



Bill Ziemba

Thoughts on the VIX Fear Index

High put prices have led to high levels of fear and plenty to play with for Vol. jockeys

The VIX is the standard deviation of the implied volatility of S&P 500 index options that are close to the money and not far into the future. Put options dominate in the various VIX calculations for the US equity and other markets. High put prices lead to high fear, reflected through high VIX values. The VIX is a weighted average of various implied volatilities of various options whose volatilities are backed out based on their prices by some option-pricing model. The VIX can vary from a low in the 10 percent range to the high 20s, into the low 30s for violent stressful markets, and as high as 70 percent to 100 percent plus in market crashes. In 1990, the VIX of the Nikkei Stock average of 225 stocks (price weighted like the Dow Jones) was in the 70 percent plus area for months and months.

As I write this on July 13, 2008, the S&P 500 is in a “so-called” bear market (down over 20 percent from its peak) at 1239.49 and the VIX at 27.49 is at the higher end of its five-year range. Figure 1 shows the 5-year VIX, with a 52-week range of 14.79–37.57 percent. Figure 2 shows the 5-year S&P 500, which shows peaks at 1527.46 on March 24, 2000 and 1520.00 on September 1, 2000, and in the past ten years a low close of 778.63 on October 10, 2002. Just like this 2007/08



The firm's Family Day would not be planned by the Vol. Desk in future

market, many stocks did not fall. This time it was financials leading the S&P 500 down, whereas in 2001/02 it was large-cap, momentum-driven stocks, technology and telecommunications; see Ziemba (2003).

Is the VIX a good predictor of future stock price movements? Figure 3 shows, as of January 10, 2007, the global 1200 index in US dollars versus the CBOE S&P 500 VIX index. Basically, as the VIX falls, stocks rally and as the VIX rises, stocks fall.

Young (2007) wrote:

“Currently, the VIX is trading at multi-year lows, suggesting that fear is in deep hibernation. But when combined with the strength in global markets over the past three years – the S&P Global 1200 is up roughly 100 percent since March 2003 – many market participants are concerned that the complacency implied by the VIX is spreading, leaving global stock markets vulnerable to attack by the dreaded bear.

Not likely, in the opinion of S&P Equity Strategy. We believe the reason for the complacency is less the sloth of bulls than the fact that equity fundamentals are, in a word, excellent. Liquidity is ample and inflation is low, both of which serve to depress interest rates and fuel unprecedented global M&A activity. At the same time, attractive 2007 growth prospects and low P/E-to-growth ratios are lending important valuation support to global stock markets.

In this climate, investors concerned about a spike in volatility should watch for any deterioration of these fundamentals. We do not believe, however, that such an erosion is nigh. Modest portfolio rebalancing is certainly appropriate in light of recent gains. But given the difficulty of

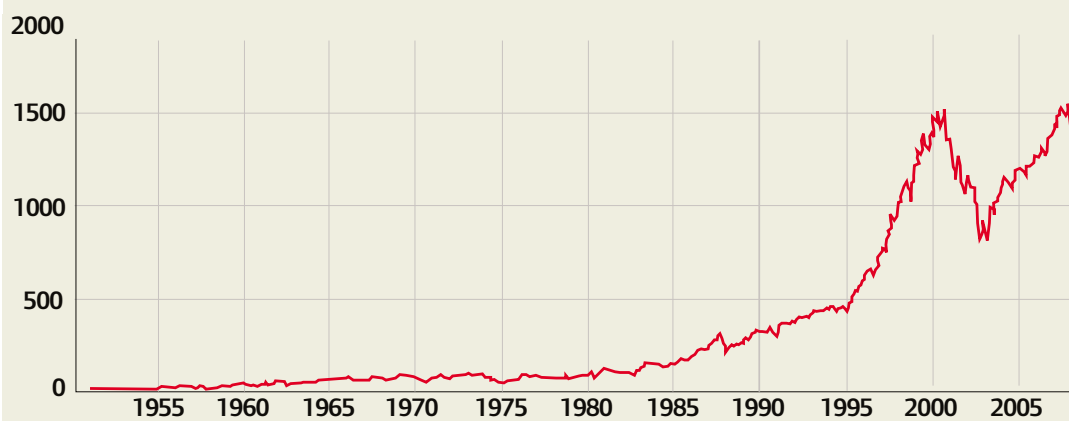
Figure 1: 5-year VIX. Source: Yahoo Finance



Figure 2: S&P 500. Source: Yahoo Finance



(a) Five-year S&P500



(b) Long term S&P500

successfully timing the market, requiring both a graceful exit at the top as well as a cool reentry at the bottom, S&P Equity Strategy does not currently advise significantly reducing equity exposure. Global equity valuations are historically low, especially given healthy 2007 earnings expectations. Despite a consensus 2007 earnings growth projection of 9 percent, above the historical average, the S&P Global 1200 index is currently trading at a P/E of only 14.6, a 12 percent discount to its long-term average of 16.5.”

Of course, this advice was not good for long-only investors (as are most individuals and institutions). During this time, the VIX reached low values of around 10 percent. However, short sellers and other option players did just fine. My own offshore hedge fund, which is currently only involved in the S&P 500 futures market, was up 49 percent after fees in the year from its June 1, 2007 start to May 31, 2008. My private accounts, which also trade currencies, gold, and anomalies, were higher because of these additional trading instruments. Of course, the future might be different for me and others.

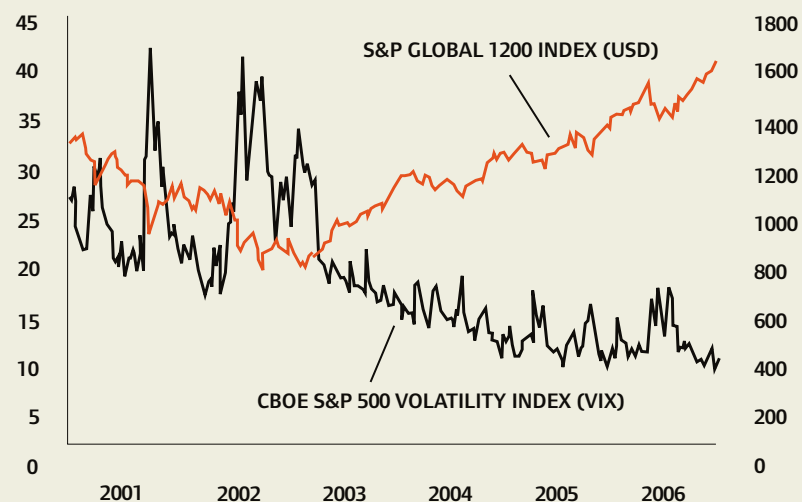
Rosen (2008) observes that although the current about 25 percent VIX may be rich by historical standards, it is low when compared to recent volatility. The S&P 500 has not been nearly as volatile this summer as it was during the first quarter of 2008, when the VIX traded at 35 percent. The 30-day current realized volatility is about 18 percent, which is slightly higher than the 15 percent long-term average, but still well below a 25 percent VIX. To justify a VIX at 35 percent, actual volatility would need to rise substantially.

Following the Bear Stearns collapse, 30-day realized volatility reached almost 30 percent. The stock market may have felt more volatile in June and July 2008, but this is not supported by the data.

The VIX only reached 26 percent (despite the S&P 500 at another 52-week low) because investors are not as exposed to equities as they were in January and March.

Those overleveraged or overexposed to stocks have long positions. This is confirmed by the latest readings from both Investors Intelligence and the ISI Hedge Fund survey, which show bear-

Figure 3: Strong fundamentals keep volatility at bay.
Source: Young, January 10, 2007



ishness, and hence defensiveness, approaching historical extremes.

Since investors are less invested than they were, they do not require as much insurance as they did during previous market declines, which partially explains why the VIX has not reached the higher levels of January and March. Another reason suggested by Fishback (2008a) is that the individual stock's correlations have dropped. While Lehman keeps dropping, Apple is rising. Both have high individual volatilities, but do not add much volatility to the index.

Will the VIX pull back from here, and will the stock market rally? Not necessarily, but the premise that stocks are headed lower on a short-term basis because implied volatility is only trading at a 67 percent premium to realized volatility also seems unlikely.

Rosen (2008) suggests that it is even more important to know what not to do in this business, so anyone who is planning to rush out and buy puts and calls, or sell equities because the VIX appears too low, should perhaps rethink the situation.

Rosen (2008) also notes the well-known phenomenon that the realized volatility of the S&P 500 was about 15 percent in the past 100 years, whereas implied volatility has averaged about 20

percent since index options started trading with some volume in 1985. S&P 500 futures started in 2002. Supply/demand imbalance plus fear leads to this overestimate of the future.

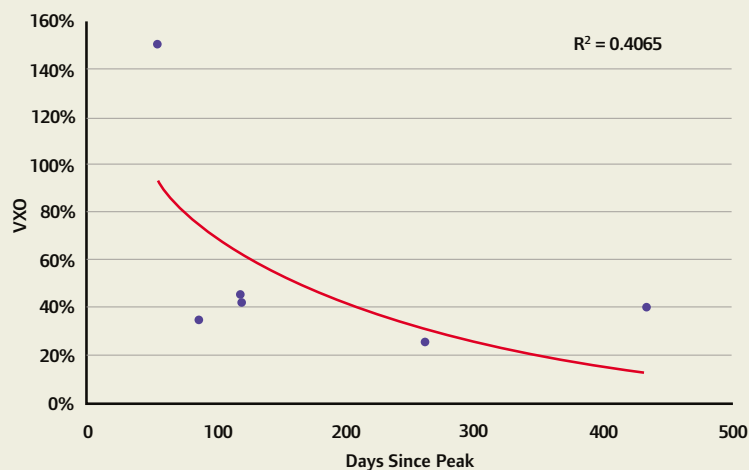
Pendergraft (2008) argues that the usual expectation, that when the S&P is down this implies a rise in the VIX and vice versa, is not working in 2008. Of course, with small changes, the usual behavior might not work but it will with large changes ($\pm 2\%$). He suggests that the future prices on the VIX affect the current VIX changes. This is a derivative on a derivative on a derivative, so the effect is complex and deserves a full study, which our team of researchers is working on.

Fishback (2008b) looks at the OEX (S&P 100) volatility index, called the VXO versus 19.9 percent and 10 percent declines. In all cases, before 2008, the VXO was 35 percent plus once the 19.9 percent decline was reached (see Table 1 and Figure 4). So why is the VXO lower now in 2008, at about 25.63 percent?

Table 1: Declines of 19.9 percent. Source: Fishback (2008b)

Date of 19.9% Decline	Dow Jones Industrials	Prior High	Date of Prior High	Number of days from peak to 19.9% decline	VXO when 19.9% decline is reached
10/19/1987	1738.74	2722.42	8/25/1987	55	150.19%
10/11/1990	2365.10	2999.75	7/16/1990	87	34.94%
3/22/2001	9389.48	11722.98	1/14/2000	433	39.70%
9/17/2001	8920.70	11337.90	5/21/2001	119	44.94%
7/16/2002	8473.11	10635.20	3/19/2002	119	42.05%
6/27/2008	11346.51	14164.50	10/9/2007	262	25.63%

Figure 4: VXO when 19.9 percent decline in DJIA is reached compared to days since DJIA peaked. Source: Fishback (2008b)



What Fishback learned is the rather obvious fact that it has been the time that it took to reach -20 percent that is crucial. When the decline was fast - that is, less than one month - the VXO always rose above 30 percent. But when the decline took longer, the VXO was under 30 percent (see Table 2 and Figure 5 for the 10 percent declines).

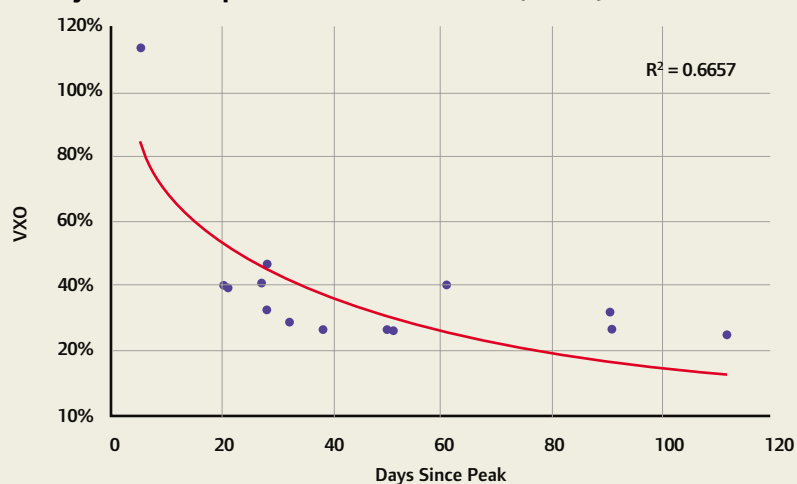
So the rather orderly decline from 1420 to the current 1228 has not led to a very high VXO and the VIX.

Still others point to lower stock prices, with some predicting that the S&P 500 will eventually fall below 1000. There are plenty of bearish writers. Prominent among them are Nouriel

Table 2: 10 percent OEX declines and the VXO when the declines are reached. Source: Fishback (2008b)

Date of 19.9% Decline	Dow Jones Industrials	Prior High	Date of 19.9% Decline	Number of days from peak to 19.9% decline	VXO when 19.9% decline is reached
10/26/1987	111.82	126.82	10/21/1987	5	113.33%
10/27/1997	417.6	473.185	10/7/1997	20	39.96%
4/14/2000	731.968	832.65	3/24/2000	21	39.33%
9/10/2002	435.99	465.55	8/22/2002	27	46.33%
11/30/1987	111.94	126.025	11/2/1987	28	46.13%
8/14/1998	522.77	581.34	7/17/1990	28	32.60%
8/17/1990	155.19	175.405	7/16/1990	32	28.60%
10/9/2000	744.23	829.83	9/1/2000	38	26.33%
10/14/1987	148.53	166.135	8/25/1987	50	26.36%
7/10/2001	608.79	678.6	5/21/2001	50	26.53%
6/26/2008	583.38	653.49	5/6/2008	51	25.91%
1/27/2003	429.47	480.36	11/27/2002	61	39.77%
10/15/1999	651.75	733.79	7/16/1999	91	31.48%
1/8/2008	651.02	729.79	10/9/2007	91	26.69%
4/26/2002	532.37	598.61	1/4/2002	112	24.64%

Figure 5: VXO when 10 percent decline in OEX is reached compared to days since OEX peaked. Source: Fishback (2008b)

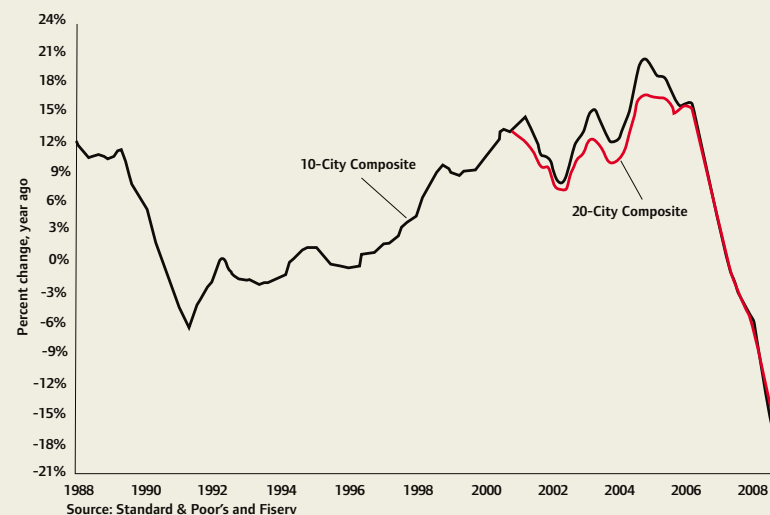


Roubini, the head of RGEMonitor.com and John Maudlin of Millennium Wave Advisors, LLC.

Roubini, an NYU professor (and, for full disclosure, my daughter's boss), has been consistently right in his forecasts and analysis, since he was the first loud voice (in 2006) arguing that the subprime housing crisis was imminent and would be

from banks and other financial assets. The banks and investment companies may need another \$400 billion. Where will they get it? Some possibly could come from the sovereign wealth funds, but their investments so far have led to large losses, so they may be very cautious. Maudlin calculates the PE ratio of the S&P 500 at 23 times for-

Figure 6: S&P /Case-Shiller Home Prices Indices, April 2008. Source: CSHomePrice-Release (2008)



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very widespread with large losses.

Maudlin tends to present the views of others but with a bearish focus. He believes that the subprime situation is 90 percent contained, but that there is much trouble to come

ward earnings, which is a lot above *Barron's* current PE of 20.52 based on trailing earnings versus 18.67 a year ago with a higher S&P 500 and higher trailing earnings. Also, there is the question of when the real estate market may stabilize, as prices may fall well into 2009 or 2010. See Figure 6 for the most recent S&P/Case-Shiller indices, which indicate the extent of the decline.

Bridgewater's estimate is that the net worth of US assets is down 13 percent, or \$8 trillion, since January 2007.

Over the years since 1989 (see Ziemba and Schwartz, 1991; Ziemba, 2003; Koivu et al, 2005; Ziemba and Ziemba, 2007), I have made good use of the bond-stock measure as a useful predictor of dangerous markets. In Berge et al (2008), we show that the simple rule: go into cash if the measure is in the danger zone, otherwise stay in

Figure 7: BSYD: 1990–2007

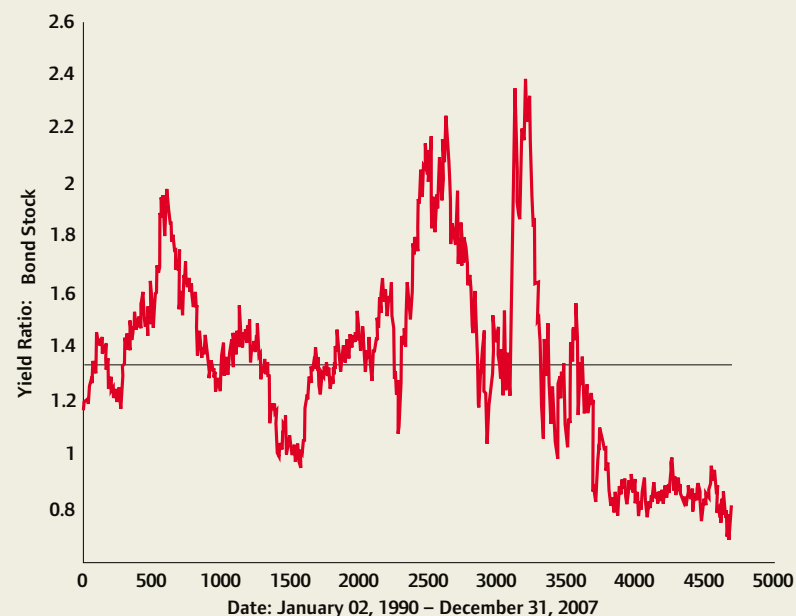
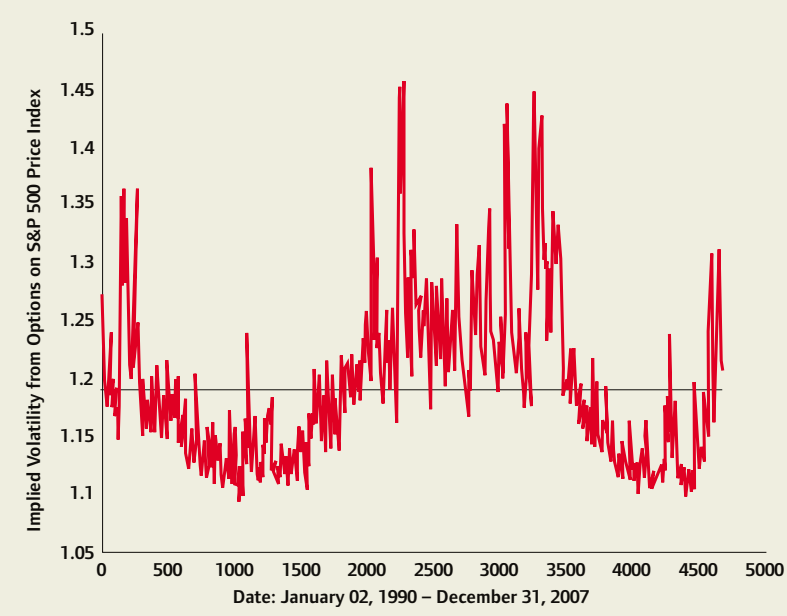


Figure 8: VIX: 1990–2007



the S&P 500, doubles in all five country studies the final wealth from 1980–2005 versus the S&P 500. Also, by being in cash, the standard deviation risk is lower, so the Sharpe ratios are even higher. Durre and Giot (2005) investigated more countries than the five (USA, UK, Canada, Germany, and Japan) that we studied.

The measure kept me out of the 2001 crash and also predicted numerous other crashes. In 2008, it has predicted the crashes in Iceland and China. See Ziemba and Ziemba (2007) for earlier analyses of these two countries. Before, it was the Japan 12 out of 12 correct predictions during 1948–1988 and the big one in January 1989 plus the USA in 1987 and 2002. The measure also predicted the 2003+ rally from the 778.63 S&P 500 low to over 1500.

But in the past few years, the model has not been in the danger zone. The market has fallen for other reasons – namely, the subprime and

Figure 9: Predicted prices



credit crises we are now in. Maudlin (2008) thinks the subprime crisis is 90 percent over. But there are some \$1.6 trillion in losses coming from write-downs, according to Bridgewater Associates. Roubini (2008) suggests it will be more, especially if \$5 trillion is needed for Freddie Mac and Fanny Mae. Last night (July 13, 2008) the S&P 500 futures were up to a high of

+15 as a deal between these agencies and the Treasury and Fed has been announced by Treasury Secretary Henry Paulson. The deal involves asking Congress to approve unlimited loans, buying of preferred stock, and use of their collateral. The market was not that impressed, and +15 ended up -11 on the S&P 500 during the day on July 14, 2008.

Indeed, in Japan in 1990+ the stock and land price falls led to even more losses and a 15-year dark period. Japan, of course, was way way overpriced in land and the PEs of 60 were completely crashed when interest rates were raised in mid-1988 to August 1990. A major error was increasing interest rates for a full eight months in 1990, once the stock market began to fall in January 1990. When the bond-stock measure goes into the danger zone, there usually is a 10 percent+ crash from the current level but with a lag. In April 1987, the signal said sell but the crash was in October. In April 1999, there was a similar signal but the stock

market only fell a year later. See Ziemba (2003) and Ziemba and Ziemba (2007) for more on these episodes.

Even if we use Maudlin's 23 PE ratio, the bond stock measure now is

$$\Delta = 10 \text{ year bond interest rate} - 1/PE = 3.96 - (100/23)$$

which is less than zero.

So, even with this high PE ratio, the model is not in the danger zone.

Despite rumblings of US and worldwide inflation, the financial situation is so dire that higher US interest rates by the Fed's action seem unlikely, at least for the next while. So how would the Δ get high enough to be in the danger zone (about 3)? It has to be lower and lower earnings, similar to late 2001; see Koivu et al (2005) for that correct

As a predictive model, adding the VIX as a second predictor adds value and predicts better than the bond-stock market alone during the 2000–2007 sample period

forecast of 2002's –22 percent on the S&P 500.

My colleagues, Giorgio Consigli, Leonard MacLean, and Yonggan Zhao, and I have been working on a series of papers looking at determining the fair value of the S&P 500 (Consigli, 2002; Consigli et al, 2008; MacLean et al, 2008). The models involve jumps.

As a predictive model, adding the VIX as a second predictor adds value and predicts better than the bond-stock market alone during the 2000–2007 sample period. The heavy tails are modeled with the addition of a homogeneous point process. The timing of the jumps in the point process attempts to predict the price reversals. In Consigli et al (2008), a non-homogeneous point process is introduced, so the intensity and size of the jumps are state dependent. The state is the stress measure, being a combination of the bond-stock and VIX measures. The direction of the shock from the VIX is revealed by the bond-

stock yield ratio. The model computes the stress thresholds and the weights of the risk factors.

Figures 7 and 8 show the bond-stock model in its ratio form (mathematically equivalent to the difference model) from 1990–2007. The predicted prices are in Figure 9.

The conclusions are:

- 1) The addition of non-homogeneous point processes to a diffusion greatly improves the fitting to actual equity returns.
- 2) Both the intensity of jumps and the size of jumps depend on the risk factors – the bond-stock measure and VIX.
- 3) The VIX and bond-stock are complementary, since during some periods the dependence on VIX is more pronounced, while in other periods the dependence on the bond-stock is stronger.
- 4) Because of the complementarity, a convex

combination of the factors averages out or smoothes the extremes and results in a low frequency of shocks and a poorer fit.

When the current crisis will end and how low the S&P 500 will go is difficult to determine. The debts, good and bad, and net positions of so many financial institutions are uncertain. We have not had the so-called bottom “capitulation” event. So far, the fall has been tense but orderly, with declines in the 1, 2, and 3 percent range. When you read this in the September issue, more will be revealed, but most likely the crisis will not be over.

By then, more will be known about Fannie Mae and Freddie Mac, whose situation, if Roubini is right (as he has been so far), will be worse than now. They have \$5 trillion in loans that they guarantee – an enormous amount. That's about 45 percent of the total mortgage market of \$12 trillion. Others, such as former Fed Governor

REFERENCES

- Berge, K., Consigli, G., and Ziemba, W.T. (2008). The predictive ability of the bond-stock earnings yield differential models. *Journal of Portfolio Management* 34:3, Spring 2008, 1–18.
- Consigli, G., MacLean, L., Zhao, Y., and Ziemba, W.T. (2008). The bond-stock yield differential as a risk indicator in the financial markets. Working paper, Dalhousie University. Dalhousie University, June.
- Durre, A. and Giot, P. (2005). An international analysis of earnings, stock prices and bond yields. Working paper, European Central Bank, Frankfurt.
- Fishback, D. (2008a). VXO and the 20% decline in the Dow Industrials. Don Fishback's Market Update, July 1.
- Fishback, D. (2008b). Index implied volatility is based on correlation and time – it's just not magnitude! Don Fishback's Market Update, July 9.
- Koivu, M., Pennanen, T., and Ziemba, W.T. (2005). Cointegration analysis of the Fed model. *Finance Research Letters* 2: 248–259.
- MacLean, L., Consigli, G., Zhao, Y., and Ziemba, W.T. (2008). Risk indicators in equity markets. Working paper, Dalhousie University, July 3.
- MacLean, L., Zhao, Y., Consigli, G., and Ziemba, W.T. (2008). Estimating parameters in a pricing model with state dependent shocks. In Pardalos, P., Doumpos, M., and Zopounidis, C., Editors. *The Handbook of Financial Engineering*. Springer-Verlag, Berlin: Springer-Verlag.
- Mauldin, J. (2008). \$1.6 trillion and counting. E-letter, *Frontline Weekly Newsletter*, July 11.
- Pendergraft, P. (2008). What's wrong with the VIX? Volatility index behaving oddly. *Investors' Daily Edge, HoweStreet.com*, July 11.
- Rosen, K. (2008). Misreading the VIX. *Barrons.com*.
- Roubini, N. (2008). Insolvency of the Fanny and Freddie predicted here two years ago. What happens next? Or how to avoid the Mother of all bailouts. *RCEMonitor.com*, July 11.
- Shiller, R. (2005). *Irrational Exuberance*. Princeton, NJ: Princeton University Press.
- Young, A. (2007). Volatility: Too low for too long? *TD Ameritrade*, January 10.
- Ziemba, W.T. (2003). *The Stochastic Programming Approach to Asset Liability and Wealth Management*. AIMR, Charlottesville, VA.
- Ziemba, W.T. and Schwartz, S.L. (1991). *Invest Japan*. Probus, Chicago, IL.
- Ziemba, R.E.S. and Ziemba, W.T. (2008). *Scenarios for Risk Management and Global Investment Strategies*. Chichester, UK: Wiley.

William Poole, think they are in bankruptcy already. They may get out of trouble and survive, but only time will tell here.