Alan Greenspan

Chairman, Board of Governors of the Federal Reserve System

Over the past two decades we have witnessed a remarkable turn-around in the U.S. economy. The aftermath of the Vietnam War and a series of oil shocks had left the United States with high inflation, lackluster productivity growth, and a declining competitive position in international markets.

But rather than accept the role of a once-great, but diminishing economic force, for reasons that will doubtless be debated for years to come, we resurrected the dynamism of previous generations of Americans. A wave of innovation across a broad range of technologies, combined with considerable deregulation and a further lowering of barriers to trade, fostered a pronounced expansion of competition and creative destruction.

The result through the 1990s of all this seeming-heightened instability for individual businesses, somewhat surprisingly, was an apparent *reduction* in the volatility of output and in the frequency and amplitude of business cycles for the macroeconomy. While the empirical evidence on the importance of changes in the magnitude of the shocks impacting on our economy remains ambiguous, it does appear that shocks are more readily absorbed than in decades past. The massive drop in equity wealth over the past two years, the sharp decline in capital investment, and the tragic events of September 11 might reasonably have been expected to

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produce an immediate severe contraction in the U.S. economy. But this did not occur. Economic imbalances in recent years apparently have been addressed more expeditiously and effectively than in the past, aided importantly by the more widespread availability and more intensive use of real-time information.

But faster adjustments imply a greater volatility in expected corporate earnings. Although direct estimates of investors' expectations for earnings are not readily available, indirect evidence does seem to support an increased volatility in those expectations. Securities analysts' expectations for long-term earnings growth, an assumed proxy for investors' expectations, were revised up significantly over the second half of the 1990s and into 2000.[1] Over that same period, risk spreads on corporate bonds rose markedly on net, implying a rising probability of default. Default, of course, is generally associated with negative earnings. Hence, higher average expected earnings growth coupled with a rising probability of default implies a greater variance of earnings expectations, a consequence of a lengthened negative tail. Consistent with a greater variability of earnings expectations, volatility of stock prices has been elevated in recent years.

The increased volatility of stock prices and the associated quickening of the adjustment process would also have been expected to be accompanied by *less* volatility in real economic variables. And that does appear to have been the case. That is, after all, the purpose of a prompter response by businesses: to prevent severe imbalances from developing at their firms, which in the aggregate can turn into deep contractions if unchecked.

As might be expected, accumulating signs of greater economic stability over the decade of the 1990s fostered an increased willingness on the part of business managers and investors to take risks with both positive and negative consequences. Stock prices rose in response to the greater propensity for risk-taking and to improved prospects for earnings growth that reflected emerging evidence of an increased pace of innovation. The associated decline in the cost of equity capital spurred a pronounced rise in capital investment and productivity growth that broadened impressively in the latter years of the 1990s. Stock prices rose further, responding to the growing optimism about greater stability, strengthening investment, and faster productivity growth.

But, as we indicated in congressional testimony in July 1999,[2] "…productivity acceleration does not ensure that equity prices are not overextended. There can be little doubt that if the nation's productivity growth has stepped up, the level of profits and their future potential would be elevated. That prospect has supported higher stock prices. The danger is that in these circumstances, an unwarranted, perhaps euphoric, extension of recent developments can drive equity prices to levels that are unsupportable even if risks in the future become relatively small. Such straying above fundamentals could create problems for our economy when the inevitable adjustment occurs."

Looking back on those years, it is evident that increased productivity growth imparted significant upward momentum to expectations of earnings growth and, accordingly, to price-earnings ratios. Between 1995 and 2000, the price-earnings ratio of the S&P 500 rose from 15 to nearly 30. However, to attribute that increase entirely to revised earnings expectations would require an upward revision to the growth of real earnings of 2 full percentage points in perpetuity.[3]

Because the real riskless rate of return apparently did not change much during that five-year period, anything short of such an extraordinary permanent increase in the growth of structural productivity, and thus earnings,[4] implies a significant fall in real equity premiums in those years.

If all of the drop in equity premiums had resulted from a permanent reduction in cyclical volatility, stock prices arguably could have stabilized at their levels in the summer of 2000. That clearly did not happen, indicating that stock prices, in fact, had risen to levels in excess of any economically supportable base. Toward the end of that year, expectations for long-term earnings growth began to turn down. At about the same time, equity premiums apparently began to rise.

The consequent reversal in stock prices that has occurred over the past couple of years has been particularly pronounced in the high-tech sectors of the economy.

The investment boom in the late 1990s, initially spurred by significant advances in information technology, ultimately produced an overhang of installed capacity. Even though demand for a number of high-tech products was doubling or tripling annually, in many cases new supply was coming on even faster. Overall, capacity in high-tech

manufacturing industries rose more than 40 percent in 2000, well in excess of its rapid rate of increase over the previous two years. In light of the burgeoning supply, the pace of increased demand for the newer technologies, though rapid, fell short of that needed to sustain the elevated real rate of return for the whole of the high-tech capital stock. Returns on the securities of high-tech firms ultimately collapsed, as did capital investment. Similar, though less severe, adjustments were occurring in many industries across our economy.

Some decline in equity premiums in the latter part of the 1990s almost surely would have been anticipated as the continuing absence of any business correction reinforced notions of increased secular stability. In such an environment, the relatively mild recession that we experienced in 2001 might still have been expected to leave equity premiums below their long-term averages. That apparently has not been the case, as the tendency toward lower equity premiums created by a more stable economy may have been offset to some extent recently by concerns about the quality of corporate governance.

The struggle to understand developments in the economy and financial markets since the mid-1990s has been particularly challenging for monetary policymakers. We were confronted with forces that none of us had personally experienced. Aside from the then recent experience of Japan, only history books and musty archives gave us clues to the appropriate stance for policy. We at the Federal Reserve considered a number of issues related to asset bubbles—that is, surges in prices of assets to unsustainable levels. As events evolved, we recognized that, despite our suspicions, it was very difficult to definitively identify a bubble until after the fact—that is, when its bursting confirmed its existence.

Moreover, it was far from obvious that bubbles, even if identified early, could be pre-empted short of the central bank inducing a substantial contraction in economic activity—the very outcome we would be seeking to avoid.

Prolonged periods of expansion promote a greater rational willingness to take risks, a pattern very difficult to avert by a modest tightening of monetary policy. In fact, our experience over the past fifteen years suggests that monetary tightening that deflates stock prices without depressing economic activity has often been associated with subsequent increases in the level of stock prices.

For example, stock prices rose following the completion of the more than 300-basis-point rise in the federal funds rate in the twelve months ending in February 1989. And during the year beginning in February 1994, the Federal Reserve raised the federal funds target 300 basis points. Stock prices initially flattened, but as soon as that round of tightening was completed, they resumed their marked upward advance. From mid-1999 through May 2000, the federal funds rate was raised 150 basis points. However, equity price increases were largely undeterred during that period despite what now, in retrospect, was the exhausted tail of a bull market.[5]

Such data suggest that nothing short of a sharp increase in short-term rates that engenders a significant economic retrenchment is sufficient to check a nascent bubble. The notion that a well-timed incremental tightening could have been calibrated to prevent the late 1990s bubble is almost surely an illusion.

Instead, we noted in the previously cited mid-1999 congressional testimony the need to focus on policies "to mitigate the fallout when it occurs and, hopefully, ease the transition to the next expansion."

It seems reasonable to generalize from our recent experience that no low-risk, low-cost, incremental monetary tightening exists that can reliably deflate a bubble. But is there some policy that can at least limit the size of a bubble and, hence, its destructive fallout? From the evidence to date, the answer appears to be no.[6] But we do need to know more about the behavior of equity premiums and bubbles and their impact on economic activity.[7]

The equity premium, computed as the total expected return on common stocks less that on riskless debt, prices the risk taken by investors in purchasing equities rather than risk-free debt. It is a measure largely of the risk aversion of investors, not that of corporate managers. An increased appetite for risk by investors, for example, is manifested by a shift in their willingness to hold equity in place of psychologically less-stressful, but lower-yielding, debt.

In this case, the cost of equity confronting corporate managers falls relative to the cost of debt. With greater access to lower-cost equity, managers are able to finance a higher proportion of riskier real assets with a lessened call on cash flow and fear of default.

Thus, it is generally the changing risk preferences of investors, not of corporate managers, that govern the mix of risk investment in an economy. Managers presumably employ market prices of debt and equity coupled with the calculated rate of return on particular real investment projects to determine the level of corporate investment. To be sure, managers' personal sense of risk aversion can sometimes influence the capital investment process, but it is probably a secondary effect relative to the vagaries of investor psychology.

Bubbles thus appear to primarily reflect exuberance on the part of investors in pricing financial assets. If managers and investors perceived the same degree of risk, and both correctly judged a *sustainable* rise in profits stemming from new technology, for example, none of a rise in stock prices would reflect a bubble. Bubbles appear to emerge when investors either overestimate the sustainable rise in profits or unrealistically lower the rate of discount they apply to expected profits and dividends. The distinction cannot readily be ascertained from market prices. But the equity premium less the expected growth of dividends, and presumed earnings, can be estimated as the dividend yield less the real long-term interest rate on U.S. Treasuries.[8]

If equity premiums were redefined to include both the unrealistic part of profit projections and the unsustainably low segment of discount factors, and if we had associated measures of these concepts, we could employ this measure to infer emerging bubbles. That is, if we could substitute realistic projections of earnings and dividend growth, perhaps based on structural productivity growth and the behavior of the payout ratio, the residual equity premium might afford some evidence of a developing bubble. Of course, if the central bank had access to this information, so would private agents, rendering the development of bubbles highly unlikely.

Bubbles are often precipitated by perceptions of real improvements in the productivity and underlying profitability of the corporate economy. But as history attests, investors then too often exaggerate the extent of the improvement in economic fundamentals. Human psychology being what it is, bubbles tend to feed on themselves, and booms in their later stages are often supported by implausible projections of potential demand. Stock prices and equity premiums are then driven to unsustainable levels.

Certainly, a bubble cannot persist indefinitely. Eventually, unrealistic expectations of future earnings will be proven wrong. As this happens, asset prices will gravitate back to levels that are in line with a sustainable path for earnings. The continual pressing of reality on perception inevitably disciplines the views of both investors and managers.

As I noted earlier, the key policy question is: If low-cost, incremental policy tightening appears incapable of deflating bubbles, do other options exist that can at least effectively limit the size of bubbles without doing substantial damage in the process? To date, we have not been able to identify such policies, though perhaps we or others may do so in the future.

It is by no means evident to us that we currently have—or will be able to find—a measure of equity premiums or related indicators that convincingly presage an emerging bubble. Short of such a measure, I find it difficult to conceive of an adequate degree of central bank certainty to justify the scale of pre-emptive tightening that would likely be necessary to neutralize a bubble.

As we delve deeper into the questions raised by the developments of recent years, the interplay between structural productivity growth and equity premiums, so evident during the past business cycle, is bound to play a prominent role. We need particularly to determine whether the periodic emergence of market bubbles, which have occurred so often in the past, is inevitable going forward. As financial wealth becomes an ever-more-important determinant of activity, we need also to understand far better how changing equity premiums affect and reflect real and financial investment decisions. If the equity premium has so demonstrable an influence on our economies as it appears to have, the value of further investigation of this topic is evident.

In conclusion, the endeavors of policymakers to stabilize our economies require a functioning model of the way our economies work. Increasingly, it appears that this model needs to embody movements in equity premiums and the development of bubbles if it is to explain history.

Any useful model needs to credibly simulate counterfactual alternatives. We must remember that structural models that do a poor job of explaining history presumably also will provide an incomplete basis for policymaking. Often the internal structure of such models has been

employed to evaluate the effect of various stabilization policies. But the results from models whose internal structure cannot successfully replicate key features of cyclical behavior must be interpreted carefully. The recent importance of movements in equity premiums and asset bubbles suggests the need to better understand and integrate these concepts into the models used for policy analysis.

I anticipate productive discussion of these and other issues related to stabilization policy over the next couple of days.

ENDNOTES

[1] These are earnings-weighted projections for S&P 500 corporations as reported by securities analysts to I/B/E/S, a financial research firm. The roughly twenty-year history of this series confirms a pronounced upward bias in these long-term projections of analysts of approximately 4 to 5 percentage points in annual expected growth. There is little evidence, however, one way or the other, of bias to *changes* in the rate of growth.

[2] Committee on Banking and Financial Services, U.S. House of Representatives, July 22, 1999.

[3] For continuous discounting over an infinite horizon, $k(E/P) = r + b - g$, where k equals the current, and assumed future, dividend payout ratio, E current earnings, P the current stock price, r the riskless interest rate, b the equity premium, and g the growth rate of earnings. The relationship holds for both real and nominal variables. If k is assumed to be 0.6, the average over the second half of the 1990s (taking account of payouts made through share repurchases), a rise in the P/E of the S&P 500 from 15 to 30, with r and b unchanged in real terms, implies an increase in g of 0.02 in real terms.

[4] If earnings are a constant share of output in the long run, then real long-term earnings growth is the product of productivity growth and growth in labor force hours. In this exercise, the growth rate of hours, driven by demographics, is assumed not to change; hence, the growth rates of earnings and productivity are the same.

5 Stock prices peaked in March 2000, but the market basically moved sideways until September of that year.

6 Some have asserted that the Federal Reserve can deflate a stock-price bubble—rather painlessly—by boosting margin requirements. The evidence suggests otherwise. First, the amount of margin debt is small, having never amounted to more than about 13/4 percent of the market value of equity; moreover, even this figure overstates the amount of margin debt used to purchase stock, as such debt also finances short-sales of equity and transactions in non-equity securities. Second, investors need not rely on margin debt to take a leveraged position in equities. They can borrow from other sources to buy stock. Or, they can purchase options, which will affect stock prices given the linkages across markets.

Thus, not surprisingly, the preponderance of research suggests that changes in margins are not an effective tool for reducing stock market volatility. It is possible that margin requirements inhibit very small investors whose access to other forms of credit is limited. If so, the only effect of raised margin requirements is to price out the very small investor without addressing the broader issue of stock price bubbles.

If a change in margin requirements were taken by investors as a signal that the central bank would soon tighten monetary policy enough to burst a bubble, then there might be the appearance of a causal effect. But it is the prospect of monetary policy action, not the margin increase, that should be viewed as the trigger. In a similar manner, history tells us that "jawboning" asset markets will be ineffective unless backed by action.

[7] The sharp stock market contraction on October 19, 1987, of more than one-fifth requires especial further study. Equity prices rose sharply during the spring and summer, again despite the rise in short-term rates through late summer of that year. The price collapse clearly had some of the characteristics of prolonged and far larger bubbles, but stock prices quickly stabilized without significant effect on economic activity. And, in line with later episodes, the failure of the collapse to have an economic impact seems to have contributed to subsequent higher stock prices.

[8] From footnote 3, $k(E/P) = D/P = r + b—g$, where D is current dividends. Hence, $D/P—r = b—g$.