Bubbles and Busts:
The 1990s in the Mirror of the 1920s

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"History is continually repudiated."

-Glassman and Hassett (1999) The Dow 36,000 (p. 11).

Stock market bubbles and busts are frightening and baffling. Although they command enormous attention, there is little consensus about their causes and effects. As the American economy is still recovering from the lingering effects of the fin-de-siecle stock market collapse, this paper attempts to provide an historical perspective to improve our understanding of its origins and consequences.

The stock market is often viewed as a barometer of current or future economic welfare. The soaring market of the 1990s was seen by many, but certainly not all, as the harbinger of a new age of sustained and more rapid economic growth. The optimists saw the bull market as driven by fundamentals, although they differed over what these were. Skeptics warned that rising stock prices were just the latest and biggest bubble, distorting consumption and investment decisions. Given the enormous climb upwards, policy makers feared that a collapse could have real economic consequences regardless of the bull market's origin and a lively debate has ensued over how to cope with the consequences of the market's retreat.

Although the sheer size of the run up in stock prices in the 1990s has obscured other bull markets in the popular eye, the boom shares many characteristics with previous episodes, notably the 1920s; and the explanations behind their rise and the policy concerns are similar. As in the 1990s, it was widely claimed that a "new economy" had taken root in the U.S. Technological and organizational innovations were viewed as raising productivity, increasing firms' earnings and justifying the wave of new issues and rapid advance of stock prices. Furthermore, the economy appeared to have reached a new level of prosperity. In both periods, unemployment was much lower than at any time in contemporaries' experience, with stable prices in the twenties and very low inflation in the nineties. Investing in the market seemed safer with reduced macroeconomic risk, and the seeming abundance of high return opportunities brought an increased participation in the market. The heralded apparent evaporation of the equity premium was not discussed in the same terms in the 1920s as it was in the 1990s, but the same potential shrinking factors were present.

Just as the new heights of the 1990s market were often challenged as the product of "irrational exuberance," so too there were critics of the fast surge in stock prices in 1928-1929. Policy makers were concerned about the distortions that the quick, in all probability, temporary, run up in stock prices would have for investment and consumption decisions. The potential presence of an asset bubble raised the question of appropriate policy responses---and in the 1920s the bull market helped to produce a grievously mistaken monetary policy.

As bull markets are relatively rare events, this paper offers a comparison of the 1920s and the 1990s to provide perspective on the question of whether the Federal Reserve should respond to booms and crashes. The answer to this question depends critically on the ability of policy makers to identify fundamental components in the stock market. Although considerable energy has been expended to justify stock price movement in terms of fundamentals and measure bubbles, it has proved an elusive effort. While this pre-empts a policy response to a boom, the Fed still has a critical role to play in preventing crashes from subverting the payments system or a crisis in intermediation.

WHAT'S A STOCK MARKET BOOM?

Although the stock market booms and crashes of the 1920s and the 1990s are well remembered, these events are imperfectly defined. While we typically think of the stock market as following a random walk, a boom is viewed as an improbably long period of large positive returns that is often cast into sharp profile by a crash. Thus, the first question is whether the twenties and nineties shared similar characteristics?

To identify the comparability of these two periods, we need to look at the long periods of consecutive real stock returns and crashes. Figure 1 shows the annual real returns on the S&P 500 for 1871 to 2003.[1] The mean and standard deviation of the series are 6.5% and 16.9%. Annual data provide the appropriate window to look for bull markets, as they are seen as long upward swings that dominate any brief retreat that might be picked up in data of a higher frequency. The 1990s stand out with a long run of high returns. From 1995 to 1999, returns were 27, 21, 22, 25 and 12%. We think of such a long series of high returns as extraordinary, if only because the probability of observing four years above 20% is .4%. If three consecutive years of returns over 10 percent is used as an arbitrary criterion, booms are relatively rare. The first boom for this annual data is 1921-1928, which stands out for a long positive run of returns of 20, 26, 2, 23, 19, 13, 32, and 39%. Next is 1942-1945, where returns were 11, 18, 15 and 30 percent. The 1950s also had a long bull market where there was a streak of positive returns, 18, 22, 15, 13, 2, 39, 25% from 1949 to 1956. The years 1963-1965, which saw gains of 17, 13, and 9% are just on the borderline of this criterion. The run-up in the 1980s is also close. From 1982 to 1986, the returns were 22, 14, 4, 19 and 26%. Fewer contemporaries seemed concerned that the booms of the forties, fifties, or sixties left the market far out of alignment, and it is the anticipation of a crash that identifies a bull market that has crested "too high."

In an earlier paper (Mishkin and White, 2003), we developed a simple method for identifying crashes. The choice of indices, the size of the collapse and the time frame are key factors in this procedure. The three most well known stock indices: the Dow Jones Industrials, Standard and Poor's (S&P) 500 and its predecessor the Cowles Index, and the Nasdaq were employed as there may be considerable differences in the fortunes for different segments of the market. Since October 1929 and October 1927 were universally agreed to be stock market crashes, they were used as benchmarks. In both cases, the market fell over 20 percent in one and two days' time. The fall in the market, or the depth, is only one characteristic of a crash. There is no similar sudden decline for the most recent collapse, but no one would hesitate to identify 2000 as the beginning of a major collapse. Thus, speed is another feature. To identify crashes, we looked at windows of one day, one week, one month and one year to capture other declines.

This net picked out 15 major stock market crashes in the twentieth century. These were 1903, 1907, 1917, 1920, 1929, 1930-1933, 1937, 1940, 1946, 1962, 1969-1970, 1973-1974, 1987, 1990, and 2000. These crashes are identified in Figure 1. In Mishkin and White (2003) we surveyed the factors behind each of these declines. Some were clearly driven by political or policy events, but only a few crashes happened after a

[1] The most frequently used data for examining booms, crashes and bubbles are the series on Robert Shiller's webpage, http://www.econ.yale.edu/~shiller/data.htm, where the return is ln(1 + real return), where the return includes dividends and the capital gain.

prolonged boom as identified above: 1929, 1946, 1987, and 2000-2001. The crash of 1946 followed rather than anticipated the postwar recession, which hit bottom in October 1945. It generated relatively little concern among contemporaries, unlike the crashes of 1929, 1987, and 2000-2001, which came at the end of heady peacetime booms. The timing and magnitude of the crash 1987 closely matched 1929. But, the rapid recovery of the market, which disguises the crash in this annual data in Figure 1, caused policy concerns to abate. The most natural comparison thus appears to be the booms of the twenties and nineties.

Figures 2 and 3 offer a more detailed comparison of the salient dimensions of these two booms and busts. For the 1990s, the Dow Jones Industrials, the S&P 500 and the Nasdaq composite index show most of the characteristics of the defining market movements. For the events of 1920-1933, the Cowles Index, a value weighted index like the S&P 500, is used to pick up the broader market movement market not captured in the Dow Jones. Unfortunately, there is no equivalent for the Nasdaq in the 1920s. Instead, to capture some of the movement for smaller, newer firms, an equally weighted index for all common stocks listed on the New York Stock Exchange is included (Fisher, 1966). To make all series comparable, the indexes are set equal to 100 in their peak month.

Table 1
Characteristics of Booms and Busts
(End-of-month indices)

	Peak	Trough	Drop	Peak to Trough (months)	Recovery to Peak Date
1920s					
Dow Jones	Aug-29	Jun-32	-0.822	34	Nov-54
Cowles	Sep-29	Jun-32	-0.849	33	Nov-53
Equally-Weighted	Feb-29	May-32	-0.896	39	Sep-45
1980s					
Dow Jones	Aug-87	Nov-87	-0.302	3	Jul-89
S&P 500	Aug-87	Nov-87	-0.311	3	Jul-89
Nasdaq Composite	Aug-87	Dec-87	-0.299	4	Jun-89
1990s					
Dow Jones	Dec-99	Sep-02	-0.339	34	?
S&P 500	Aug-00	Sep-02	-0.463	26	?
Nasdaq Composite	Mar-00	Oct-02	-0.741	32	?

The figures highlight the similarities and differences of these two great bull markets. The boom market in 1929 was focused more on the larger companies. Both the Dow Jones and Cowles indices moved almost in lock step on the way up, although the boom is greater in the bigger Dow Jones companies. This feature is made clear by the inclusion of the equally weighted index, even if the earlier years are missing. The rise is nowhere near as steep and the peak of the market---emphasizing the fate of smaller company stocks---is in February 1929. The crash of October 1929 sends both the Dow Jones and Cowles indices downwards to join the third index in the bumpy ride to the

bottom. Table 1 shows the dimensions of the decline for the markets of the twenties, eighties and nineties. Although starting from different peaks, all indices for the 1920s lost over 80 percent by the time they hit bottom in three years later. The recovery to peak was over a decade away emphasizing the role of the Great Depression in humbling the market.

In contrast to the 1920s, the 1980s boom appears to have been spread across the whole market, even if the stocks in the Nasdaq were more volatile. All indices crash at the same time, and their recovery is very similar. The 1980s upward bound and initial crash map very closely into the 1920s, in fact, it is easy to superimpose any two series. Using the Dow Jones, the peaks are in August 1929 and August 1987; after which there is a softening in prices until the collapse of over 20% in two days and one day in October 1929 and October 1987. They continue their downward movement to November 1929 and November 1987, losing 37% and 30% respectively. Then, in mirror-like movement, the markets appear to recover from the shock, reducing the losses to 25 and 22 percent. Afterwards, they part company. By July 1989, nineteen months after the peak, the Dow has completely recovered, but at the same distance from the peak July 1931, it was now 64% below the peak. While the market of the 1930s, continued its decline, the eighties turned into the boom of the nineties.

The rising tide of the 1990s certainly lifted all boats, but the high tech, small company stocks of the Nasdaq rode the crest. In comparison to the 1920s when large companies dominated the rising market or the 1980s when all figured, the Nasdaq firms were the center of the boom, rising far higher and falling much further, as seen in Figure 3. The collapse of the "tech bubble" looks more like the busts of October 1929 and October 1987. From the peak in March 2000, the Nasdaq lost 20% within a month. The jagged slump from peak to trough produces a loss of 74%; the size and timing matching the collapse from 1929. In Table 1, the larger, more established companies represented by the Dow Jones and the S&P 500 are shown to experience the same magnitude of loss as all indices in 1987 and the initial decline from August to November 1929; but it is a slower, more gradual price deflation. By the end of 2003, all three indices have recovered partly but with markedly different success. However, this paper will focus on the twenties and nineties because unlike the eighties, they experience no quick recovery, leaving serious post-collapse problems.

BUBBLES OR FUNDAMENTALS?

Discussion of booms and busts sets observers along a great divide, as broad and deep as the Grand Canyon. There are those who believe that fundamentals are solely responsible for the movements in stock prices and those who believe that stock prices are largely detached from fundamentals, moved by the fluctuating optimism and pessimism of investors.

These positions have always been well represented. Looking back on the boom and bust of the 1920s, Professor John B. Williams of Harvard wrote:

> Like a ghost in a haunted house, the notion of a soul possessing the market and sending it up or down with a shrewdness uncanny and superhuman,

> keeps ever reappearing….Let us define the investment value of a stock as the present worth of all the dividends to be paid upon it (Williams, 1938).

Viewing the same period, John Maynard Keynes chose to differ:

> A conventional valuation which is established as the outcome of the mass psychology of a large number of ignorant individuals is liable to change violently as the result of a sudden fluctuation of opinion which do not really make much difference to the prospective yield…..the market will be subject to waves of optimistic and pessimistic sentiment, which are unreasoning (Keynes, 1936).

On the threshold of the great bull market, the divide remained. Robert Shiller observed:

> I present here evidence that while some of the implications of the efficient markets hypothesis are substantiated by data, investor attitudes are of great importance in determining the course of prices of speculative assets. Prices change in substantial measure because the investing public en masse capriciously changes its mind (Shiller, 1991).

In contrast, John Cochrane expounded:

> We can still argue over what name to attach to residual discount-rate movement. Is it variation in real investment opportunities not captured by current discount model? Or is it "fads?" I argue that residual discount-rate variation is small (in a precise sense), and tantalizingly suggestive of economic explanation. I argue that "fads are just a catchy name for the residual (Cochrane, 1991).

These extreme positions can be maintained because of the observational equivalence in any empirical test between a market driven by a bubble and one where it is driven by fundamentals but there are omitted factors (Flood and Hodrick, 1990). Skeptics of rational explanations point to the wide, seemingly inexplicable swings in the markets as evidence of swings in investor optimism and pessimism; while their opponents search for the elusive factors that explain precisely the fluctuations. In the academic world, the latter have the upper hand because they are able to generate research agendas that add to our understanding of the market's movement. Those favoring fundamentals base their explanations on the powerful paradigm of efficient markets.

Rational expectations is based on the twin assumptions that (1) individuals have rational information processing and (2) individuals have a correct model of the fundamental structure of the economy. Bubbles or manias may arise if either condition is violated. If the first is violated there will be an irrational bubble or mania and if the second is violated there will be a rational bubble. With either violation, asset prices will deviate from fundamentals (Blanchard and Watson, 1982). In rational bubbles, market participants may have rational expectations but prices may differ from fundamentals because the sequence of prices in rational expectations models may be indeterminate.

Bubbles will be rational as long as the bubble component in the stock price is the expected discounted value of the future bubble. In an irrational bubble, market participants may focus on "noise" instead of fundamentals. Some noise traders in a market may overwhelm rational investors if the time horizons for arbitrage are finite (De Long, Shleifer, Summers and Waldman, 1990).

The question of whether the market is driven by fundamentals or a rational or irrational bubble has more than academic interest because if share prices are moved by a bubble it will induce distortions into the market that may require policy intervention. At the same time, the observational equivalence of bubbles and omitted fundamentals is a warning against hasty intervention.

FUNDAMENTALS AND EMPIRICAL REGULARITIES

What are the driving fundamental factors behind the great bull markets of the 1920s and 1990s? Even if one believes that a bubble or investor euphoria was the pre-eminent factor that drove the markets, the natural starting point is how much fundamentals contributed to prices. Fundamentals require that stock prices equal the present discounted value of expected future dividends. The simplest approximation to this fundamentals based stock market valuation is the Gordon growth model---and it is this model that underlies almost all academic, financial analysts' studies, and even popular discussions of market movements. While expected future dividends and interest rates may variable considerably, the simple Gordon model assumes constant values for all parameters. Dividends are assumed to grow at a constant rate g and investors are assumed to command a return (employ a discount rate for dividends) of a constant r, composed of a risk free rate and an equity premium. Usually framed in terms of the aggregate price level of the stock market, P, the Gordon model is rationally:

(1) $P = (1+g)D/(r-g)$

If a constant fraction of earnings, E, are paid out as dividends, where b is the proportion of reinvested earnings, then $D = (1-b)E$. If the marginal physical product of capital MK is also constant, the growth rate $g = pMK$, the growth of dividends will constant. The Gordon growth model can then be written simply written as the price-dividend ratio or the dividend yield:

(2) $P/D = (1+g)/(r-g)$ or $(D/P)(1+g) = r-g$ often simplified to $D/P = r-g$

The model captures all explanations for asset price movements, including booms and busts: (a) Technological change increasing productivity and leading to higher dividend growth, (b) Changes in the payout rate, (c) Changes in the risk free rate, (d) Changes in the equity premium

While the Gordon model neatly outlines the simple fundamental relationship, explaining stock price movements has proved frustratingly difficult. The problem is that prices should be wholly forward looking, representing the expectations of the future course of dividends appropriately discounted. If expectations are rational, we would

think that stock prices should effectively embody the realized dividends in the future. In a classic article, Shiller (1981) found that stock prices moved far too much than was warranted by the movement in dividends, where the ex post rational price was equal to the discounted value of the future stream of realized dividends. Even if there were deviations in was expected from what was realized, the fit should have been good over his long period of observation, 1871-1979, yet the variation of prices exceeded the variation in fundamental prices violating any reasonable test. Critics attacked the small sample properties of Shiller's tests and his methods of detrending (Flavin, 1983; Kleidon, 1986) but in a survey West (1988) concluded that Shiller's results were reasonably robust against these and other criticisms.

While it has proved difficult to explain the behavior of prices in terms of the movements of future dividends and discount rates, a very different literature has found empirical regularities, explaining the behavior of current prices in terms of past fundamentals. This predictability is surprising, given that prices should be forward looking, and it provides a further instrument for analyzing the unusual behavior of prices during stock market booms.

A standard starting point for empirical analysis is the dynamic dividend growth model of Campbell and Shiller (1988, also see Lamont, 1998). A log linear approximation to the accounting identity where current stock price is equal to discounted future dividends and the capital gains can be rewritten so that the expected return on stocks is equal to the current price, the discounted sum of future dividends and expected future returns. In this identity, returns and expected future returns are stationary and mean reverting. If one assumes that dividend growth and price are nonstationary and have a common trend, a generally observed feature, future dividends then represent the permanent component of stock prices. This relationship can be used to forecast actual returns on lagged prices and proxies for lagged dividends and returns. If dividends follow a random walk, the dividend yield (dividend-price ratio) is a stationary variable. Using the dividend yield imposes the assumption that current dividends are a good measure of the discounted sum of future dividends. This may be an appropriate assumption, if as it is believed generally, managers target a level of dividends equal to a fraction permanent level of earnings, with slow adjustments to new target levels when changes occur in earnings.

Fama and French (1988) found that both the lagged dividend yield and the lagged earnings yield had explanatory power for stock returns. Lamont (1998) has argued that high dividends predict high future returns because dividends measure the permanent component of stock prices, reflecting the dividend policy of managers. But in addition, the payout ratio (dividend-earnings ratio) forecasts returns because the level of earnings is a measure of current business conditions and forecasts returns.[2] It is generally observed that investors required high stock returns in recessions and low returns in booms, and risk premia on stocks covary with the business cycle. As earnings vary with the business cycle, current earnings forecasts future returns, thus both dividends and earnings have information for stock returns. Cointegration evidence emphasizes that dividends contain long-term information on the pattern of payments, as dividends and prices, and dividends and earnings are cointegrated but there is only weak evidence that

[2] One concern about using dividends to forecast returns is if stock repurchase replace dividends then past history of dividend yields and payout ratios will not be a good guide to stock returns.

prices and earnings are cointegrated.[3] Prices adjust to dividends but dividends do not adjust to prices, reflecting their permanent component of value. A higher dividend yield implies higher prices, and conditional on the dividend yield, a higher earnings yield reduces future returns reflecting the transitory component of earnings. This can also be stated that conditional on the dividend yield, the higher dividend payout ratio forecasts higher returns.[4]

While these results are typical of most empirical studies, it should be noted that the variation explained is very modest, not surprisingly as rational pricing should be forward looking. Dividends and earnings contribute most of their power at the quarterly and annual frequencies. In forecasting over a longer horizon, the dividend yield and payout ratio are still significant but most of the explanatory power is found in the level of stock prices.

The key variables in these studies—the dividend yield, the earnings price ratio and the payout ratio---are presented in Figures 4 and 5. Some observers have pointed out that there has been a secular shift in these ratios, with the post-World War II values well below their pre-1945 rates. For example, the dividend yield averaged 5.3% percent from 1871 to 1945 but was 3.7% from 1945 to 2003---although the earnings-price ratio is little different between these two periods: 7.8 and 7.4%. The payout ratio, however, has declined from 71 to 51%. Apart from these trends, what do these empirical regularities have to say about the booms of the 1920s and 1990s?

Table 2 gives a closer look at these key ratios for each of the boom periods. For the quarter century before the late twenties bull market, there was considerable movement. The events of 1928 and 1929 must have been an eye opener for contemporaries. Real dividends and earnings rose to historic highs in those two years, but the market rose so much that the dividend yield and earnings to price ratio fell below traditional levels, and the payout ratio moved back to its earlier level. If these two years did indeed represent a new era, with significantly higher earnings paying out higher dividends but with a greater share being reinvested, then optimists seem to have had good cause for paying higher stock prices. Yet, from the empirical regularities, we would anticipate that the long and substantial fall in the dividend yield would reduce future returns, with the falling earnings price ratio mitigating it to some degree. The steady rise in yearly returns is not easily explained by these regularities. For the 1990s, the picture is a little different. Real earnings per share do jump, suggesting a change; but little is paid out in dividends, most earnings were retained. Again, the market's surge caused both measures of return to collapse to unprecedented lows; and the abrupt rise in the market was not anticipated empirically by the changes in the key ratios.

[3] Lamont (1998) finds an error correction mechanism where, when payout ratio is high, dividends fall and earnings rise in the future.

[4] These results hold even when a stochastically detrended short interest rate and a lagged dependent variable are added.

Table 2
The Dividend Yield, Earnings to Price Ratio and Payout Ratio in Two Booms

	Real Dividends	Dividend Yield	Real Earnings	Earnings To Price	Payout Ratio	Real Price
1900-1909	**7.6**	**4.6**	**12.7**	**7.6**	**60.4**	**173.1**
1910-1919	**8.0**	**5.9**	**13.5**	**10.1**	**62.4**	**149.6**
1920-1924	**5.3**	**6.3**	**7.6**	**8.8**	**81.9**	**83.5**
1925	**6.1**	**5.7**	**12.7**	**11.8**	**48.0**	**110.9**
1926	**7.1**	**5.5**	**12.8**	**9.8**	**55.6**	**128.1**
1927	**8.1**	**5.7**	**11.6**	**8.3**	**69.4**	**138.8**
1928	**9.0**	**4.8**	**14.6**	**7.9**	**61.6**	**183.7**
1929	**10.3**	**3.9**	**17.1**	**6.5**	**60.2**	**263.6**
1930	**11.2**	**4.5**	**11.1**	**4.5**	**101.0**	**230.2**
1931	**10.4**	**5.1**	**7.7**	**3.8**	**134.4**	**182.2**
1932	**7.0**	**6.0**	**5.8**	**4.9**	**122.0**	**105.2**
1933	**6.0**	**6.2**	**6.0**	**6.2**	**100.0**	**99.6**
1970-1979	**13.2**	**4.1**	**29.4**	**9.4**	**45.5**	**360.9**
1980-1989	**13.5**	**4.6**	**28.1**	**9.5**	**48.6**	**321.5**
1990-1994	**15.9**	**3.2**	**27.6**	**5.4**	**59.8**	**521.7**
1995	**16.2**	**3.0**	**39.9**	**7.3**	**40.6**	**561.2**
1996	**17.0**	**2.4**	**44.1**	**6.3**	**38.5**	**721.5**
1997	**17.4**	**2.0**	**44.6**	**5.2**	**39.0**	**873.1**
1998	**17.9**	**1.7**	**41.6**	**3.9**	**43.0**	**1080.8**
1999	**17.9**	**1.3**	**51.7**	**3.9**	**34.6**	**1378.0**
2000	**16.8**	**1.1**	**51.8**	**3.5**	**32.5**	**1531.2**
2001	**16.1**	**1.2**	**25.3**	**1.9**	**63.8**	**1378.1**
2002	**15.8**	**1.4**	**30.3**	**2.7**	**52.1**	**1167.3**

Source: Robert Shiller's webpage, http://www.econ.yale.edu/~shiller/data.htm

In a telling out-of-sample exercise at the outset of the nineties bull market, Lamont (1998) forecasted the cumulative return of buying stocks on December 31, 1994. For his sample period (1947-1994), the unconditional mean excess return (quarterly returns on the S&P Composite Index less returns on Treasury bills) over a five year period was 33%. But using a VAR regression with a starting point of December 31, 1994, the out-of-sample forecast is one percent below total Treasury bills returns to 2000! Even with a potential total forecast error of 21 percent this is well below the performance of the market.[5] His conclusion was that in the mid-1990s, U.S. stock prices were very high relative to any benchmark. The surprising failure of stock prices to conform to some simple rational model or the empirical regularities requires a closer examination of the "fundamentals" components of the Gordon model.

[5] In alternate specifications, Lamont drops dividends and earnings variables to see if a shift away from dividend payments to share repurchases or changes in accounting practices for earnings have had any influence, but these have only a minor impact on five year returns.

EXPLANATION: TECHNOLOGICAL CHANGE

In both the 1920s and the 1990s, many bulls heralded the arrival of a "new" economy. They saw a higher rate of technological change as the driving force behind a faster growing economy and a rapidly rising stock market. Surging initial public offerings, many based on technological or managerial innovations, flooded the markets in both periods. Technological innovations were viewed as improving the marginal product of capital, increasing earnings and hence dividend growth. A wave of innovations, sometimes characterized as a new general purpose technology was believed to have placed the economy on a higher growth path.

In the 1920s, many bulls found in surging stock price proof of new economy. In New Levels in the Stock Market (1929), Charles Amos Dice Ohio State argued that higher stock prices were the product of higher productivity. Dice identified increased expenditure on research and development and the application of modern management methods as prime factors behind the boom. Irving Fisher (1930) saw the stock market boom as justified by the rise in earnings, driven by the systematic application of science and invention in industry and the acceptance of the new industrial management methods of Frederick Taylor. Comparing corporate earnings in the first nine months of 1929 to 1928, Fisher concluded that "This record is eloquent justification of a heightened level of common stock prices." While this bullish sentiment spread across the country, not everyone was so sanguine. A.P. Giannini, head of Bancitaly (the future Bank of America) stated in 1928 that the high price of his bank's stock was unwarranted given the planned dividends. Some management other high flying companies, including Canadian Marconi and Brooklyn Edison, also became alarmed and publicly announced that their shares were overvalued (Patterson, 1965).

As suggested by the relatively stronger performance of the largest companies, reflected in the stock indices in Figure 2, the boom of the 1920s was centered on large scale commercial and industrial enterprises that took advantage of continuous process technologies. These were coordinated by the emerging system of modern management that produced more efficient vertically-integrated enterprises, capturing economies of scale and scope (Chandler, 1977). Among the "new" industries were automobiles. The Ford Motor Company had pioneered mass production techniques, but General Motors developed a diversified line of production and a more advanced management and organization system, becoming the industry leader. GM's president predicted that its stock price would rise from 180 to 225 and he promised to return 60 percent of earnings to stockholders.

Other new technology industries included radio, movies, aircraft, electric utilities and banking. Like many fast-growing companies, RCA did not pay dividends but reinvested its fat-growing earnings. Other prominent new technology companies were Radio-Keith Orpheum in movies, the United Aircraft and Transport Corporation in aircraft and the Aluminium Company of America, providing the new inputs. The electric utility industry was transformed in the 1920s. Utilities had been local industries, but there were now technological opportunities to for economies of scale in production and transmission that provided incentives to expansion and consolidation within the industry. In a wave of mergers and consolidations, banks expanded and acquired other types of financial institutions to expand the range of services, yielding advantages of

scale and scope. Stock indices available for utilities and banking outstripped the Dow Jones and S&P500 indices, much as the tech company stock indices of the 1990s did.[6]

Some students of the 1920s have sought to explain the boom as primarily driven by technological change driving the growth of dividends.[7] Sirkin (1975) applied a version of the Gordon model to Dow-Jones stocks in the 1920s to see if price earnings ratios could have been justified by a temporarily higher growth of earnings. As seen in Figure 4 and Table 2, S&P 500 earnings-price ratios were typically higher before the bull market. For Dow Jones stocks, price-earnings ratios had ranged between 12 to 15, while the mean and median at the peak in 1929 were 24.3 and 20.4. Assuming a fixed discount rate of 9%, Sirkin calculated the higher earnings growth and number of years that would be needed to justify peak price earnings ratios. In his best case, if the higher growth rate of 8.9% typical of 1925-1929 had been sustained for ten years, the price-earnings ratio of 20.4 would have been justified; thus he concludes that the market was not overvalued.

Although very simple, Sirkin's study is fairly typical of many exercises devised to explain the booms of the 1920s and 1990s, which focus on one variable, largely to the exclusion of others. As such, these non-nested calibrations are sensitive to changes in the parameters and time frame. Here, Sirkin's results are sensitive to the selection of 1925-1929 as representative of high sustainable earnings. If one selected the years 1927-1929, all price- earnings ratios he examined are justified, while if one used the growth rate for 1900-1914, the ratios seem absurdly high. This point reflects the fact found in econometric studies that earnings are highly variable, compared with the permanent component of dividends.

Donaldson and Kamstra (1996) found a similar complete explanation for the 1929 boom and bust, focusing on changes in the expected growth of dividends. In the simple Gordon growth model, dividend growth cannot explain the price peak. Prices moved far away from their fundamentals, and simple tests show that one cannot reject the presence of a bubble.[8] However, using pre-1920 dividend data, Donaldson and Kamstra estimated a non-linear ARMA-ARCH model for discounted dividend growth and found that out-of-sample forecasts produce a fundamental price series with a similar time pattern to the actual S&P index. The fit is so close that it would appear hard to reject their conclusion. In this monocausal explanation, the discount rate plays no significant role. While Donaldson and Kamstra used alternatively a constant discount rate and a variable one, they do not allow for any significant variation in the equity premium, a key feature of the boom.[9] Close inspection of their charts reveals that their fundamental peak follows the actual peak, suggesting that the fit may partly reflect the highly persistent behavior of

[6] The new face of American industry dominated by vertically integrated industry was reflected in the mix of stocks in the Dow Jones Industrial Average. Between September 1916 and September 1928, Anaconda Copper, Central Leather, National Lead and Peoples' Gas were dropped while Allied Chemical, American Can, American Locomotive, AT&T, American Tobacco, International Harvester, Mack Trucks, Paramount Famous Lasky, Sears Roebuck, the Texas Company (Texaco), United Drug, Western Union and Woolworth were added.

[7] See Bierman (1991) for example.

[8] Even the ex post warranted price is sufficiently different from actual stock prices so that a bubble cannot be rejected.

[9] Their variable rate is the commercial paper rate, a very short-term rate, not typically used, and one which does not reflect the riskiness of stocks, to which they add a constant risk premium. One rate that captured the moving equity premium, the of the brokers' loan rate (see Rappoport and White, 1993, 1994) which jumped as the market boomed. Use of this more appropriate rate would reduce the fundamental.

dividends. Like other papers in this genre, it proposes one explanation and finds a good fit; but there is no nested testing.

In contrast to Sirkin and Donaldson and Kamstra, Barrie Wigmore (1985) saw no evidence in earnings that could justify the run up in stock prices. In his detailed survey of the behavior of individual stocks, he pointed out that at the market's peak stock prices average 30 times 1929 earnings up from 10 and at most 20 before the boom. Although 30 was the average, many stocks fell in the 30-50 range, with a number over 100. He concluded that "such stock prices were clearly dependent on further price rises rather than on the income generated and distributed by companies.…as the low returns on equity show, these high valuations placed little emphasis on earnings."[10] Wigmore arrives at a position similar to some econometric studies that emphasize the primacy of the current price in determining future returns over more than a short horizon.

The idea of a new technological age played a key role in the mind of the 1990s' bull market. The rapid changes in computer/information technology and biotechnology were heralded as placing the economy of a higher trajectory. This "new era" view was supported by some economists. Comparing the computer revolution to the introduction and spread of electricity and internal combustion, Jovanovic and Rousseau (2002) projected that this general purpose technology would have an even greater impact on productivity growth. Reasons for optimism could be based on "Moore's Law" that the number of transistors per integrated circuit doubles every 18 months, The increased efficiency in computing, a product of experience in production and sales drove down prices. While their estimated average annual price declines for electricity and automobiles were both around 2%, computer prices collapsed at a rate of 24%. Prices for electricity and automobiles had declined sharply in the 1910s and 1920s, and most quickly after 1924, suggesting a key role for technology in the boom of the 1920s. The much faster rate of change and price decline in the 1990s, promised higher levels of growth and consumption.

Yet, this rosy future is not supported by more general studies of productivity growth. In a reassessment of long-term multi-factor productivity (MFP) growth, Gordon (2000a) painted a broad picture of slow growth in the nineteenth century. From an average annual growth rate of 0.39% for 1870-1891, MFP began to climb, hitting 1.14% for 1890-1913. After World War I, it continued its upward movement, rising to 1.42% for 1913-1928 before cresting at 1.90% in 1928-1950. Gordon argued that this peak of MFP growth is attributable to a cluster of four inventions. These were electricity, the internal combustion engine, petrochemicals-plastics-pharmaceuticals, and communications-entertainment (telegraph, telephone, radio, movies, television, recorded music and mass-circulation newspapers and magazines). These were all well established before World War II, except for television, and their diffusion and improvements thus contributed to the peak of MFP growth of 1928-1950. MFP growth subsided to 1.47% for 1950-1964 and then plummeted to 0.89% for 1964-1972, hitting bottom at 0.16% for 1972-1979. The recovery to 0.59% in 1979-1988 and 0.79% for 1988-1996 remained far below the peaks, leading Gordon to conclude that the contributions from the four earlier general purpose technologies dwarfed today's technology information computer/chip-based IT revolution. Gordon (2000b) found the most recent increase in MFP for 1995-1999 to be 1.35%, consisting of a 0.54 unsustainable cyclical effect and 0.81% in trend

[10] Wigmore, p. 382.

growth which he attributes wholly to the computer-IT sector. For the remainder of the economy, MFP did not revive, and outside of durables it actually decelerated. Oliner and Sichel (2000) obtain a similar conclusion, although the data they use show that the new economy over-explains the revival.

Contrasting this skepticism of the IT revolution, Nordhaus (2002) believed that IT provided only a modest contribution to the revival of labor productivity, which was much more broad-based. Using income-side GDP measures and four measures of labor productivity, which can be decomposed by source, Nordhaus found that manufacturing productivity growth increased by 1.61% from 1977-1989 to 1995-2000, of which the "new economy" contributed 0.29%. However, Gordon (2002) doubted this finding and trying to reconcile the differences in data and timing, he recalculated Nordhaus' labor productivity growth with the result that the computer-IT sector accounted for virtually all the increase.

The differences in productivity growth in the late 1990s between IT industries and the rest of the economy look like a potential good explanation for the greater buoyancy of the Nasdaq compared to the rest of the market. Certainly, it would explain a knee-jerk investor response to developments in the IT industry. However, the boom outside of the new economy would seem surprising without a major increase in productivity growth, giving skeptics ammunition. For example, Shiller (2000) dismissed the idea that the bull market of the 1990s was driven by earnings, arguing that prices outstripped earnings growth and the price-earnings ratio was at an unwarranted historic high. Near the peak of the market, Wigmore (1998) considered the market to be extremely overvalued on the basis of a simple model that employed the IBES two year projections for earnings

The implications of the modest increase in productivity growth for the value of stocks is found in Heaton and Lucas'(1999) study, which parallels Sirkin's exercise for the 1920s. They calculate the growth rates that would be needed to justify the peak price-dividend ratio in equation 2, using Shiller's annual data (1872-1998). For this 126 year period, the average price-dividend ratio was 28 and real earnings growth rate was 1.4%, implying a discount rate of 5%.[11] To match the 1998 high ratio of 48 with required returns of 5% and 7% would demand growth rates of 2.9% and 4.9% growth of earnings---huge historical leaps. Note that they would effectively require a doubling of productivity growth, something which is not evident in the data. Consequently, Heaton and Lucas are skeptical of any explanation of the 1990s can be principally based on technological change. Like the 1920s, the conclusion for the 1990s is fairly clear: expected dividend growth was not a major factor driving the boom. The surge in earnings was part of a robust business cycle but did not have a sufficient permanent component to raise stock prices.

EXPLANATION: PAYOUT CHANGES

The payout ratio, depicted in Figure 5 may contain some information on the 1920 and 1990s. A trend shift in this ratio, produced perhaps by a rise in earnings, may indicate that managers decided to retain and greater share of earnings and invest them for shareholders leading ultimately to faster growth. However, the payout ratio also moves

[11] They point out that at higher discount rates of 7% to 9% percent that were usually presumed to have prevailed, very high growth rates of 3.4% to 5% would have been required.

cyclically and a lower payout ratio, driven by a rise in earnings, will be expected to lower forecasted stock returns.

For the twenties, Table 2 reveals a steady slow rise in real dividends, suggesting that managers were adjusting gradually to higher earnings. Earnings were more variable and fluctuations in the payout ratio seem to be driven primarily by this volatility, with the ratio centered on 60%. However the story appears to be different for the nineties. Real dividends barely changed, but earnings were steadily rising, producing a drop in the payout ratio. Falling to 40%, it touched 32% in 2000, an historic low for Figure 5.

Assuming the return on stocks relative to other assets does not decline (and it may have if the equity premium declined), this drop in payout is surprising. For a constant return, the drop in the dividend yield in the late nineties requires a considerable appreciation in stock prices. Higher earnings that are reinvested will produce future growth that justified the price by future dividends. But there is another factor that can increase price: stock repurchases.

Repurchases of stock reduce the number of outstanding shares, increasing the remaining shares' claim on earnings. Instead of current payment of dividends, repurchases can increase outstanding share value. Firms hesitate to raise dividends in response to transitory earnings. But share repurchases are one time policy and allow flexibility for temporary higher payouts.

The literature on repurchases in the 1920s is silent, suggesting that these were not a factor; but in the nineties they were prominent. Since 1995, repurchases have exceeded dividends for nonbank firms in the S&P500 (Carlson, 2001). At the same time some firms have been issuing new stock; net retirements turned positive in 1994. At the same time there has been an increase in employee stock options. When these are exercised, as occurred in the 1990s, the new issue of shares dilutes the value of the existing shares. Liang and Sharpe (1999) examined a sample of 177 of the largest firms in the S&P500 and found that while share repurchases would have reduced the outstanding shares at a rate of 2% a year, the exercise of options halved the rate of retirements. The recent large-scale net stock retirements and stock options are usually not incorporated into analysis of share value, and this may represent a serious omission. For Liang and Sharpe's sample, the dividend payout from earnings in 1994 was just under 40%, similar to the number in Table 2. But, not all retained earnings were reinvested; about 12% were accounted for by net retirement payout and 3% for stock option payout, leaving 55% for reinvestment. As the boom was peaking in 1998, dividend payout was about the same, but retirements and stock option payout rose so that there was only 20% remaining for reinvestment. Liang and Sharpe concluded that this level of high actual payouts was unsustainable if earnings continued to grow at their postwar rate. If these developments are representative of the market, it would cast further doubt on the role of earnings growth and future dividend payments as an explanation for the boom in the nineties.

EXPLANATION: CHANGES IN THE DISCOUNT RATE

The stock yield or return required for holding stocks equation 1 has become the fundamental factor most often viewed as the driving force behind stock market booms. Composed of a risk free rate and an equity premium, this discount rate for dividends is believed to be moved primarily by the latter, as the risk free rate is held to be relatively constant. In the Gordon stock valuation model, where there is a constant expected growth of future dividends, the stock yield is

$$(3) \qquad r_t = E(D_{t+1} / P_t) + g$$

The equity premium is then calculated as the difference between the stock yield and a measure of the risk free rate. This simple formulation points to the fact that the equity premium is largely driven by share prices, as even the very important movements in the growth rate of dividends are small in their effect compared to price movements.

Figure 6 graphs a measure of the equity premium and the stock yield. The stock yield is based on the S&P500, while the bond yield is three series spliced together: the 10 year constant maturity U.S. government bond rate for 1941-2003, high grade industrial bonds for 1900-1940, and high grade railroad bonds for 1871-1899.[12] The estimated expected stock yield is equal to the dividend yield and the average growth of dividends for the sample. The nominal rate of growth was 3.9% and the real rate of growth deflated by the CPI was 1.7%.

The broad movements of the equity premium are captured in Figure 6; they are similarly described by Blanchard (1993) who employs a measure where the growth of dividends is not fixed, however the pattern is scarcely altered. After a long period of relatively constancy from around 4% in the nineteenth century, the equity premium rose to over 6% after World War I. During the 1920s, it declined back to its previously level, then during the boom fell to its lowest point yet. If measured on a monthly basis, the equity premium hit an unprecedented 2% during the bull market of 1928-1929. The Great Depression elevated the premium to its historic high, from which it gradually declined. By the 1960s, it returned to the nineteenth century level. The brief period where there appears to be an equity discount is not the result of any decline in the dividend yield. In the early 1980s, the stock yield rose considerably; but it was the unexpected rise in interest rates that created this inversion. From the late 1980s to the present there has been a steady decline in the stock yield, accompanying the fall in bond yields so that the equity premium appears to have collapsed. The disappearance of a substantial equity premium seems to bear out Mehra and Prescott's (1985) claim that at reasonable levels of risk aversion, it is not possible to justify risk premium any larger than 0.25 percent in the absence of market imperfections that do not allow investors to fully insure against risk outside of stock markets.

The perception that equities are less risky and hence the equity premium should decline was a common explanation for the nineties boom. Among the most bullish of the

[12] U.S. government constant maturity bonds yields are found on www.freelunch.com. The high grade industrials (series 13026) and McCaulay's railroad bonds (series 13019a) were obtained from the NBER website.

bulls were Glassman and Hassett whose book The Dow 36,000 (1999) proclaimed a "paradigm shift":

> Stocks *should* be priced two to four times higher---today. But it is impossible to predict how long it will take for the market to recognize that Dow 36,000 is perfectly reasonable. It could take ten years or ten weeks. Our own guess is somewhere between three and five years, which means that returns will continue to average about 25 percent per year. (p.13)

Their optimism was predicated on equation 3, where the required return on stocks set by the real long term bond rate of 2% and the real growth rate of dividends is assumed to be 2.3% permits a dividend yield of 1.5% to fall to 0.5% with a tripling of stock prices.[13] The Dow 36,000 was typical of the widespread belief in the reduced risk of stock market investing. Among others, Glassman and Hassett argued that a diversified portfolio of stocks was no more risky than an investment in U.S. government bonds. Once investors fully appreciated this fact, the equity premium would vanish as stock prices were bid up. To support their argument, they pointed to the fact that transactions costs had been greatly lowered by mutual funds, 401(k) plans, internet trading, computerization and other innovations that permitted investors to more easily acquire information diversify their portfolios.

The same factors---increased participation and diversification---that have been used to explain the recent decline in the equity premium were also present in the 1920s. Unfortunately, we lack precise measures of these developments, although there is abundant circumstantial evidence that they may have played a role. Traditionally, investing in the stock market had been largely restricted to the well-to-do but the wider public entered the market in the 1920s. The change was initiated during World War I, when the government pressed the banks and other intermediaries to enlist the general public in its bond campaigns. After the war, they used their established sales networks to sell securities. The wider demand for securities caused the brokerage business to boom. In 1925, NYSE member firms had 706 offices. By 1928 this has risen to 1,059 offices, jumping to 1,658 in 1929. The NYSE strained to accommodate new business and the price of a seat on the NYSE climbed from a low of $290,000 in 1928 to $625,000 in 1929, reflecting value of access to the floor of the exchange.[14]

Smaller investors were brought into the market as innovations made it easier for them to diversify their portfolio. The key development was the expansion of the investment trusts---precursors to today's mutual funds. Growing from 40 in 1921 to 750 in 1929, the investment trusts sold their stock to the public and used the proceeds to investment in stocks and bonds.[15] Initially fixed trusts were the most common form of organization where portfolios could not be altered. They tended to be more conservative, purchasing blue chip securities. But by the late 1920s, management trusts where the managers had discretion in the selection of the portfolio became the preferred form of organization for new trusts. Sponsored by professional managers, investment banks, trust companies and commercial banks and their affiliates, many trusts were closely tied

[13] Glassman and Hassett, p. 72-73.
[14] New York Stock Exchange, Yearbook, 1929-1930.
[15] Carosso, 1970

to their parent firm, acting together in the purchase, distribution and underwriting of securities.

The stock market collapse of 1929 and the prolonged depression left the market deserted by the small investor returned only slowly in the last quarter of the century. The re-entry into the equity market is no better seen in the growth of stock mutual funds. Between 1990 and 2002, the number of these funds climbed from 2,338 to 7,267, while their accounts and net assets rose from 61 million with $1,065 billion to 251 million with $6,392 billion. Ownership became more diffused. In 1990, 25 percent of all households owned mutual fund shares; but by 2002 this had risen to 50 percent, representing 54.2 million households. An important factor behind this expansion was the use of mutual funds for retirement savings, which accounted for $2.1 trillion or 21 percent of the "retirement" market by 2002. Half of these funds were in employer sponsored defined contribution plans, and the other in IRAs, where mutual funds' share had grown from 22 percent in 1990 to 46 percent in 2002.[16]

While we have better data for the 1990s, the impression is that these long-term factors did not contribute significantly to any quick drop in the equity premium. An increase in the stock market participation rate could decrease the required risk premium on stocks because it would spread market risk over more of the population. Participation rates climbed noticeably in the 1990s. The Survey of Consumer Finances (SCF) showed that the number of shareholders in the U.S. rose from 52.3 million in 1989 to 61.4 million in 1992 and 69.3 million in 1995, with people entering the market at younger ages (Heaton and Lucas, 1999). In addition, stockholders seem to be more diversified, which would allow holders to demand a lower rate of return. Whereas, few very investors had more than ten stocks in the 1960s, (Friend and Blume, 1974), diversification has increased, abetted by mutual fund ownership. Diversified households should have a higher risk tolerance (the admission in a survey of willingness to take higher risk to earn higher returns in the SCF), yet tolerance increased only slightly from 1989 to 1995. Heaton and Lucas (1999) also point out that individuals who already own stocks are more risk-tolerant than those who do not, implying that the addition of new stockholders might lower the average level of risk tolerance, reducing the effect of wide ownership on the equity premium.

To examine the effects of increased participation and diversification, Heaton and Lucas (1999) calibrated an overlapping generations model where only some households hold equity and there is aggregate and idiosyncratic income risk.[17] They found that participation rates do not have a large effect. Increasing participation from 50 to 80 percent of the population only reduced the rate of return by less than one tenth of one percent. They found a greater impact possible if there was high diversification. Yet households may not have diversified much. Mutual funds may have mushroomed, but as late as 1995 only 16.5% of equity was owned through mutual funds. Data from the SCF indicate that households holding stock in their employing company had it accounting for almost half of their total stock holdings (Vissing-Jorgensen, 1999). Increased

[16] Investment Company Institute (2003).

[17] One problem is that in this type of model, aggregate income risk and dividend risk alone do not generate an equity premium as large as that observed, and Heaton and Lucas set aggregate risk higher than is observed to create one.

participation and diversification may be partly responsible for the downward trend in the equity premium but there is little evidence that they were tied to the boom.

In addition to the long swings identified in the movement of the equity premium, there are higher-frequency movements that appear to be correlated with inflation. Blanchard (1993) noted that the post-World War II decline in the premium was briefly reversed in the 1970s when inflation increased. When inflation subsided, it moved back to trend. In VAR regressions, Blanchard found that an increase in inflation briefly (up to two years) raises real bond rates before the complete Fisher effect takes over. Unanticipated inflation reduces stock prices in the first year, and in subsequent years increases the dividend yield. In addition, an innovation in inflation increases dividend growth. Taken together with the increase in the dividend yield, the real stock yield increases in response to inflation. This delayed response explains the why the premium has tended to decrease in response to inflation.

The strong relationship between inflation and both the dividend yield and the equity premium represents a puzzle as it does not appear to be rational within the context of the Gordon model. Using independent measures of equity risk from cross sectional data, Campbell and Vuolteenaho (2004) examined the behavior of the dividend yield, as it is driven by inflation (measured by the nominal bond yield). They find that a simple regression for monthly data from 1926 to 2002 explains half of the movement in the dividend yield. The falling dividend yield of the late 1920s is attributable to a drop in risk, as inflation was steady. The increase in the dividend yield in the 1930s and 1940s was dominated by the increase in risk, which overwhelms the effect of deflation that might have lifted prices. The declining dividend yield of the 1950s and early 1960s is again moved primarily by the falling measures of equity risk. But rising inflation from the late 1960s through the 1970s raises the dividend yield. By the late 1980s and 1990s, it is falling again, this time because both risk and inflation are declining.

Campbell and Vuolteenhao found that higher inflation is not correlated with any subjective measure of risk that would imply rational pricing. Instead it inflation increases the long-term real dividend growth. They argue that investors form subjective growth forecasts by extrapolating past nominal growth rates without taking inflation into consideration. The result is that stocks tend to be overpriced when inflation is low and underpriced when inflation is high. They blame this phenomenon on the "mispricing" of stocks by the persistent use of the "Fed model" by many contemporary investment professionals. The simple idea is that investors should chose between stocks and bonds, and professionals counsel that investors compare the yield on stocks (often the dividend yield) with the yield on Treasury bonds plus a risk factor and suffer from some inflation illusion.[18] They concluded that at the end of 1999, when dividend growth and the risk measures justified a dividend price ratio of 3.3, it was observed to be 1.2.

[18] Campbell and Cochrane (1999) offer a tantalizing theoretical explanation of the behavior of stock prices and the equity premium based on habit formation. Consumption behavior is conditioned by slow moving habit formation that induces investors to fear stocks because they do poorly in recessions. Assuming a fixed risk free rate of interest, as consumption falls towards the habit in a tough, the curvature of the utility function rises; risky asset prices fall and expected returns rise—producing a slowly time-varying risk premium. The representative agent's habit level depends on the history of aggregate consumption and habit moves slowly in response to consumption, producing slow mean reversion in the price-dividend ratio and the long-horizon return forecastability. As observed equity premia are higher at business cycle troughs than they are at peaks. Excess returns on common stocks over Treasury bills are forecastable and many of

While a huge effort has been expended by financial economists to explain the movement of stock prices in terms of fundamentals, it has fallen far short of success. Changes in earnings growth, the payout ratio, and the discount rate cannot fully account for the buoyant markets of the 1920s and 1990s. As Campbell (1999) bleakly explained:

> The recent run-up in stock prices is so extreme relative to fundamental determinants such as corporate earnings, stock-market participation, and macroeconomic performance that it will be very hard to explain using a model fit to earlier historical data. The relation between stock prices and fundamentals appears to have changed, and it may be a long time before a definitive interpretation of this change is possible. (p. 261).

This conclusion is buttressed by the presence of several anomalies that suggest the market is not rationally pricing stocks. Most descriptions of the stock market booms in 1928-1929 and the 1990s describe a mass enthusiasm for stocks, with new investors quickly entering the market. The descriptions of public enthusiasm for stocks in 1928-1929 by contemporaries have the aura of a "fad" or "herd behavior." One anomaly pointed out by Shiller (1989) was that individual stock prices covary too much on average to accord with the efficient markets hypothesis. This phenomenon was documented by Pindyck and Rotemberg (1992) who found that there was excess comovement observed between individual stock returns, once the common macroeconomic and industry factors were eliminated. Applying this methodology to the 1920s, Rappoport and White (1994) found excess comovement among Dow Jones stocks, which rose over the course of the decade, suggesting increased herding. There is excess comovement for 1920-1926, and rises further to 1927 to 1930, pointing to herding during the boom.

De Long and Shleifer (1991) claimed to have discovered a measure of excessively optimistic investor sentiment in the premia on closed end mutual funds. Unlike stock prices, the fundamentals prices of closed end mutual funds are easy to measure; they are simply the current market value of the securities that make up their portfolios---that is the net asset values. It is common to look at the difference between prices and the net asset values as a measure of investor sentiment. In the post-World War II period, it is usual to observe modest discounts, but in the period of the 1920s bull market, there was a very large premium that disappears after the crash. They estimated it to be 45 percent in July 1929. Given that it is feasible to replicate the composition of any fund, they point to the premium was a sign of excessive investor optimism and concluded that the S&P500 composite was 30 percent above fundamentals by late summer of 1929.

The cost of borrowing on market in the 1920s, the margin requirements and interest rates, have anomalous behavior that strongly points to excessive investor optimism. Typically, short-term money markets were well-integrated, and their yields typically moved very closely together over the business cycle because investors judged

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the variables that predict the excess returns are related to business cycles (Fama and French 1989). Dividend/price ratios move procyclically, indicating a large countercyclically variation in excess returns (Campbell and Shiller, 1988, Cochrane, 1991). Furthermore, conditional variances in returns change over time but they do not move closely with the conditional mean returns, implying that the slope of the conditional mean-variance frontier, a measure of the price of risk changes with the business cycle.

these assets to involve a similar exposure to risk. However, during the 1920s, an extraordinary premium arose on brokers loans, suggesting that lenders no longer regarded brokers' loans as very safe (Rappoport and White, 1993, 1994). The appearance of premia mirrors the rise in the market, and interest rate spreads on other risky assets evidenced no significant change.[19] At the same time margin requirements, which were not regulated, rose from roughly from 25 to 50%, reflecting a general concern, evident in the financial press, that stocks were overvalued. The requirements were dropped immediately after the crash of October 1929, indicating that banks and brokers felt there was less risk in the market. The margin requirements demanded by brokers reflect crudely their concern about the magnitude of a plunge—of about 50 percent. Rappoport and White (1993) provide two estimates from their analysis of the brokers' loan market of the size of the bubble at its peak in the Dow Jones index, 63% and 80%, which probably overestimate its magnitude.

Furthermore, there appears to have been considerable expectation in 1929 and 1987 that a crash was imminent, though no similar conjecture has been put forward for the slower price decline after the 2000 peak. Examining the S&P 500 futures options for evidence of expectations of a crash, Bates (1991) suggested that the 1987 crash had, ex post, the appearance of a rational bubble, with the dramatic gains of one year suddenly erased. He found that in the year prior to the crash prices of stock options indicated that a large drop in prices was expected. For 1929, Rappoport and White (1994) track the implied volatility in the option implicit in brokers' loans and report that there was expectation of a substantial fall, just prior to the crash.

Overall, there is fair evidence that something of a bubble was embedded in stock prices in the late 1920s and 1990s. The presence of a bubble in stock prices would have distorted consumption and investment. A boom in stock prices will raise household wealth helping to drive consumption, and undertaking new investment will look more attractive because soaring stock prices will raise market value to book value in Tobin's q. In addition, the improvement in the value of collateral will allow more firms to borrow. Firms may also switch to equity finance from debt finance, if there is a prospect of investors accepting a lower equity premium. Rising stock prices by increasing investment will also drive up the observed real growth rate, making the apparent productive capacity of the economy greater. Yet, if stock prices do not reflect fundamentals, some investments should not have been undertaken because did not really have had positive internal rates of return. The result will be overinvestment and unusable capacity. Keynes poetically described the effects of a decision-distorting bubble:

> Speculators may do no harm on a steady stream of enterprise. But the position is serious when enterprise becomes the bubble on a whirlpool of speculation. When the capital development of a country becomes a by-product of the activities of a casino, the job is likely to be ill-done (Keynes, 1936).

The effects of a stock market boom have been explored for 1929. Romer (1990) compared the behavior of consumer spending and stock market wealth for the crashes of

[19] For example, the spread between BAA corporate bonds and long term government bonds was remarkably constant (Board of Governors, 1943).

1929 and 1987. She found that the relationship between stock price variability and consumer spending are similar for both periods, although the continued high level of volatility after 1929 was greater. In the boom and bust, wealth had its strongest effect on consumer durables, raising purchases during the bull market then drastically reducing consumption after the crash. The rapid rise in stock prices could have a huge, possibly distorting effect on investment through the effect on Tobin's q. Eichengreen and Mitchener (2003) estimate an investment equation, where the doubling of q that occurred between 1926 and 1929, produced an 18% increase in investment and the collapse afterwards yielded a greater effect.

The upward swing of the market encourages more equity finance, but whether it actually produces a distortion in the market is less certain, as one would presuppose from the Modigliani-Miller theorem. Suggestive of this conjecture, Blanchard (1993) finds that the cost of capital from 1929 to 1933 may not have been altered. His graph of the equally weighted average cost of real bond and real stock yields is remarkably constant over sixty five years. Firms that have access to both equity and bond finance will not be very affected by changes in the equity premium, but those who rely on debt finance will be hurt.[20]

The effects of the stock market boom on wealth and finance are not in doubt. If fundamentals drove the market then there was no unwarranted consumption or investment. The studies of fundamentals cast doubt on whether the two stock market booms were entirely attributable to fundamentals, suggesting that if one could measure the deviations from fundamentals, it would be possible to determine the magnitude of excess consumption and investment. If this were possible, then there may be a role for incorporating assets prices or some measure of asset mis-pricing into the Federal Reserve's decision-making.

WHAT IS THE OPTIMAL POLICY?

If a consensus had been reached in macroeconomics at the end of the twentieth century, it was that monetary policy should have as its primary goal price stability. And yet, some have begun to doubt this orthodoxy as wide swings in asset prices have disturbed both national and global economies. The astonishing upward rise in the American stock market, centered on the technology stocks led to Alan Greenspan's 1996 warning that the market was possessed with "irrational exuberance." This pronouncement astonished many schooled in the history of the Federal Reserve. It had been long been held as a near article of faith that the Fed had erred critically in 1929 when it diverted its attention from price stability and growth and focused on the buoyant stock market. After attempting a "direct action" policy of jawboning and pressure on member banks, the Fed raised interest rates. The action of tightening policy as the economy was entering a recession is generally viewed as making a mild recession worse, initiating the Great Depression of the 1930s. Greenspan's jawboning was eerily reminiscent of the Federal Reserve Board's policy in early 1929. It was surprising because he was well aware of the history of the Fed and could not have missed the parallel with his predecessors' efforts in 1929. Although the Fed did not follow up and

[20] Of course, this type of graph does not capture the severity of the credit crunch of the 1930s.

tighten policy as it did in the 1920s, it opened the debate on whether monetary policy should respond to asset volatility.

The question whether the central bank should respond to asset booms and busts is relatively new to those concerned with monetary policy. The current standard framework for policy is inflation-targeting (Bernanke and Mishkin, 1997). Publicly announced medium-term inflation targets are used to set a nominal anchor for monetary policy, while allowing the central bank limited flexibility to stabilize the real economy in the short-run. Here, the central bank should only respond to changes in the stock market if they affect the central bank's inflation forecast. In a small calibrated macroeconomic model, Bernanke and Gertler (2000, 2001) found that an inflation-targeting rule stabilizes inflation and output when asset prices are volatile, driven either by a bubble or technology shock. They concluded that there is no additional gain from responding directly to asset prices because although a response to stock prices can lower the variability of the output gap, it may increase the variability of inflation. Furthermore, a key problem, they believe is that it is more difficult for the monetary authority to identify the fundamental component of stock prices than it is the output gap. Any attempt to address asset volatility runs the risk of imparting instability to prices and output, especially of measurement of fundamentals is flawed.

Within the flexible inflation-targeting framework, Mishkin and White (2003) suggest a rationale for short-term intervention. Surveying stock market crashes of the twentieth century, they argue that when balance sheets of financial institutions are initially weak, a stock market crash can increase the problem of asymmetric information because the net worth of firms falls sharply and no longer serves as good collateral. This development worsens the adverse selection problem because the probability of loan defaults increase and makes it more difficult for lenders to screen borrowers. Consequently, risk premiums on debt will rise. The response of intermediaries will be to cut lending, thereby increasing contractionary pressure on the economy. The Great Depression is the most extreme example of this effect. In 1929, the prompt action of the Fed halted and reversed the rise in the risk spread but the second collapse in the market beginning in early 1930 sent risk premia soaring, helping to shatter the system of intermediation. The weakened state of the bank sector led to a quick sharp rise in the risk premia when the stock market collapsed in 1990. In contrast, when the market began to decline in 2000, the banking and financial sector had recovered from the problems of the 1980s and risk premium were not affected until the outbreak of the Enron scandal. If the central bank is following a flexible inflation-targeting rule, these sharp declines in the presence of weak balance sheets in the financial sector should bring about short-term easy monetary policy as happened in 1987 and initially in 1929.

Yet, some have argued that asset prices ought to be directly incorporated into inflation targeting Cecchetti, Genberg, Lipsky, and Wadhwani (2000) propose that a central bank should adjust monetary policy not only in response to forecasts of future inflation and the output gap, but also to asset prices, developing procedures to identify asset price "misalignments." They believe that it is no more difficult to measure stock price misalignments than it is the output gap or the equilibrium value of the real interest

rate.[21] In following an interest rate targeting rule including the deviation of the equity premium from a 20 year moving average, their model shows that there is a smoother path for output and inflation. Based on the long-term trends, they estimated that the warranted risk premium in 2000 was 4.3%, which would have justified a S&P500 level less than half of the observed 1466. Their augmented model suggests that by 1997, the Federal Funds rate should have a Fed funds rate of 10.35% as opposed to the actual 5.51%, which would have kept inflation at under 3%, a very small output gap and a risk premium of just under 3%.

Bordo and Jeanne (2002) address some of the limitations of Cecchetti, et. al.'s approach and make a case for pre-emptive monetary policy. They avoid the question of whether a boom is driven by fundamentals or a bubble and structure a model with a Taylor rule where productivity shocks can cause large price reversals. They identify boom-bust episodes with a simple filter where the three year growth of real stock prices exceeds a critical value composed of the average growth rate of prices and some threshold multiple of the standard deviation that has identified these events in the past. They are concerned that during a boom, rising stock prices raise the price of collateral, inducing firms to borrow; while a bust creates financial instability by quickly lowering the value of collateral, yielding a collateral-induced credit crunch. They treat the question of whether the central bank should preemptively restrict monetary policy in terms of insurance, trading off the loss in output and price stability against the probability of a costly credit crunch and a fall in real output. Their concern is that an increase in the probability of a bust would reduce the expected level of inflation, but in a forward looking Taylor rule, a lower inflation forecast would call for monetary ease which is the opposite of the appropriate response as it would fuel the boom. They find that a proactive policy, responding to a bull market, is sometimes dominates a simpler Taylor rule in its sacrifice of current output against the risk of a credit crunch.

This literature is new and growing, and there is no consensus about whether the Fed should incorporate asset prices directly into its policy considerations. However, these papers do provide a means to analyze whether the Fed would have intervened had it followed the proposed rules.

THE ROLE OF THE FEDERAL RESERVE

How did policy makers in the twenties and nineties confront the booming markets? Did their policies hinder or aggravate the booms? In many respects, the general economic conditions and the behavior of the Federal Reserve in both periods are similar and offer instructive comparisons.

The bull market of the twenties had its origins in the long post-World War I economic boom. However, the boom had been preceded by an upheaval. During the First World War and its aftermath, the economy had been through the wringer with high inflation followed by a postwar boom and hard recession. It was a wrenching experience for financial intermediaries, with large-scale bank failures. However, the economy

[21] Bernanke and Gertler (2001) are highly critical of Cecchetti and argue his policy rule requires that the central bank know that the boom is driven by no-fundamentals and the exact time when the bubble will burst.

quickly stabilized and began to grow rapidly with two brief contractions in 1923-1924 and 1926-1927, each just over a year. Overall, between 1922 and 1929, GNP grew at a rate of 4.7% and unemployment averaged 3.7%. Anchored by the gold standard, prices varied but there was no trend inflation.[22]

After World War I, the Federal Reserve was freed from its obligation to assist the Treasury in financing the war debt; and the government balanced its budget, cutting expenditures and taxes. Once released from keeping interest rates artificially low, the Fed took an active role in managing the economy. The Fed accommodated seasonal demands for credit and the close coincidence in the timing of the actions of the Fed and the turns in the business cycle, imply that it helped to smooth economic fluctuations.

Some have argued that the initial stock market boom of 1928-1929 was fueled by expansionary monetary policy that began in the spring of 1927 driven by international considerations. Having returned to gold at an over-valued prewar parity, Britain was suffering from high unemployment and a balance of trade deficit. In the spring of 1927, Germany raised interest rates intensifying the pressure on the British balance of payments. At the same time, the Bank of France attempted to halt the appreciation of the franc by selling francs for sterling, which it then attempted to covert into gold at the Bank of England.

At a Long Island secret conference in July 1927, the president of the New York Fed, Benjamin Strong, the head of the Reichsbank, Hjalmar Schacht, the Governor of the Bank of England, Montagu Norman and a represent of Emile Moreau, the Governor of the Bank of France met to discuss how to meet this threat to the newly restored gold standard. While both France and Germany offered minor concessions, the U.S. took the lead and eased monetary policy. The discount rate was cut from 3 ½ to 3% and the Fed purchased bills and government securities. The slowdown of the U.S. economy played a role in convincing the Board to follow this policy, but the minutes of the Open Market Investment Committee make it clear that the majority worried about how the stock market would react to the shift in policy. As one Board member, Edmund Platt spouted in the meeting: "Lower [the discount rate] in New York first and to hell with the stock market." (quoted in Clarke, 1967, p. 127).

While this shift in Fed policy was unexpected, it is difficult to see how it would have had a big impact on the stock market. The interest cut was small and brief, as a contractionary policy was initiated by open market sales in January 1928 and a discount rate ascending from 3 ½ to5 percent by August 1928. In addition, there were heavy open market sales. Although the discount rate remained unchanged for another year, monetary policy has been characterized generally as tight for the remainder of stock market boom (Hamilton, 1987). In 1928 and 1929, high-powered money and the consumer price index fell and M1 grew only slightly in 1929. In spite of this evidence, many, including Strong felt that this tightening was begun too late; it should have occurred at the beginning of 1928, to halt the advance of the stock market (Clarke, 1967).

The importance of easy credit in igniting the boom was emphasized by both Charles Kindleberger (1986) and John Kenneth Galbraith (1954). Galbraith blamed the ability to purchase stock on margin as a great speculative lure, and Kindleberger argued that stock market credit was a key element in generating the mania. Yet, it was not the credit aggregates that expanded but the credit flows to the stock market. A key feature of

[22] Historical Statistics, p. 135 and 226.

the stock market boom of the 1920s was the use of credit to purchase stock. Investors received margin loans from their brokers to buy securities. In turn, brokers obtained brokers' loans from their banks and the floor of the stock exchange to supply their customers and to fund their inventories of securities. The demand for credit to invest in the market, and the hesitancy of lenders, contributed to the huge premia paid for margin and brokers loans and dried up other debt markets. At the same time, as brokers' loans increased, rising from $4.4 billion on January 1, 1928 to $8.5 billion on October 1, 1929, commercial paper outstanding plunged from $600 million in September 1927 to $265 million by September 1929. Similarly, new issues of foreign securities nearly disappeared, falling from $1.3 billion to $673 million, while domestic notes and bonds declined from $3.2 billion to $2.1 billion.

Although concerned about protecting international gold reserves, the Federal Reserve was obsessed with the stock market and what it regarded as the excessive credit for speculation. Following the "real bills doctrine," the founders of the Fed had hoped that the bank's discounting activities would channel credit away from "speculative" and towards "productive" activities. Even in the early 1920s, the many members of the Board and banks were enormously frustrated by the amount of credit that the stock market seemed to absorb, and looked for some way to reduce the volume of brokers' loans. Almost all Fed officials agreed about this issue but they were split over the appropriate policy, and the inaction in policy after the last increase in the discount rate in August 1928 reflected an intense struggle.

The Federal Reserve Board believed that "direct pressure" or jawboning could be used to channel credit away from speculation. The Board also wanted the Federal Reserve banks to deny access to the discount window to member banks making loans on securities. In contrast, the Federal Reserve Bank of New York contended that it could not refuse to discount eligible assets and that it was impossible to control credit selectively. It argued that speculation could only be reduced by raising the discount rate. The Board was not persuaded; and between February and August 1929, it refused New York's 11 requests to raise the discount rate.[23] According to Clarke (1967, p. 155), the New York Fed believed that if the Fed could break the boom early, the adverse effects on the U.S. would be small compared to the "disastrous consequences for both the domestic and international economies that would result from a prolongation of speculative excesses and from the inevitable and violent collapse of the speculative bubble."

The Board prevailed initially. In February 1929, the chairman Roy Young spoke out against excessive speculation and issued a letter to all Federal Reserve banks, instructing them to limit "speculative loans." Brokers' loans by member banks did not increase after this date, but the growing market was supplied instead by non-member banks, corporations and foreigners. This policy was opposed by the President of the New York Fed, Benjamin Strong. After his death in October 1928, his successor George Harrison continued to push for a rise in the discount rate to halt speculation. The stalemate lasted until August 1929 when the discount rate was raise from 5 to 6%, just as the economy was reaching its cyclical peak. This increase came at an inopportune time. Prices were falling making real rates higher. Furthermore, there was evidence of an oncoming recession. Although it was not available until later, the Federal Reserve's index of industrial production first

[23] Friedman and Schwartz, Chapter 6.

dropped in July 1929. In August and September, other indices of economic activity began to fall.

The market peak for the Dow Jones was on September 3. The market started drifting downwards in early October. There were vertical price drops on Black Thursday October 24 and Black Tuesday October 29. With stock prices falling on average over 20%, there were margin calls and distress sales of stock, prompting a further plunge. Out-of-town banks and other lenders withdrew their loans to brokers, threatening a general disintermediation. Into this breach, the New York Fed stepped and quickly encouraged the New York City banks to increase their loans to brokers, made open market purchases, and let its members know that they could freely borrow at the discount window. The direct effects of the crash were thus confined to the stock market. The Fed's prompt action ensured that there was no panic increases in money market rates and no threat to the banks from defaults on brokers' loans. While recognized in hindsight as the correct response, the Board disapproved and censured the New York Fed. In spite of the recession, the Board maintained its tight monetary policy, aggravating the economy's slide and provoking a further decline in the market. The fall in the stock market, reducing household wealth and the value of collateral added to the monetary shock that collapsed the economy (Friedman and Schwartz, 1963).

The Fed's experience in the 1920s has three possible lessons. The first, and the one most subject to debate, is that the Fed should not have loosened policy in 1927, as it may have exacerbated the boom at a time when it could have been restrained. Board member Adolph Miller and many other critics after the crash blamed Strong for permitting an excessive credit expansion (Meltzer, 2003). While even some modern students, including Eichengreen (1992) have concluded that the Fed erred in loosening its policy thereby allowing a surge in the market, it is difficult to see how contemporaries or modern Taylor rules would have justified tightening policy. In fact, monetary growth for the year was quite modest, at a little over 1%. The money stock, currency and demand deposits grew at abut 1.5% (Meltzer, 2003). Also, the economy had hit its peak in October 1926, and most contemporary indicators suggested to the Fed that policy should be eased, as would an increase in the output gap for a Taylor rule.

Although contemporaries worried about speculative excess in the market, mid-1927 is before any of the conventional dating of the stock market boom's beginning. Viewed in Figure 2, the Dow Jones had been at 133 in July 1925, rising to 160 in July 1926. But it was not much high at 166 by the end of June 1927, though it climbed to 182 by end of July 1927. When a tighter policy was discussed in the OIMC meeting of July 27, 1927, it is hard to envision a speculative excess, except perhaps from a "real bills" perspective focused on brokers' loans. Given the complaints even in the mid-1920s of the excess speculation in the OIMC meetings, their upset in 1927 may represent nothing new; and the attacks on Strong after the crash (and his death) suggests a bit of a witch hunt. In terms of the contemporary models that rationalize intervention to halt the market, Bordo and Jeanne's (2002) measure of excessive asset growth does not identify a boom in mid-1927 as worthy of intervention. If an augmented-Cecchetti et.al.-Taylor rule were imposed on policy, it is doubtful that the risk premium would have prompted any change, as equity premium for 1927 in Figure 6 was 4.9%, somewhere near the historic average. The point made by Bernanke and Gertler that booms are ex ante difficult to identify for

policy makers seems hard to refute, and it does not appear possible to draw any strong lesson for policy that recommends early intervention.

The second lesson is that the Fed focused too much on the stock market boom after 1927, eventually ignoring the fact that the economy was entering a recession. As Bordo and Jeanne (2002) suggest, the Fed may have waited too long and intervention at that stage was too costly. However, the continued preoccupation with potential speculative excess after the crash certainly induced the Fed to continue a restrictive policy long after the market had collapsed and the economy was in a steep decline. This lesson certainly has encouraged most central bankers to take a position of "benign neglect" vis-à-vis asset bubbles. The last lesson of the 1930s, long identified and respected, is that the Fed should intervene to prevent a crash from spreading to the rest of the financial system (Friedman and Schwartz, 1963). In 1929, this action clearly halted the spread of shocks to the rest of the system as interest spreads did not widen (Mishkin and White, 2003).

The first two lessons are striking have striking parallels for the 1990s. During the long stock market boom of the nineties, Americans could look back on the previous two decades with satisfaction. The unanticipated inflation of the 1970s and the Fed's decision to wring out inflation in 1979 contributed to distress of financial intermediaries with a wave of bank and saving and loan failures cresting in the mid-1980s. By the beginning of the new decade, banks had increased their capital accounts and strengthened their balance sheets. After a sharp recession in 1990-1991, the economy experienced its longest expansion of 120 months, according to the NBER reference cycles, from March 1999 to March 2001. Real gross domestic product grew at 3.3% and unemployment averaged 5.5%, trending down from a high of 7.9% in 1992 to 4.0% in 2000, with inflation averaging 2.5%. In many respects, the nineties was the most stable post-World War II decade, as the variability of these three key variables was lower than previous decades.[24]

In 1993, the chairman of the Federal Reserve Board, Alan Greenspan announced that the Fed would pay less attention to monetary aggregates than it had in the past, as their behavior did not appear to give a very reliable policy guide. The Fed shifted to interest rate targeting, and in particular the Federal funds rate. Most observers believe that the Fed followed some approximation of a Taylor rule where an increase in core inflation of one percent was met by a greater increase in the Fed funds rate to cool off the economy, and a one percent increase in unemployment (an indicator of future inflation) was countered by a more than one percent decrease in the rate. Using a simple Taylor rule, Mankiw (2003) found that it forecasts policy behavior in the 1990s fairly well. He concluded that given the contemporaneous correlation the Fed did not act pre-emptively, and other issues that inflamed public debate, including fiscal policy "irrational exuberance," and international financial crisis, did not have much influence on the Fed.

In contrast to Mankiw's contention that there "scant evidence" that the stock market had an independent role in the formulation of monetary policy, Cecchetti (2003) claimed that as equity prices boomed, the FOMC adjusted its interest rate targets. Examining the FOMC minutes and transcripts from 1981 to 1997, he measured the relative occurrence of references to the securities markets and found that it rose just as

[24] As measured by the standard deviation. Part of this success may be attributable to policy and part to luck as the size of food and energy price shocks were smaller. See Mankiw (2003).

the equity premium was falling. Estimating an augmented Taylor rule with additional variables, the equity premium for the presence of a bubble and a measure of banking system leverage for financial distress, he found that the FOMC was not simply talking about the market but was adjusting interest rates, where a one percent fall in the equity premium prompted a two-thirds cut in the interest rate. If true, this behavior would represent a major change in policy, though the equity premium may be a proxy for aspects of inflation and output growth not captured by the traditional variables in a Taylor rule. Yet, even if this was Fed policy is seems unlikely that it had much influence on the market.

By the mid-1990s, well before the IT-Nasdaq boom, the bull market raised concerns at the Fed, just as it had become alarmed in 1927-1928 before great surge. In an uncharacteristically bold speech in 1996, Federal Reserve Board Chairman Alan Greenspan castigated the stock market as exhibiting "irrational exuberance." Yet, this jaw-boning, seeming to mimic, the actions of early 1929 was not followed by any action by the Fed to tame the market. In spite of the evidence compiled by Cecchetti (2003), the lesson of intervention in the market may have may have restrained the Fed. In the mid-1990s, the price-earnings ratio was increasing rapidly and yet, all measures of productivity growth at that point showed little reason for expecting a future surge in earnings and dividends. Just as the Fed was stalemated in 1927-1928, so too the Fed after 1996 did not appear to react to the market. But, the Fed certainly would have been wary about trying to deflate one group of stocks in the technology sector without affecting the whole market. Furthermore, the evidence of a productivity upsurge, of which the IT revolution was a part, was beginning to appear, giving the Fed little cause to fear that its low interest rate policy would lead to inflation. The Fed's policy was based in part on the observed rise in productivity growth of which the IT revolution was a part.

Of course, the Fed of the 1990s did not blindly follow a rule. There were, however, two episodes when policy seems to have deviated from simple Taylor rules. The first, occurred when the Fed raised interest rates 3% between February 1994 and February 1995, after a rapid expansion following the 1990-1991 recession. This produced a recession-less "soft landing" and can be characterized as "pre-emptive." Former Board member Alan Blinder described the period from 1966 to mid-1999 as a "period of forbearance" where except for the 1998 financial crisis the Fed did not react to the fast growth of the economy (Blinder, 2003). Following the Asian crisis, it was widely feared that the September 1998 collapse of Long-Term Credit Management (LTCM) a $100 billion hedge fund would panic American financial markets. To manage the short-term liquidity problems, the New York Fed strong-armed the leading New York banks to assist with an orderly liquidation and to reassure the market, while the Fed cut the Fed funds rate three times. Some critics have asserted that this action left policy too loose and allowed the boom in the stock market to take off in its final phase. They argue that it was too late when the Fed finally began to raise interest rates in June 1999. Like the loosening of policy in 1927, this action is sometimes blamed for encouraging an already excessively optimistic stock market. Yet, as after the 1927 episode, it appears clearer in hindsight and there cannot be a strong lesson drawn from these events. The second lesson of the 1920s that the Fed should not become preoccupied by the stock market has been largely absorbed, aided in no small part by a discrediting of the real bills doctrine.

Although the market collapse of the 1990s was epic, it was a matter of deflation rather than collapse, and the third lesson from the 1920s is best seen in the Fed's response to the stock market crash of 1987. In pattern similar to the 1920s, the Fed increased the discount rate from 5.5 to 6% on September 4, which may have contributed to the crash on October 19, 1987. The financial system came under enormous stress as brokers needed to extend a huge amount of credit to their customers who were hit by margin calls. Specialists and traders in stock index futures found it difficult to obtain credit. Fearful that there would be a collapse of securities firms, with ramifications for the clearing and settlements system, Greenspan announced on October 20 that the Fed was ready to serve as a source of liquidity to the financial system. The Open Market desk increase bank reserves by 25% and the Fed pushed commercial banks to supply broker-dealers and others with credit (Mishkin and White, 2003). While interest rate spreads widened at the beginning of the crisis, they quickly diminished. Finally the Fed withdrew most of the high-powered month that it had provided as the crisis subsided.

CONCLUSION

The conclusion I draw from this comparison of the booms and busts of the 1920s and 1990s is that the central bank should not respond to stock market booms. In spite of the spate of recent papers that suggest that an augmented Taylor rule that incorporates some measure of stock market excess has superior properties, Bernanke and Gertler (2001) seem to be correct that it is much more difficult to identify the presence and magnitude of a bubble compared to other policy indicators.

My survey of fundamentals-based equity valuations reveal the enormous difficulty of identification of fundamentals in highly forward looking assets. Yet, little evidence can be mustered to support Shiller's (2000) assertion that the markets are driven primarily by waves of optimism or pessimism. Estimates that apportion the degree to which bubbles determine asset prices relative to fundamentals are at best fragile. Given this impasse, it is not surprising that Shiller does not offer concrete policy proposals. Oddly, "benign neglect" seems to be the accepted policy by both those who favor fundamental and bubble explanations.

The Fed has been blamed for contributing to these two stock market booms. Two instances—in 1927 when the Fed helped Britain stay on the gold standard and in 1998 when the Fed responded to the crisis generated by LTCM—are sometimes used to argue that the Fed should have pursued tighter policy at the bubble's early stage. However, it is hard to regard these very modest stimuli as central to an explanation of the subsequently soaring markets. Furthermore, this criticism has a 20-20 hindsight quality, as potential measures of a bubble that should have alerted policy only appeared in 1928 and 1999.

Fortunately, the Fed in the 1990s was not fixated on speculative credit, as was the Fed of the 1920s and 1930s, saving it from dangerous deviations from the appropriate policy targets of price stability and full employment. The Fed does have a limited but vital role, however, in responding to stock market crashes. When the abruptness of the crash threatens the payments system and intermediation, a classic lender of last resort is appropriate as occurred in 1929 and 1987. In addition, even if the market's descent is slower and the financial system has weak balance sheets, intervention may be appropriate

to prevent a broader financial crisis. But in both of these instances, it is a brief intervention that is required not a shift in the Fed's intermediate or longer-term goals.

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Figure 1
Real S&P Returns 1871-2003
and Twentieth Century Crashes

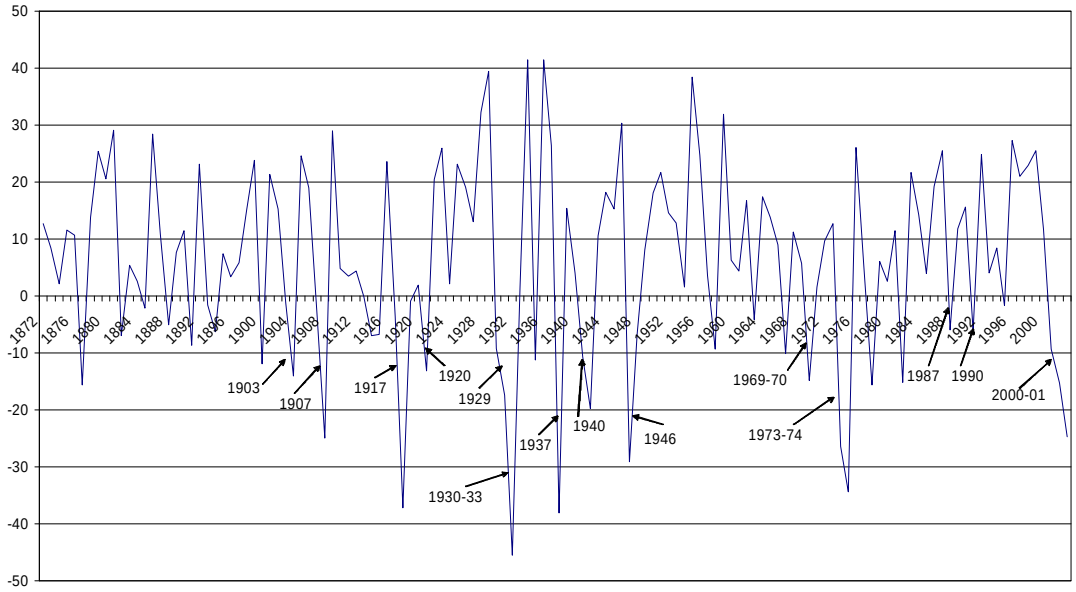

Figure 2
Boom and Bust 1920-1933

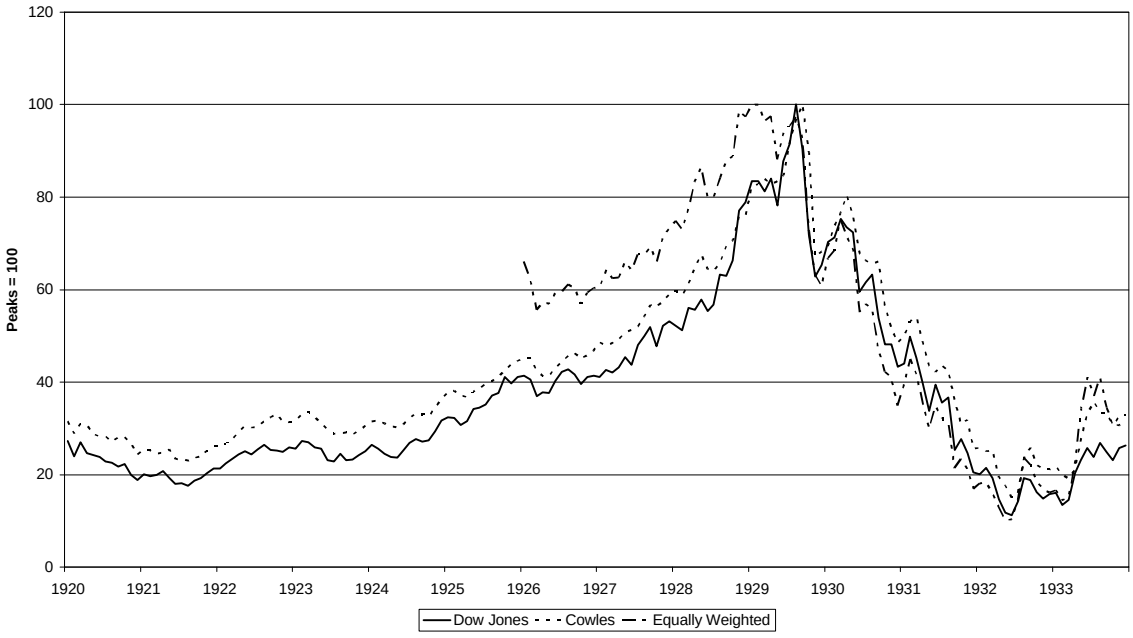

Figure 3
Boom and Bust 1990-2003

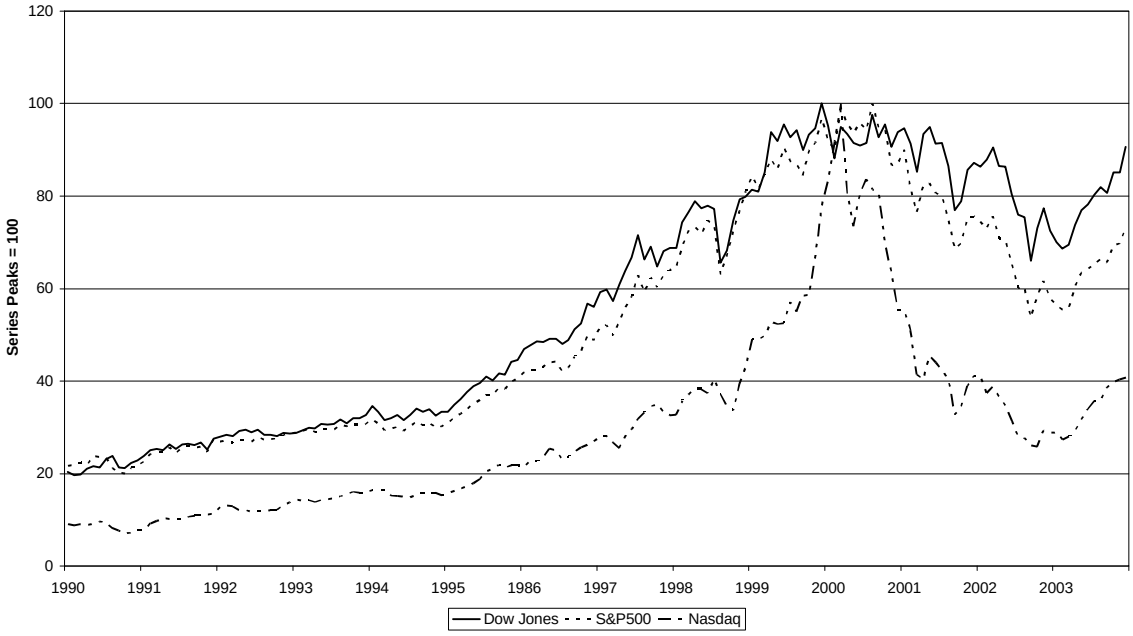

Figure 4
Dividend Yield and Earnings-Price Ratio
1871-2003

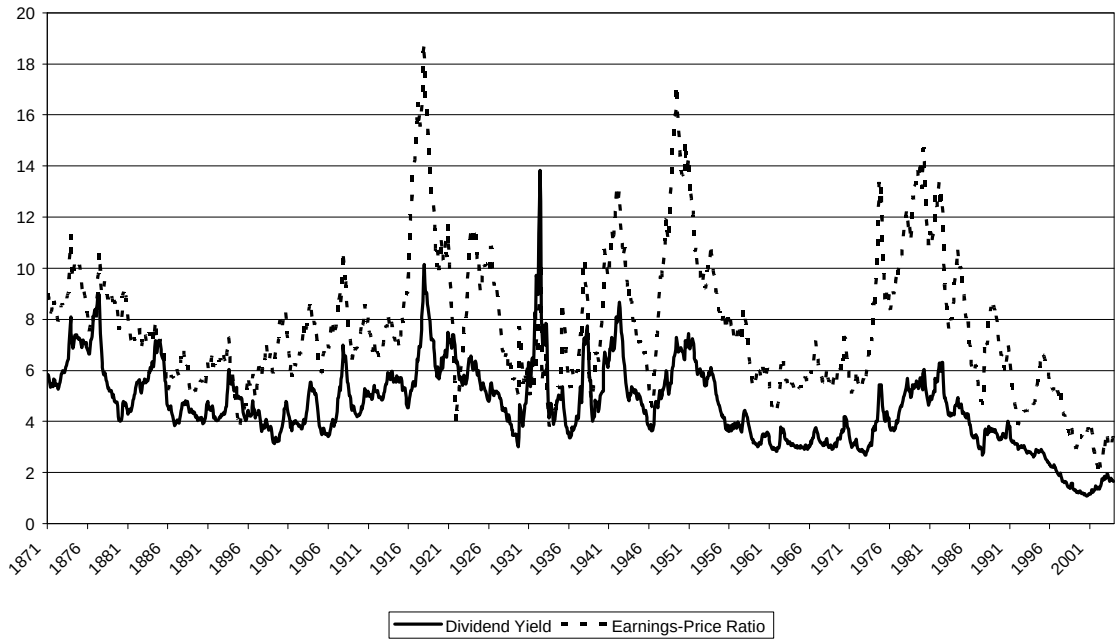

Figure 5
Dividend Earnings Ratio
1871-2003

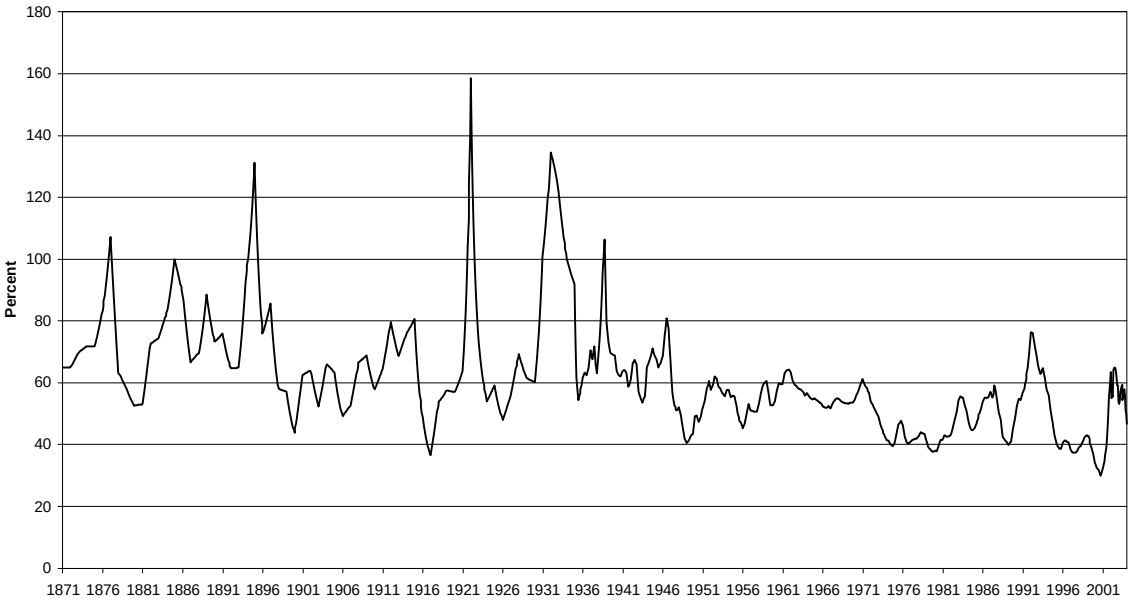

Figure 6
Stock Yield and Equity Premium
1871-2003