working paper 0113

Will the Valuation Ratios Revert to Their Historical Means? Some Evidence From Breakpoint Tests

by John B. Carlson, Eduard A. Pelz and Mark Wohar

FEDERAL RESERVE BANK OF CLEVELAND

Working Paper 01-13 September 2001

Will the Valuation Ratios Revert to Their Historical Means? Some Evidence From Breakpoint Tests

by John B. Carlson, Eduard A. Pelz and Mark Wohar

If valuation ratios return to their historical means any time soon, then either equity prices must fall substantially or earnings and dividends must accelerate sharply, or some combination of these events must happen. Historical patterns over the past century or so suggest that stock prices will fall to align valuation ratios with their means. Of course, the means of the valuation ratios could have changed. To assess the likelihood of such changes, the authors employ breakpoint tests on the means of the valuation ratios. The test procedures employed allow for multiple breakpoints at unknown break dates. The authors also review alternative explanations for changes in the ratios. Although no single explanation may be convincing by itself, taken *in toto* with empirical evidence of structural change, the authors conclude that the preponderance of evidence suggests that the mean of the dividend-price ratio is now somewhere between 1% and 2%, probably nearer to 1%. They also conclude that the mean price-to-earnings ratio is now somewhere between 20 and 25, perhaps even higher.

JEL Codes: G12
Key Words: price-earnings ratio, dividend price ratio, asset pricing

John Carlson is an Economic Advisor at the Federal Reserve Bank of Cleveland and may be reached at John.B.Carlson@clev.frb.org.
Eduard A. Pelz is Senior Economic Research Analyst at the Federal Reserve Bank of Cleveland and may be reached at Eduard.A.Pelz@clev.frb.org
Mark E. Wohar is Enron Professor of Economics at the University of Nebraska at Omaha and may be reached at wohar@unomaha.edu.

Stock market participants experienced both exhilaration and disappointment during the past decade. Their experience accompanies a great debate on stock market valuation. At one end, we find a perspective based on examining 130 years of historical experience, well documented by Shiller [2000] and Campbell and Shiller [1998, 2001]. This view argues that the stock market is substantially overvalued, even after its recent correction. At the other end, we find a view based on assessing supposed economic fundamentals. Glassman and Hasset [1999], for example, argue that historically the market has been undervalued, and was so even at its most recent peak. According to them, investors have become calmer and smarter and now value stocks at levels more commensurate with their inherent risk. For this view, history is irrelevant. In the middle we find a plethora of stories that identify a variety of potential sources of change in fundamentals.[1]

The crux of the issue is conveniently summarized in the behavior of valuation ratios such as the dividend-price ratio and the price-earnings ratio, particularly the latter. Exhibits 1 and 2 illustrate an apparent stability in these series over long periods of time. Both series have tended to revert to some historical norm. This characteristic—"mean reversion"—is the essential basis of the bearish outlook recently reaffirmed in Campbell and Shiller [2001]. As in their earlier work, they show that deviations from these norms have provided valuable forecasting information for future stock prices. When the P-E ratio has been above its historical mean, stock prices tended to fall. Likewise, when the D-P ratio has been above its mean, stock prices tended to rise.

Such historical yardsticks do breakdown, even after 130 years. Campbell and Shiller [2001] stress, however, that mean reversion in the valuation ratios and the forecasting relationships based on this property were not discovered yesterday. Rather, mean reversion has been recognized and continually discussed as a forecasting tool over the last century. On one hand, they note, "The very fact that ratios have moved so far outside their historical range poses a challenge, however, both to the traditional view that stock prices reflect rational expectations of future cash flows, and to our view that they are substantially driven by mean reversion." [2001, p. 26.] On the other hand, they argue that it is unwise to dismiss evidence of mean reversion:

"There is no purely statistical method to resolve finally whether the data indicate that we have entered a new era, invalidating old relations, or whether we are still in a regime where ratios will revert to old levels." [2001, p. 26.]

Below, we examine this latter issue more closely. Specifically, we apply some recently developed breakpoint test procedures to determine if purely statistical evidence is silent on the issue. We find strong evidence of structural change in the mean of the D-P ratio in recent years using both quarterly and annual data. Because substantial movements away from the historical mean occur late in the sample, annual data are not sufficient to provide an unambiguous test for a mean break in the P-E ratio. Quarterly data since 1945, however, do provide strong statistical evidence of a simple upward break in mean. We argue that the preponderance of evidence indicates that the new mean P-E ratio is now substantially higher.

1. Implications of Mean Reversion.

Campbell and Shiller's pessimistic scenario is predicated on a rather strong assumption about the stability of the valuation ratios. Mean reversion implies the ratios fluctuate around some approximate long-run mean values. Stability implies that the means are relatively unchanged over time. Campbell and Shiller stress the important implication for mean reversion if a valuation ratio is stable: when a ratio is above or below its mean, either the numerator, denominator, or both must adjust in a direction that restores the ratio to a more normal level. Thus, they argue, either the numerator, denominator, or both must be forecastable based on the ratio. For example, a high D-P ratio must forecast some combination of below-normal dividend growth and above-normal price appreciation. Similarly, a high P-E ratio must forecast some combination of above-normal earnings growth and price decline if not lower price appreciation.[2]

Various simple efficient-market models imply that the ratios should be useful in forecasting dividend growth and earnings growth but not future stock prices changes.[3] Using scatter plot analysis, Campbell and Shiller [1998, 2001] provide a battery of evidence that

demonstrates valuation ratios *have been* historically useful for forecasting stock price changes.[4] Also, contrary to the predictions of efficient-market models, the ratios do poorly in forecasting dividend and earnings growth. Moreover, valuation ratios have little forecasting value for productivity growth. They conclude that the data refute simple efficient-market models, such as the random-walk model. Evidence contrary to market efficiency implies an irrational element and suggests recent valuations may be explained by irrational exuberance.

Moreover, historical experience suggests that recent record-low dividend yields and high P-E ratios imply a sharp fall in stock prices. More precisely, Campbell and Shiller's estimates portend that the next time the dividend yield crosses its historical mean again (if it indeed happens), the stock market would be 75% below its market value at the time of their calculation. On the basis of their fixed-horizon estimates, the recent record low dividend yield implies a real decline in the stock market of 55% over the next ten years. Though the dividend yield has been a widely used ratio for market timing, Campbell and Shiller note that it has the disadvantage that its behavior can be affected by shifts in corporate finance policy.[5] We return to this issue shortly.

They then turn their attention to the P-E ratio. There, too, they find that mean reversion implies a substantial overvaluation of stock prices, although they offer no explicit quantitative estimate. While Campbell and Shiller acknowledge the likelihood of a structural change in the D-P ratio, they do not concede much on the possibility of a change in the mean of the P-E ratio.

We do not take issue with the implication of the Campbell and Shiller results for assessing market efficiency historically. Our interpretation of the spirit of their paper—that going forward, mean reversion will continue to provide relevant information about stock prices—seems agreeable to us. Where we differ is the extent to which we believe fundamentals have changed the mean levels of the valuation ratios.

Campbell and Shiller conclude that no purely empirical evidence can indicate that the means have changed, especially regarding the P-E ratio. We find, on the other hand, reasonably strong empirical evidence that the ratio means have changed substantially. This evidence is based

on the premise that over periods of time the ratios are well behaved, that is, they have some relatively stable structure, which allows us to identify statistically significant changes in that structure.

Unfortunately, the change in structure we find occurs near the end of our sample, making it difficult to quantify the recent magnitudes precisely. Moreover, estimates of valuation ratio means have been affected by other transitory factors, such as the 1970s inflation episode. We argue that the episode obscured an upward shift in the P-E ratio in the latter part of this century.

2. Testing for Structural Changes in the Valuation Ratios

To test for structural change in the valuation ratios, we use procedures suggested by Bai and Perron [1998]. These procedures are particularly well suited for the question at hand. First, they provide rigorous tests for *multiple* breakpoints at *unknown* break dates, allowing the data to reveal the timing of any potential change in structure instead of imposing it. This feature makes the testing procedure particularly suitable as a "purely empirical" approach.

2.1 Evidence of Structural Change in the Dividend-Price Ratio

We test for structural change using annual data from 1872 and quarterly data from 1945. Exhibit 3 presents the test statistics, and exhibits 4 and 5 (annual sample from 1872 and quarterly from 1945) illustrate the findings for the D-P ratio. Using Shiller's annual series, the data do not reject the hypothesis that there were two downward breaks, one in 1955, and another in 1982.[6] The Bai-Perron procedure, however, requires the user to specify a lower limit on the distance between breakpoints—stated in terms of a fraction of sample length. For sample sizes of between 100-200 observations, Bai and Perron recommend break fractions of no less than 15%.[7] Given our sample size of 130, we choose the 15% break fraction, which corresponds to a break period of no less than 19 years over the whole sample used by Shiller.[8] Given that the recent decline in the D-P ratio occurred in the 1990s, we are not surprised that the annual data fail to find a third break.

Using quarterly data beginning in 1945, the Bai-Perron tests reveal a downward break, in 1992:IVQ.

Two of the break dates that we find occur around times of well-understood "permanent" changes in dividend policy. For example, Siegel [1998] documents the early postwar change, showing that the decline in dividend yields was associated with higher dividend growth—consistent with unchanged valuation in the standard approach. The rise in dividend per share growth, however, reflected the fact that dividend reinvestment provided the same return on the retained earnings, leaving total return unchanged, and thus corroborating a change in corporate finance policy.

Siegel notes that the shift in dividend policy led many investors to expect a catastrophic market decline. This view climaxed in 1958 when the dividend yield fell below the bond yield for the first time in history. Siegel describes the alarm evident in the market commentary in the wake of the yield reversal: "*Business Week* noted this even in an August 1958 article entitled 'An Evil Omen Returns,' warning investors that when yields on stocks approached those on bonds, a major decline was in the offing" [1998, p. 71]. Subsequently, the D-P ratio remained *permanently* below bond yields. Siegel concludes that benchmarks for valuation are valid only as long as economic institutions do not change.

The 1992 break in the quarterly D-P ratio is also corroborated by independent evidence of an institutional change. It is well known that around the mid-1990s firms began to shift their payout policies increasingly away from paying dividends to the more tax favorable share repurchases. When a firm repurchases its shares, it reduces the number of shares outstanding; thus, share repurchases increase future *per share* earnings even if total earnings remain unchanged. The corresponding boost to earnings per share is sometimes called the repurchase yield.

Cole, Helwege, and Laster [1996] construct an estimate of this yield and suggest that dividend yields were 0.8% lower in 1996 than they would have been if payout policies had not

changed. Liang and Sharpe [1999] develop this adjustment to take into account that some shares repurchased are in anticipation of expected dilution related to exercising of stock options. Using a sample of the 144 largest firms in the U.S., they estimate that repurchases net of retirements averaged about 1% of share value from 1994-1998 and argue that this may persist in the range of 0.5-1.0%. Furthermore, Fama and French [2001] also find that the downward trend in dividend yields is permanent.

The import of our empirical analysis is that purely statistical tests like the Bai-Perron test provide strong evidence of structural change in the D-P ratio. Moreover, the break dates correspond to well-documented changes in dividend policies. Though recent changes in dividend policies can be reversed in principle, it seems unlikely since the tax structure favors stock repurchases over dividend repayments. Based on the quarterly data, we expect a mean D-P ratio of less than 2% going forward.

2.2 Evidence of Structural Change in the Price-Earnings Ratio

Despite tax implications, corporate finance policies above have little implication for price-earnings ratios unless investment policies are affected. The institutional changes discussed above essentially wash out. Consider a general interpretation of simple Gordon growth formula:

$$(1) \qquad P_{t+1} = \frac{(1+g)D_t}{r-g}$$

where *D,* is defined as a total payout (including dividends and share repurchases), *r* is the required return, and *g* is the growth rate of earnings. If *D* is equal to some fixed proportion of earnings (αE), the P-E ratio equals:

$$(2) \qquad P_{t+1} / E_t = \frac{(1+g)\alpha}{r-g}$$

If the *total* payout ratio (α) is unchanged, the price earnings ratio is unaffected by the form of payout (dividend or share repurchase). Lower dividend yields are matched by higher "repurchase

yields" leaving the valuation unchanged. Thus, according to this simple analysis, corporate finance policies should not be manifested in structural change of the P-E ratio.[9]

Structural change can occur, however, if there are permanent changes in the other parameters. For example, advocates of the view that the equity premium is shrinking would argue that *r* has fallen as investors have come to realize that stocks have historically been a great bargain (see Siegel [1998]). Thus, one might expect an upward shift in the mean of P-E ratio to a level substantially higher than its historical average.

Do the data speak on this issue? Exhibit 6 presents the Bai-Perron test statistics on both annual and quarterly data. We use the ratio of current price relative to the past year's earnings. Campbell and Shiller emphasize the ratio of current price relative to average earnings for the past 10-years. It should be evident that structural changes due to permanent shifts in parameters of equation (2) affect the means of both measures in a similar fashion.

Surprisingly, we find no break in the annual data. (We find but do not report a break in the 10-year average earnings P-E ratio in 1982 at the 10% level of significance.) The quarterly data, however, reveal an upward break late in the sample (1992:QIV, see exhibit 7) consistent with several explanations for the recent ascent in stock prices. The P-E ratio has averaged 23.7 since then and thus generally supports the shrinking equity premium hypothesis. But what can we make of the conflicting results?

The quarterly data provide a substantial increase in the number of observations—almost double—allowing greater precision of test statistics. Moreover, the higher data frequency accommodates a shorter break period of approximately 8 years. The break, which comes near the end of the period, occurred 10 years ago, exceeding the minimum break distance allowed by the test using quarterly data, but substantially shorter than the 19-year-break fraction allowed using annual data. (The estimated break date in the 10-year average earnings P-E ratio noted above occurs as close to the end of the sample as the 19-year break fraction allows.) We stress the

implication that the test found *no other 8-year interval* within the past 56 years that was as extraordinary as the past 10 years.

We conclude that that the mean P-E ratio has increased substantially. Nevertheless, we do not dismiss the results based on the annual data. Did we find evidence of a natural law—a Shiller constant?

In Carlson, Pelz and Wohar [2001] we examine some empirical issues concerning the Bai-Perron tests when applied to the annual data. We find evidence that the autocorrelation changes substantially around 1945, with persistence also increasing substantially. This is evident in figure 2 as the P-E ratio crosses its mean less frequently in the latter part of the sample.[10]

We find that the increased persistence in the P-E ratio relates in part to the persistence of inflation in the 1970s.[11] Exhibit 8 illustrates the relationship between inflation and the P-E ratio over the whole sample period. We also find that the relationship between the P-E ratio and inflation changes in the postwar era. We thus conclude that persistent inflation in the 1970s may have obscured an upward shift in the P-E ratio. Jones [2000] concludes that due to falling transactions costs, the equity premium fell by one percentage point over the past century. This might be associated with a gradual upward drift in the P-E ratio. The more rapid fall in shareholder costs since 1990 thus corresponds to the more recent and substantial increase in the P-E ratio.

3. A Synthesis of Empirics and Explanations

Finding evidence of structural changes is one thing, assessing implications for the future is another. The latter requires some convincing explanation—either economic or institutional. For example, we have already discussed how corporate payout policies can have a "permanent" effect on the D-P ratio. More precisely, these policies have reduced the D-P ratio's mean. The mean changes because new policies are presumed to be in some sense permanent. Of course, such policies could be reversed and the old means could again become relevant.

This suggests that it is useful to treat valuation-ratio means as conditional on other fundamental factors. Thus, when applying Campbell and Shiller's scatter plot analysis, one would want to adjust the valuation ratio means to account for the changing policies. Campbell and Shiller [2001] recognize this and suggest adjusting the recent D-P ratio upward. They add the Liang and Sharpe [1999] estimates of net share retirements in 1997 and 1998 to the dividend yields in those years. They conclude that such an adjustment to the D-P ratio accounts for only a small portion of the recent deviation and hence, is not a sufficient explanation for the abnormal valuation in recent years. We consider alternative explanations, which affect both valuation ratios—tending to increase the mean P-E ratio and to lower the mean D-P ratio.

3.1 Transactions Costs and Increased Diversification.

Advances in information and telecommunications technology have greatly reduced the costs associated with asset transactions, enhancing net returns and making asset markets more accessible to greater numbers of investors. To appreciate the potential quantitative effect it is useful to recast equation (2) as follows:

$$(3) \qquad P_{t+1} / E_t = \frac{(1+g)\alpha}{r_G - g},$$

where r_G (expected gross real return) is equal to $(1+\tau)r_N$, τ is some measure of the transactions cost in terms of the yield, and r_N is the net return. Siegel [1999] documents that gross real returns on equity r_G have historically been about 7%. He argues that though this approximates the real return on equity indexes, it does not represent the *realized* return to the equity holder. He focuses on two reasons: transactions costs and diversification.[12]

In the framework above, it is net return that matters to the investor. Thus, falling transactions costs (τ) should be associated with a decrease in required gross returns and hence, a higher P-E ratio. Siegel [1999] notes that the advent of mutual funds has substantially lowered the cost of holding a diversified portfolio—especially since the introduction of index funds. Rea and Reid [1998], for example, estimate that the average annual fee for equity mutual funds

declined 76 basis points between 1980 and 1997. Moreover, index funds with annual costs of less than 20 basis points are now available to small investors.

Further, Siegel argues, that prior to the availability of low-cost mutual funds, the risk-return trade-off was less desirable than that calculated from stock indices. On a risk-adjusted basis, historical returns have a lower expected return than the total market. He infers that equity investors experienced real (net) returns in the neighborhood of 5% to 6% over most of the nineteenth and twentieth centuries in contrast to historical returns of 7%.[13] Siegel notes that a 20 price-to-earnings ratio corresponds to a real return of 5%.

A related explanation emphasizes the demographic effects of the baby boomers. In the 1990s, the baby-boomer cohort reached the wealth-building years of its life cycle, increasing the demand for stocks relative to past cohorts. One variation of this view holds that boomers are willing to pay higher prices for stocks than previous cohorts. A key reason is that baby boomers are the first generation to fully appreciate the historical undervaluation of equities.

Indeed, economists have been puzzled by the historical equity premium ever since Mehra and Prescott [1985] showed that the premium is too high to reconcile with independent estimates of risk aversion based on micro data. Siegel [1998] presents compelling evidence that stocks yield better returns than alternative assets when held over long periods even. His analysis was perhaps the first widely accessible evidence of the favorable risk-adjusted returns from holding stocks over long periods and may have increased public awareness of the value of a diversified stock portfolio. For many small investors, this evidence was an epiphany, illustrating clearly and forcefully the advantages of a buy-and-hold strategy for equities.

Heaton and Lucas [1999] and Vissing-Jorgenson [1998] show that broader participation and greater diversification can account for a decrease in expected return and hence an increase in the P-E ratio. Heaton and Lucas's estimates suggest that such effects might account for only about half of the difference between a P-E ratio of around 32 (as measured by accounting

earnings) and the historical mean of 14.5. Based on a standard valuation approach, Siegel [1999] estimates that a prospective return of 5% is consistent with a P-E ratio of around 20.

In assessing the implications of falling transactions costs on the future mean of the P-E ratio, it is useful to distinguish between a "permanent" structural change and a highly persistent, but transitory one. The explanations discussed above suggest "permanent" changes in the valuation ratios. For example, lower transactions costs result largely from advances in technology and are hence not likely to be reversed. Neither is increased diversification. Thus, to the extent that higher P-E ratios are driven by lower transactions costs and increased diversification, the P-E ratio mean should be permanently higher.

Of course, other factors could become "permanent" and offsetting. For example, policymakers have from time to time proposed a transactions tax on asset trading to discourage high frequency speculation. Such a tax, however, would not have much effect on the returns of a buy-and-hold strategy.

3.2 The inverse relationship between inflation and the P-E ratio

An alternative explanation for the recent ascent in stock prices (and high mean P-E ratio) focuses on the decline in inflation seen since the early 1980s. (See Modigliani and Cohn [1981], Ritter and Warr [1999] and Sharpe [1999]). The argument is as follows: If there are nominal rigidities in the economy such that nominal dividend or earnings growth do not move one-for-one with inflation, then increases in inflation will result in a decline in expected real dividend (or earnings) growth. Ritter and Warr [1999] suggest that stock prices rise because investors confuse nominal and real returns.

Sharpe [1999] has argued that the high earnings forecasts of analysts and investors may reflect the fact that they have not adjusted their nominal earnings forecasts for the effects of declining inflation (a form of money illusion first noted by Modigliani and Cohn [1979]). Thus, the decline in inflation that has occurred since 1983 may be reflected in an increase in the

expected growth rate of earnings (g) in equation (1), increasing the P-E ratio and decreasing the D-P ratio respectively.

In Carlson, Pelz and Wohar [2001], we find a statistically significant inverse relationship between inflation and the P-E ratio. Our estimates show that the elasticity of the P-E ratio with respect to inflation has become more negative since 1945. On the basis of the postwar sample, an inflation rate between 0% and 2% implies a mean P-E ratio of 21% to 17%. Hence to the extent that monetary policy may contain inflation in this range, one should expect higher P-E ratios.

3.3 Other Explanations

Hall [2000] argues that earnings have become increasingly understated in recent years because much of the investment in the new economy is in intangible capital, which, for accounting purposes, is treated as a current expense. McGrattan and Prescott [2001] estimate that corporate earnings correctly measured to account for investments in intangible capital would be 27% higher. They conclude that the stock market is appropriately valued, suggesting a P-E ratio mean in the neighborhood of its recent levels.

4. Assessing the Evidence

When it comes to assessing the evidence *in toto*, it is useful to draw an analogy from law—where evidentiary requirements for proof differ in criminal versus civil cases. In the former, the rules of evidence require juror belief beyond a reasonable doubt. In the latter, a proof only requires juror belief founded on the preponderance of evidence. We believe that neither side of the valuation debate can be refuted beyond a reasonable doubt. Basing our assessment on the preponderance of evidence, we conclude that going forward valuation ratios will tend to revert to norms substantively different from historical levels. Given that much of the structural change in the ratios has occurred within the last decade, the experience is too limited to offer precise estimates. Rather, we offer reasonable ranges for the new norms.

In the case of the D-P ratio, we find the evidence supports a mean between 1% and 2%, probably lower than higher. As we have seen, such a projection hinges on corporate finance policies. But recent changes in corporate finance policies are not sufficient to explain the magnitude of decline encompassed in our range. Other factors must also be at play. Evidence of substantially lower transactions costs and increased diversification tend to support a lower D-P ratio and higher P-E ratio. Moreover, continued low inflation can also corroborate such changes.

Campbell and Shiller find neither of these explanations persuasive. They argue that most equity is now and always has been controlled by wealthy people who have faced few barriers to stock market participation and diversification. Moreover, they argue that correlation between stock prices and inflation is much stronger before the mid-1990s than during the last 5 years. But how convincing are such correlations in light of the fact that inflation has not varied much in the latter period? Clearly, the long-term evidence indicates that inflation is bad for the stock market.

Campbell and Shiller also argue that the association between stock prices and inflation seems to fly in the face of the efficient-market theory because it is generally assumed that stock prices reflect future real dividends discounted at a constant real interest rate. It may be, however, that inflation introduces inefficiencies in the economy that lead to lower growth.[14] That this is true and recognized seems evident from the number of central banks that have elevated price stability to their primary objective. It is difficult to explain the increasing incidence of inflation targeting around the world otherwise.

Arguments such as those raised by Campbell and Shiller call into question the ability of any one explanation to account for a substantial increase in the P-E ratio norm. When explanations are taken together, however, and in light of our purely empirical result, we find that the preponderance of evidence suggests a higher P-E ratio norm—in a range between 20 and 25, perhaps even higher.

5. Conclusion

This paper had two primary objectives. The first was to examine whether purely statistical methods provide any evidence of structural change in valuation ratios. We apply the Bai-Perron [1998] breakpoint test procedure and find two downward break points in the D-P ratio, one in 1955 and a second in 1982, using annual data. Using quarterly data from 1945, we find one break in 1992:QIV. These breaks are consistent with permanent downward shifts in the mean of the D-P ratio that can be corroborated with evidence of changes in corporate finance policy. We also find evidence of one upward break in the quarterly mean P-E ratio around 1990, about the time that shareholder costs began falling sharply for stock mutual funds.

Our second objective was to assess the magnitude of the structural change in light of economic and institutional explanations. Although no single explanation may be convincing by itself, taken *in toto* with empirical evidence of structural change, we conclude that the preponderance of evidence suggests that the mean of the D-P ratio is now somewhere between 1% and 2%, probably nearer to 1%. We also conclude that the mean P-E ratio is now somewhere between 20 and 25, perhaps even higher. Thus, unlike Campbell and Shiller we do not find current values of the S&P 500 to be alarming. In light of the recent stock market correction, stabilization at current levels is comforting.

Our results need to be qualified, however. Historical experience reveals that persistent, high inflation has been bad for equities. When high inflation persists, stock prices fall relative to current earnings. Thus, our estimated range for the P-E ratio is predicated on an assumption that monetary policy will avoid the kinds of past mistakes that led to large, persistent inflations and deflations. Increasing use of inflation targets by central banks worldwide offers some corroboration for such an assumption.

One should think of the P-E ratio as a stochastic process that will continue to cycle, but within a higher range. Thus, substantial fluctuations in valuation ratios—albeit around a higher mean—will continue to support Campbell and Shiller's contention that markets are less than

perfectly efficient. The recent Nasdaq bubble illustrates that mean reversion in P-E ratios is still alive and well. Unsustainably high P-E ratios provided the basis for Siegel's [2000] warning about excess valuation in large-cap tech stocks. That warning was validated by the subsequent precipitous decline in the P-E ratios of those stocks.

It is important to stress that looking back 20 years from now, our analysis suggests that stock *gross* real equity returns will likely average between 4% and 6% over long holding periods, significantly lower than the historical return of 7%. Thus, future returns would still range above the recent return on inflation-protected Treasury bonds, (a reasonable benchmark for a risk-free security, see Siegel [1999]). Given that surveys indicate that many investors continue to expect returns at historical levels or even higher, one might expect some disappointment ahead, but no disaster.

Endnotes

[1] See Heaton and Lucas [1999], Siegel [1999], Liang and Sharpe [1999], Carlson and Pelz [2000], and Balke and Wohar [2000a, 2000b].

[2] Campbell and Shiller [1988] develop a cogent analysis of dividend forecasts in the context a log-linearized representation of the efficient markets theory. For a textbook treatment, see Campbell, Lo, and MacKinlay [1997].

[3] More precisely Campbell and Shiller [2001] focus on the random-walk version of the efficient-markets theory, noting that the unpredictability of returns under the theory is essentially tantamount to the unpredictability of stock prices.

[4] Campbell and Shiller [1998, 2001] and Shiller [2000] focus on price earning ratio.

[5] See Cole Helwege and Laster [1996], Liang and Sharpe [1999], and Campbell and Shiller [2001].

[6] $SupF_T(1)$ denotes the F-statistic for testing the null of no breaks against the alternative of 1 break. $SupF_T(k+1|k)$ denote the F-statistic for testing the null of k breaks against the alternative of k+1 breaks. We present the Bai-Perron test statistics of the sequential test under the global null as suggested by Bai and Perron, that is, if the null of no breaks is rejected, then the number of breaks is determined by looking at the sequential $supF_T(k+1|k)$ statistics.

[7] Bai and Perron base this on Monte Carlo simulation results in Bai and Perron [1998].

[8] We also look at a minimum break fraction of 0.1 or 13 years and test for changes in the mean of the log values of the ratios. The results are consistent with the findings reported here and are available on request.

[9] Liang and Sharpe [1999] note that when corporations use stock option grants as a form of compensation, the implicit cost is not deducted from earnings. Thus, their growing importance has also created distortions in earnings-based valuation measures such as the P-E ratio. Liang and Sharpe estimate that excluding the value of option grants from expenses boosts annual earnings growth by an average of 1½-percentage points from 1994 to 1998. Given space limitations we ignore these effects here.

10 The Bai-Perron test includes an option that constructs the covariance matrix along the lines of Andrews [1991]. This option yields tests that are robust to autocorrelation.

11 Balke and Wohar [2000b] find evidence that the log of the 10-year average earnings P-E ratio is nonstationary over the period 1881-1999 using unit root tests.

[12] Siegel recognizes that taxes are also relevant but abstracts from this factor given his focus on the equity premium.

[13] Siegel focuses on developing a case for a shrinking equity premium. We are concerned here only with the effects on the P-E ratio.

[14] Of course one must be cautious about attributing causation from changes in inflation to changes to stock prices. Favorable supply shocks decrease inflation. While low inflation and high stock prices may be inversely related, it may be that stock prices increase as a result of increases in productivity which lead to increases in earnings and/or dividend growth.

REFERENCES

Andrews, Donald. "Heteroskedasticity and Autocorrelation Consistent Covariance Matrix Estimation." *Econometrica*, May 1991, pp. 817-58.

Bai, Jushan, and Pierre Perron. "Estimating and Testing Linear Models with Multiple Structural Changes." *Econometrica*, January 1998, pp. 47-78.

Bai, Jushan, and Pierre Perron. "Computation and Analysis of Multiple Structural Change Models." Working Paper, 1998.

Bai, Jushan. "Estimating Multiple Breaks One at a Time." *Econometric Theory*, December 1997, pp. 315-352.

Balke, Nathan S., and Mark E. Wohar. "Low Frequency Movements in Stock Prices: A State Space Decompostion." Working Paper, 2001.

Balke, Nathan S., and Mark E. Wohar. "Why Are Stock Prices So High: The Case for Fundamentals?" Working Paper, 2001.

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

Campbell, John Y., and Robert J. Shiller, "Valuation Ratios and the Long-Run Stock Market Outlook: An Update." NBER Working Paper 8221, April 2001.

Campbell, John Y., and Robert J. Shiller. "Valuation Ratios and the Long-Run Stock Market Outlook." *Journal of Portfolio Management*, Winter 1998, pp. 11-26.

Campbell, John Y., and Robert R. Shiller. "Stock Prices, Earnings, and Expected Dividends." *Journal of Finance*, July 1988, pp. 661-676.

Carlson, John B., Eduard A. Pelz, and Mark E. Wohar. " Empirical Issues in Estimating Breakpoints in Valuation ratios, Working Paper, August 2001.

Carlson, John B., and Eduard A. Pelz. "Investor Expectations and Fundamentals: Disappointment Ahead?" *Economic Commentary*, Federal Reserve Bank of Cleveland, May 2000.

Cole, Kevin, Jean Helwege, and David Laster. "Stock Market Valuation Indicators: Is This Time Different?" *Research Paper* 9520, Federal Reserve Bank of New York, September 1995.

Fama, Eugene, and Kenneth French. "The Equity Premium." Working Paper, January 2001.

Glassman, James, and Kevin Hassett. *Dow 36000: The New Strategy for Profiting from the Coming Rise in the Stock Market*. New York: Times Business, l999.

Hall, Robert E. "Struggling to Understand the Stock Market." The Richard T. Ely Lecture, *American Economic Review* May 2001, pp 1-23.

Heaton, John and Deborah Lucas. "Stock Prices and Fundamentals." *NBER Macroeconomics Annual*, 1999, pp. 213-262.

Jones, Charles. "A Century of Stock Market Liquidity and Trading Costs." Working Paper, Columbia University, November 2000.

Liang, J. Nellie, and Steven A. Sharpe. "Share Repurchases and Employee Stock Options and Their Implications for S&P 500 Share Retirements and Expected Returns." *Finance and Economic Discussion Series* 1999-59, Board of Governors of the Federal Reserve, November 1999.

Mehra, Rajnish, and Edward Prescott. "The Equity Premium: A Puzzle." *Journal of Monetary Economics,* March 1985, pp. 145-61.

Modigliani, Franco, and Richard Cohn. "Inflation and the Stock Market." *Review of Financial Conditions in Italy*, October 1981, pp. 415-31.

Modigliani, Franco, and Richard Cohn. "Inflation, Rational Valuation and the Market." *Financial Analyst Journal*, March-April 1979, pp. 24-44.

McGrattan, Ellen R., and Edward C. Prescott. "Is the Stock Market Overvalued?" *Quarterly Review* Federal Reserve Bank of Minneapolis, Fall 2000, pp. 20-40.

Rea, John, and Brian Reid. "Trends in the Ownership Costs of Equity Mutual Funds." *Perspective*, Investment Company Institute, November 1998, pp. 1-12.

Ritter, Jay, and Richard Warr. "The Decline of Inflation and the Bull Market of 1982 to 1997." Working Paper, University of Florida, June 1999.

Sharpe, Steven. "Stock Prices, Expected Returns, and Inflation." *Finance and Economic Discussion Series* 1999-2, Board of Governors of the Federal Reserve, July 1999.

Shiller, Robert. *Irrational Exuberance*. Princeton: Princeton University Press, 2000

Shiller, Robert. *Market Volatility*. Cambridge: MIT Press, 1989.

Shiller, Robert. "Stock Prices and Social Dynamics." *Brookings Papers on Economic Activity*, 1984, pp. 457-498.

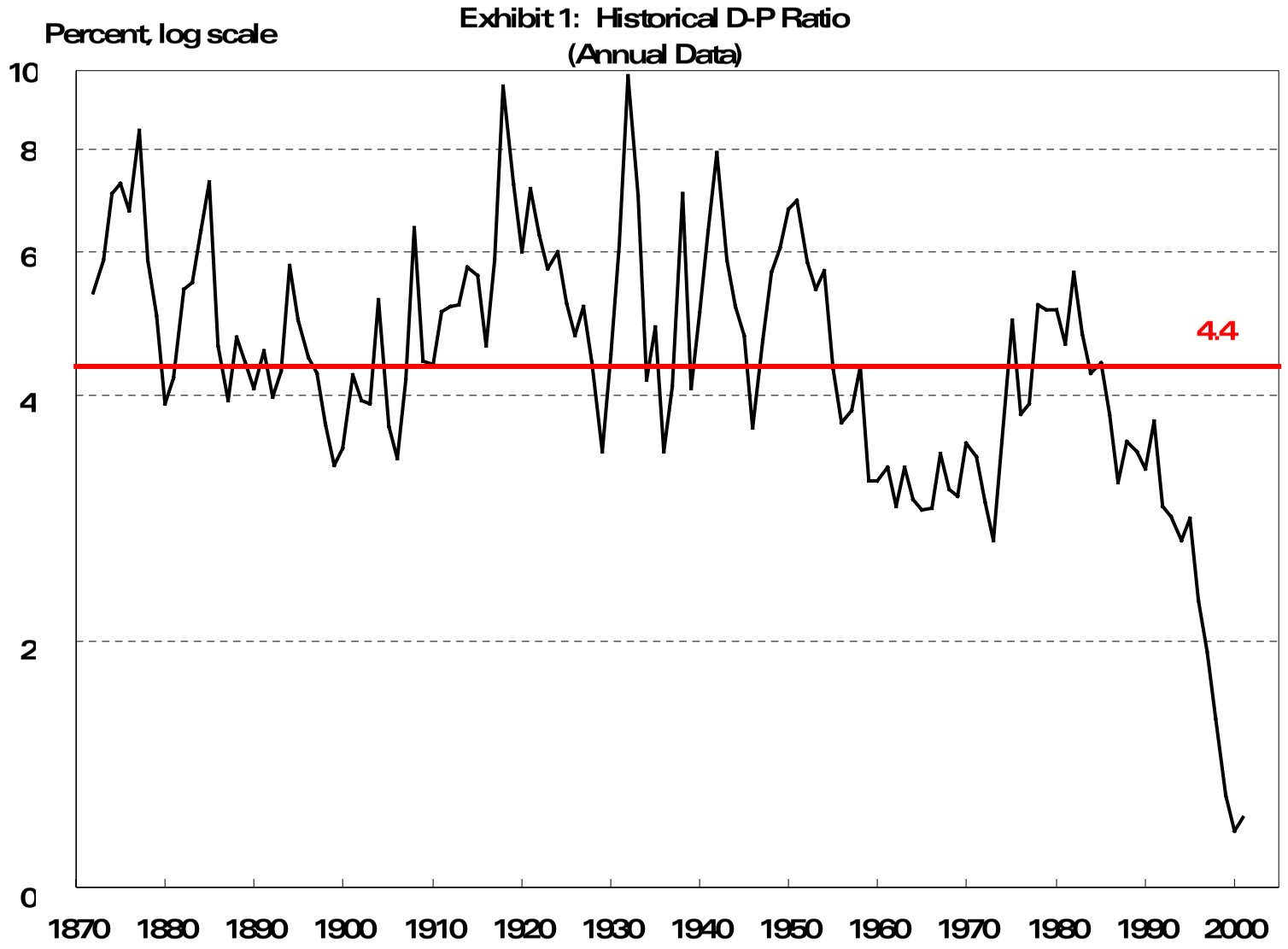
Shiller, Robert. "Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?" *American Economic Review*, June 1981, pp. 421-436.

Siegel, Jeremy. "Big-Cap Stocks Are a Sucker Bet." *The Wall Street Journal*, March 13, 2000, pp. A30.

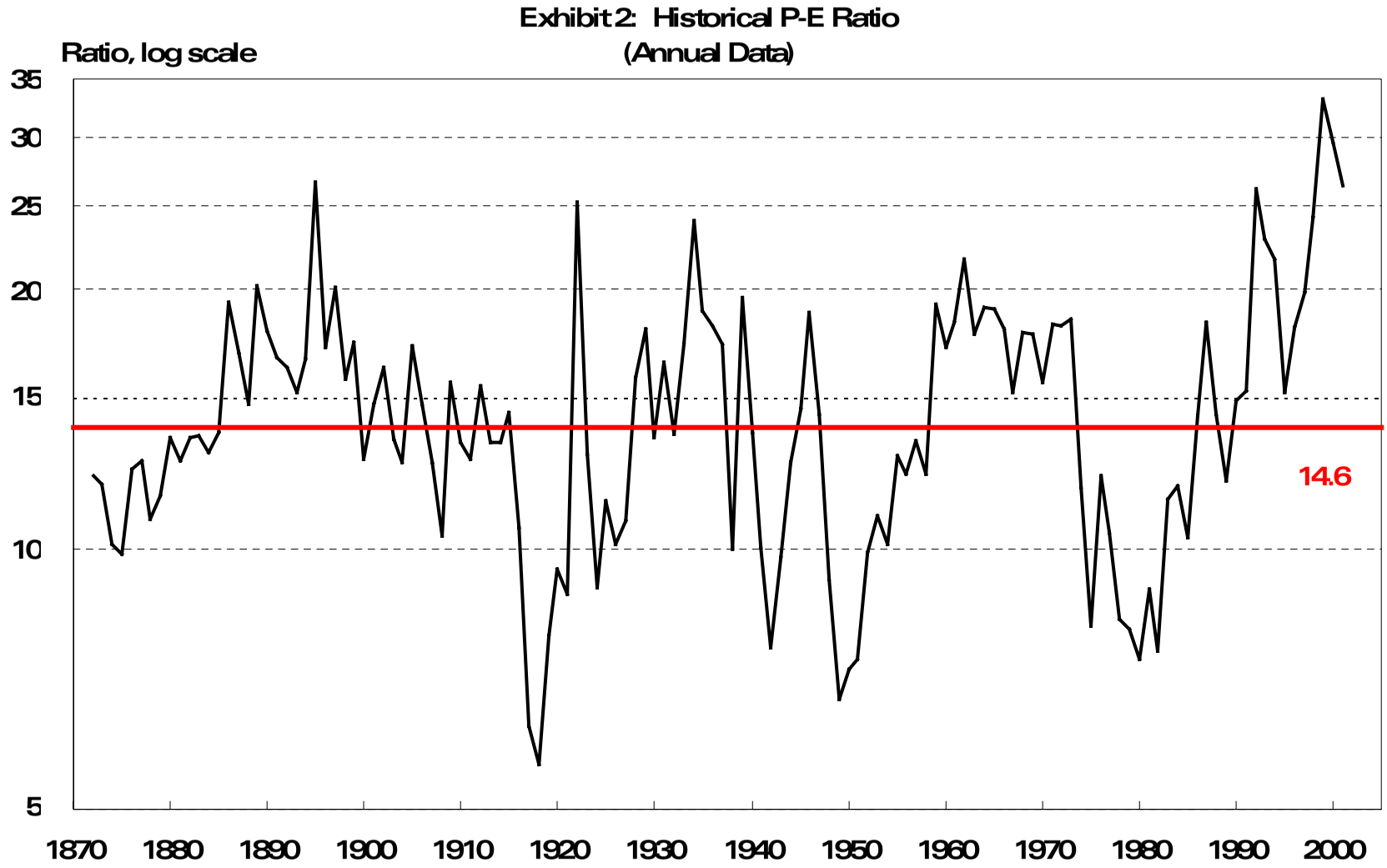
Siegel, Jeremy. "The Shrinking Equity Premium." *Journal of Portfolio Management*, Fall 1999, pp. 10-17.

Siegel, Jeremy. *Stocks for the Long-Run: The Definitive Guide to Financial Market Returns and Long-Term Investment Strategies*. New York: McGraw-Hill, 1998.

Vissing-Jorgenson, Annette. "Limited Stock Market Participation." Dissertation, Massachusetts Institute of Technology, 1998.



Source: Robert J. Shiller, http://aida.econ.yale.edu/~shiller.



Source: Robert J. Shiller, http://aida.econ.yale.edu/~shiller.

Exhibit 3. Bai-Perron Results for D-P Ratio

A. 1872-2001, annual data.

Test Statistics

Global[a]

$SupF_T(1)$
15.14**

Sequential under the global null[b]

$SupF_T(2\|1)$	$SupF_T(3\|2)$
20.33**	3.47

B. 1945:IQ-2001:IVQ.

Test Statistics

Global[a]

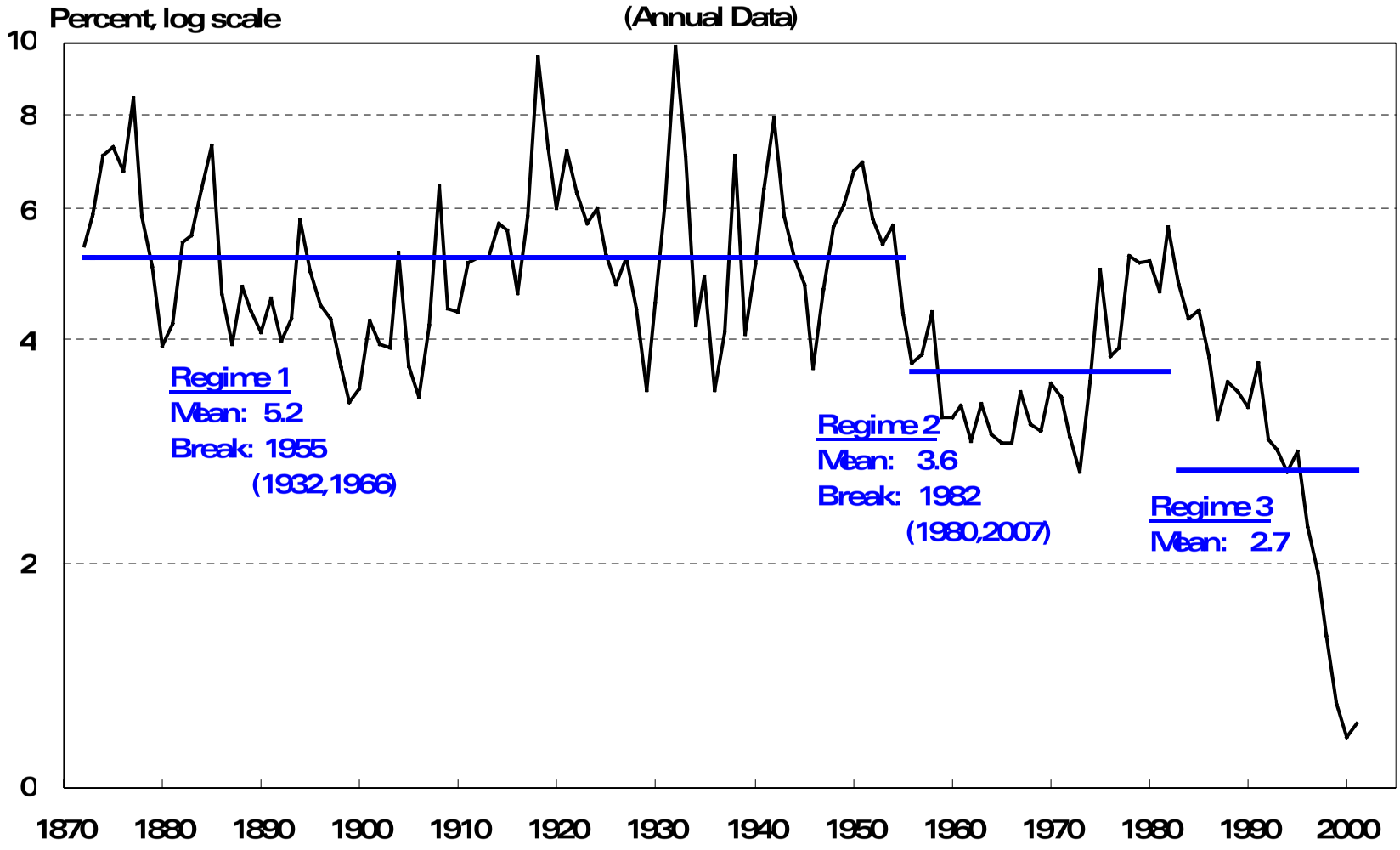
$SupF_T(1)$
15.77**

Sequential under the global null[b]

$SupF_T(2\|1)$
7.78

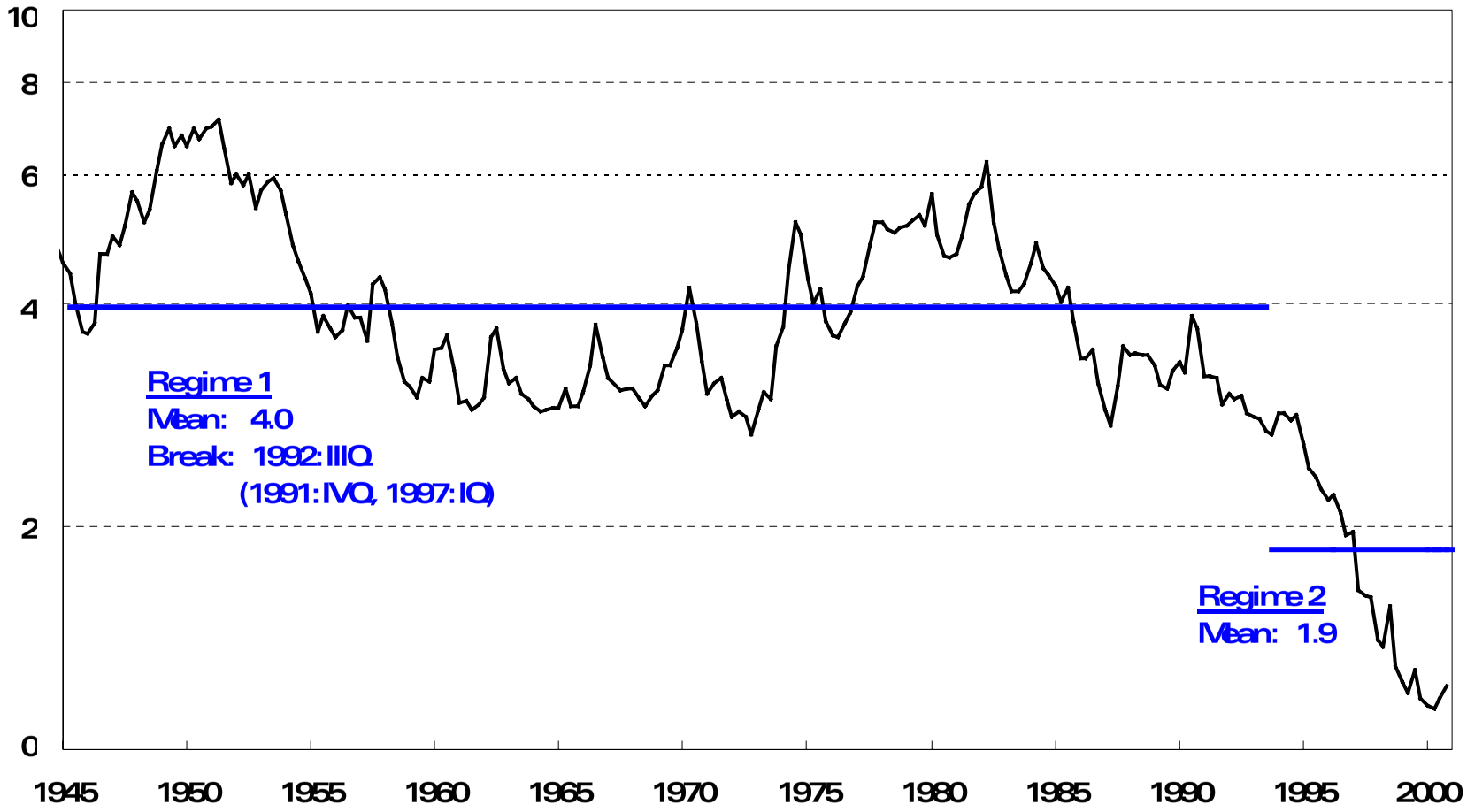
a. Null hypohthesis: 0 versus 1 break
b. Null hypohthesis: i versus $i + 1$ breaks
* Indicates significance at the 5% level.
** Indicates significance at the 1% level.

Exhibit 4: Historical D-P Ratio and Means Between Estimated Breakpoints



Source: Robert J. Shiller, http://aida.econ.yale.edu/~shiller.
Note: Date ranges in parentheses represent 95% confidence ranges around the estimated break date.

Exhibit 5: D-P Ratio and Means Between Estimated Breakpoints
(Quarterly Data)



Source: Robert J. Shiller, http://aida.econ.yale.edu/~shiller.
Note: Date ranges in parentheses represent 95% confidence ranges around the estimated break date.

Exhibit 6. Bai-Perron Results for P-E Ratio

A. 1872-2001, annual data.

Test Statistics

Global[a]

$SupF_T(1)$
2.63

B. 1945:IQ-2001:IVQ.

Test Statistics

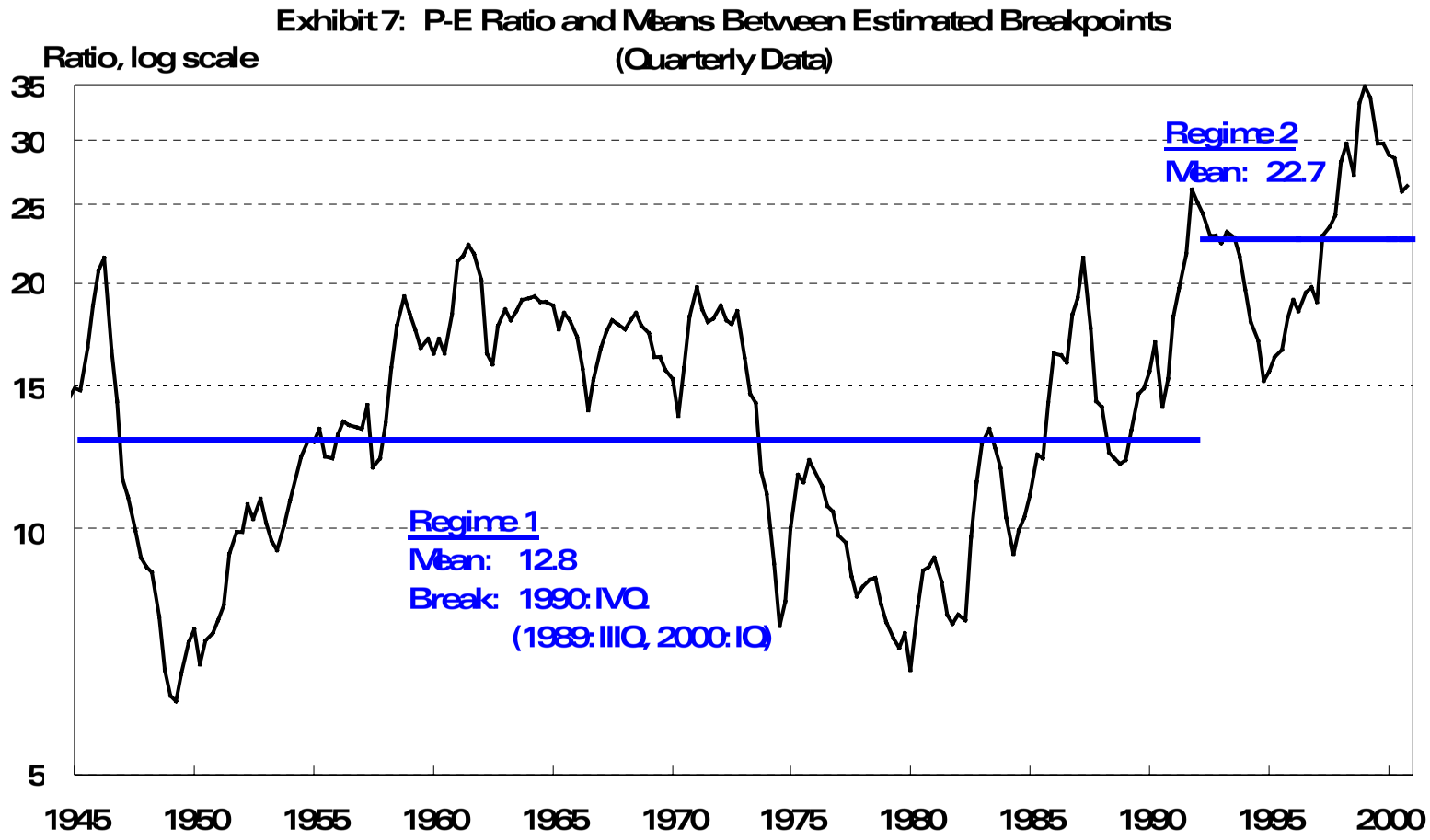
Global[a]

$SupF_T(1)$
9.30*

Sequential under the global null[b]

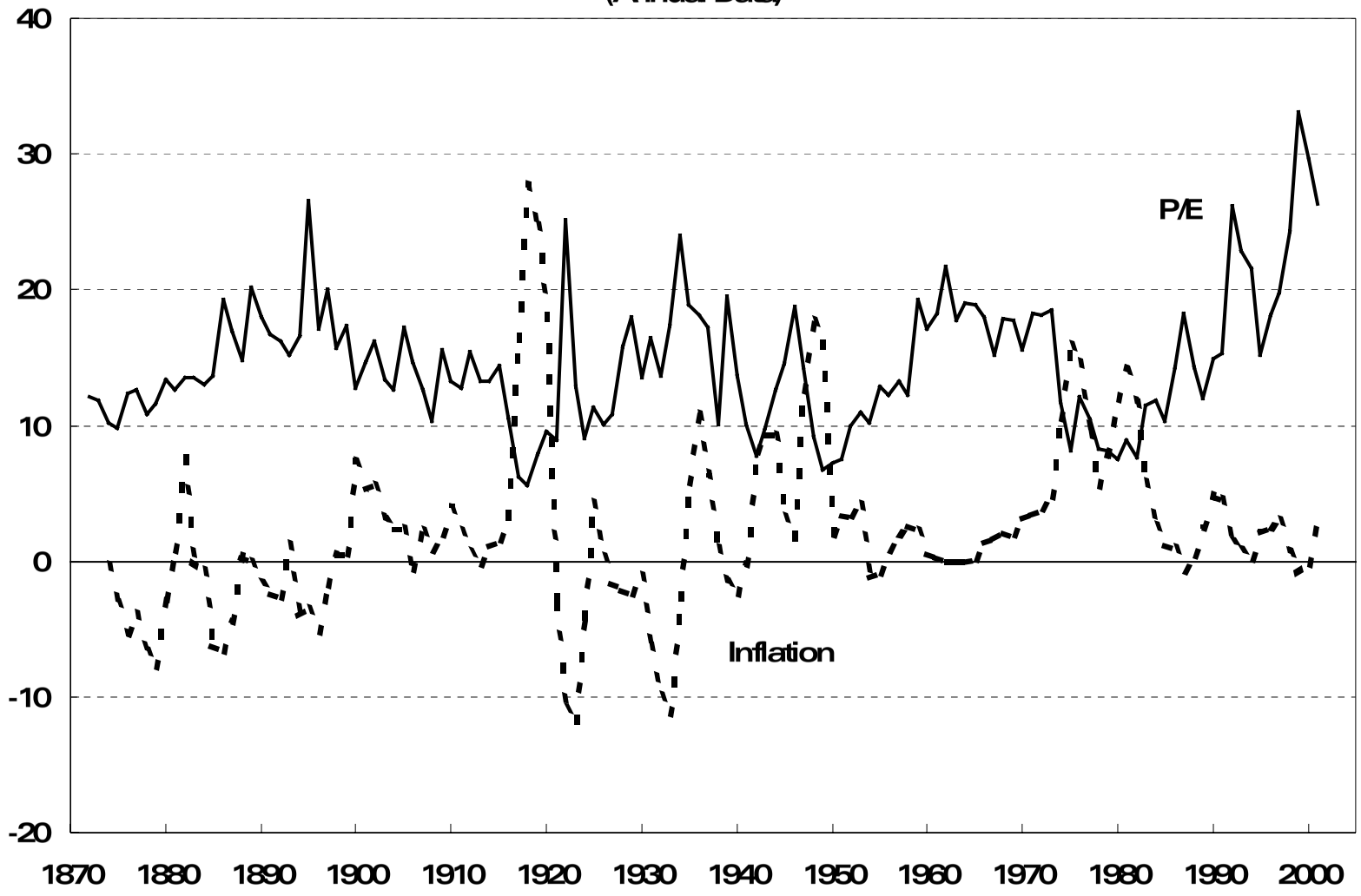
$SupF_T(2|1)$
1.87

a. Null hypohthesis: 0 versus 1 break
b. Null hypohthesis: *i* versus *i* + 1 breaks
* Indicates significance at the 5% level.
** Indicates significance at the 1% level.



Source: Robert J. Shiller, http://aida.econ.yale.edu/~shiller.
Note: Date ranges in parentheses represent 95% confidence ranges around the estimated break date.

Exhibit 8: Historical P-E Ratio and PPI Inflation (3-year Moving Average)
(Annual Data)



Source: Robert J. Schiller, http://aida.econ.yale.edu/~shiller.

Federal Reserve Bank
of Cleveland
Research Department
P.O. Box 6387
Cleveland, OH 44101

Address Correction Requested:
Please send corrected mailing label to the
Federal Reserve Bank of Cleveland,
Research Department,
P.O. Box 6387,
Cleveland, OH 44101

PRST STD
U.S. Postage Paid
Cleveland, OH
Permit No. 385