 and beyond.

Three key implications of this analysis are as follows:

- The U.S. stock market—as a leading economic indicator—is already pricing in an extremely severe U.S. recession for 2009 that would be approximately twice as severe as the deep U.S. recessions of 1974 and 1982, although not nearly as devastating as the Great Depression of the 1930s.
- Based on nearly 140 years of U.S. data, neither the level of realized volatility, nor the return of the stock market in the previous year, has been a meaningful predictor of the market's return in the following year.
- Over longer investment horizons, we observe a more significant (albeit imperfect) inverse relationship between current stock valuation metrics (i.e., P/E ratios) and future stock returns. Based on early 2009 valuation levels, our analysis would suggest that a reasonable starting point for a central-tendency estimate for the expected return of the U.S. stock market over the next decade would be the market's long-term average return of 8%–10%.

References

Ambrosio, Frank J., and Francis M. Kinniry, 2008. *Stock Market Volatility in Perspective*. Valley Forge, Pa.: Investment Counseling & Research, The Vanguard Group.

Balke, Nathan, and Robert Gordon, 1989. The Estimation of Prewar Gross National Product: Methodology and New Evidence. *Journal of Political Economy* 97: 38–92.

Campbell, John Y., Martin Lettau, Burton G. Malkiel and Yexiao Xu, 2001. Have Individual Stocks Become More Volatile? An Empirical Exploration of Idiosyncratic Risk. *Journal of Finance* 56(1).

Campbell, John Y., Andrew W. Lo, and A. Craig MacKinlay, 1997. *The Econometrics of Financial Markets*. Princeton, N.J.: Princeton University Press.

Campbell, John Y., and Samuel Thompson, 2005. *Predicting the Equity Premium Out of Sample: Can Anything Beat the Historical Average?* NBER Working Paper No. 11468. Cambridge, Mass.: National Bureau of Economic Research.

Cochrane, John H., 2004. *Asset Pricing* (Revised Edition). Princeton, N.J.: Princeton University Press.

Davis, Joseph H., 2008. *Macroeconomic Expectations and the Stock Market: The Importance of a Longer-Term Perspective*. Valley Forge, Pa.: Investment Counseling & Research, The Vanguard Group.

Ferreira, Miguel A., and Pedro Santa-Clara, 2008. *Forecasting Stock Market Returns: The Sum of the Parts Is More Than the Whole*. NBER Working Paper No. 14571. Cambridge, Mass.: National Bureau of Economic Research.

Goyal, Amit, and Ivo Welch, 2008. A Comprehensive Look at the Empirical Performance of Equity Premium Prediction. *Review of Financial Studies* 21: 1455–1508.

Krainer, John, 2002. Stock Market Volatility. Federal Reserve Bank of San Francisco Economic Letter, 2002-32.

Schwert, G. William, 1990. Stock Returns and Real Activity: A Century of Evidence. *Journal of Finance* 45(4).

Shiller, Robert J., 2008. Home Page of Robert J. Shiller, www.econ.yale.edu/~shiller/.

Stambaugh, Robert F., 1999. Predictive Regressions. *Journal of Financial Economics* 54: 375–421.

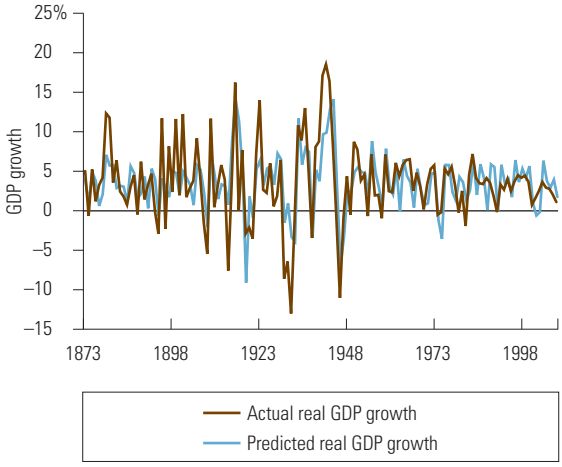
Wallick, Daniel W., Roger Aliaga-Díaz, and Joseph H. Davis, 2009. *Vanguard Capital Markets Model*. Valley Forge, Pa.: Investment Counseling & Research, The Vanguard Group.

Appendix

Forecasting real GDP growth with past stock market data

Figure 10 summarizes the statistics of a simple regression model that attempts to explain annual real GDP growth based on two lagged stock market variables: (1) the previous year's inflation-adjusted stock return and (2) the change in the previous year's realized stock market volatility. We also include two dummy variables in the regression to account for the massive increases in military spending during World War I and World War II (variable *"WW"*) and the subsequent near-term declines in real output once those wars ended (variable *"WW_over"*). The model is estimated using annual data for the years 1871 through 2008. The time series for annual real GDP growth comes from Balke and Gordon (1989) for the period 1871–1928 and from the U.S. Bureau of Economic Analysis thereafter.

Figure 11. Actual versus predicted real GDP growth: 1873–2008



Source: Vanguard.

Figure 10. Real GDP growth forecasting regression

Dependent variable: U.S. real GDP growth

Sample (adjusted): 1873–2008 (136 observations)
Newey-West HAC Standard Errors & Covariance (lag truncation=4)

Variable	Coefficient	t-statistic	p-value
Constant term	**0.02**	**3.79**	**0.00**
Lagged real GDP growth	0.08	0.98	0.33
Lagged real stock return	**0.11**	**5.21**	**0.00**
Lagged change in stock volatility	**(0.51)**	**(4.02)**	**0.00**
World War dummy variable (=1 if WW)	**0.08**	**3.80**	**0.00**
World War over dummy variable	**(0.13)**	**(3.21)**	**0.00**

R-squared	50.3%
Adjusted R^2	48.4%
S.E. of regression	0.04
F-statistic	26.31
Prob(F-statistic)	0.00

Sources: S&P, Shiller, Dow Jones, Datastream, U.S. Bureau of Economic Analysis, and Vanguard.

Figure 11 displays the model's fitted values versus actual historical real GDP growth. Overall, this simple model does a fairly good job of predicting annual real GDP growth, with an R^2 of approximately 50%. Both past stock returns and changes in volatility are statistically significant and have the appropriate signs. The regression results were similar when we included nonlinear and/or asymmetric terms for stock returns and/or changes in volatility (these additional variables were statistically insignificant).

The regression equation in Figure 10 was used to produce the real GDP forecast discussed in Figure 5.

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