

“Excess Volatility” on the London Stock Market, 1870-1990*

J. Bradford De Long
Harvard University

Richard S. Grossman
Wesleyan University

January 1993

Abstract

We study “excess volatility” in long-run British stock prices over the period from 1870–1990. We find that the British stock market does exhibit “excess volatility” if the pre-WWI period is included in the sample. British price/dividend ratios before World War I were low relative to those of other nations or to post-WWI Britain, suggesting that pre-war investors were extraordinarily suspicious of those equities quoted on the market. This fear of equities may have caused the British stock market to perform poorly as a social capital allocation mechanism before World War I, and may have played a role in British industrial decline.

*We would like to thank Marco Becht, Ian Bulkley, Forrest Capie, Michael Edelstein, Mike Lovell, Jeffrey Miron, Steven Sheffrin, Richard Sylla, and Peter Temin for helpful discussions; we would like to thank Joshua Stevens for excellent research assistance; and we would like to thank the NSF, the Pew Foundation, and the NBER for financial support.

I. Introduction

In this paper we search for signs of “excess volatility,” in the sense of Shiller (1981, 1989), in the British stock market.¹ After constructing and examining a real index of British stock market values since 1870, we conclude that the British market *has* exhibited signs of excess volatility over the past century.² The strongest evidence against the simple constant required rate of return dividend-discount model is found in the pre-World War I experience of the British stock market. Price/dividend ratios were markedly lower before World War I than they have been since. Yet there appears to be no sufficient fundamental reason—neither greater risk, nor higher real interest rates, nor sufficiently lower rates of dividend growth—for this reduced price/dividend ratio. British investors before World War I appear to have been excessively fearful of holding equities that were quoted on the stock market. The shift in behavior from a pre-World War I market fearful of equities to a less-suspicious post-World War I market is a major source of measured stock market “excess volatility.”³

In this “fear of equities” pre-World War I British investors were different from investors elsewhere. Investors in the German and American stock markets were more willing to pay high prices for equities, and prices were significantly higher multiples of dividends (Shiller, 1989; De Long and Becht, 1991). Pre-World War I British investors’ fear of equities may have helped keep British companies from transforming themselves into the publicly-owned, professionally-managed enterprises that were to dominate the twentieth century. It may have played a role in Britain’s failure to develop the high-tech

¹Robert Shiller’s (1981, 1989) and Steven LeRoy and Richard Porter’s (1981) finding of “excess volatility” in long-run U.S. stock market indices has sparked a huge literature: LeRoy’s (1989) survey article runs to 39 pages and contains 169 items in its bibliography. For the current state of the art in tests of excess volatility in the U.S., see Campbell and Shiller (1988) and Mankiw, Romer, and Shapiro (1991).

Surprisingly, given this concentration of economists’ time on “excess volatility,” relatively few have searched for its presence in the stock markets of other industrial nations. Aside from Bulkley and Tonks (1989), discussed below, the few exceptions include Shiller (1989); Beltratti and Shiller (1990, 1991); Poterba and Summers (1988); Cutler, Poterba, and Summers (1990); French and Poterba (1991); and De Long and Becht (1991).

²This conclusion is conditional on the maintained hypothesis that the required real rate of return was constant. The validity of this hypothesis is briefly discussed in section IV.

³Our study follows the ground broken by Bulkley and Tonks (1989), who provide one of the few studies of excess volatility in markets outside the U.S. They found some evidence of excess volatility in the post-World War I British stock market. However, they did not accept the standard interpretation: that such excess volatility indicates that stock prices are set by non-rational “animal spirits” rather than by rational estimates of fundamental values. Instead, they argued that the parameters of the dividend process were not known *ex ante*, and that investors at the time had to form their forecasts using not the true parameters but what they could deduce from that portion of past history they could observe: investors did about as good a job at pricing the stock market as one can expect, given their lack of knowledge about the structure of the economy.

Our paper differs from Bulkley and Tonks (1989) in using different stock market indices. More important, it examines the pre- as well as the post-World War I British stock market. Because of the extended data set it examines, it reaches different conclusions: it finds much stronger evidence of excess volatility.

industries of the turn of the century, and consequently its relative industrial decline.

After this introductory section, the second section of this paper presents the real stock market indices used in this paper. The third section applies statistical tests to discover whether the British market in fact exhibits “excess volatility.” The fourth section presents alternative interpretations of excess volatility, and discusses the implications of the British stock market’s performance for the real economy of Great Britain: investors’ excessive fear of equities may have played a role in generating Britain’s rapid turn of the century relative economic decline. The fifth section summarizes the argument of the paper.

II. Data

Data Sources

The British Economy: Key Statistics, issued by the London and Cambridge Economic Service [LCES] (1973), presents (table M, p. 16) a continuous series of annual average prices of industrial ordinary shares in the United Kingdom from 1900 to 1970, with a dividend yield attached beginning in 1926. In fact, the LCES (1973) series splices together four different indices: from 1962 to 1970 the series is the *Financial Times*-Actuaries 500-stock industrial share series; from 1949 to 1962 it is the Moody’s Services Ltd. sixty-stock index; from 1924 to 1949 it is the LCES series found in Bowley *et al.* (1931); and from 1900 to 1924 it is the backward extension of the LCES series constructed by Smith and Horne (1934).

The series reported in LCES (1973) can be extended both forwards and backwards. Since 1970, the *Financial Times* has continued to publish the FT-Actuaries index and the dividend yield associated with that index. Before 1900, the LCES’s retrospective investigation (Smith and Horne, 1934)—which is itself the source of their 1900-1924 estimates—reports its series back to 1867. Drawing on the price and dividend data reported in December issues of the *Investors Monthly Manual*, we have constructed a dividend series for the LCES index extending back to 1870.⁴ In the process of data construction we have

⁴Capie (1991) has also calculated a dividend yield on the Smith and Horne (1934) stock price series from 1871 to World War I. Our results closely correspond to his.

found no anomalies or shifts in composition in the pre-WWI era that would make us conclude that the behavior of the LCES index prices, or of their associated dividend yields, were very different from the behavior of the whole market.⁵

Note that the stock price index used here is different from that used by Bulkley and Tonks (1989), and by Shiller and Beltratti (1990, 1991). They examine the Barclays-de Zoete Wedd (BZW) stock price index, which covers thirty blue-chip stocks from 1918 to the present. The series constructed here has the advantage of being based on many more securities in the post-World War I period. It has the potential disadvantage of being composed not of one consistent series, but of several raw series spliced together. Changes in behavior—for example, changes in average dividend yields or in growth rates—must therefore be carefully examined to see if they are spurious and arise from changes in the index rather than from shifts in the behavior of the broad stock market of which the index is supposed to be a measure.

Appendix table A.1 presents the real stock price and dividend series we use.

The Course of the British Stock Market

Figure 1 plots, on a logarithmic scale, the British stock price index and dividend series. The dividend series has been multiplied by twenty to give it approximately the same range of variation as the stock price series.

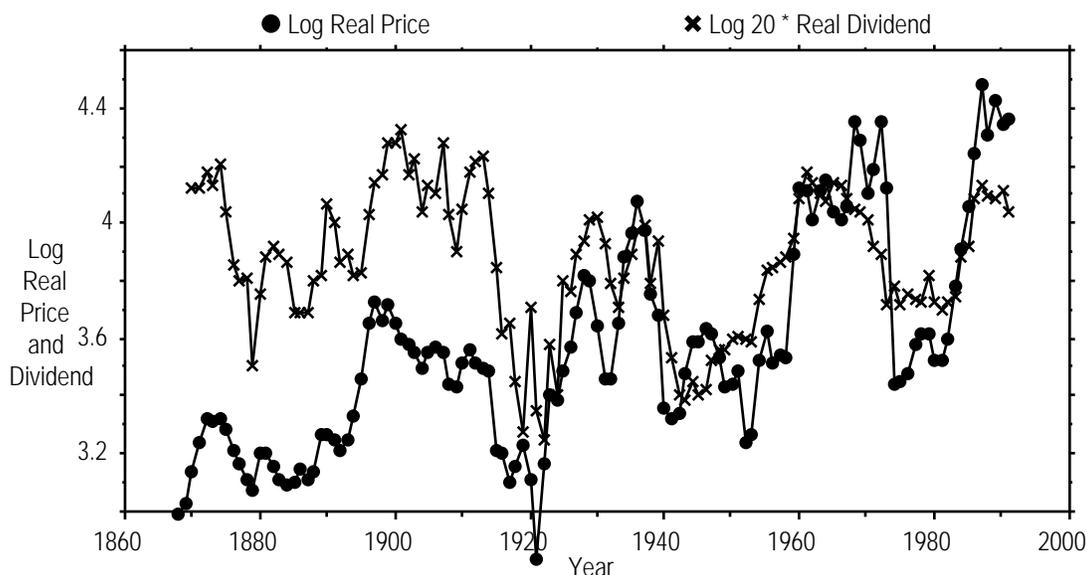
The British stock market exhibits roughly the same major bull and bear markets as does the American (Barsky and De Long, 1990): the market triples in the 1980s, in the 1950s-1960s, and in the 1920s; it falls substantially in real terms during the World War I inflation and the post-World War I recession; and it falls by two-thirds in the early 1970s.⁶ British real dividend levels undergo several substantial declines. The most recent is associated with the macroeconomic stagflation during 1965-1975. Earlier large declines include one associated with the outbreak of World War II, one decline

⁵The series reported by LCES (1973) and Smith and Horne (1934) are in nominal terms. To express them in real terms a deflator is needed. There are two possibilities: the consumer price index or the GDP deflator, both from Feinstein (1972). We use the consumer price index, although results are substantially the same if the GDP deflator is used.

⁶The Great Depression has a much smaller effect on the British stock market than on the American. By 1934 the real value of the British market is above its 1928-29 highpoint. The major bear market of the 1920-45 period in Britain is associated not with the Great Depression, but with the coming of World War II. Otherwise, the bull and bear swings of the post-1914 British stock market are similar to those of the American market.

associated with World War I, a major and extended Edwardian-era decline, and a short-lived decline in the late 1870s which we attribute to credit market stringency.⁷

Figure 1
British Stock Prices and Dividends, 1870–1990



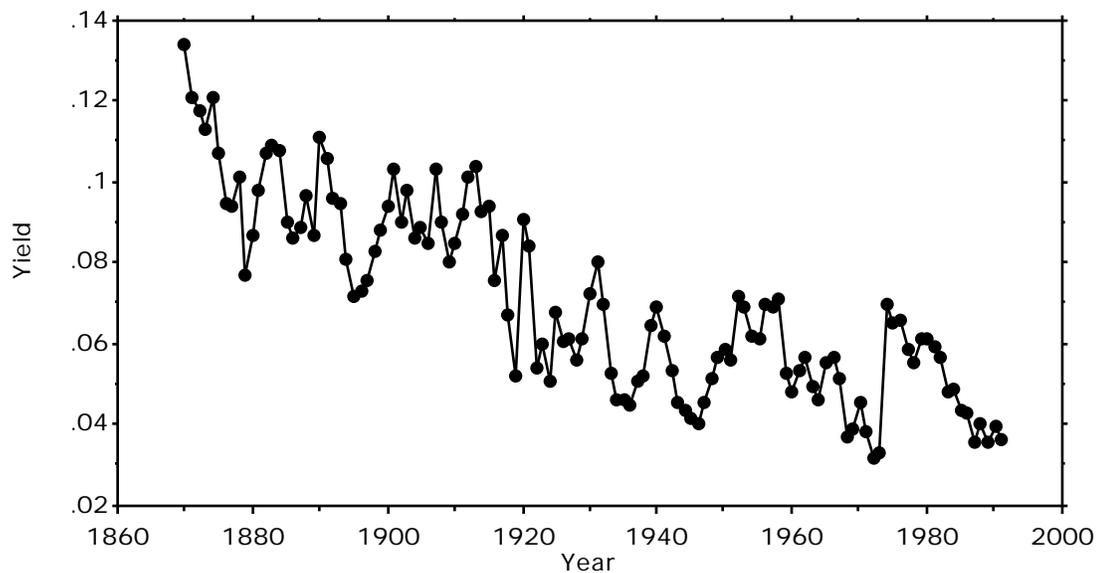
Before World War I, British price/dividend ratios are low relative to their post-war levels: while their average level is not far from twenty after World War I, the average price/dividend ratio before the Great War is closer to twelve. From the early 1920s to the present, British real dividends grow by about 1.3 percent per year, and real stock prices grow by about 2.0 percent per year. But between 1870 and 1913 real dividend levels paid on the LCES index are constant. And real dividend levels fall by sixty percent between 1913 and 1920. An investor who in 1870 had purchased the stocks that make up the LCES index, and who had continued to hold the index through to the present day (spending only the current dividends), would today be receiving the same level of real dividends that he had received in 1870. A century of economic growth has not been translated at all into a higher dividend-paying power for a share of the index. By contrast, real prices today are far above their levels of 1870 by a multiple of about 4.5. In 1870, a share of the index could be purchased for 10.2 times its annual dividend. Today, a share of the index costs 23.3 times the annual dividend it pays.

⁷Associated with the crisis surrounding the collapse of the City of Glasgow Bank. See Capie (1988, 1991).

Data Reliability

Might this shift from the pre- to the post-World War I period in the price/dividend ratio reflect a change in the definition of the index, and not a change in the behavior of the market? While the Smith and Horne (1934) series is certainly not immune from criticism,⁸ the fall in the dividend yield occurs in the period that the underlying stock price series is entirely the Smith and Horne (1934) series: the dividend yield has already fallen into the 5-6 percent range by the early 1920s, as figure 2 shows.

Figure 2
British Dividend Yields, 1870–1990



The fact that both the high dividend yields of the pre-1900 years and the low yields of the 1920s are both derived from the Smith and Horne (1934) index is not conclusive proof that it reflects a change in the behavior of the market. The composition of the index shifts over time: in 1914 it is made up of seventy-five stocks, but in 1871 it consisted of merely twenty-eight stocks. And the overlap—those stocks quoted as part of the index in 1871 that were still part of the index in the 1920s—is even smaller: nineteen stocks, of which eight are in “heavy industry”⁹ and three are textile manufacturers. Thus there

⁸Before the 1890s some sectors are represented by one or zero firms. As Capie writes: “A number of sectors were [completely] ignored...e.g. railways, banks, mining. Also, it is a price index and not a value index since the prices were not weighted...[it was] simply the arithmetic mean of the monthly percentage changes in prices.” It thus corresponds to a portfolio with equal amounts invested in each security, rebalanced every year.

⁹What Smith and Horne (1934) call “Group 1”: “Coal, Iron and Steel, Engineering, etc.”

is ample room for shifts in the behavior of the index to arise from shifts in its particular composition rather than from shifts in the behavior of the stock market. Nevertheless, the fall in the dividend yield cannot be ascribed to such a shift in composition. In fact the fall in dividend yields for those stocks that are common to the index in both 1871 and in the 1920s is larger than the fall for all stocks in the index. Thus none of the reduction in dividend yields recorded for the index between its beginnings and the eve of World War I is due to a shift in the composition of the index.

The post-World War I regime sees behavior much closer to that of stock price indices in other major industrial nations. In large part, stock price movements correspond percent-to-percent with movements in real dividends: a regression of the log stock price on the log dividend level for the post-World War I period accounts for sixty-one percent of the variation in stock prices, and associates each one percent increase in dividends with a 1.22 percent increase in stock prices. The bulk of post-World War I stock price movements can be understood in terms of the rule of thumb that post-World War I stock index prices do not remain far from twenty times dividends.

The pre-World War I regime, by contrast, appears to be characterized by a great “fear of equities” on the part of investors: a given annual cash flow is valued by the market at little more than ten years’ purchase. Dividend payouts are a large component of present values, and an equity share is an asset with a cash-payout duration of little more than eleven years. During this first regime, raising money on the stock market is extraordinarily expensive—much more expensive than in the other leading industrial economies of the turn of the century like Germany and the United States (see Barsky and De Long, 1990; De Long and Becht, 1991).

III. Assessing Excess Volatility

Perfect-Foresight Valuations and Efficient Markets

Figure 3 presents for Britain the figure that was Shiller’s original graphical argument that the U.S. stock market exhibited excess volatility. It calculates the perfect-foresight valuation: the amount that a rational investor with perfect foresight who knew the future dividends that the stocks that make up the

index would be willing to pay if he intended to buy and hold the index portfolio.¹⁰

Figure 3
British Stock Prices and Ex-Post Values, 1870–1990

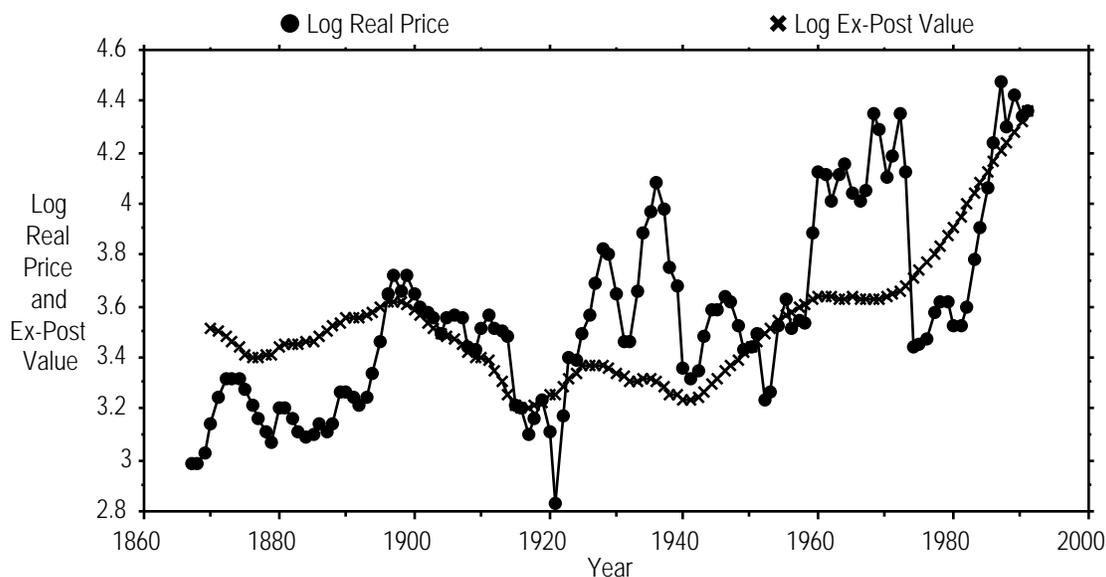


Figure 3, and all the statistical tests in this section, assume that future dividends are discounted at a constant rate of eight percent per year in real terms. This is the average real rate of return on the British stock market since 1870.¹¹ Below we briefly discuss whether allowing for a time-varying rate of discount would substantially change the findings of this paper, and conclude that it would not.

For convenience, let lower case letters represent logarithms and upper case letters levels. Thus P_t stands for the level of the real stock index price and p_t for the log level, D_t for the real dividend paid on the index and d_t for the log dividend, and so forth. Whenever the (log) stock index price p_t is below the perfect foresight valuation—denoted p_t^* —an investor buying and holding earns excess returns. Such an investor at a date in the future would look back and, with hindsight, congratulate himself on the good deal that he had gotten when he bought the stock index. Conversely, whenever p_t is above p_t^* the dividends that an investor receives fail to mount up in present value to the original purchase price.

¹⁰The perfect-foresight valuation requires an estimate of the present value of dividends paid after the end of the sample period. For simplicity, and as was first done by Shiller (1981), this paper uses the end of sample price as its estimate of the present value of post-sample dividends in constructing perfect-foresight valuations. Such an assumption tends to artificially reduce the gap between actual prices and perfect-foresight valuations in the last decade or so of the sample.

¹¹However, it was chosen *ex ante* because it was the real discount rate used by De Long and Becht (1991) in their study of the German stock market.

Shiller's observation, which holds for the British stock market as depicted in figure 3 as well as for the American stock market analyzed in Shiller (1981), was that the actual price of the stock market index exhibited more volatility than did the perfect-foresight valuation. This, he argued, was inconsistent with the efficient markets hypothesis: rational-expectations prices must be less volatile than perfect-foresight valuations. If not, then investors can earn excess returns by selling when stock prices are high (relative to some naive-forecast benchmark) and buying when they are low.

Shiller's (1981) test is based on the insight that under rational expectations the current price p_t of the stock market index can be seen as a forecast of the perfect-foresight valuation p_t^* . If the market is efficient, no one at time t can successfully forecast any part of $p_t - p_t^*$, of the divergence between current prices and the perfect-foresight valuation. Thus p_t must be the best forecast available at time t of the then-unknown quantity p_t^* .

If a rational investor could successfully forecast that the expected value (as of time t) of p_t^* was above p_t , he could earn excess returns by going long the stock market index. If he could successfully forecast that the expected value (as of time t) of p_t^* was below p_t , he could earn excess returns by going short. Since an efficient market is one in which no trading strategies systematically produce excess returns, the rational forecast as of time t of the perfect-foresight valuation p_t^* must be p_t itself:

$$(1) \quad p_t = E_t(p_t^*)$$

or:

$$(2) \quad p_t^* = p_t + \epsilon_t$$

where ϵ_t is a forecast error variable that no one can predict as of time t . It has an expected value of zero— $E_t(\epsilon_t) = 0$ —and its covariance with any z_t a rational investor knows at time t is zero: $E_t(z_t \epsilon_t) = 0$

Subtract off from both sides of equation (2) a "naive" forecast benchmark, p_t^0 , of the present value of the future dividends that will be paid on the index—a naive forecast that is simple to construct, and that all investors have access to at time t . This serves as a benchmark against which volatility can be measured. Square both sides of equation (2), observing that the difference $p_t - p_t^0$ is known as of time t and must therefore be uncorrelated with ϵ_t , and taking unconditional expectations produces:

$$(3) \quad E\{(p_t^* - p_t^0)^2\} = E\{(p_t - p_t^0)^2\} + E\{\epsilon_t^2\}$$

Equation (3) reveals that the volatility of the perfect-foresight valuation p^* about the naive forecast

benchmark p^0 must, if the market is efficient, be greater than the volatility of the actual price p about the naive forecast p^0 . If this is not so, then p cannot be the proper rational-expectations efficient-markets price. The rational-expectations price is the best forecast of p^* , and if the volatility of p is greater than the volatility of p^* a better forecast can be constructed by taking some weighted average of p and the naive forecast benchmark p^0 . Thus the efficient markets hypothesis can be tested by seeing whether the volatility of p^* is in fact greater than the volatility of p when measured relative to some appropriate benchmark.

Other implications of the efficient markets hypothesis can be derived from (3) by noting that the forecast error $p_t^* - p_t$ is simply $p_t^* - p_t$. Substituting into equation (3):

$$(4) \quad E\{(p_t^* - p_t^0)^2\} = E\{(p_t - p_t^0)^2\} + E\{(p_t^* - p_t)^2\}$$

Equation (4) reveals that volatility of $p_t^* - p_t$ —the difference between the perfect-foresight valuation and the actual price—must be less than the volatility of $p_t^* - p_t^0$. If not, then the actual price p_t is a worse forecast than the naive forecast p^0 : the market would be more efficient if prices were simply set equal to the naive forecast.

p^0 Benchmarks in the Excess Volatility Literature

The excess volatility literature of the past decade can be understood as revolving around repeated tests of the implications of the efficient markets hypothesis contained in equations (3) and (4). The issues investigated have been two-fold. First, empirical tests of the restrictions contained in equations (3) and (4) involve estimating volatilities from small samples. Determining whether rejections of variance bounds are significant requires calculating the small-sample distributions of the test statistics. Second, different researchers have different views on what “naive” p^0 forecast benchmark is appropriate.

Shiller’s original (1981) article took the p^0 benchmark to be an exponential trend. Some subsequent researchers, for example Kleidon (1986) or Marsh and Merton (1987), argued that contemporary investors did not know or have enough information to estimate such exponential trends. They sought to prove that Shiller’s finding of significant violations of the efficient markets hypothesis was in large part driven by this use of an inappropriate p^0 .¹²

¹²The intuition behind the possibility that an inappropriate p^0 benchmark might lead to spurious findings of excess volatility

However, subsequent research has diminished the force of such critiques. Excess volatility in the U.S. stock market has been confirmed using different naive forecast benchmarks—different p^0 's—that are less vulnerable than an exponential trend to the criticism that they were not known by investors at the time. For example, Mankiw, Romer, and Shapiro (1985, 1991) and Shiller (1990) have found excess volatility using a naive p^0 forecast benchmark equal to a constant multiple of dividends. In addition, Campbell and Shiller (1988) and others have used naive forecasts based on long moving averages of earnings and dividends to confirm excess volatility in the U.S. market.

Testing for Excess Volatility

Table 1 below presents volatility tests and ratios using a number of alternative naive p^0 benchmark forecasts. Column one assumes the simplest of possible p^0 's: a constant, equal to the mean of observed real prices. Dividends at the end of the sample are nearly the same as dividends at the beginning, so there is no strong evidence for any upward trend in the fundamentals of the British stock market. If companies sought to make dividend payouts as large as possible without reducing earning power, one would not expect an upward price trend. Forecasting that prices would be constant would be an appropriate and unbiased (but naive) rule of thumb.

Table 1
Volatility Bounds Ratios for the British Stock Market

Naïve forecast:	$p^0 = \text{constant}$	$p^0 = \text{exp. trend}$	$p^0 = \text{const. x dividends}$	$p^0 = \text{const. x MA(dividend)}$	p^0 from past div. growth
[1] Volatility of P^*/P^0	0.066	0.058	0.100	0.102	0.178
[2] Volatility of P/P^0	0.124	0.079	0.160	0.227	0.282
[3] Volatility of P^*/P	0.091	0.091	0.091	0.091	0.091

is straightforward. A test for excess volatility implicitly suggests a profit-making trading strategy: if prices are too volatile they are at times too high and at times too low, and an investor can earn excess returns by selling high and buying low. In an efficient market such straightforward profit-making trading strategies do not exist. Suppose that an economist using an inappropriate naive forecast benchmark p^0 —one that investors at the time did not have available—finds evidence of excess volatility vis-a-vis this benchmark. He thus claims to have rejected the efficient markets hypothesis: rational investors should have bought when the price was low relative to p^0 and sold when it was high, yet they did not do so. But if investors at the time could not calculate this p^0 , the rejection of market efficiency is spurious. Investors could not have earned excess returns by following a buy low-sell high trading strategy, for they could not know whether prices were high and low relative to the p^0 benchmark in time to buy or sell.

[4] Volatility Ratio: (2)+[3])/[1]	3.26	2.93	2.51	3.12	2.10
Monte Carlo Significance— Error-Correction Model: Speed of Dividend Adjustment					
Fast ($\alpha=0.1$)	.001	.001	.001	.001	.001
Slow ($\alpha=0.5$)	.001	.001	.002	.001	.005
MC Significance—AR Model	.001	.001	.001	.001	.007

Column two of table 1 constructs p^0 by an exponential trend fitted to the average rate of growth of prices. This is the procedure that Shiller (1981) implicitly used. It has been heavily criticized by Kleidon (1986). If the sample period is relatively short and shocks to dividend levels persistent, then the current value of an exponential trend fitted ex post depends heavily on the (unknown) future values of shocks. Such a p^0 could not have been constructed by investors at the time. Rejections of the efficient market hypothesis that implicitly find investors culpable for failing to take advantage of the information contained in such an impossible p^0 are spurious.

Column three uses a constant multiple—12.5—times dividends.¹³ Column four uses the same multiple of a long moving average—in this case, a twenty-year moving average—of lagged dividends.¹⁴ These are the methods for constructing p^0 used by Mankiw, Romer, and Shapiro (1985, 1991), by Shiller (1990), and by Campbell and Shiller (1988). They are not vulnerable to Kleidon's (1986) critique.¹⁵

The final column, column five, proceeds in the spirit of Bulkley and Tonks (1989) in its choice of the naive p^0 forecast benchmark. For every date t , it fits a least-squares exponential trend to the set of past dividend observations only. This least-squares trend produces an estimate of the current “permanent” level of dividends, d^*_t , and of the rate of dividend growth, g^*_t . The naive forecast price is

¹³The lack of any upward trend in real dividends, and the assumption that the required rate of return is equal to the actual average real return of eight percent, together lead to 12.5 as the steady-state average price/dividend ratio.

¹⁴Dividends before 1870 are imputed by backcasting from the estimated 1870-1900 least-squares trend.

¹⁵However, they can show spurious evidence of excess volatility if the dividend process is characterized by permanent or near-permanent shocks to its *level*, and thus the price/dividend ratio is non-stationary or subject to persistent shocks. See Barsky and De Long (1990). There is reason to believe that the growth rate of dividends is not constant, but time varying. The British price/dividend ratio does appear to be non-stationary over the sample period, as is discussed in section IV below. But it is not possible to connect this non-stationarity to any shift in low-risk interest rates or in dividend and economic growth rates.

then calculated as:

$$(5) \quad p_t^0 = d_t^* - \ln(r - g_t^*)$$

Equation (5) is simply the logarithmic transform of the familiar:¹⁶

$$(6) \quad P_t = D_t / (r - g)$$

which states that the value of an asset at time t is equal to its current payout D_t , divided by the difference between the required real rate of return r and the rate g at which the real payout is expected to grow in the future. In column five the naive forecast benchmark is thus the present value of expected future dividends, if one expects dividends in the future to track the exponential trend estimated from period 0 up through period t exactly.¹⁷

Table 1 presents volatility ratios for each of these possible ways of constructing the naive forecast benchmark. The first line gives the volatility—the average squared deviation—of the log of the perfect-foresight valuation relative to the naive forecast. The second line gives the volatility of the actual price relative to the naive forecast: the ratio of [2] to [1] was Shiller's original volatility test. The third line gives the volatility of the actual price relative to the perfect-foresight valuation.

The fourth line gives the ratio of [2] plus [3] to [1]. Deviations of this ratio from unity reveal the extent to which equation (4) fails to hold. If the ratio is significantly in excess one, there is evidence of excess volatility (see Mankiw, Romer, and Shapiro, 1991) even if Shiller's original comparison of [2] to

¹⁶This procedure is in fact slightly different than the one used by Bulkley and Tonks (1989). They form an estimate of the "trend" dividend level d_t^* by fitting an exponential growth curve to dividends between the start of the sample and period t .

They then construct p_t^0 by a procedure that is arithmetically equivalent to multiplying the "trend" dividend by the average price/dividend ratio that has prevailed from the start of the sample to period t . Thus future dividends are implicitly discounted at rates that depend on past average price/dividend ratios: when price/dividend ratios have been relatively high in the past, the required rate of return on the market is low. The procedure used here maintains the constancy of the required rate of return on the market.

¹⁷One might think that this naive forecast is along one dimension perhaps a little too naive. It estimates a single constant growth rate process for dividends over more than a century. As Bulkley and Tonks point out, what dividend growth was in 1889 has as much weight in the forecast of dividend growth in 1991 as what dividend growth was in 1989. An alternative procedure would weight the distant past less than the more recent past in estimating the expected future growth rate of dividends g^* .

Barsky and De Long (1990) argued that investors in the United States in the twentieth century had set stock index prices as if $g_t^* = g_{t-1}^* + (1 - \alpha) d_t$. Each period the representative investor constructs his estimate g_t^* of the long-run expected future growth rate of dividends by taking a weighted average of last year's estimated long-run growth rate g_{t-1}^* (with weight α) and this year's actual year-over-year change in dividends d_t (with weight $1 - \alpha$). Such a procedure automatically places heavier weight on the more recent past. Barsky and De Long found that assuming that investors used equation (6) with $\alpha = 0.97$ to construct their estimates of future dividend growth accounted for perhaps three quarters of the long swings in U.S. stock market. But the α that fits best for the British stock market is $\alpha = 1.00$, which does not downweight the distant past in estimating dividend growth, and which leads to naive forecasts almost identical to those of column three.

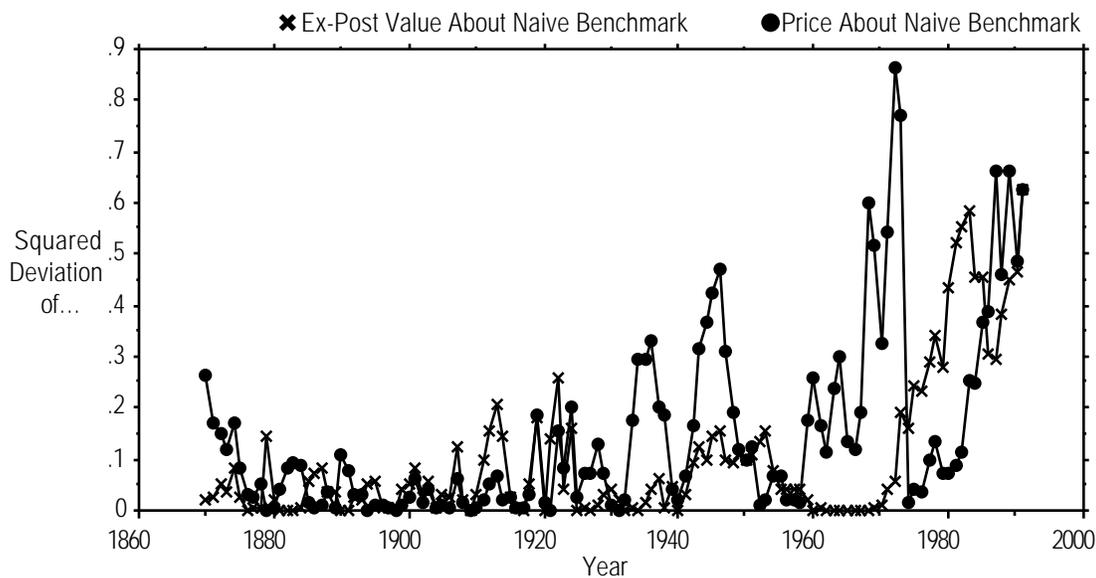
[1] does not generate a high volatility ratio.

Subsequent lines of table 1 report Monte Carlo estimates of the significance levels of the finding of excess volatility assuming that the dividend process adjusts to news only slowly because it follows an error-correction models. The following subsection discusses the exact specification of the alternative potential generating processes. They show that the excess volatility found in the British stock market appears to be highly significant for a wide range of potential dividend and price generating processes.

The last line of table 1 reports significance levels calculated by fitting a first-order autoregressive process to the annual observed values of line [4], and calculating the variance of the average taken over the sample.

Table 1 shows that no matter which of the possible “naive” forecasts is chosen, the British stock market always appears to exhibit excess volatility. The volatility of the actual price relative to the naive forecast, given in line 2 of the table, is greater in all cases save column two than is the volatility of the perfect-foresight valuation relative to the same naive forecast, given in line 1. In these cases there is extra information in the naive forecast benchmark that is not incorporated into the current market price. A better forecast of perfect-foresight valuations could be built by taking a weighted average of actual prices and the naive forecast, and an investor who used such a weighted average forecast to guide his trades would earn excess returns.

Figure 4
Squared Deviations of Actual Prices and Ex-Post Values from Constant Dividend
Multiple Benchmark



Moreover, in two of the five cases the volatility of the actual price relative to the perfect-foresight valuation, given in line 3, is greater than the volatility of the naive forecast relative to the perfect foresight valuation. In these cases the naive forecast is a better guide to valuation than the market price—not only is there information in the naive forecast benchmark, but there is more information than in the current market price.

Figure 4 presents the evidence underlying the volatility ratios reported in column 3, which uses 12.5 times the current dividend as its benchmark. Figure 4 plots the squared deviations of actual prices and of perfect-foresight valuations from the constant-dividend multiple benchmark. In almost every year (except for a few years in the 1910s, and the period beginning in the mid-1970s) the deviation of the perfect-foresight valuation from the constant dividend multiple p^0 benchmark is smaller than the deviation of the actual market price from the benchmark.¹⁸

This finding of excess volatility does not depend on the assignment of a 12.5 multiple of dividends to the naive forecast, or on the assumption of an eight percent required rate of return on the market. A required rate of return of five percent, and a naive forecast dividend multiple of 20 would to a first

¹⁸Note that the perfect-foresight valuation is by construction equal to the current price at the end of the sample. If some alternative procedure were used to estimate the present value of post-sample dividends, for example if the average value of p^* to p^0 were used, then the period from the mid-1970s on would also show prices further than perfect-foresight valuations from the benchmark.

approximation leave the deviation of the perfect-foresight valuation from the naive benchmark unchanged—the higher multiple would raise the constant dividend multiple forecast, but the lower rate at which future dividends were discounted would raise the ex-post valuation. This would diminish the gap between post-World War I and, especially, post-World War II actual prices and the naive forecast. It would reduce post-World War II evidence of excess volatility. But it would carry pre-World War I prices very far away from the naive forecast benchmark—the spikes in figure 4 would then occur in the pre-WWI era.

Thus the chief source of evidence for excess volatility in the British stock market is the *contrast* between the pre-World War I and the post-World War I periods. Before World War I price/dividend ratios are close to twelve. After World War I they are closer to twenty. It is this shift that forces all the columns of table 1 to report evidence of “excess volatility”: it carries actual prices far from all of the different naive forecast either before 1914 or after 1920.

Assessing Statistical Significance

Table 1 suggests that for the British stock market findings of excess volatility are not dependent upon particular assumptions about the form of the naive p^0 forecast, and thus fragile in the sense that they could be reversed with slightly different specifications of investors' information sets. No matter which naive forecast is considered, the variance bounds are still violated.

Criticisms of the evidence for excess volatility in the U.S., however, pointed not only to the necessity for carefully choosing only such naive p^0 forecasts as were actually in investors' information sets, but also to the potentially skewed small-sample distributions of test statistics like those reported in table 1. The previous subsection has shown that the British stock market exhibits apparent excess volatility for a wide variety of p^0 specifications. To meet this potential criticism, table 1 reports not just volatility ratios but Monte Carlo-generated estimates of their statistical significance.

The Monte Carlo estimates reported in table 1 of the statistical significance of the volatility ratios were calculated under the assumption that the level of dividends follows an error-correction model. The error-correction model assumes that the sustainable payout of the stock market is subject to permanent random shocks, and that each year the dividends paid on the stock price index are adjusted toward the

current sustainable level by a proportion $1 - \alpha$, with α between zero and one. The closer α is to zero, the less inertia there is in the dividend process. Dividends approximate a random walk, and quickly adjust to changes in the fundamental value of the market. The closer α is to one, the slower are dividends to adjust. With a high α , dividends lag behind and are a bad indicator of the current fundamental value.

The error-correction model assumes that dividend policy is irrelevant to the firm's value—that money not paid out but reinvested yields an expected increase in firm value of r . Thus the levels of prices and dividends satisfy:

$$(7) \quad E_t P_{t+1} = (1 + r)[P_t - D_t]$$

Call the “permanent” level of dividends:

$$(8) \quad D_t^* = (r - g)P_t$$

for some parameter g . Then real expected dividend payouts and prices grow at an annual rate of approximately g .

Let a representative firm set the current year's dividend equal to a weighted average of last year's actual dividend and this year's “permanent” dividend:

$$(9) \quad D_t = (1 + g)D_{t-1} + (1 - \alpha)D_t^*$$

The levels of $\alpha = 0.1$ and $\alpha = 0.5$ bracket the range that is reasonable for the British case. The low value of α produces insufficient variation in the price/dividend ratio to be realistic. And there is no evidence of persistent shifts in dividend growth caused by the shifts in earnings payout ratios implicit for the high value of α .

The third set of significance levels reported in table 1 was estimated by fitting a first-order autoregressive process to the annual observations of the excess volatility ratio given in line [4] of table 1, and then calculating the variance of the average over the sample.

In all cases the rejections of the null hypothesis of no excess volatility appear substantial. Such significant rejections, however, do not mean that the efficient markets hypothesis is completely and decisively refuted. As Mankiw, Romer, and Shapiro (1991) point out, the distributions of test statistics are sensitively dependent on the exact specification of the generating process. Relatively small variations in the generating process have the potential to produce relatively large variations in levels of statistical significance. Perhaps some process generating dividends and prices that we have not modeled

would produce volatility ratios as high as we have found. Nevertheless, many reasonable dividend and price processes based on the dividend-discount model—including processes proposed by critics of Shiller (1981, 1989) as having promise for reconciling his results with rational expectations and the dividend discount model—generate volatility ratios lower than those we have reported in table 1.

IV. Pre-World War I “Fear of Equities” and Other Potential Explanations

In large part our finding of “excess volatility” is due to the contrast between low price/dividend ratios, not far above 10, before and higher price/dividend ratios, not far below 20, after World War I. This section speculates on possible causes of high pre-World War I dividend yields, and considers the potential impact of a high required yield on equity issues on the British economy.

Shifts in Long-Run Growth Rates

In the pre-World War I sample the average price/dividend ratio is 10.5; in the post-World War I sample the average price/dividend ratio is 18.3. The average rate of real dividend growth from 1870 to 1913 is 0.4 percent per year; the average rate of real dividend growth from 1920 to 1985 is 1.2 percent per year. One possibility is that investors before World War I knew that they were in a regime of stagnant dividends, while investors after World War I knew that dividends would rise at one percent per year plus on average, and this shift in the rate of dividend growth lies behind the shift in the average price/dividend ratio.

Table 2 below provides a back-of-the-envelope calculation showing that this shift in dividend growth is much smaller than would be required to account for the shift across World War I in average price dividend ratios. Rows of table 2 present calculations for the post-World War I and pre-World War I periods, and for two subperiods of the pre-World War I period—the 1871-1900 period of dividend growth, and the 1900-1914 period of real dividend decline. The first column of table 2 gives the (geometric) average price/dividend ratio. The second gives its inverse—the average dividend yield. The third column gives the average dividend growth rate over the period.

Table 2

Required Rates of Return Needed to Justify Shifting Average Price/Dividend Ratios

	Average Price/Dividend Ratio	Average Dividend Yield	Trend Dividend Growth Rate	Required Real Rate of Return to Match P/D	Real Consol Yield
Pre-WWI	10.5	9.5%	0.4%	9.9%	2.9%
Post-WWI	18.3	5.5%	1.2%	6.7%	3.1%
Pre-1900	10.1	9.9%	0.8%	10.7%	3.4%
1900-14	10.9	9.2%	-0.5%	8.7%	2.3%
Interwar	17.2	5.8%	2.2%	8.0%	4.9%
Post-WWII	18.9	5.3%	1.2%	6.5%	3.0%

The formula:

$$(10) D_t/P_t = r - g$$

relates the dividend yield to the difference between the required real rate of return r and the expected future growth rate g of real dividends. Under the rational-expectations assumption that the dividend growth rate expected was the average dividend growth rate observed, the second and third columns can be summed to produce the required real rate of return that investors would have had to demand in order to be consistent with the observed average price/dividend ratio. This real rate of return required to match is given in the next to last column of table 2.

The first and second lines of table 2 show that the shift in the trend dividend growth rate is far from sufficient to account for the shift in the average price/dividend ratio. The dividend growth rate differs by 0.8 percent per year between the pre- and post-World War I periods. If this shift in average growth rates was matched by an equivalent shift in the growth rates expected by investors at the time, then an additional 2.4 percent per year fall in the required real rate of return on the stock market is necessary to account for the observed rise in average price dividend ratios.

Thus considering shifts in rates of dividend growth does not, at first glance at least, help in accounting for the long-term shifts in the price/dividend ratio that the British economy has seen. Comparing the pre- to the post-World War I periods, larger shifts in required rates of return are needed to reinforce the implications of shifting dividend growth rates. Within the pre-World War I period, shifts in rates of dividend growth raise rather than resolve anomalies in the behavior of the price/dividend ratio.

Shifts in Rates of Return on Alternative Assets

Shifts in real rates of return on relatively secure assets are also of no help in accounting for the large swings in the British stock market's price/dividend ratio. Consider consol rates—the widely available interest rate that most nearly corresponds to the duration of a stock exchange share.

The average consol yield was 2.89 percent before 1914 with an average inflation rate of 0.05 percent per year, giving an average real consol yield of almost three percent—2.94 percent per year. In the interwar period the price level fell by 0.88 percent per year on average, while consol yields averaged 4.05 percent per year. Thus the interwar real interest rate of 4.93 percent per year was two full percentage points higher than the prewar rate. The corresponding average post-World War II rate was 1.48 percent per year: a nominal interest rate of 8.19 percent per year combined with inflation averaging 6.71 percent.

Real interest rates on safe assets have thus been lowest since World War II, at intermediate levels before World War I, and highest between the wars. Yet average price/dividend ratios have been about the same in the interwar and post-World War II period—16.8 and 18.7, respectively and were lowest, averaging 11.46, before World War I. Shifts in safe interest rates do not appear to account for shifts in price/dividend ratios across the world wars. To account for the shift in price/dividend ratios between the pre-World War I and interwar periods requires a very large fall in the risk premium of 3.9 percentage points after World War I. Real interest rates on safe assets move in the wrong direction to account for the shift in average price/dividend ratios between the pre-World War I and the interwar period.

Moreover, such attempts to account for price/dividend ratio movements are also unsuccessful when applied to subperiods of the pre-World War I era. Comparing the high dividend growth period 1870-1900 with the Edwardian period of decline, the yields on consols were almost identical in the two subperiods: 2.87 and 2.91 percent, respectively. Inflation was negative over 1870-1900, averaging -0.24 percent per year, and positive at 1.07 percent per year from 1900-1913 after the gold rushes of the turn of the century and the resulting expansion of the world's money supply (see Barsky and De Long, 1991).

Real consol yields were thus 1.3 percentage points lower after 1900 than before. But this is only a

small part of the large 6.5 percent per year swing in required rates of return—from 10.6 percent per year over the 1870-1900 period to 4.1 percent per year over 1900-1914—needed to account for the failure of post-1900 price/dividend ratios to fall in the face of declining dividend levels.

“Fear of Equities”

The price/dividend ratio is determined by the trend rate of growth of dividends, the real interest rate on safe assets, and the risk premium required for investing in the stock market. Since neither shifts in the trend growth rate of dividends nor shifts in safe interest rates account for the rise in price/dividend ratios across World War I, the higher post-World War I era price/dividend ratios must be (in an accounting sense at least) due to a fall in the (unobserved) risk premium: given that the rise in real consol interest rates from the pre-World War I to the interwar period more than compensates for the shift from an era of stagnant to one of positive dividend growth, the risk premium required for stock market investments must have declined by 3.1 percent per year from the pre-World War I to the interwar period. After World War I, British price/dividend ratios and dividend yields are at levels that are normal by the benchmark provided by the stock markets of other industrial economies.¹⁹

Such an abnormally high risk premium is difficult to explain, and hard to reconcile with the rational-expectations assumption that investors knew the likely risks and returns of the different investments available to them. If anything, investments in stocks would appear to be more risky in the uncertain economic environment of the interwar years than under the stable gold-standard regime of the pre-World War I era: given the uncertainty and instability of the interwar world economy, the risk premium should have been higher after World War I, not lower.

Figure 5
Difference Between Stock and Bond Returns in the Pre-World War I Era

¹⁹Some believe that the risk premium in the stock market's required rate of return is always too high. See Mehra and Prescott (1985). The British pre-World War I stock risk premium is yet another level “too high”: higher than is “normal” for a stock market.

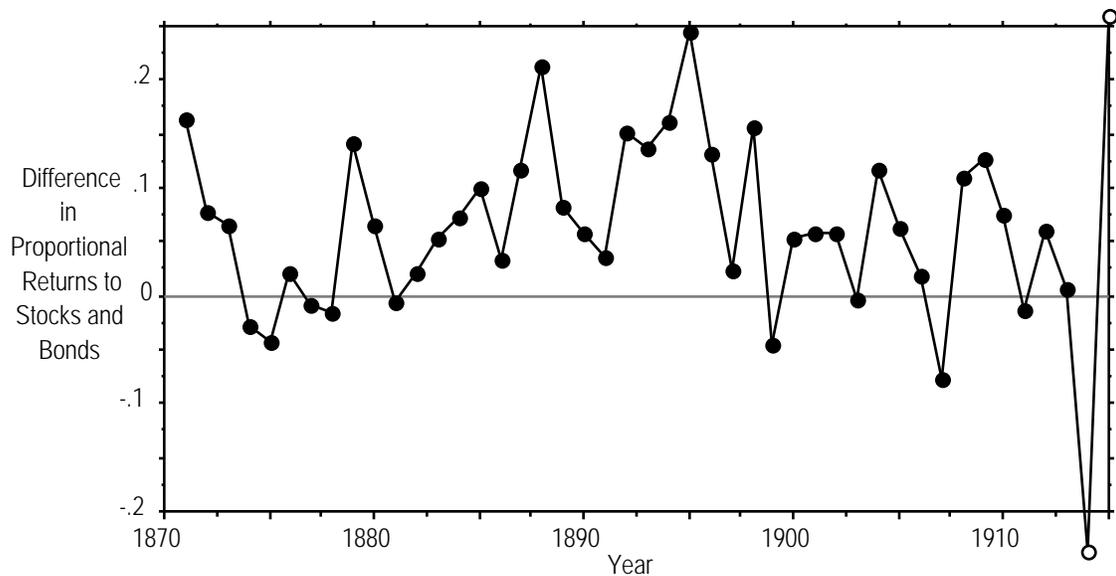


Figure 5 graphs the difference between one-year returns received by an investor buying the LCES index in one year, holding it to the next, and then selling his portfolio and one-year returns earned by an investor placing his money in safe bonds. The average extra return received by the investor choosing stocks is 6.6 percent per year. In 34 of the 43 pre-World War I years, the investor in stocks receives the higher return. Moreover, the extra gains when stocks do well can be substantial: the peak difference in real returns is the twenty-five percent edge earned during 1895-96. The losses when stocks perform badly is small: in only one of the 43 years (1907-08) is the edge in returns received by the investor choosing bonds as large as the average extra return received by the investor choosing stocks. Pre-World War I investments in stock market indices pay high average returns, and pay them without requiring investors to bear any significant risk.

One possible explanation for British investors' suspicion of equities is that they did not grasp that a diversified portfolio of stocks greatly reduced risk: investments in individual stocks are likely to either compound rapidly or lose all their value, but such risks are largely hedged away by choosing a diversified portfolio. Investment advisors like Smith (1924) clearly understood the benefits of diversification, but according to many observers (for example, Bernstein, 1991) the insight that a diversified portfolio of stocks was much less risky than the stocks that made it up (and was in fact less risky than bonds) was not firmly established in investors' minds until the 1970s. However, such an explanation of low pre-World War I British price/dividend ratios does not give one confidence in the

performance of the British stock market as a social capital allocation mechanism: investors whose reasoning is sufficiently poor that they overlook the benefits to diversification are unlikely to wisely guide the industrial development of a country.

An alternative justification of low price/dividend ratios is that stock investments are very good in normal times, but are unlikely to be profitable in times of catastrophe. Figure 5 plots, although the pre-World War I period does not contain, relative stock vs. bond returns for 1914-15 and 1915-16. In the year surrounding the outbreak of World War I stocks lose more than twenty percent of their value relative to bonds. Investments in bonds insure against such large losses in times of catastrophe.

One flaw in this argument is shown by the 1915-16 data point plotted in figure 5. Over 1915-16 bonds lose twenty-five percent of their value relative to stocks. As the British war economy shifts into high gear inflation begins. Stock values more or less keep pace with inflation, but bonds do not. Stock market investments are less risky than bond investments even in times of economic dislocation and catastrophe if such times are likely to be times of inflation as well. They are: World War I, World War II, and the post-1973 oil shock-induced stagnation all saw substantial inflation. Only the Great Depression sees large real stock market declines unaccompanied by price-level increases.

One possible conclusion to draw is that British investors before World War I were mistaken in their excessive suspicion of equities—their fear appears to have no source other than depressed or deficient “animal spirits.” The risk premia they required before they would invest in the stock market appear to have made the stock market a better investment in almost all states of the world. If this interpretation is correct, the low price/dividend ratios of the British pre-World War I stock market would be the equivalent of the £100 pound note left lying on the sidewalk. But such a radical conclusion cannot be strongly supported by an underlying base of data as narrow as the one we have used in this paper.

British Pre-World War I Relative Economic Decline

German and American investors do not appear to have shared the British “fear of equities.” Their greater willingness to invest pushed price/dividend ratios in Germany and the U.S. before World War I up to levels near twenty. Thus they eliminated the opportunity of making wealth without significant risk that the British stock market apparently left open. Nevertheless, investors in Germany and the U.S.—

like investors in Britain—failed to push up the demand for *British* equities.

The higher price/dividend ratios outside of Britain may have given entrepreneurs and investment bankers in other nations a leg up on those in Britain. An entrepreneur seeking to raise money to establish or expand a firm in America or Germany could raise \$20 or 20 RM for each \$1 or 1 RM he could promise in annual dividends. His counterpart in Britain could raise only little more than £10 for each £1 he could promise in annual dividends.²⁰ “Fear of equities” on the part of British investors meant that British industrialists faced a higher cost of equity capital than did their competitors in other countries. This higher cost may have reduced their ability to compete and expand—especially in the large-scale capital-intensive leading-edge high technology industries of the 1890s and 1900s, like electricity, chemicals, automobiles, and machinery, where the ability to raise and deploy large amounts of capital was a key to success and which were the locus of much technological progress.

Britain’s relative economic decline in the generation before World War I has often been seen as abnormally rapid, especially in the high-technology industries. In 1870 Britain was the workshop of the world: the leading industrial nation with the highest standard of industrial productivity, and the most experience at creating, modifying, and improving the machine-based technologies of the industrial revolution. The world’s industrial leader has, or ought to have, a strong comparative advantage in high-technology industries. Yet Britain did not show evidence of such a comparative advantage in the generation before World War I. By 1914 it was, as far as high-technology industries were concerned, an industrial also-ran.²¹

As Lewis (1978) puts it, at the end of the nineteenth century: “organic chemicals became a German industry; the motor car was pioneered in France and mass-produced in the United States; Britain lagged in the use of electricity, depended on foreign firms established there, and took only a small share of the export market. The telephone, the typewriter, the cash register, and the diesel engine were all exploited by others.” Industry after technologically-sophisticated industry in which one would have expected

²⁰Industry can also obtain finance from the bond market or from bank loans. To the extent that a company fails to raise a substantial pool of equity capital to provide a buffer between the asset value of a firm and its debt, it is unlikely to be able to borrow significantly even on the bond market or from banks. It is not clear whether firms were unable to establish close links with finance, or whether—once founding families had decided to retain both substantial ownership and control rather than sell their stake into the depressed stock market—they did not wish to. See Capie (1988, 1991), Cottrell (1980).

²¹Landes (1969) remains the best source.

British industry, by virtue of its larger industrial base, head start, and strong scientific bent, to have a strong position was dominated by producers from other nations that had originally been followers.

Slow British growth in capital-intensive industries did not arise because low domestic savings rates starved the heavy industrial sector of capital. Britain's domestic savings rates were very healthy indeed. Alongside Great Britain's pre-World War I relative industrial decline went a tremendous surge of capital exports. In 1913 net interest, profits, and dividends from overseas investment amounted to 9.3 percent of GDP. Accumulated balance-of-payments surpluses since the mid-1880's amounted to perhaps 110 percent of GDP, and Britain had been running balance-of-payment surpluses much longer. It is not unreasonable to speculate that Britain in 1913 may have had net overseas assets that exceeded its total domestic capital stock. And Britain in 1913 certainly had considerably more than a year's worth of gross output invested abroad.

For the most part, this large overseas investment portfolio was invested in debt, often in debt guaranteed by foreign governments (Edelstein, 1981). According to Edelstein, almost three quarters of British new overseas portfolio investment went into social overhead capital projects, like railways and tramways, docks, telephones and telegraphs, and gas and electricity. Such projects often carried government guarantees. Governments or mixed public-private firms were principal borrowers for social overhead purposes. Most of the remainder was invested in mines and plantations.

Along with Britain's slow development of high-technology industries and high rate of capital export, there was a retardation of the evolution of the internal structure of British companies as well. The transition to "managerial capitalism"—to an economic system dominated by firms with widely dispersed share ownership managed and operated by a hierarchy of professional and salaried managers—proceeded more slowly in Britain. Chandler (1990) draws a sharp contrast between firms run by salaried managers in Germany and the United States, and the more "personal capitalism," in which descendants and relatives of founding entrepreneurs retain substantial equity stakes and managerial positions, in Britain.

British investors' fear of equities provides two reasons for the slow growth of large managerial capitalist firms. First, firms in Britain find it more difficult to expand to the size where a professional managerial hierarchy becomes a necessity because it is more expensive for them to raise capital. Second,

founding families retain their large stakes in firms for longer because they cannot sell them on terms as attractive as can their counterparts in Germany and the United States. To a large extent, the selling out and retirement of founding families from active involvement in business and their replacement by salaried managers depends on founding families' receiving what they regard as a good price for the firm. Investment bankers would find such transactions more difficult to manage, and founding families harder to satisfy, in a British stock market in which shares can only be sold for ten times dividends than in an American or German market where they could be sold at a price/dividend multiple of twenty.²²

The role played by British investors' "fear of equities" in bringing about Britain's turn of the century industrial decline may have been minor. The constraints British firms and entrepreneurs faced were tight. A militant labor movement often hostile to innovation and always hostile to speed-up (Baines, 1981) and an educational system deficient in training workers for the economy of the twentieth century (Landes, 1969) perhaps placed stringent constraints on British industrial development. An excessive fear of equities is only a factor making pre-World War I British development difficult.

But the role may have been more significant. It is interesting that the failures of the British economy identified by Chandler (1990) and Lewis (1978)—a failure to develop managerial capitalism, and lack of success in the high-tech industries of the turn of the century where Britain as the world's industrial leader should have had a natural comparative advantage—are areas in which excessive fear of equities might have played a significant and damaging role.

V. Conclusion

Robert Shiller (1981, 1989) and many others have studied excess volatility in long-run U.S. stock market indices, but few have examined excess volatility in other contexts. Bulkeley and Tonks (1989) found little sign of excess volatility in post-World War I Britain. We follow in their footsteps but examine a longer period and find, in contrast to their conclusions, substantial signs of excess volatility.

The chief feature of the data that leads to such different conclusions when the 1870--present period

²²The German banker Riesser (1909) blamed the institutional structure of British investment banking for poor economic performance. See De Long (1991).

is examined is a secular rise in price/dividend ratios around World War I. British price/dividend ratios were in the neighborhood of ten before World War I—a low number relative to either British post-World War I experience or to the experience, pre- or post-World War I, of the German and American markets.

This anomalously low pre-World War I price/dividend ratio does not appear to be driven by pre-World War I expectations of a low trend growth rate of dividends, or by a high pre-World War I required rate of return on assets in general. Pre-World War I real rates of return on relatively safe assets were substantially lower than interwar rates of return. Instead, the anomalously low pre-World War I British price/dividend ratio appears driven by an anomalously high risk premium required by British investors before they would invest in equities. This may have been the equivalent of the £100 note left lying on the sidewalk. It raises the possibility that the British stock market performed poorly as a social capital allocation mechanism, at least in the years before the First World War. And there may be a connection between the low price/dividend ratios on the London market and Great Britain's rapid pre-World War I loss of its economic predominance.

Appendix Table A1
Real Stock Price and Dividend Series

Year	Real Index Price	Yield	Real Dividend
1870	23.039	.134	3.087
1871	25.543	.121	3.091
1872	27.598	.118	3.257
1873	27.498	.113	3.107
1874	27.612	.121	3.341
1875	26.592	.107	2.845
1876	24.847	.095	2.36
1877	23.728	.094	2.23
1878	22.351	.101	2.257
1879	21.583	.077	1.662
1880	24.648	.087	2.144
1881	24.669	.098	2.418
1882	23.52	.107	2.517
1883	22.413	.109	2.443
1884	21.977	.108	2.374
1885	22.31	.09	2.008
1886	23.18	.086	1.993
1887	22.42	.089	1.995
1888	23.13	.097	2.244
1889	26.21	.087	2.28
1890	26.24	.111	2.913
1891	25.76	.106	2.731
1892	24.79	.096	2.38
1893	25.71	.095	2.442
1894	28.06	.081	2.273
1895	31.86	.072	2.294
1896	38.54	.073	2.813
1897	41.36	.076	3.143
1898	38.97	.083	3.235
1899	41.08	.088	3.615
1900	38.49	.094	3.618
1901	36.49	.103	3.758
1902	35.82	.09	3.224
1903	34.97	.098	3.427
1904	32.97	.086	2.835
1905	34.97	.089	3.112
1906	35.49	.085	3.017
1907	34.85	.103	3.59
1908	31.15	.09	2.803
1909	31.02	.08	2.482
1910	33.68	.085	2.863
1911	35.27	.092	3.245
1912	33.58	.101	3.392
1913	33.14	.104	3.447
1914	32.65	.093	3.036
1915	24.81	.094	2.332
1916	24.52	.076	1.864
1917	22.21	.087	1.932
1918	23.56	.067	1.579
1919	25.37	.052	1.319
1920	22.41	.091	2.039
1921	17.01	.084	1.429
1922	23.8	.054	1.285
1923	30	.06	1.8
1924	29.61	.051	1.51
1925	32.73	.068	2.226
1926	35.47	.061	2.16
1927	40	.061	2.45
1928	45.69	.056	2.56

1929	44.86	.061	2.75
1930	38.38	.073	2.79
1931	31.72	.08	2.55
1932	31.77	.07	2.22
1933	38.71	.053	2.04
1934	48.52	.046	2.25
1935	52.89	.047	2.46
1936	59.16	.045	2.66
1937	53.27	.051	2.72
1938	42.75	.052	2.22
1939	39.6	.065	2.57
1940	28.67	.069	1.99
1941	27.59	.062	1.71
1942	28.35	.053	1.51
1943	32.41	.046	1.48
1944	36.24	.044	1.58
1945	36.15	.042	1.51
1946	37.95	.04	1.53
1947	37.12	.046	1.7
1948	34.09	.052	1.76
1949	31.03	.057	1.76
1950	31.1	.059	1.82
1951	32.82	.056	1.84
1952	25.41	.072	1.82
1953	26.12	.069	1.81
1954	33.8	.062	2.09
1955	37.51	.062	2.31
1956	33.61	.07	2.35
1957	34.56	.069	2.39
1958	34.17	.071	2.42
1959	48.97	.053	2.58
1960	61.61	.048	2.96
1961	61.3	.053	3.27
1962	55.16	.057	3.14
1963	61.34	.049	3.02
1964	63.46	.046	2.94
1965	56.64	.055	3.14
1966	55.02	.057	3.12
1967	57.58	.052	2.97
1968	77.73	.037	2.87
1969	72.79	.039	2.84
1970	60.77	.045	2.75
1971	65.6	.038	2.51
1972	77.9	.032	2.46
1973	61.7	.033	2.05
1974	31.26	.07	2.19
1975	31.49	.065	2.05
1976	32.33	.066	2.14
1977	35.81	.058	2.09
1978	37.24	.056	2.07
1979	37.31	.061	2.28
1980	33.8	.061	2.07
1981	34.07	.059	2.02
1982	36.36	.057	2.07
1983	43.86	.048	2.12
1984	49.72	.049	2.42
1985	57.86	.044	2.53
1986	69.43	.043	2.98
1987	88.01	.035	3.12
1988	73.92	.041	3
1989	83.33	.036	2.96
1990	76.57	.04	3.05
1991	78.66	.036	2.85

References

- Derek Aldcroft (1964), "The Entrepreneur and the British Economy," *Economic History Review* 17: pp. 113–34.
- Dudley Baines (1981), "Labour Supply and the Labour Market, 1860–1914," in R. Floud and D. McCloskey, eds., *The Economic History of Britain since 1700: Vol. 2. 1860 to the 1970s* (Cambridge: Cambridge University Press).
- Robert Barsky and J. Bradford De Long (1990), "Bull and Bear Markets in the Twentieth Century," *Journal of Economic History* 50 (June): pp. 265–81.
- Robert Barsky and J. Bradford De Long (1993), "Why Does the Stock Market Fluctuate?" *Quarterly Journal of Economics*
- Andrea Beltratti and Robert Shiller (1990), "Stock and Bond Yields: Can Their Comovements Be Explained in Terms of Present Value Models?" (Cambridge, Mass.: NBER xerox).
- Andrea Beltratti and Robert Shiller (1991), "Actual and Warranted Relations Between Asset Prices" (Cambridge, Mass.: NBER xerox).
- Peter Bernstein (1991), *Capital Ideas: The Improbable Origins of Modern Wall Street* (New York: Free Press).
- A.L. Bowley, G.L. Schwartz, and K.C. Smith (1931), *A New Index of Prices of Securities* (London: London and Cambridge Economic Service special memorandum 33, January).
- George Bulkley and Ian Tonks (1989), "Are UK Stock Prices Excessively Volatile?: Trading Rules and Variance Bounds Tests," *Economic Journal* 99 (December): pp. 1083–98.
- Arthur F. Burns (1930), *Stock Market Cycle Research* (Boston: Twentieth Century Fund).
- John Campbell and Robert Shiller (1988), "Stock Prices, Earnings, and Expected Dividends," *Journal of Finance* 43 (July): pp. 661–76.
- Forrest Capie (1988), "Structure and Performance in British Banking, 1870–1939," in P. Cottrell and D. Moggridge, eds., *Money and Power: Essays in Honour of L.S. Pressnell* (Basingstoke, Hampshire: Macmillan).
- Forrest Capie (1991), "British Banks and British Industry, 1870–1914" (London: City University Business School xerox).
- Alfred Chandler (1990), *Scale and Scope: The Dynamics of Industrial Capitalism* (Cambridge, Mass.: Harvard University Press).
- P.L. Cottrell (1980), *Industrial Finance, 1830–1914: The Finance and Organization of English Manufacturing Industry* (London: Methuen).
- David Cutler, James Poterba, and Lawrence Summers (1991), "Speculative Dynamics," *Review of Economic Studies* 58 : pp. 529–46.
- David Cutler, James Poterba, and Lawrence Summers (1989), "What Moves Stock Prices?," *Journal of Portfolio Management* (Spring) pp. 4–12.

- J. Bradford De Long and Marco Becht (1991), "'Excess Volatility' and the German Stock Market, 1876–1990" (Cambridge, Mass.: NBER xerox).
- J. Bradford De Long (1991), "Did J.P. Morgan's Men Add Value?: An Economist's Perspective on Financial Capitalism," in P. Temin, ed., *Inside the Business Enterprise: Historical Perspectives on the Use of Information* (Chicago, Ill.: University of Chicago Press).
- Michael Edelstein (1981), "Foreign Investment and Empire, 1860–1914," in R. Floud and D. McCloskey, eds., *The Economic History of Britain since 1700: Vol. 2. 1860 to the 1970s* (Cambridge: Cambridge University Press).
- Barry Eichengreen (1982), "The Proximate Determinants of Domestic Investment in Victorian Britain," *Journal of Economic History* 42, pp. 87–95.
- C.H. Feinstein (1972), *National Income, Expenditure, and Output in the United Kingdom 1855–1965* (Cambridge: Cambridge University Press).
- Marjorie Flavin (1983), "Excess Volatility in the Financial Markets: A Reassessment of the Empirical Evidence," *Journal of Political Economy* 91 (December): pp. 929–56.
- Kenneth French and James Poterba (1991), "Were Japanese Stock Prices too High?" *Journal of Financial Economics*
- Robert Giffen (1877), *Stock Exchange Securities: An Essay on the General Causes of Fluctuations in Their Price* (London: George Bell and Sons, 1877).
- Charles Goodhart (1972), *The Business of Banking, 1891–1914* (Brookfield, Vt.: Gower Press).
- William Kennedy (1987), *Industrial Structure, Capital Markets, and the Origins of British Economic Decline* (Cambridge, U.K.: Cambridge University Press).
- Allan Kleidon (1986), "Variance Bounds Tests and Stock Price Valuation Models," *Journal of Political Economy* 94 (October): pp. 953–1001.
- David Landes (1969), *The Unbound Prometheus* (Cambridge: Cambridge University Press).
- Stephen LeRoy (1989), "Efficient Capital Markets and Martingales," *Journal of Economic Literature* 28 (December): 1583–1621.
- Stephen LeRoy and Richard Porter (1981), "The Present Value Relation: Tests Based on Implied Variance Bounds," *Econometrica* 49 (May): pp. 555–74.
- W. Arthur Lewis (1978), *Growth and Fluctuations* (London: Allen and Unwin).
- London and Cambridge Economic Service (1973), *The British Economy: Key Statistics* (London: London and Cambridge Economic Service).
- Gregory Mankiw, David Romer, and Matthew Shapiro (1985), "An Unbiased Examination of Stock Market Volatility," *Journal of Finance* 40 (July): pp. 677–87.
- N. Gregory Mankiw, David H. Romer, and Matthew D. Shapiro (1991), "Stock Market Forecastability and Volatility: A Statistical Appraisal," *Review of Economic Studies* 58:3 (May), pp. 455–77.
- Terry Marsh and Robert Merton (1986), "Dividend Variability and Variance Bounds Tests for the Rationality of Stock Market Prices," *American Economic Review* 76 (June): pp. 483–98.

- Donald McCloskey (1970), "Did Victorian Britain Fail?" *Economic History Review* 23, pp. 446–59.
- Donald McCloskey (1981), *Enterprise and Trade in Victorian Britain* (London: Allen and Unwin).
- Donald McCloskey and Lars Sandberg (1971), "From Damnation to Redemption: Judgements on the Late Victorian Entrepreneur," *Explorations in Economic History* 9, pp. 89–108.
- Rajnish Mehra and Edward Prescott (1985), "The Equity Premium: A Puzzle," *Journal of Monetary Economics* 15 (March): pp. 145–61.
- James Poterba and Lawrence Summers (1988), "Mean Reversion in Stock Prices: Evidence and Implications," *Journal of Financial Economics* 22:1 (October), pp. 27–59.
- Jacob Riesser (1911), *The German Great Banks and Their Concentration* (Washington: Government Printing Office).
- Lars Sandberg (1981), "The Entrepreneur and Technological Change," in R. Floud and D. McCloskey, eds., *The Economic History of Britain since 1700: Vol. 2. 1860 to the 1970s* (Cambridge: Cambridge University Press).
- Robert Shiller (1981), "Do Stock Prices Move too Much to Be Justified by Subsequent Changes in Dividends?" *American Economic Review* 71 (June): pp. 421–36.
- Robert Shiller (1989), *Market Volatility* (Cambridge, Mass.: M.I.T. Press).
- Robert Shiller (1990a), "Comovements in Stock Prices and Comovements in Dividends," *Journal of Finance* 44 (July): pp. 719–29.
- Robert Shiller (1990b), "Market Volatility and Investor Behavior," *American Economic Review* 80:2 (May), pp. 58–62.
- Edgar L. Smith (1924), *Common Stocks as Long-Term Investments* (New York: Macmillan).
- K.C. Smith and G.F. Horne (1934), *An Index Number of Securities 1867–1914* (London: London and Cambridge Economic Service special memorandum 37).
- Peter Temin (1987), "Capital Exports, 1870-1914: An Alternative Model," *Economic History Review* 40:3 (August), pp. 453-8.