

The Sustainability of the U.S. Stock Market Bubble from the Perspective of Volatility

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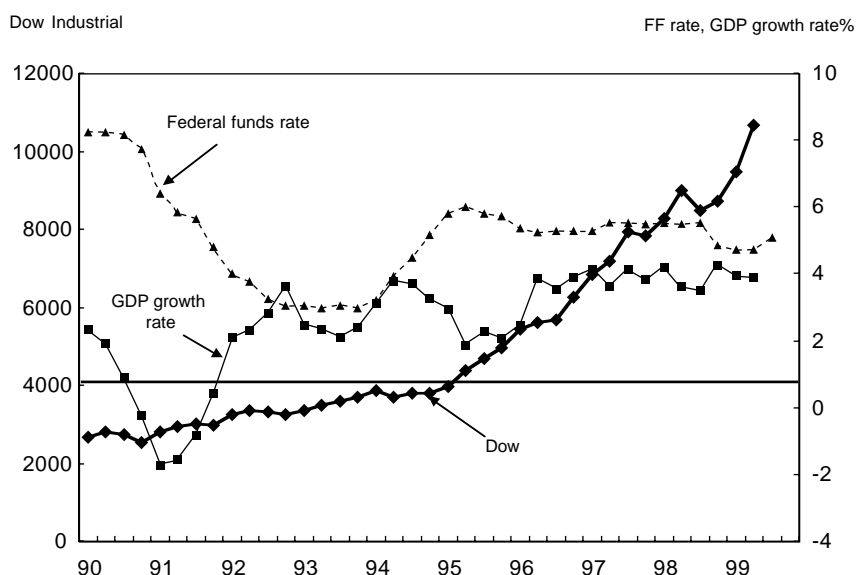
1. Rising U.S. Stock Market Causes Concern

(1) U.S. Stock Market Trend in the 1990s

Since bottoming out in October 1990, the U.S. stock market has been rising for the past decade. The bull market has been particularly strong since the Federal Reserve Board (FRB) shifted from a tight stance to a neutral one in 1995. In the first half of the decade before the shift, the Dow Industrial Average rose 140%; after the shift, it rose 285%. Despite a 10% decline in reaction to the Russian financial crisis of August 1998, the market broke through the 10,000-point barrier in March 1999, peaking at 11,326 in August. However, in October it retrenched below 10,000.

The decline can be attributed to expectations of interest rate hikes following comments by FRB Chairman Alan Greenspan about market risk and uncertainty, along with September wholesale price data showing the strongest surge in nine years. Other factors included concerns about the economy, inflation, and the market's high levels.

Figure 1 The U.S. Economy and Stock Market



(2) Causes of the Market's Strength

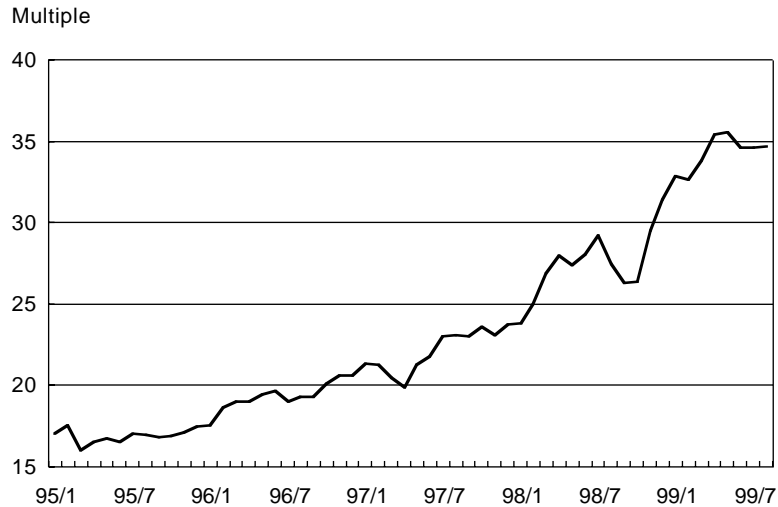
The U.S. stock market's sustained strength can be attributed to the following factors.

1. *Strong economy and corporate earnings* — The present expansion, which began in March 1991, was 104 months long as of October, and is likely to exceed the record expansion in the 1960s of 107 months. Moreover, corporate earnings have been strong primarily led by information technology (IT) related industries, creating the phenomenon known as the "New Economy." According to the New Economy argument, advances in IT and growth of the service economy will lead to improved inventory management technology and productivity gains, causing traditional business cycles to disappear and enabling the economy to achieve growth without inflation. In fact, companies in the S&P 500 index continued to post strong earnings growth of 16% year on year in the second quarter.
2. *Wealth effect of rising stock prices* — In 1998, stock holdings exceeded 20% of household assets. As the value of these assets increases, households spend more and borrow more, causing consumption to increase. This stimulates the economy and corporate earnings, leading to further stock price increases.
3. *Inflow of pension funds* — Long-term investment funds such as pension funds are flowing into the stock market through mutual funds and other channels. In 1996, pension funds accounted for 25% of all stock holdings, and their influence on the market is growing. In 1998, the number of participants in 401(k) defined contribution plans reached 25 million persons, and assets under management amounted to \$1 trillion.
4. *Stock repurchases* — To maintain an ROE (return on equity) that satisfies stockholders, companies are limiting the number of outstanding stock by repurchasing stock and conducting mergers with the exchange of stock. This improves the market balance.

2. Stock Market Bubble Exceeds 30%

Present stock market valuations defy explanations based on earnings and supply and demand factors. The S&P 500's PE ratio of 35 is well above the postwar average of 17 (Figure 2). This suggests that the extended bull market itself is perpetuating a bubble by creating expectations of further gains.

Figure 2 Price to Earnings Ratio for the S&P 500



This can be tested by performing a factor analysis of stock prices that distinguishes between fundamental and bubble factors. Fundamentals can be obtained from the discounted present value of present and future earnings. The difference between the actual value and value derived from fundamentals can be attributed to strong convictions that prices will continue to rise. The ratio of this difference to actual prices is the bubble ratio, which is not necessarily always positive; expectations of a bear market can create a negative bubble and cause the market to plunge. Figures 3 and 4 show the bubble ratio, actual price, and the fundamentals-derived price, which estimated from corporate earnings and 30-year bond yield. The graphs raise the following points.

- The bubble ratio moves in a cyclical manner. It reached 32% in August 1999, near the all-time high.
- The bubble ratio has exceeded 30% twice amid declining fundamentals: during the period before Black Monday (December 1986 to September 1987), and the present (since February 1998).

Figure 3 Ratio of the Bubble Component to Stock Price Level

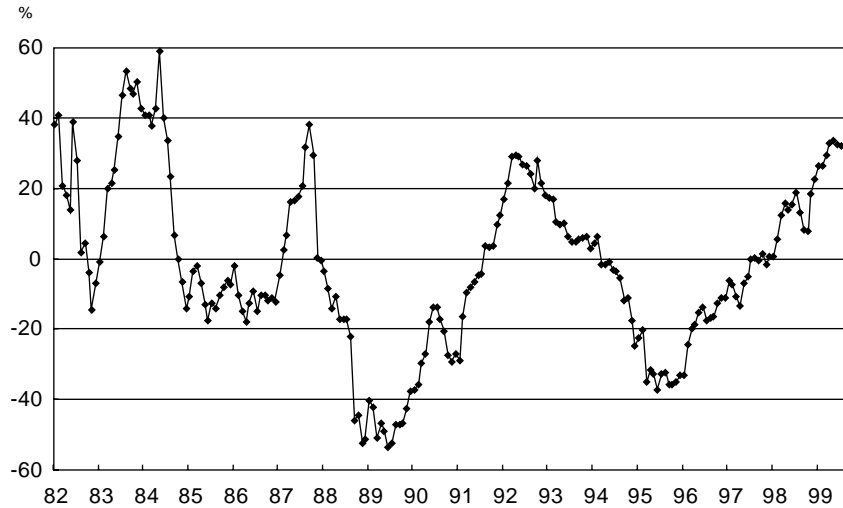
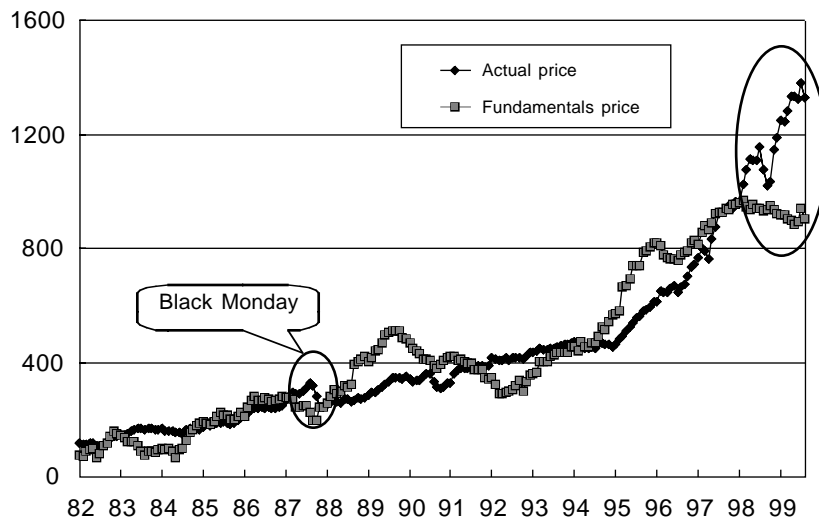


Figure 4 The S&P 500 Index and Fundamentals-Derived Stock Price Level



Another factor contributing to the stock market's rise has been the growth of online trading. In 1999, over 30% of stock transactions by individuals in the U.S. were done over the Internet. Of these, day traders with little investment knowledge conduct enough trades to cause price distortions. The high trading volume they generate increases the stock market's volatility, producing the same effect as the bubble. Under these circumstances, a deterioration in fundamentals or other factor can quickly turn expectations around, causing the market to correct more severely than normal, and perhaps even triggering a crash.

3. Measuring the Bubble's Sustainability

(1) Sustainability and Risk Aversion

Is it possible to predict the collapse of the bubble? Mr. Greenspan has commented that economists are unable to. Theoretically, it is impossible to predict the bubble's collapse, because otherwise the arbitrage process would discount the bubble out of stock prices.

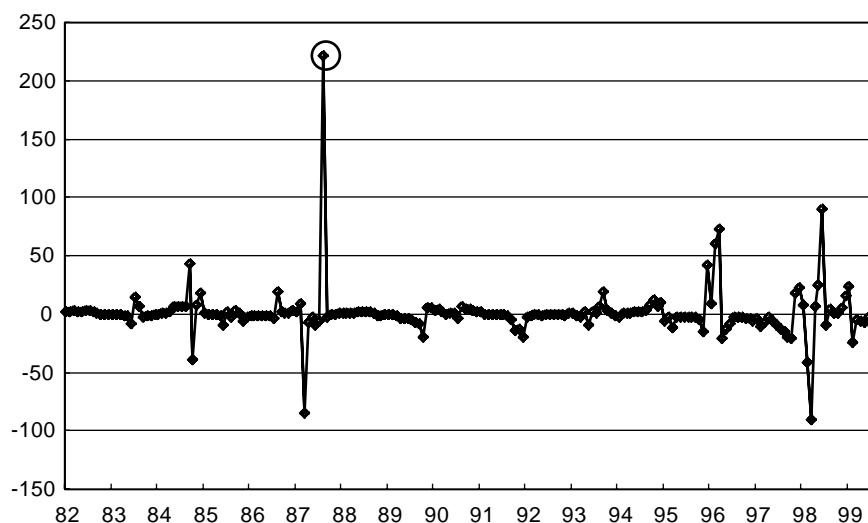
Returning to Figure 3, we can see that the divergence (bubble) of stock prices from fundamentals expands and contracts at regular intervals. This suggests that the bubble expands based on past trends, but does not expand indefinitely, and instead bursts at a particular probability as prices adjust by converging with fundamentals. Let us then try to measure the probability that the bubble will persist.

The bubble's sustainability is closely related to the degree of relative risk aversion in the investment behavior of individuals (portfolio allocation between safe bonds and risky stocks). If investors become more risk averse, the investors who most strongly prefer safety will lead a withdrawal from the stock market. As more investors pull out, the probability of the bubble's persistence decreases, and eventually drops to zero as the bubble becomes unsustainable and pops.

Relative risk aversion, assuming that investor behavior maximizes utility, can be expressed in terms of the return spread (risk premium) and covariance of stock and bond returns. Since actual returns are observable, it is possible to measure the degree of risk aversion (Figure 5).

By indexing the relationship between the bubble's sustainability and risk aversion, and setting the level of risk aversion immediately prior to Black Monday as trigger level for the bubble's collapse, we estimate the probability of persistence.

Figure 5 Degree of Relative Risk Aversion

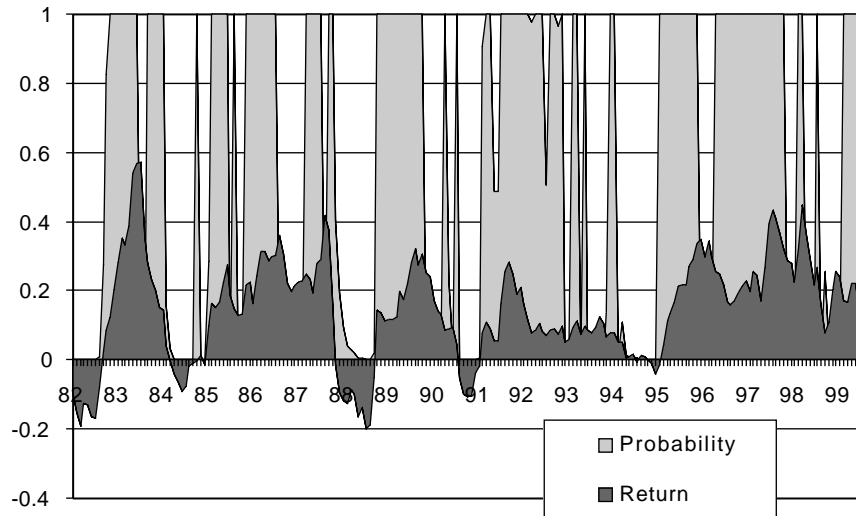


(2) Difficulty of Predictions Based on Sustainability

Figure 6 shows the bubble's sustainability expressed as a probability, and stock returns. While we assume a smooth probability distribution from zero to one, the actual probabilities obtained in the empirical analysis are dispersed and approach either zero or one.

The pattern that emerges is that in phases when the probability is near one, returns are either positive or increasing; conversely, when the probability is near zero, returns are either negative or declining. However, a prolonged high-probability phase and large bubble ratio may help confirm the existence of a bubble, but provide no clues for predicting when the bubble will burst. This is because when the probability declines it drops to zero almost immediately. Thus in making predictions, we must focus not on the bubble itself but on other indicators that are correlated with bubble conditions.

Figure 6 The Bubble's Sustainability and Stock Returns



4. Stock Price Volatility and the Bubble

(1) Volatility as a Leading Bubble Indicator

A carefully watched indicator that moves closely with the stock market bubble is the volatility of stock price returns (standard error ratio).

When plotted against the bubble ratio, the peaks and bottoms of stock return volatility appear to lead stock price bubble ratio peaks and bottoms by six months to one year (Figure 7). Particularly since 1995, when stock prices began rising faster, the bubble ratio declined less with respect to volatility fluctuations, indicating that the bubble ratio has risen. The FRB has responded with frequent rate hikes and warnings on asset prices (such as Mr. Greenspan's "irrational exuberance" comment in December 1996), attempting to suppress the mushrooming expectations of investors. As a result, volatility fluctuation cycles have recently been moving in a smaller range and shorter periods.

In addition, if time lag coefficients are used in the relationship between volatility and the bubble, the highest correlation is observed when the volatility peak leads the bubble ratio peak by nine months. Volatility is also statistically observed to have a leading correlation with bubble movements.

Figure 7 Stock Price Volatility and the Bubble

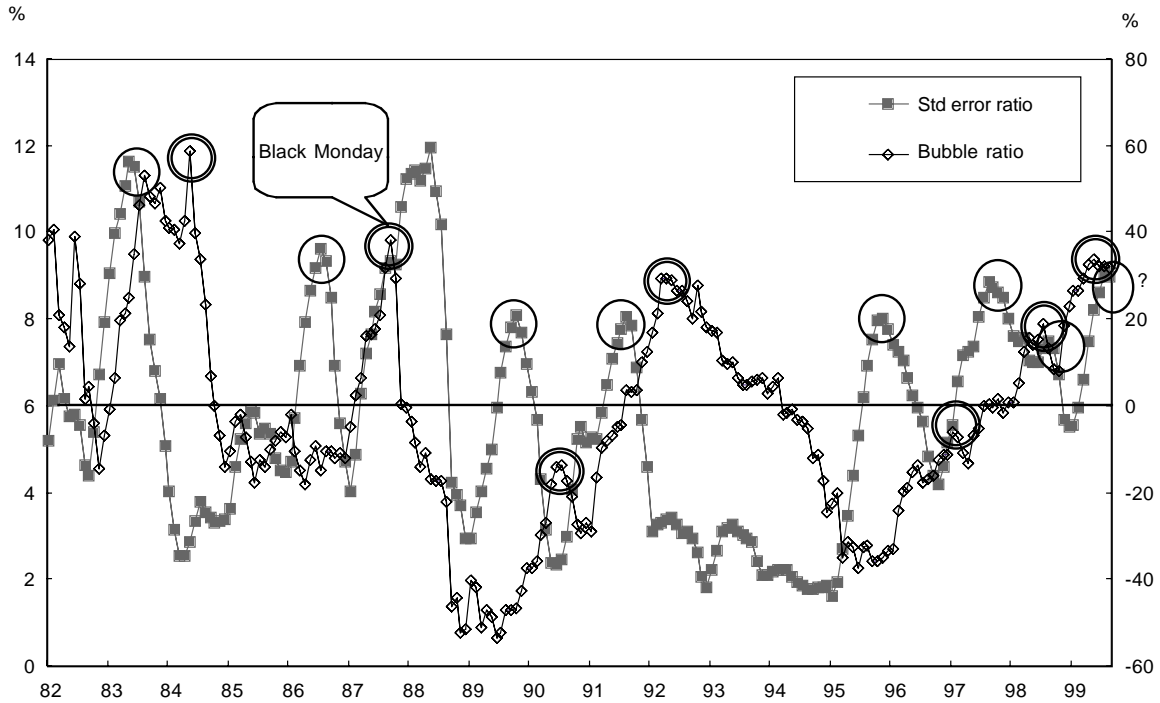
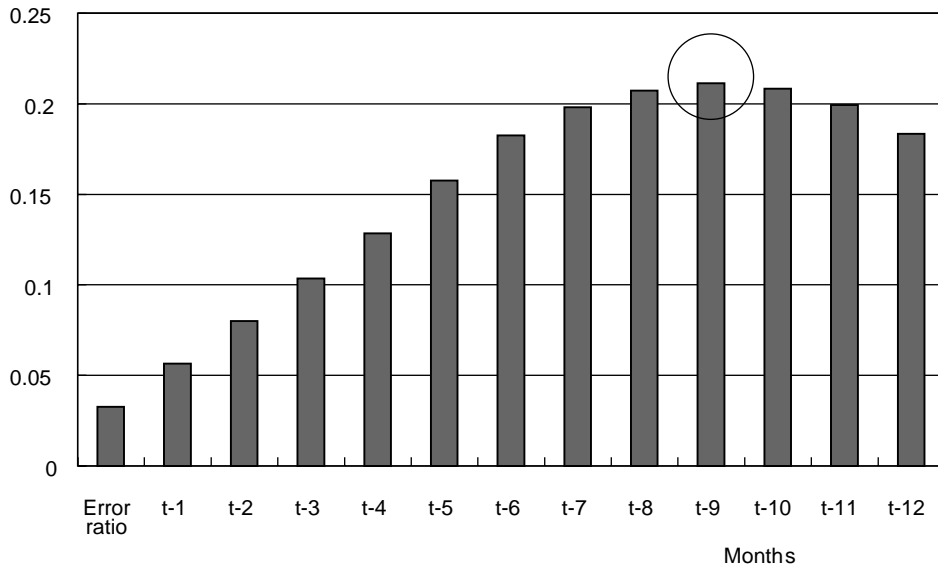


Figure 8 Correlation Coefficient Between the Error Ratio and Bubble Ratio

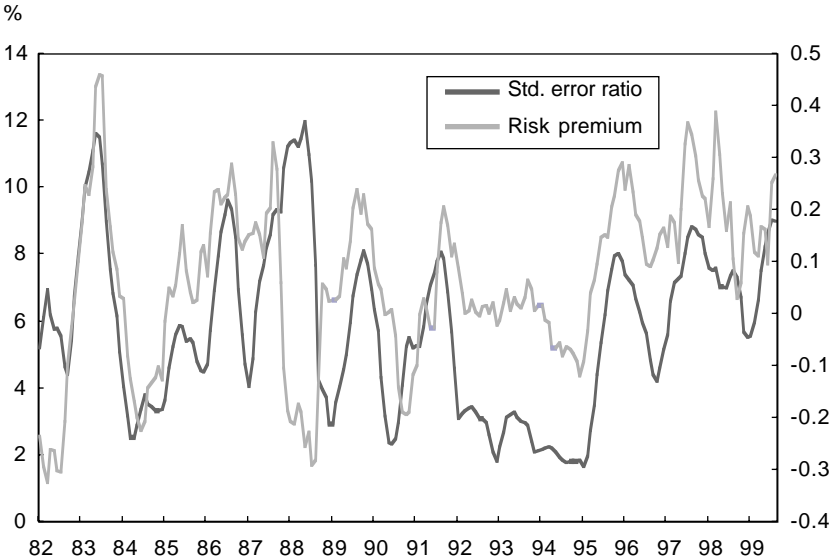


(2) Prediction of Volatility

The correlation between volatility and bubble phenomena occurs due to the existence of risk premiums. Since investors are generally risk averse, if given different assets with identical expected returns, they will prefer assets with more reliable returns. If stock prices surge and future returns become more uncertain, the expected returns become more dispersed (volatile),

causing investors to seek higher returns (risk premiums) to compensate for the higher risk. Because the risk premium is a variable in relative risk aversion, its increase causes risk aversion to increase. As a result, the bubble loses its sustainability and ultimately collapses (Figure 9).

Figure 9 Volatility and the Risk Premium

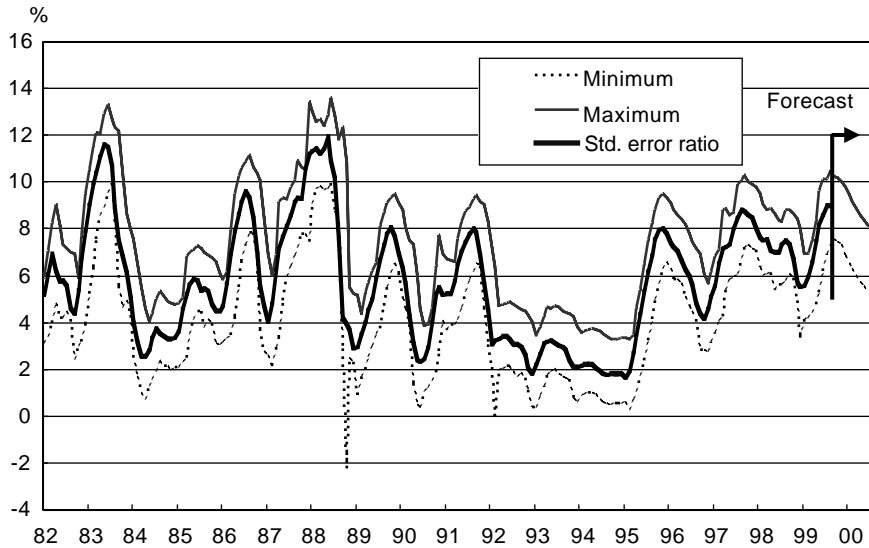


The lead time between volatility and bubble phenomena can be attributed to two things: (1) expectations are formed based on volatility information accumulated over a period of time, thereby affecting the bubble’s fluctuations, and (2) there is a lag before volatility is recognized and acted on.

Although we are unable to predict the bubble’s future, by using the observed correlation between volatility and bubble phenomena, we can estimate the bubble’s course by grasping volatility trends. This brings us to the prediction of volatility.

The prediction results are shown in Figure 10. According to the ARCH model, volatility peaked last July, and is predicted to trend downward.

Figure 10 ARCH (1) Process of Volatility



5. Will the Market Crash?

(1) Differences from Black Monday

With regard to volatility and bubble phenomena for Black Monday, since volatility continued to rise after the bubble collapsed, a negative bubble occurred in the down phase — the opposite of normal — causing the bubble ratio to plunge (from +40% to -50%) and stock prices to plummet (Figure 7). One factor behind the crash was that much time was needed for volatility to converge, because investors' expectations were destabilized by daily price declines of as much as 22% during October.

Present signs indicate that the bubble ratio peaked out in May 1999, and that volatility also peaked in July 1999 and is trending downward. The process that would cause a crash has not been observed, uncertainty amplifying with respect to bubble adjustment causing a negative bubble and leading to a crash. This can be attributed to a monetary policy that has sought to preemptively restrain investors' expectations.

(2) Stock Market Prediction

More recently, volatility has registered peaks in August 1998 and July 1999, and valleys in January 1998 and January 1999. Considering the nine-month lead time between volatility and bubble phenomena, the bubble ratio peak in May 1999 can be associated with the August 1998 volatility peak. Judging from the subsequent volatility trend, we predict the bubble ratio

will bottom out in the second half of 1999 and start trending downward in the first half of 2000.

We can observe an upward trend from 1995, corresponding to phases of neutral to easy monetary policy. Should inflationary concerns emerge, monetary policy could tighten as a preventive measure. This means that interest rate hikes will reduce fundamentals-based stock prices, and at the same time correct the upward trend.

If trend factors decline, cyclical factors play a large role in the bubble ratio's fluctuation, and possibly trigger a 30% market correction over the next year.

With respect to fundamentals, corporate earnings growth remains strong, and third quarter 1999 earnings are expected to grow 20% on year. On the other hand, monetary policy is expected to one or two interest rate hikes in response to inflationary concerns, causing fundamentals-based stock prices to remain in a neutral to moderate decline phase.

Combining both factors, we predict that while the volatility growth does not signal a market crash, it implies large market swings in fiscal 1999, followed by a correction in fiscal 2000. Going ahead, volatility will need to be closely followed to determine the extent of the bubble's correction and the possibility of a negative bubble that would lead to a crash.