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1920s NYSE Bubble**

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“Theory anchors” explain the 1920s NYSE Bubble

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Abstract

The NYSE boom of the 1920s ended with the infamous crash of October 1929 and subsequent collapse in common stock prices from 1929-1932. Most approaches have suggested an overvaluation of 100%, usually dating from mid-1927 to September 1929. Excessive speculation based on high real earnings growth rates from 1921-8, amid a euphoric “new age” for the US economy, has been given as the cause. However, the 1920s witnessed the emergence of new ideas emanating from new research on the long-term returns to common stocks (Smith, 1924). The research identified a large premium on common stocks held over the long term compared to corporate bonds. This, in turn led to the formation of new investment vehicles that aimed to hold diversified stock portfolios over the long run in order to earn the large equity risk premium. Whilst such an approach was capable of earning substantial excess returns over bonds, new ideas derived from the research led to a change in stock valuations.

The paper reconstructs fundamental values of NYSE stocks from long run dividend growth and stock volatility data, and demonstrates why such a change in theoretical values was unjustified. Investors switched to valuing stocks according to a new theory, which ignored the compensation for stock return volatility, which made up the Equity Risk Premium (ERP), on the assumption that “retained earnings” were the source of the observed ERP.

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Introduction

Substantial gold inflows to the USA during WW1 facilitated a large increase in the volume of bank lending to finance the First World War (Meltzer, 2002). The large increase in the US Money supply resulting from this lending led to large price level increases (Barro, 1979) (Friedman and Schwartz, 1963). Nominal earnings and dividends for NYSE common stocks rose as a direct result of the nominal GDP expansion, during the 1920s. From 1915-1929 the Consumer price index increased by 73% and the level of NYSE dividends rose by 100% from 1915-1929 (see Fig. 1), reflecting a continuation of its historical real growth trend from 1900-1914 and the effects of the monetary expansion. Therefore by 1929, at the peak of the NYSE boom, real dividends of the NYSE broad common stock index (Cowles, 1938) were back to their historical trend and, on the surface, the expansion in lending and price level changes did not have any real cyclical effects on dividends of NYSE stocks.

A large increase in the relative share of residential mortgage debt of total private debt (Kuvin 1936), and a 200% increase the ratio of US residential debt to residential wealth occurred during a home construction boom during the 1920s (Wheelock, 2008). Both monetary expansion in the WW1 era and this mortgage debt expansion increased systemic risk via bank assets and excessive consumer debt. However, we treat any potential changes in systemic risk as neutral in our modelling approach when valuing stocks, ex-ante.

[insert fig 1 about here]

The increase of common stock prices on the New York Stock Exchange (NYSE) from 1921-29 in part reflected the growth of nominal dividends described above. However another, non-monetary, component which we identify, caused an additional and simultaneous rise in stock prices from 1927-9. From mid-1927 to September 1929, the indexes of common stock prices and dividends diverged (White, 1990). This divergence ended by July 1930. This is what JK Galbraith described as a “mass escape into make-believe” (Galbraith, 1954). This divergence of prices and dividends, and the causes of it are the subject of the paper.

(see Fig 2)

[insert fig 2 about here]

In aiming to isolate the cause of this second phase of the boom, we focus on the change in price/dividend ratios of NYSE stocks from a value of 18 to a value of 33, which occurred from 1927 to 1929 and the subsequent fall back to a valuation ratio of 18 by mid 1930, as shown by the index of common stock prices from Cowles (1938) in Shiller (2012). This phase of the boom is generally regarded as the “bubble” or unexplained phase.

Our data set resembles the Cowles (1938) estimate of the bubble but we focus on large common stocks of commercial and industrial firms and Cowles (1938) captures the broad market index including Utilities stocks. Using our data, the change from 1928-peak manifested as a movement from an average NYSE price/dividend ratio of 16 to 30.8, for the 146 largest industrial and commercial common stocks.

What is known from previous analyses is that after this change had reversed by late 1930 dividends remained at the same level as in 1929¹ (White, 1990). This observation allows us to isolate the crash in prices from peak levels to mid-1930 from the later collapse of dividends until 1932, which was due to the onset of the Great Contraction (Freidman and Schwatz, 1963).

Before the 1920s, the majority of investors generally did not use the common stock of Industrial and Commercial firms for investment instead focussing on bonds or Preference shares. Stocks were deemed “risky” and highly speculative. Stocks were not used for investment and there were no significant numbers of institutional investors (Rutterford, 2004). The academic literature, on valuation theory had not examined how to value them with early formal models traced to Fisher (1906). This is not to say that professional investors did not know how to value them. Our research, together with the large-scale historical price and return data of Goetzmann and Ibbotson (2006) indicate that NYSE asset prices from the 1870s to 1925 display a high degree of valuation sophistication in that investors before the 1920s understood short-run² asset return volatility and demanded compensation in the form of a premium for this. This disconnect between the academic literature on valuation and market based knowledge is important for our later analysis of the underlying causes of the boom.

In 1924 a small book entitled “Common Stocks As Long Term Investments” (Smith, 1924) began the change in the general investor’s ideas on the potential returns to this asset class. Prior to Smith, Smith (1924) there were no long run published data on the broad market returns to long-term stock investment strategies for the US market. His data showed a large historical excess return to common stocks compared to corporate bonds. The total return to a

¹ See Fig 2

² in our tests at annual frequency

10 common stock portfolio was 2.5% per annum³ more than the total return on corporate bonds, when measured over the long run of 60 years. He suggested that investors could earn what modern finance theory calls an equity risk premium⁴ by holding a 10-stock diversified portfolio over the long term, rather than corporate bonds⁵.

Crucially, what Smith did not discuss directly was why these returns were so high, although he did conduct tests to show a concept called “time hazard”- his measure of the investment horizon over which the probability of capital loss was reduced to zero. In sum, he claimed that diversification reduced the volatility of returns, and that investing over relatively short horizons, of as low as 4 years, could achieve a zero probability of capital loss on stocks.

Modern Portfolio Theory, which indicates that higher returns to stocks are due to the higher short-run volatility of returns compared to other assets. Under the observation of investor risk-aversion, a superior return is available to an investor that holds over the long run as compensation for the return volatility of stocks, which a short-term investor bears, directly. The book (Smith, 1924) did not define a new valuation formula for stocks. The book did indicate in Chapter X, that volatility was important and that volatility could be mitigated over short horizons. However, this failure to connect the risk premium to return volatility led to a “grey area” which we identify as the cause⁶ of the 1928-9 bubble.

Smith’s work was to introduce new concepts of valuation in to non-specialist investors’ minds. The identification of the premium on long-run stock investment was correct. However, the failure on Smith’s part (Smith, 1924) was to leave an ambiguity in investors’ minds as to the reason for the premium. Thus, the empirical results led to a new valuation theory based on the premise that retained earnings were the source of the excess returns on stocks, and not compensation for risk-averse investors in highly volatile stocks.

The new findings were used and extended by new investment companies known as closed-end funds, which issued stock to pool money from investors and construct diversified portfolios of stocks⁷, which they aimed to hold over the long run. An investor holding 8 stocks in 1927 who moved to an investment in such a fund could have reduced their volatility

³ The figure is derived from the arithmetic average of the geometric returns that we re-calculated from the data, in his tests.

⁴ It should be noted that Smith did not define or use these terms himself.

⁵ Given valuations of common stocks in 1924.

⁶ We use the term cause in the sense that it was the theory used to justify higher prices. The use of this idea may have itself have been due to the high returns to stocks or optimism and euphoria.

⁷ The average number of common stocks held by closed-end funds was 50

of returns by 20-45% and still expect a 3.6% return over risk-free Government bonds over the long run. In this sense, the book was a key financial innovation for the long-term investor.

What we observe is that from 1927-1929 the compensation for risk inherent in prices changed dramatically. Our models indicate that a market portfolio of NYSE stocks was priced to yield a 3.6% excess return or over Long-term Government Bonds in 1927.

By the peak in 1929 the premium reached minus (-) 0.4%. The question we seek to resolve is whether from 1927-9, such a change in valuations was justified. And if not, what could have triggered the change and the subsequent collapse of valuations?

The time frame of the emergence of these new investment funds from 1927-29, when numbers increased exponentially from less than 30 to over 200, (Bullock, 1959) (De Long and Shliefer, 1993) matches the alleged deviation of prices from dividends, which is identified by Galbraith, (1954) and White (1990) as the bubble phase.

Together with the fact that the funds embodied the new ideas (Smith, 1924) on stock valuation, they are the prime candidates for either acting as the catalyst for the boom in stock prices and an indicator that new valuation theories derived from Smith (1924) were adopted at this time.

The findings lead to a new causal channel of the observed valuation changes for stocks from 1927-9. We show that a new valuation theory regarding the equity risk premium was used by the new funds to earn long-term returns as a result of Smith (1924), but a competing interpretation of the data (Smith, 1924) emerged which led to a theory based jump of stock prices.

This change in valuation theory increased prices to new valuation levels, which were far removed from fundamentals. According to our econometric modelling of expected returns and asset volatility, NYSE market valuation ratios should not have changed from 1927-9. Our paper therefore isolates the cause of the change in valuation ratios from 1927-9.

The sections are arranged as follows:

Section I provides the historical background on common stock pricing theory around the time of the 1920s boom.

Section II produces a framework for the types of data and models that were available to investors. We then identify the new investor group of closed end funds and investigate the timing of its formation. We then show the data set, assumptions, sources and methods used to

construct a valuation model (DDM) for stocks to derive the expected return to the market portfolio of large NYSE common stocks in 1929.

Section III looks at actual data from the NYSE in 1929 to compare the model we build to actual stock prices and details scenario tests of valuation models when changing the expected risk premium and dividend growth rate assumptions. It also shows how we calibrate the risk premium to volatility changes under different levels of diversification.

Section IV proposes an explanation for the change in the risk premium from 1927-30.

Further data on the historical equity risk premium on US Common stocks and investor risk aversion are used to indicate what caused prices to change when they did and how the new valuation theory drove the 1927-9 phase of the boom.

Section V shows the conclusions of the paper and Section VI discusses future avenues for research and discussion of the areas of the paper subject to limitations in their assumptions.

I. The evolution of common stock valuation theory in the USA in the 1920s

a. E L Smith (1924): The Long term return on Common Stocks

Smith (1924) illustrated a method for calculating the long-term historical returns to diversified common stock holdings. Smith's seminal book, "Common stocks as long term investments", detailed comparative tests of 10-stock and 10-bond sample portfolios, over a 56-year time frame from 1866-1922. By comparing the return on stocks to the return on bonds, he found major evidence of superior total return performance for stocks.⁸ Using Smith's original data our analysis suggested an investor could earn a total return including capital gains and dividend income, which was 2.5% per annum higher than corporate bonds, when holding over a long time frame⁹.

This text (Smith, 1924) also introduced new ideas on the "riskiness" of stocks. A new concept called "time hazard" was demonstrated in Chapter X. The most optimistic findings showed that an investment horizon for the 10-stock portfolio of more than 4 years reduced capital losses to zero. In other words, that there was no need for stocks to be deemed "risky" when held over the longer-term. Even the more conservative measure of this "zero capital loss" horizon using data from the 1830s to the 1920s was only 15 years.

Smith also indicated that the volatility of economic growth in the USA around its long-term trend had been falling since the 1830s. The US economy was therefore seen as becoming more stable and hence the "riskiness" of stocks was falling as the US Economy developed.

The ideas put forward were that "riskiness" or volatility was reduced:

⁸ Smith's actual method was to construct a "spliced" long-term return series made up of total returns to common stocks over 20 year sub-frames⁸;

He suggested to investors the need to calculate dividend income returns and adjust for "stock splits" and "bonus shares".

Data from Moody's Manuals of Investments provided detailed information on profits and dividends, debt levels, and data related to "bonus shares" and "stock splits" extending back to 1900. Therefore, the data needed to perform the calculations advocated, were accessible to investors over a reasonably long horizon in the 1920s.

⁹ From holding a 10 stock portfolio

- Over time as the US economy became more stable
- When investors used a longer holding period of 4 years or more
- By using diversification to smooth out returns- reducing volatility

Smith (Smith, 1924) had discovered what we now call the equity risk premium, but was also implicitly challenging whether short-term volatility was a meaningful concept when investors held over the long term. Smith also did not explicitly connect the volatility of stocks with excess returns to stocks¹⁰.

The relevance of Smith (1924) for our tests for the origin of the 1927-9 bubble component is that these new ideas could have triggered the adoption of new methods of stock pricing derived from these findings. The exact nature and feasibility of the new theories are examined below.

d. Evidence of new valuation theories and a new type of investor in the late 1920s:

The legendary investor JM Keynes, who himself was the first major institutional investor to advocate high allocations of equities for UK institutional investors which he also used for King's College Cambridge's endowment from 1920-1948 (Chambers, 2012), reviewed the work¹¹, thereby increasing its visibility, internationally. Keynes invited Smith to join the Royal Economic Society as a result of the work. Keynes anticipated a perversity of interpretation, which could have arisen, in his 1925 review, identifying the potential dangers of such new data¹².

¹⁰ Smith went on to form Investment Managers Company and a fund called "Investment Trust Fund A" in 1925. This fund's structure reflected a change in his investment thinking from the 1924 book. He diversified to a much higher extent with 50 industrial common stocks, thereby expecting to earn a long-term premium with a lower level of "riskiness" than in his original study, which used 10 stocks, as the volatility of the returns would be lower. He was also implicitly holding his stocks for the long run.

¹¹ "Mr. Smith's most important point ... and certainly his most novel point, well-managed industrial companies do not, as a rule, distribute to the shareholders the whole of their earned profits. In good years, if not in all years, they retain a part of their profits and put them back in the business. Thus there is an element of compound interest operating in favor of a sound industrial investment."

JM Keynes, (1925) The Nation and The Atheneum

¹² "It is dangerous...to apply to the future inductive arguments based on past experience, unless one can distinguish the broad reasons why past experience was what it was."

JM Keynes, (1925) The Nation and The Atheneum

Smith's ideas also featured in the NY Times (1925) thereby reaching a wide audience.¹³ Graham and Dodd (1934) and JB Williams (1938) noted, ex post, that a change in valuation method was occurring during the 1920s and significant debate about how to value common stock was occurring¹⁴. In their classic book "Security Analysis" (Graham and Dodd, 1934) Graham and Dodd claimed that new valuation methods based on the theoretical work of Smith (1924) caused the boom and bubble in prices. They disagreed with the validity of the new ideas introduced by Smith (Smith, 1924) and stated clearly that the data showing that stocks outperformed bonds over the long term led investors to mistakenly buy stocks up to excessive price levels which neglected the reasons for the superior performance. They attribute the change to valuations based on "earnings power" where a stock was valued according to its ability to generate future earnings.¹⁵ Their central line of reasoning for why

¹³ "I have been unable to find any twenty-year period within which diversification of common stocks has not, in the end, shown better results, both as to income return and safety of principal, than a similar investment in bonds. It was a surprise to me, for my studies were undertaken with the intention of proving the probably future advantage to be gained from bonds over stocks"

EL Smith (1925), "New Tests Show Stocks Excel Bonds in Yield," *The New York Times*, February 22, 1925

¹⁴ "Some time ago intrinsic value was thought to be about the same thing as book value i.e. it was equal to the net asset value of the business, fairly priced. This view of intrinsic value was quite definite, but it proved almost worthless as a practical matter because neither the average earnings nor the average market price evinced any tendency to be governed by the book value. Hence the idea was superseded by a newer view..., that the intrinsic value of a business was determined by its earning power. But the phrase "earning power" must imply a fairly confident expectation of certain future results. It is not sufficient that to know what the past earnings have averaged, or even that they disclose a definite line of growth or decline. There must be plausible grounds for believing this average or this trend is a dependable guide to the future"

(Graham & Dodd, 1934)

¹⁵ There was however, a radical fallacy involved in the new era application of this historical fact (**referring to Smith's discovery of the equity return premium**). This should be apparent from even a superficial examination of the data contained in the small and rather sketchy volume from which the new era theory may be said to have sprung. The book is entitled *COMMON STOCKS AS LONG TERM INVESTMENTS*, by Edgar Lawrence Smith, published in 1924. Common stocks were shown to have a tendency to increase in value with the years, for the simple reason that they earned more than they paid out in dividends, and thus the reinvested earnings added to their worth....The attractiveness of common stocks for the long pull thus lay essentially in the fact that they earned more than the bond interest rate upon their cost....but as soon as the price was advanced to much higher price in relation to earnings, this advantage disappeared, **and with it disappeared the entire theoretical basis for investment purchases of common stocks**....Hence in using the past performances of common stocks as the reason for paying prices 20 to 40 times their earnings, the new era exponents were starting with a sound premise and twisting it into a woefully unsound conclusion.

the rise was not justified was that when stocks were bought up to new levels to equal the return on bonds, this negated the initial premise that stocks would outperform bond returns. They did not make the connection between return volatility and the premium. They suggest that a cognitive bias generated a new valuation method that was a contorted interpretation of the initial ideas of Smith (1924). JB Williams (1938) also lays the general blame for the general boom and crash on the adoption of the ideas of Smith (1924) although he identified bubbles in prices due to more complex factors, such as in the mispricing of Utility Holding Companies.

Fisher (1930) also stated that valuation increases were driven by Smith's (Smith, 1924) theory on the riskiness of stocks and the reduction of risk by diversified investment funds¹⁶. What is salient from the historical literature is a definite observation that a change in asset valuation theory and the perception of the riskiness of common stocks relative to bonds was occurring during the 1920s.

The new institutional investors in the 1920s

Bullock (1959) details the emergence of long-horizon investors in the form of Investment Trusts in the 1920s. "Investment Companies"- the generic term given to corporations involved in securities investment and trading¹⁷, existed in a broad spectrum of sizes,

¹⁶ "a potent reason for the long bull market rising to the plateau of stock prices 1923-1930 is that there has been a material change during this period in the estimate of the public as to the risk of investing in common stock. Whether this change is justified or not, the change has occurred.

Among (sic) several important books which emphasise the important role of changes in the value of the dollar, none has impressed the investing public so profoundly as certain events that gave rise to investment counsel and investment trusts in America, including especially the publication of Edgar Lawrence Smith's book, **common stocks as long term investments**.

The series of writers on the subject have proved, statistically that bonds are not, as compared with well selected and diversified stocks, what they have been cracked up to be; that they are especially deceptive during rising prices and that even when prices are falling they are not all that superior to stocks... they show that whatever truth there is in the "risk" carried by the stockholder as compared with the bondholder, this risk can be partly neutralised by diversification....both Smith and Van Strum show how this diversification does neutralise the risk and correct the unsteadiness of the stockholders income."

I Fisher "The stock market crash and after" (1930)

¹⁷ as distinct from Large stock exchange traders and Investment pools

management style, sector focus and leverage ratios¹⁸ (Moody's manual of investments: insurance companies, investment trusts, real estate, finance and credit companies, 1930). The Closed-end funds, a key subgroup, grew rapidly in both number and assets under management from 1927 to 1929. Funds under management grew very quickly from \$700m in the mid 1920s to \$3 billion in 1929. (Bullock, 1959) Importantly, their emergence coincided with the alleged “bubble” component of asset prices on the NYSE from 1927 to the peak in September 1929.

Data from Bullock (1959) shows a sample of the number of closed-end funds formed and indicates the rate of formation (see Fig 3). The actual numbers of Closed-end funds formed were over 180 in number, by 1929 (De long and Schliefer, 1991).

The increase in their numbers illustrates how a new investor class, with different risk characteristics to the existing investor population in 1927, emerged rapidly.

These new investors embodied a new theory based on diversification to reduce risk and to hold over the longer term to earn a return premium over risk-free assets, which originated with the ideas of EL Smith (1924). Data available from Moody's manual of Investment (1930) suggest 50 common stocks as the arithmetic average holding of common stocks of a closed-end fund¹⁹ indicating they had moved beyond Smith's original idea of holding 10 stocks, by 1927. The manual also shows closed-end funds using an “equal weighted” holding strategy.²⁰

[Insert Fig 3 about here]

We can therefore see that new ideas from Smith (1924) were both a correct and useful theoretical innovation behind the formation of new funds, but also may have led to a distorted

¹⁸ The total amount of funds under the management of investment companies as a whole, including trusts, closed end funds and general investment companies was approx. \$7 billion in 1929. Moody's Manual of Investments (1930) states that large numbers of the “investment companies” operated under varying degrees of covenant restrictions. \$4 bn of the total of \$7 bn could be described as of the “management type” whereby managers decided the fund's allocation strategy and changed holdings.

²⁰ The Closed-end funds were designed to hold mainly common stocks²⁰ over the longer term in diversified holdings. This decreased the risk of losses from any one firm and reduced the volatility of returns. The idea of holding over the longer term meant that a higher return could be earned compared to the return on bonds, which was identified by Smith (1924) when holding stocks over 20 year horizons. By holding over long time frames it was likely that such funds would not face losses from the short term fluctuations of stock prices which were more volatile than bonds

idea on the reason for the premium and the use of new stock valuation approaches. The timing of the new funds' emergence shows the 1927-1929 phase of boom was linked to the implementation of Smith's (Smith, 1924) ideas.

II. Historical returns to NYSE common stocks and the expected return on the market portfolio

The models we build establish a hypothetical closed end funds' valuation for the market portfolio of NYSE stocks. The model we build is directly analogous to the expectations of stock values under Modern Portfolio Theory as the fund holds the market portfolio of large common stocks.

a. Model summary

The final model we build to estimate valuations, is shown below. The inputs to the model and how it was constructed are listed in the following sections. The output from the model shows what we would expect as the Price/Dividend ratio of the market portfolio of common stocks on the NYSE to be before and after the emergence of a new valuation method by varying the discount rate.

$$PV = \sum_{t=1}^{30} \frac{D_t}{(1+k)^t} + \sum_{t=31}^{80} \frac{D_t}{(1+k)^t}$$

$$D_t = \begin{cases} (1 + \Omega^{LCompDR})^t, & t=1, \dots, 30 \\ (1 + \Omega^{LCompDR})^{30} * (1 - 0.06)^{t-30}, & t=31, \dots, 80 \end{cases}$$

- PV = Average common stock or market Price/Dividend ratio
D = Dividends at time t
k = Discount rate
 $\Omega^{LCompDR}$ = Risk and inflation adjusted dividend growth rate of an equal-weighted market portfolio from 1900-1929

The sections are arranged as follows:

Section b shows the general method of our tests.

Section c calculates the growth rate of dividends from the market portfolio of common stocks from 1900-1929 and the adjustment for long-term risks to dividends, in the model.

Section d calculates the longevity of income streams from the market portfolio of common stocks and the adjustments of the dividend income in the model assuming different lifespans of the market portfolios. It also shows alternative DDMs to test whether the results are sensitive to these changes in model estimation.

Section e shows the final model in the context of its construction, the discount rate assumption in a risk neutral version of the model where the return to common stocks is the return to corporate bonds and looks at alternative forms of the DDM

b. General Method

[See appendix]

c. Measuring the income return of large common stocks from 1900-1929

i. Method

By measuring the total dividend return growth rates of an equal weighted market portfolio of large stocks from the five major Industrial and Commercial sectors of the USA we can generate a feasible forward looking expectation of those growth rates, based on historical experience to use in our valuation models for NYSE stocks.

We recreate what investors in the 1920s could have expected in the way of dividend income from holding the market portfolio of large stocks in 1929.²¹ We also construct a Dividend Discount Model using firm survival data to model expected valuations.

²¹ Comprehensive data sources were available to investors in the 1920s to be able to derive a total return data set for the common stocks of large firms. One source was the 1900-1929 data contained in Moody's manuals of Industrial Investments, which have continuous data on dividends and adjustments for common stocks from 1900-1929²¹. Smith (1924) explains how to adjust for splits and bonus stock.

The "real" or inflation adjusted historical dividend growth rates for an equal weighted holding of large firm common stock over the 29 years from 1900-1929 could have been calculated by investors; the method of calculation including "bonus" stock and "stock splits" and the adjustment of nominal to real growth rates using a price index was known

Due to the nature of the models we develop we exclude the prospect of capital gains. This is because the historical survival rates of firms were low and therefore do not warrant any expectation of survival over the long term.²²

ii. Data Sources

Using Moody's Manual of Industrial and Miscellaneous Securities (1900)²³ a list of stocks from five main industrial stock categories were formed:

Sector 1 Industrial companies- motive power, automobile, electric power, compressed and liquid air, cycle, automatic, phonographic, pneumatic, prismatic, signal, slot machine and allied industries.

Sector 2 Manufacturing companies- iron, steel, lead, zinc, brass, brick, clay, cement, celluloid, car appliances, car manufacturers and allied industries

Sector 3 Food products- packing, distilling, malting, brewing companies etc

Sector 4 Manufacturing companies – miscellaneous

Sector 5 Manufacturing companies- textile and allied industries

The categories **excluded**²⁴ were:

- 6) Water and Water power
- 7) Financial, Trusts and Banks
- 8) Miscellaneous Corporations

²² Data for small firms were also present but are not comprehensive enough to be able to derive any meaningful forward looking growth estimates from them as the data exist for very few of the sample and the failure rate is very high.

²³ The first edition devoted to Industrial Stocks.

²⁴ The reason for these exclusions was because our tests focus on industrial, commercial and manufacturing common stocks, with the other categories using more complex pricing models (such as mining stocks or financials) or were regulated utilities by 1929 and hence historical returns may not be a dependable guide to valuation in 1929.

- 9) Mining companies- gold, silver, lead, copper, zinc, coal etc
- 10) Guaranteed Railroad Stocks

iii. Data collection

The firms from part ii were then categorized as “Large”: by the criterion of full balance sheet data listings in the source manuals. A total of 254 firms were listed using this method.

A data set was collected by hand for 168 of the 254 large firms using the available data on annual dividends from Moody’s Industrial and Miscellaneous Securities manuals from 1900, 1908, 1919 and Moody’s Manual of Investments (American and Foreign) from 1930.

Annual cash dividend data for each firm was collected over the 1900-1929 timeframe.

Annual cash dividends data for each individual firm were adjusted to reflect increases in the holding of the original shareholder²⁵ due to bonus stock²⁶.

²⁵ This method reflects the method suggest by EL Smith (1924)

²⁶ If a bonus dividend of 50% (Of Par) was paid as more stock instead of cash, then all subsequent dividends were increased to reflect the additional shares of the original 1900 owner of stock. The Par value of the share was assumed as the price of the additional shares so that original shareholders were assumed to have 50% more shares. Additional irregular cash dividends were excluded from the adjustment of the total share holding which introduces a minor downward bias in our values for dividend return growth rates.

Where data was not found for any companies, of the 254 firms, which were listed in 1900, these stocks were recorded as having no data.

Where companies were taken over or merged during the 1900-1930 period, the dividend growth rate of the acquiring company or the new merged company was used.

- Missing data from before 1912 was replaced with data from Poor’s Manual of Industrials from 1912.
- Where data was not listed or not found they were excluded from the data set.
- We exclude the possibility that dividends are reinvested

iv. A Composite growth rate from Sector-specific data

The **total** cash dividends for an equal-weighted holding of large firms from each sector, was tabulated for each year from 1900-1929.

The total cash dividends in 1900 and 1929 for each sector were then used to derive five sector growth rates, denoted:

$$\Omega^{LSEC,1} \dots \Omega^{LSEC,5}$$

by the following formula:

$$\sum dividends(1900) * (1 + \Omega^{LSEC,i})^{29} = \sum dividends(1929)$$

$$i = 1, \dots, 5$$

These five total dividend return growth rates were adjusted for inflation using the Consumer Price Index from 1900-1929 from Shiller (2012) to derive an inflation adjusted geometric rate of growth per annum for each sector. Due to the large bias arising from the high level of cash dividends of Sector 5²⁷, the textile manufacturing industry, and the implicit high weighting in the resulting unadjusted growth rate, a composite inflation adjusted growth rate Ω^{LcompD} was calculated by giving equal weighting to each sector's growth rate in the composite growth rate by the following formulae:

[insert equation A + B about here]

[See Appendix]

v. Results: Total dividend return growth rates by sector

Table A shows the individual sector growth rates both adjusted for an unadjusted for inflation and the composite growth rate.

Sector	Cash dividends (1900)	Cash dividends (1929)	Nominal growth (% ann. geo.)	Inflation adjusted growth (% ann. geo.)
1	42	181.65	5.175	2.475
2	122.25	195.25	1.625	-1.075
3	111.15	632.91	6.2	3.5
4	33	116.00	4.45	1.75
5	317.85	244.78	-0.009	-2.709
Un-weighted total Composite	626.25	1370.59	2.74	0.04
			4.15	1.45

Table A

The value of Ω^{LCompD} : 1.45 % and the Unadjusted growth rate: 0.04% are significantly different, and given their importance to the results, warrant discussion. The unadjusted growth rate is lower because of the very high weighting of textiles in the historical data.²⁸

b. Adjustments of the composite growth rate to reflect longer-term risks

i. Method

In order to capture investors' adjustments of the 29-year data from Moody's to reflect longer term risk, a long-term real dividend growth rate from Shiller (2012) using the Cowles (1938) index was used. This index gives a 1.6% annualised geometric growth rate of dividends from 1871-1929, however the measure is biased when used for our purposes by the changing underlying composition of the firms in the Cowles index. In essence, new firms enter the index and weak firms exit, which creates a survival and growth bias.

²⁸ The reason why we can have confidence in using the re-weighted composite growth rate is that no such large sector existed in the 1929 data. The composite growth rate therefore reflects a more realistic forward-looking expectation of income returns from holding the market portfolio of stocks in 1929 when based on a long-term realized growth path

We adjust these data to replicate a non-indexed holding, which capture the effects of firm failure and non-entry of new firms to the index.

Cowles' data shows that inflation adjusted dividend growth rates for this index were 1% over 1871-1900, and 2.1% from 1900-1929.

We assume that our growth rate Ω^{LCompD} would have been lower over the 1871-1900 timeframe by the same ratio as between our data and Shiller's data²⁹ from Cowles (1938) suggests for 1900-1929.

We therefore derive the new growth rate by the following formula:

$$\Omega^{LCompDR} = \left(\frac{\Omega^{LCompD}}{C^{00-29}} * C^{71-00} + \Omega^{LCompD} \right) / 2$$

Where,

C^{00-29} = Geometric growth rate of dividends in Cowles (1938) index for 1900-1929

C^{71-00} = Geometric growth rate of dividends in Cowles (1938) index for 1871-1900

ii. Results: The risk and inflation adjusted growth rate

$$\Omega^{LCompDR} = 1.05\%$$

This risk and inflation adjusted growth expectation was then used in our DDMs. The growth rate we use is low when compared to the actual long-term growth rate of the US economy of 2.9%. However, this value includes adjustments for long-term risks. It is based on a realistic estimate of how common stocks rewarded investors over long term US history prior to 1929 and a realistic forward growth expectation for investors in the late 1920s.

²⁹ Cowles' growth "1900-1929": 2.1% and Cowles growth "1870-1900": 1%

*c. Longevity of dividend income streams from a diversified holding of Large NSYE
common stocks*

The hazards to firm survival were high in the 1900-29 era³⁰. The idea that the timescale of income produced by an asset was important when valuing an asset was established in Fisher (1906). We use a “life-table” method, which was known to have been in use prior to 1929, to estimate the timescale over which dividends of firms would have been expected for a holding of 168 large common stocks. In essence, we estimate how many firms would survive over the long term and how this would affect dividend income for an investor holding the market portfolio of stocks.³¹

i. Method

Using our “Large firm” growth data set from 1900-1929: Binary survival data in the form 0 or 1 was collected for firms in each of the five sectors from Moody’s (1900) at an annual frequency.

The absence of a firm from the subsequent Moody’s manuals³², was treated as the “death” of the firm, denoted as “0”, Firms which underwent merger, name changes or takeover were treated as survivors, denoted as “1”.

Survival rates from sectors 1, 2, 3 and 4 were used but Sector 5 (Textiles) was excluded to avoid an upward bias in the estimate resulting from the age of the industry over the sample period.³³

The estimated arithmetic average death rate per annum was calculated as:

$$\text{deaths (\%)} / \text{years} = (\%) \text{ death rate per annum}$$

This “death rate” was used to calibrate a dividend income horizon for the market portfolio holding assuming a monotonic % death rate of the original cohort of firms. This means that

³⁰ 37% of all large firms from 1900 had failed by 1929.

³¹ We use these “life-span” data because indexation was not in use in 1929. Nowadays an index-tracking fund can be bought which will absorb new firms and eject poor ones to track the market index of a group of firms. In 1929 such a contract was not used. Therefore any dividends expected from holding the market portfolio must reflect expected “death rates” of firms from the original holding, based on ex ante hazard data, rather than the return to a continuously surviving index, which includes new firms and excludes failed firms.

³³ As an old and established industry from the 1830s, US textile companies had significantly higher survival rates over the period and were therefore excluded.

given the death rate of firms of 37% of the initial cohort over 29 years, assuming that this death rate continued, all firms would be expected to have failed over 80 years. Therefore no further dividend income could be expected.

ii. Results

Table A: **Estimation of dividend income timescale of large firm holding**

<i>Years</i>	<i>Deaths (% of total)</i>	<i>Death rate (% per annum)</i>	<i>Implied life span</i>
29	37	1.3	78

The results indicate a dividend income timescale of 80 years, for a holding of diversified stocks could be expected in 1929. The results imply a feasible estimate for the lifespan of the market portfolio to be 80 years.³⁴

d. Alternative estimates of dividend income from years 30-80 in the DDM

We also use two additional models to control for the effect of different assumptions of the expected dividends post year 30³⁵:

Model A: We assume a zero growth rate of dividends from year 30-50

Model B: We assume a monotonic growth rate decline in dividends from year 30 to 80 that dividends decline to 30% of the initial dividend level in Year 1

³⁴ Although significant numbers of the firms from our 1929 sample survive today, we develop an expected lifespan of the market holding given firm historical survival rates.

³⁵ See data appendix for formulae

e. The Dividend Discount model

[see section a]

The estimates of $\Omega^{LCompDR}$ and the results from the analysis in the previous sections were then used as inputs for our DDM pricing tool.

$$PV = \sum_{t=1}^{30} \frac{D_t}{(1+k)^t} + \sum_{t=31}^{80} \frac{D_t}{(1+k)^t}$$

$$D_t = \begin{cases} (1 + \Omega^{LCompDR})^t, & t=1, \dots, 30 \\ (1 + \Omega^{LCompDR})^{30} * (1 - 0.06)^{t-30}, & t=31, \dots, 80 \end{cases}$$

PV = Analogous to Price/Dividend ratio
D = Dividends at time t
k = Discount rate

i. Alternative dividend discount models

In order to see how a DDM behaves using various assumptions of dividend income and the assumptions discussed in the section above, we use five DDMs in our econometric tests³⁶.

- 1) 30 Year DDM
- 2) 50 Year DDM
- 3) 80 Year DDM with a monotonic negative growth rate in dividends to “zero” dividends from year 30-80³⁷
- 4) 50 Year DDM with 0% dividend growth from year 30-50
- 5) 80 Year DDM with a monotonic decline in dividends to 30% of year 1 dividends from year 30-80³⁸

The results are shown in Part III. Section a.i & ii

³⁶ See data appendix for formulae

³⁷ This model was deemed our most realistic model and is reported in section a

³⁸ the assumption of a monotonic hazard to firm survival and hence the pattern of dividend income expected in the 80 year DDM may not be accurate as some firms may have been expected to survive at such horizons

III. *Diversification, investment horizons and the equity risk premium: The new theory*

A large historical excess return to stocks over bonds³⁹ and a higher annual volatility of returns to stocks than bonds up to the 1920s indicate investors were rewarded for this excess volatility⁴⁰.

In this section we quantify by how much a diversified investor could have reduced their risk (volatility) relative to a single stock investor.

We then test how much the Equity Risk Premium (ERP) could have been reduced if investors believed there was a reward for diversifiable risk.

We also perform two further tests:

We test a valuation model where stocks and bonds were expected to produce the same returns irrespective of return volatility. The test follows the interpretation of the boom as the change to a theory of “earnings power” (Graham and Dodd, 1934), which assumed the large historical ERP was due to stocks ability to reinvest earnings, which were not paid out as dividends. We also test whether Smith’s (Smith, 1924) ideas on “zero capital loss” probabilities over longer holding periods could have caused the bubble.

Section a shows the method for comparing our models to actual NYSE data and the values generated from our main model (risk-neutral) and alternative DDMs (risk-neutral).

Section b shows how we “reverse-engineer” the implied equity risk premium of common stocks in 1927 from NYSE market data, using our model.

Section c details three tests, which illustrate the new valuation models and their inputs.

Section d shows three alternative hypotheses for the boom; A new theory change based on lower risk based pricing of stocks relative to bonds due to longer horizons of investment; assuming that stocks had originally been priced to reflect no reward for diversifiable risk, before 1927. The second that prices should have increased to reflect diversification, lowering risk, assuming stocks did not reflect potential gains from diversification in 1927.

Section e shows whether fears of recession caused the reversion of valuation ratios.

³⁹ Goetzmann and Ibbotson (2006)

⁴⁰ We assume that both diversifiable and un-diversifiable risk was rewarded. Therefore the ideas of Modern Portfolio Theory did not apply before 1927.

a. NYSE-based valuation ratios for large common stocks

We use the actual Price/Dividend ratios for the market for large firms on the NYSE in 1929. We collected data from the NYSE for 146 firms in our data set, which approximate the number of firms for which we have dividend growth data. The sample represents 75 % of the total market value of NYSE Common stocks, deemed to be representative of a large section of the market.⁴¹

i. Method

A data set was collected by hand for 700 of the 900 firms listed in Moody's manual (1930) with data for 1929. The following additional data was collected for each firm:

- Shares outstanding
- Net current assets
- Maximum prices reached during 1929
- Dividends per common share

187 large firm stocks were filtered from this database using the following filter:

Large firms = [Net current assets >\$8m]

Price data for 146 of the 187 firms from the large firm data set were collected for which data were available from the Commercial and Financial Chronicle from 1929.

The average price/dividend ratios in the 2nd week of September 1929 for firms in our filtered data were calculated as follows:

Prices (intra-week high) from the 2nd week of September 1929 (Commercial and Financial Chronicle, 1929) were collected.

The dividends (annual) of these firms were collected from Moody's Manual (1930) for 1929 from the filtered database. The Price/ Dividend ratio was derived using the following formula:

⁴¹ As measured by total market value: 146 large firms = \$30 bn and others at \$8 bn

$$NYSEPD = \frac{\left(\sum pricepershare\right)}{\left(\sum divpershare\right)}$$

ii.Results

The results are summarized in table B where they are compared to the expectation of P/D ratios from our main model (3) from part II, which expects stocks to earn the same return as US Long-term Government bonds and AAA corporate bonds.

Table B:

VALUATION METHOD	P/D ratio
146 NYSE stocks avg. P/D ratio (1929)	30.8
80 Year Monotonic growth hazard DDM (Year 30-80) ⁴² (Risk-neutral)	28.7
80 Year Monotonic growth hazard DDM (Year 30-80) ⁴³ (Risk-averse with AAA Bond premium)	25.7

The table B above indicates that our risk-neutral DDM model shows a 6% overvaluation at peak prices and 20% with the AAA bond premium.

Table C: valuation ratios generated using different DDMs

	P/D ratio	% Overvalued
NYSE AV P/D (1929)	30.8	
1) 30 Year Constant growth DDM	21.0	46.7
2) 50 Year Constant growth DDM	28.5	8.1
3) 80 Year Monot.hazard DDM (Year 30-80)	25.7	19.8
4) 50 Year Zero growth DDM (Year 30-50)	27.8	10.8
5) 80 Year Monot.hazard DDM (Year 30-	27.8	10.8

⁴² This model assumes that risk neutral investors used the return to Government bonds as the return expectation to stocks.

⁴³ This model assumes that risk neutral investors used the AAA corporate bond premium + the return to Government bonds to determine the return on stocks.

As can be seen from table C, variations in the models do not generate majorly significant changes in the expected level of valuation ratios. The only exception to this being model 1, where the timescale of income flows is much lower.

b. The Equity risk premium implied by 1927 stock valuation ratios

i. Using our DDM to estimate the ERP from NYSE valuations

In order to generate the implicit ERP prior to the bubble phase from 1927-9, we use model (3) and solve for the expected return (k) and derive the premium using a P/D ratio of 16 taken from actual NYSE data from 1927.

ii. Results

The value of the return premium was 3.6% per annum or a 6.5% return per annum. This central case establishes our estimate of the market risk premium as we assume that stocks were priced to reflect a market risk premium and did not reward diversifiable risk in 1927.

iii. Alternative estimates of the long term return to NYSE stocks

The long term historical return to stocks from Goetzmann and Ibbotson (2006) was estimated at 3.1% from income returns and 1.1% from capital gains which gives a forward looking return of 4.2%. Our analysis of Smith (1924) suggests a risk premium of 4.1%.

c. The return on common stocks with risk-averse investors

i. Method

We assume that a larger expected return on common stocks than corporate bonds should have been demanded due to the greater “riskiness”⁴⁴ of common stocks compared to corporate bonds.

A potential way to estimate the expected return to common stocks is to use the long-term observed return for NYSE stocks. We needed to find a theoretical source of the change in the risk premium and hence employ a volatility based calibration technique. We use the calibration technique to derive the excess reward per unit excess volatility, denoted γ , which we assumed was constant across assets and can be used to estimate the equity risk premium, ex ante:

(1)

$$\gamma = \frac{\alpha}{\beta}$$

α = excess return on AAA bonds

β = excess volatility of AAA bonds

Using these data⁴⁵, assuming that all assets have the same gamma value;

$$ER_{premium} = \frac{\omega}{\gamma}$$

where,

⁴⁴ Measured as the volatility - Standard Deviation (S.D.) of annual returns

⁴⁵ Moody's data in Global Financial Data (2012)

ω = Excess volatility of common stocks (Goetzmann and Ibbotson, 2006)
 $ER_{premium}$ = Excess volatility based expectation of the Equity Risk Premium

As a benchmark for the risk premium on corporate bonds, we used the annual S.D. of Moody's Railroad bond index, which gives a 20-bond portfolio's excess volatility over Govt. bonds, which we used to impute a risk premium for bonds earlier (see Table 1). The S.D. of annual returns was calculated as before to give the excess return to railroad bonds as:

$$Bondpremium = \gamma * \omega^{railbond}$$

where,

$Bondpremium$ = Excess annual returns on railroad bonds
 $\omega^{railbond}$ = Excess annual return volatility on railroad bonds

We then conducted three tests of new valuation approaches, which could have been inferred from Smith (1924).

Table 1: Calibration of the expected Equity and Bond Risk Premiums

Name	Dates	S.D. (%)	Ann.return (%)	Gamma
AAA index	1871-1926	4.87	3.6	
Moody's Railroad	1871-1926	7.54	4.4*	
L-term Govt	1871-1918	2.99	2.9	
NYSE stocks	1871-1926	14.00	7.01*	0.37296
ER Premium	1871-1926	-	4.1*	
Bond Premium	1871-1926	-	1.5*	

* estimated from calibration

Test 1: New funds as the driver of the risk premium

Given our knowledge on the level of investors' diversification up to 1927, where the average investor do not hold the market portfolio, we assumed that investors believed the historical returns to common stocks included un-diversified investors' compensation for diversifiable risk. Therefore, the 3.6% risk premium which we "reverse-engineered" from 1927 prices, was the reward for bearing the stock volatility of a single or low numbers of stocks.

i. Method

We used data from the "Old NYSE Database"⁴⁶ (Goetzmann and Ibbotson, 2012) to calculate the S.D. of capital returns for individual stocks from 1900-1915 and from 1915-1925. The S.D. of the total portfolio of stocks (N=70 and N=90) was also calculated from these data.

To complement these data we used our database of large stocks in Section II. We measured the annual volatility of capital returns for each individual firm using annual price data⁴⁷ from the Commercial and Financial Chronicle (1900-1920). This gave us our own benchmark of the average 'riskiness' of a single stock using the S.D. of annual returns.

We also derived the S.D. of a diversified holding of the 20 common stocks from our dataset⁴⁸ for which price data was available and reliable S.D. calculations could be determined.

We assumed a proportional linear relationship between the percentage change in the S.D. of returns from N=1 to a portfolio with $N > 1$, and the percentage change in the risk premium. Therefore a 20% fall of volatility of returns as more stocks were added would equate to a 20% fall in the risk premium.

We then estimated the "equity risk premium" (ERP)- the expected excess return from common stocks over risk-free government bonds from three portfolios - two from Goetzmann and Ibbotson (2006), and one from our dataset. We used the following formula for all calculations:

$$\text{ERP} = (\text{Portfolio S.D.} / \text{Market S.D.}) * (\text{1927 ERP})$$

⁴⁶ Data from W N Goetzmann ICF/Yale website

⁴⁷ January prices

⁴⁸ For a portfolio without replacement so that firms that exit are not counted and no new firms enter.

The test was augmented to ensure robustness because we originally assume a change from N=1 to N=93. A more realistic approach is that stock returns reflected a holding of N= 8 stocks in 1927. We therefore use an N=8 to N= 93 and N=30 change. This allows us to replicate the effect of the average fund holding of N=30 to the more accurate N=93 of the market portfolio

ii. Results

Table C

Source	Time-frame	Stocks (N)	Portfolio S.D.	Single stock S.D.	risk reduction factor	ERP
Goetzmann+Ibbotson (2006)	1915-1925	93	14	32	0.44	1.58
Goetzmann+Ibbotson (2006)	1900-1915	70	13	28	0.46	1.67
Kabiri	1900-1920	20	21	36	0.58	2.10
Cowles (1938)	1900-1920	-	17	-	-	-
1927 NYSE	1927	-	-	-	-	3.60

A change from a single-stock to a more highly diversified portfolio would have lowered the forward-looking equity risk premium. This implies a 55% decrease in the ERP.

We estimate that a risk premium reduction of only 20% was achievable from a change of N=8 to N=50, following Elton and Gruber (1977). This assumes prices in 1927 already reflected a return based on a portfolio of N=8 stocks.

We set an upper bound for a maximum fall in the premium of 45%. This was based on our 2.1% ERP for 20 stocks. From N=8 to N=20 the premium could have been expected to fall from 3.6% to 2.1%.

Assuming that the return on common stocks included a reward for bearing diversifiable risk before 1927, we estimated that a fall in risk premium from 3.6% to a range of 2.9%- 2.0% was expected as the new return on the market or return to a closed-end fund.

Test 2: Changes in investor risk preference

i. Smith (1924) and the new volatility-metrics for longer-horizon investors

Smith (1924) shows an innovation in the estimation of risk, which is different from how our Gamma value (1) is calculated.

He estimated a new measure of risk-“time hazard”. This measured the horizon over which there was a 100% probability of no capital loss. Therefore all returns were from dividend income. This is compatible with our DDM.

Two estimates were made in Smith (1924):

- 1) A 4-year holding period needed to eliminate capital loss from volatility based on 40 years of data (1882-1922) which excluded major crashes or recessions
- 2) A 15-year holding period needed to eliminate capital loss, which was based on 75 years of data (1847-1922) and included crashes and recessions

Method

We modeled what would happen to valuations if investors switched from the Gamma model

(1) to a new set of models (2):

(1)

$$\gamma = \frac{\alpha}{\beta}$$

α = Excess return on common stocks

β = Excess volatility of common stocks

(2)

$$\gamma^{t4} = \frac{\alpha}{\beta^{t4}}$$

or

$$\gamma^{t15} = \frac{\alpha}{\beta^{t15}}$$

where

$$\beta = 0, \text{ over the time horizon of the investment}$$

The NYSE data on holding periods from 1920-1930 was then compared to the horizons shown above to establish whether the method was representative of the actual investment horizons of investors.

Results

Investors' actual horizons were one year in 1928. Therefore the model was not representative. Had the model been adopted it would have been adopted in error. This error would be highly unusual across all investors.

The expected premium on stocks would have fallen to 0% under the strictest interpretation. It is therefore more likely that a heuristic was employed to use a risk premium of 1.5%, based on corporate bonds returns, thus if holding over four years a higher valuation ratio of 22 was feasible.

The use of a 15-year horizon valuation method is ruled out given its wide deviation from actual horizons of one year. The credibility of this cause, given that data used to derive a 4-year horizon was much more empirically weak also makes this channel less probable.

Test 3: “Earnings Power” valuation: the expectation of the same return as bonds

The third test replicates the method which investors derived from the empirical data (Smith, 1924) which assumed that stocks and bonds should be priced to give the same return, irrespective of the higher volatility of stocks (Graham and Dodd, 1934).

This was based on the idea that stocks had a higher historical return (Smith, 1924) due to the retained earnings.

This meant a risk premium of 1.5% on the NYSE common stock market portfolio. The valuation approach, which we model, violates the underlying assumption of the gamma model (1). The change investors made was to a new model (3) as shown below.

(3)

$$\gamma^{stocks} = \frac{\alpha^{bonds}}{\beta^{stocks}}$$

$$\alpha^{Bonds} = \alpha^{Stocks}$$

where,

α^{Bonds} = Excess return on market portfolio of bonds

β^{Stocks} = Excess volatility of stocks of equivalent firms

Results

The directly measured implicit return premium in 1927 using a DDM was 3.6% for the market portfolio of common stocks.

Our gamma model (1) based on the excess volatility / excess return tradeoff, produced an expected 4.1% risk premium on common stocks. This suggested that investors were using a gamma model (1) before the bubble phase. This result is powerful in the sense that it indicates strongly that market knowledge in the 1920s included the reward for volatility.

The risk premium on railroad bonds⁴⁹ - our proxy for the risk on the bonds of our common stock sample was estimated using the same method at 1.5% using the same method, with an excess volatility of 4.5% (S.D) over Government bonds.

In this case the excess returns expected from stocks, based on historical returns, and bonds were equalized. Comparative return volatility was a redundant concept when using this method and suggests that some investors were unaware of the concept due to the ambiguity in Smith (1924).

If the return premiums were expected to be the same for stocks and bonds, the value of alpha for stocks would decrease to 1.5% from 3.6% reflecting an expected valuation ratio (P/D) of 22.

d. Simulating valuation ratios with changes in the risk premium and dividend growth

We tested our DDM for various scenarios and the valuations expected when the risk premium was changed. We also tested for a range of dividend growth rates to capture any effects of higher growth expectations.

[Insert Fig 4 about here]

⁴⁹ Moody's data (1900-1929)

i. Sensitivity Analysis of the DDM

Table D:

VALUATION METHOD	P/D ratio
146 NYSE stocks Average P/D ratio (1929)	30.8
1.5% Risk Premium (risk-averse model)	22.0
0.6% Risk Premium (risk-neutral model)	25.7
2.0% Risk Premium (risk-averse model) + 1.1% div growth	20.3
2.0% Risk Premium (risk-averse model) + 2 % div growth	23.2
3% Risk Premium (risk-averse model) + 1.1% div growth	17.2
3% Risk Premium (risk-averse model) +2 % div growth	19.5

Table E:

VALUATION METHOD	P/D ratio
146 NYSE stocks Average P/D ratio (1929)	30.8
3.6% Risk Premium (risk-averse model) + 1.1% div growth	16
3.6% Risk Premium (risk-averse model) + 2% div growth	18.2
3.6% Risk Premium (risk-averse model) + 3% div growth	20.8
1.5% Risk Premium (risk-averse model) + 1.1% growth	22
1.5% Risk Premium (risk-averse model) + 2% div growth	25.3
1.5% Risk Premium (risk-averse model) + 3% div growth	29.6
0.6% Risk Premium (risk-neutral model) + 1.1% div growth	25.7
0.6% Risk Premium (risk-neutral model) + 2% div growth	29.9

On the basis of these and previous tests:

- Optimistic real growth rates are excluded as the sole driver of the boom as this only led to a valuation ratio of 18.2, which is too low compared to actual peak prices.
- Peak NYSE P/D ratios imply a real long-term growth rate of over 5% per annum.
- Both a higher real growth of 2% and a risk premium of 1.5-2% were combined they produce a ratio of 23.2-25.3 which suggests that such a change could have been the driver of the boom.

We are left with some key results from these tests:

A change to a theory that risk had been reduced by diversification with the emergence of closed-end funds (test 1), a change to a less volatility-averse pricing model (test 2), or a simple assumption that stocks and bonds should produce the same returns whilst ignoring short term volatility (test 3) could all have generated a large part of the rise on the NYSE from 1927-9.

We have therefore defined and measured the results of three general modeling approaches, which investors could have used in the 1920s to justify the high prices reached and also seen that long-term real growth rate changes were not likely to have been the generator of the change.

In the next section we discuss the results in light of the historical evidence from ex post accounts and evidence from the formation of investment funds for the use of new valuation techniques.

e. The change in stock valuations and dividends from 1929-1930

In order to test whether the rise and fall in valuation ratios was due to a fall in earnings or dividends from 1929 onwards, we used Cowles (1938) data to see whether there was any fall over the 1929-mid 1930 time frame.

Fig 1 shows that dividends for the market index of NYSE stocks (Cowles, 1938). Dividends for the NYSE did not fall over this timeframe but valuation ratios fell substantially. Similarly by mid 1930 earnings had only fallen by 10%. Therefore a fall in dividends or earnings, which could have indicated an impending recession, did not cause the fall in valuation ratios. On this basis a change in valuation ratios themselves can be identified as a potential reason for stock prices falling by 45% from 1929 to mid-1930.

[insert fig 1 about here]

Table F shows the changes to the Equity Risk Premium derived from actual changes in Price/Dividend ratios on the NYSE.

Table F

	<i>Price/Dividend ratio</i>	<i>Equity risk premium</i>
1927 (pre-bubble)	16	3.6
1929 (peak)	30.8	-0.4
1930 (post-bubble)	16	3.6
Risk-averse expectation ⁵⁰	22.0-25.3	1.5
Risk-averse expectation ⁵¹	20.3-23.2	2.0
Risk-averse expectation ⁵²	22.0-25.3	1.5
Risk-neutral expectation	28.7	0.0

These data illustrate how a change in the risk premium could have changed valuation ratios from 1927-30. This test allows us to isolate a change in the risk premium as a potential the driver of the bubble phase.

⁵⁰ equal returns on stocks and bonds of same quality (TEST 3)

⁵¹ lower risk due to investment funds (TEST 1)

⁵² 4-year horizon method (TEST 2)

IV. “Anchoring” to a new valuation theory or a mass escape into make-believe? ; The 1927 to 1930 bubble

a. The transmission from theory to prices: “Anchoring” to a new theory

The concept of “anchoring” (Kahneman and Tversky, 1974) is a form of cognitive bias, which draws on the human tendency to attach or "anchor" our thoughts to a reference point - even though it may have no logical relevance to the decision at hand. During normal decision making anchoring occurs when individuals overly rely on a specific set of information to govern their thought-processes.

We propose that the NYSE bubble from 1927-30 was a result of the cognitive biases of investors. These investors became anchored to a new theory and valuation model, which they later abandoned, which explains the observed boom and crash from 1927-30. We cannot assume that the rising 1921-1927 market did not influence the use of the new method of valuation as a rising market would make the emergence and propagation of ideas which indicated future returns would also be high, made investors more susceptible to their use. However, the aim of our analysis is to provide a clear picture of what drove valuations, in contrast to simple explanations of euphoria.

Because of the observation that the transmission of the theory to prices began occurring 2½ years after the publication of Smith’s work in December 1924, but in tandem with the emergence of closed-end funds from mid-1927, the timing of the bubble suggests these new models may have been triggered by the emergence of closed end funds. The formation of the funds may also be indicative of the widespread use of Smith (1924).

The institutional funds’ show that new methods were being used, as they embodied the new theory- that high diversification and longer holding periods would yield a large return over bonds. However, the funds had a 5% (\$3.5bn) market share of the NYSE (\$70bn)⁵³ by 1929 and hence any effect on valuations was to reinforce the validity of the new theory in the minds of investors rather than change valuations directly.

The work of Smith, Smith (1924) had created a “grey area” in the minds of its readers as to the cause of the observed return premium on stocks. Investors seem to have understood the need for return volatility compensation before the “bubble” phase. The work (Smith, 1924)

⁵³ Assets under management of Closed-end funds

allowed new ideas to develop surrounding why the premium existed which investors adopted and “anchored” to.

b. Discussion of the three tests for causality

A transmission channel from the new theory of Smith (Smith, 1924) directly to NYSE prices via a model where the return compensation per unit excess volatility (γ) fell, is highly plausible given the results of our tests. However, given that there are data to show the original level of gamma was correct and return expectations consistent with volatility across assets in 1927 before the bubble, we investigate how these three potential channels operated.

i. Test 1:

The surge in formation of closed-end funds, which were sold to the public as a means of earning a long-term return (De Long and Schliefer, 1993), indicates that the wider public understood the diversification benefits of using these vehicles to invest in common stocks. It is therefore plausible that some investors believed that stock prices should rise to reflect the lower risk premium expected by diversified investors. I Fisher (1930) indicated that diversified funds influenced investors’ risk perceptions and hence this channel was a potential cause for the boom. In essence we assume that investors believed diversifiable risk was not rewarded or reflected before 1927.

We have demonstrated that new methods in Smith (1924) were extended by closed-end funds.⁵⁴ Those listed in Moody’s Manual (1930) show an average 50 stocks in 1929. Smith’s theory (Smith, 1924) had therefore evolved to a new form.

If the assumption of reward for diversifiable risk in 1927 valuations was mistaken as fact, then an observation that funds were entering the market in large numbers could have led to a fall in the market risk premium to a price NYSE stocks at a P/D ratio of 20-23. In this case, the emergence of investment funds would have triggered the valuation change.

Such a channel is unlikely to have significant, as the idea of the non-reward for diversifiable risk was unlikely to have been widely assumed by investors. Furthermore, there is no reference to it other than in Fisher (1930).

⁵⁴ Edgar L Smith, the author of the book that changed investor perceptions formed a closed-end fund called Investment Trust Fund A in 1925, which held 50 common stocks in an approximately equal-weighted portfolio

ii. Test 2

Volatility and the equity risk premium was generally a less well-understood topic in the 1920s, as few investors had been collecting this 60-year risk premium as compensation for the short-term volatility of stocks.

Smith (1924) suggested, using statistical methods, that a return premium of 4.2% over the risk-free rate could be gained from dividends, with no loss of capital, over only 4 years, based on data going back 40 years which excluded crashes and recessions. A more realistic timeframe was a 15-year holding period, which was based on 75 years of data, which included crashes and recessions.

A rise in NYSE valuation ratios would require large numbers of buyers to adopt the new theory. It is possible that investors adopted the new theory because it matched the horizon of investment (Smith, 1924). Therefore investors thought that a short horizon, which was close to their own, was all that was needed to justify higher valuations of stocks.

The metric used to price stocks was therefore changed to:

$$\gamma^{t4} = \frac{\alpha}{\beta^{t4}}$$

where beta(t4) was the 4-year horizon (where probability of capital loss was zero)

NYSE data show the average holding period was falling from two to one year from 1920-1930. The new theory was therefore not representative of actual holding periods of investors. This channel is therefore weakened as a causal channel, as it assumes investors adopted a miscalculation of their own holding periods and adopted a much higher tolerance for risk, en masse.

iii. Test 3: The valuation of Stocks according to the same expected return as Bonds

A transmission channel from Smith, (1924) to NYSE prices via a new model, which misinterpreted the empirical data, is cited in Graham and Dodd (1934) and Williams (1938). Investors were known to have thought stocks were capable of earning high excess returns over bonds due to retained earnings (Graham and Dodd, 1934). In other words, earnings not paid as dividends ended up enhancing future returns and this inference was made as attempt to explain the excess returns on stocks over bonds, identified empirically in Smith (1924). Although the theory of “earnings power” valuation (Graham and Dodd, 1934) was correct in the sense that firms do retain earnings, we demonstrate that this was not the source of the premium on stocks. Data from 1927 used with our historical-volatility calibrated DDM, show that this premium reflected a compensation for the excess volatility on stock returns which was uniform across assets.

Under the rubric of the new “earnings power” approach, stock prices were too low in 1927 and needed to adjust upwards to make returns equal on stocks and equivalent bonds.

Investors appeared to be eliminating a “free-lunch” and in the process become less sensitive to the “excess volatility” of asset returns.

The timing of the formation of new closed end funds indicate that new ideas were being used at this time and the ambiguity in Smith (1924), created a fertile ground in the minds of new investors as to the source of the premium.

In the absence of clarity from Smith (1924) on the cause of the ERP and the emergence of new investors in the 1920s aiming to earn the premium suggest strongly that a new theoretical driver led to mispricing.

Price to earnings ratios (P/E ratios), were also used widely for the first time in the 1920s when the dividend yield had always been the operative method in the UK and USA (Rutterford, 2004). The use of new metrics linked to the earnings of firms is important, as we know the retained earnings were thought, erroneously, to be the source of the Equity Premium.

V. *Conclusions*

Our tests and analysis delineates the meteoric increase in prices for stocks on the NYSE from 1921-1929 in to two components. The first source of the underlying rise was a change in the nominal level of dividends, the second the fall in the equity risk premium due to new valuation theories.

The main focus of the paper was to identify the cause of the change and to quantify the change.

The paper aimed to produce feasible estimates of prices for large common stocks in 1929 from a long-term dividend growth data set and models which were available to long term investors. We therefore replicated the expected prices of common stocks on the NYSE using a hypothetical closed end fund.

Within this framework we measured:

- Long term dividend growth rate expectations based on 1900-1929 data
- Firm survival to estimate common stock dividend income over the timeframe of our models
- An adjustment factor for long term risks not included in the 1900-1929 data using data from 1871-1929 in Cowles (1938)

Based on the sensitivity tests of our Dividend Discount models and actual prices in September 1929, the 146 largest NYSE common stocks were 100% overvalued using our growth rate of 1.05%.

Our second conclusion is that from 1927-29 new investors emerged who used a new theory based on high diversification to gain a sizable risk premium by holding over the long term. This was a justifiable. The timing of the emergence of new closed-end funds that embodied the new theory (Smith, 1924) also matches the timing of the change in the valuation ratios of NYSE stocks. This indicates the ideas were being used.

The transmission of the new theory to valuation ratios should not have occurred. The dominant cause, given the analysis of Fisher (1930), Graham and Dodd (1934) and Williams (1938) and our own analysis was the new belief, arising from the ambiguity as to the cause of

the observed superior equity return performance over US history, that stocks should give the same return as bonds, ignoring the comparative volatility of returns. The timing of the change suggests that in 1927, investors and some fund managers switched to the new theory of stock valuation (Model 3). These valuations reached from 1927-9 were unjustified. The use of the new method explains 75% of the observed bubble component. The residual component of the overvaluation could be explained by momentum, from a rising market, or other non-observed causes⁵⁵.

We conclude that previously unexamined theory channels caused the bubble from 1927-9. This conclusion stands in contrast to two alternative theories. The first view of Galbraith (1954) contends that a bubble existed but its cause is unknown or due to euphoria. The second, by Sirkin (Sirkin, 1975) contends that valuations reached in 1929 can be justified by using a small sample period for dividend growth rates from 1921-1929. Using a 2-stage DDM, investors used “real” dividend or earnings growth rates from data over the 1921-8 timeframe, which disguised the monetary expansion and price level changes from 1915-1929. These high rates signaled that real dividend growth rates were due to a new technological and corporate era. Sirkin’s idea of investor irrationality, in the form of naïve extrapolation, lacks corroboration by historical accounts and also assumes a high degree of error. Our new approach challenges these views. Our data suggest there was a large deviation of NYSE stock values from fundamentals of the order of 100% from 1927-9. The work of EL Smith (Smith, 1924) created an innovation boom based initially on sound reasoning. The ambiguity of the research (Smith, 1924), in failing to link volatility directly to superior stock returns led to the emergence of an “earnings power” theory which valued stocks and bonds according to their returns. Investors who were unfamiliar with the volatility-based valuation of stocks adopted their own interpretation of the data (Smith, 1924), which led to the boom. The crash was the result of the deflation of the “theory bubble” to mid 1930.

⁵⁵ Such as smaller changes in expected future growth rates due to lower firm hazards or technology patents

VI. Discussion and Future Research

Limitations of our models

Our results are based on some key underlying assumptions in our models, which may be addressed in future research and should be considered when assessing the conclusions of the analysis:

Firstly, that our historical dividend growth rate data reflected accurate long-term expectations for risk-adjusted future growth based on historical data. Secondly, that monetary expansion, increased nominal debt levels and a change in the composition of debt, toward the urban real estate sector did not increase risks of a major recession⁵⁶ and hence invalidates the “neutrality assumption” of debt composition changes towards home mortgages, and money supply increases. The implication being that investors would no longer view the boom and therefore price stocks, according to a neutral assessment of future returns.

The first assumption is open to the criticism that our sample period had unusually high or low rates of growth for common stock dividends, which were unlikely to be repeated⁵⁷, and our adjustments of this growth rate to reflect long-term risks are too generous or cautious when using our choice of data for 1870-1900 from Cowles (1938). What we excluded from our models on the basis of using only ex ante data, are a higher rate of survival of firms, a higher growth rate of dividends due to higher productivity levels or development of technological patents which indicated a change towards higher dividend growth. We also excluded gains from capital growth.

The second assumption is more complex to address and involves an understanding of systemic risk due to changes in the debt structure of an economy given the increased hazards in the event of a systemic shock or that such a rapid increase in the nominal debt level increases the likelihood of a systemic crisis. We cannot say, given our present knowledge whether investors were irrational to assume that nominal dividend expansion as a result of WW1 or Home loan growth should have altered investors’ valuations ratios.

The increased hazards for the economy or financial system in the face of large monetary/debt expansions, changes in debt composition towards the home loan sector or due to changes in

⁵⁶ It is not known whether this type of latent systemic risk, was understood by Economists or investors.

⁵⁷ Due to an unusually expansive phase of corporate growth from 1900-1929

the international economic system of the post WW1 era remain a feasible objection to our models, and future research is welcomed.

Future avenues for research

The closed-end funds themselves also warrant further research. Data on closed end funds were partially restricted due to some of the investments being a “trade secret” in the late 1920s, but more data was released post-crash.

New research on the ex-post returns to these funds over the timeframe of our model, are also planned. Data from a fund named “INVESTMENT TRUST FUND A” formed by E L Smith based on the ideas from his 1924 book. Looking at returns over the long term from 1925-2010 are made possible as the fund survives through merger and acquisition as Fundamental Investors Fund, a part of Capital Group, USA.

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Graphs

Fig 3

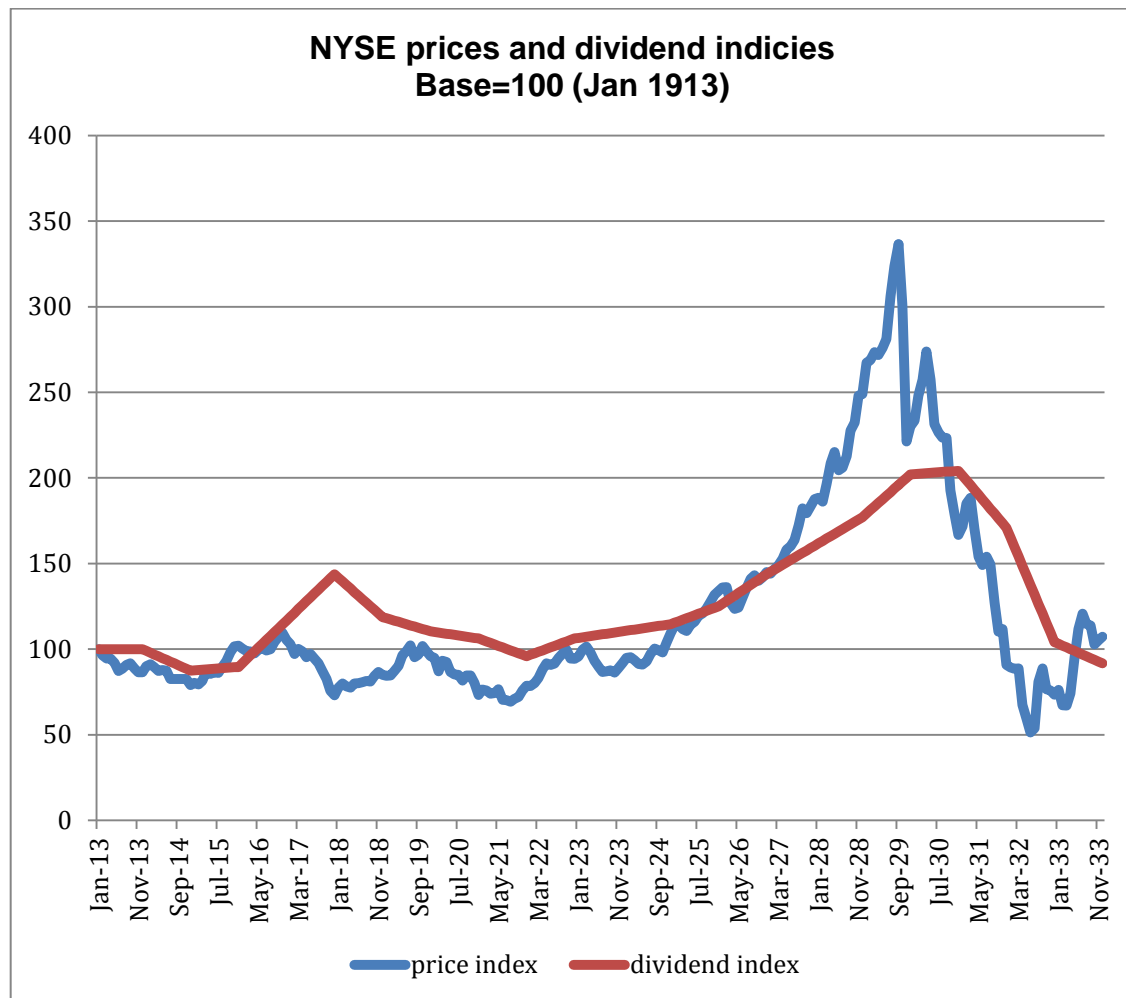


Fig 1 Source: Cowles (1938)

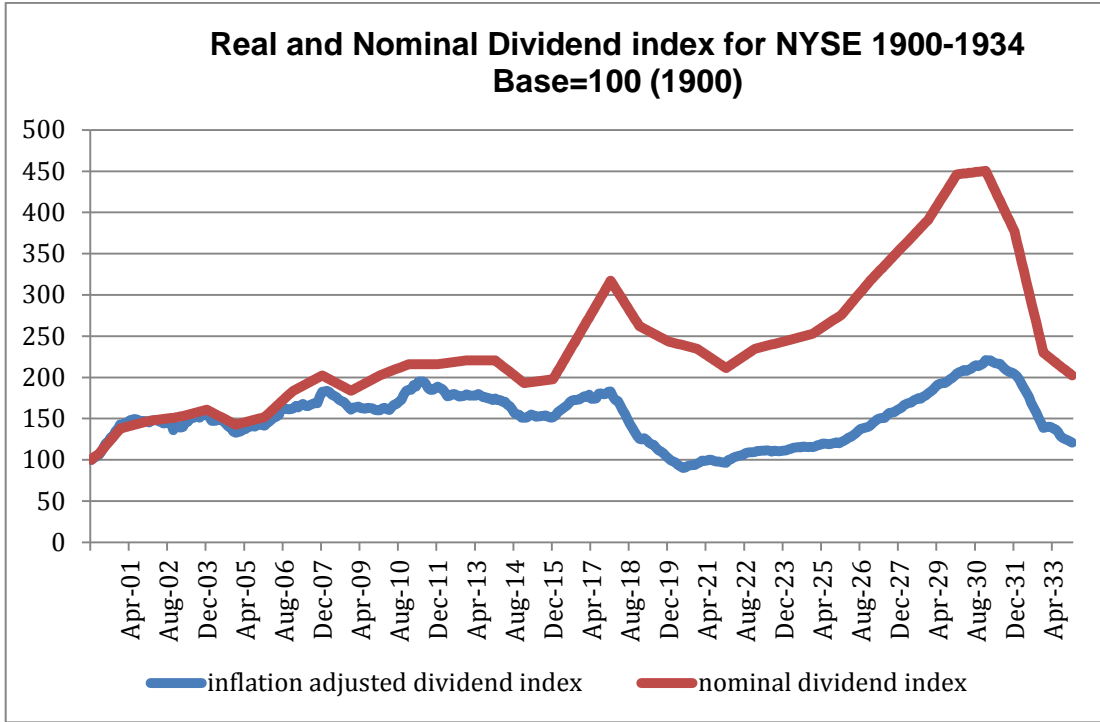


Fig 2

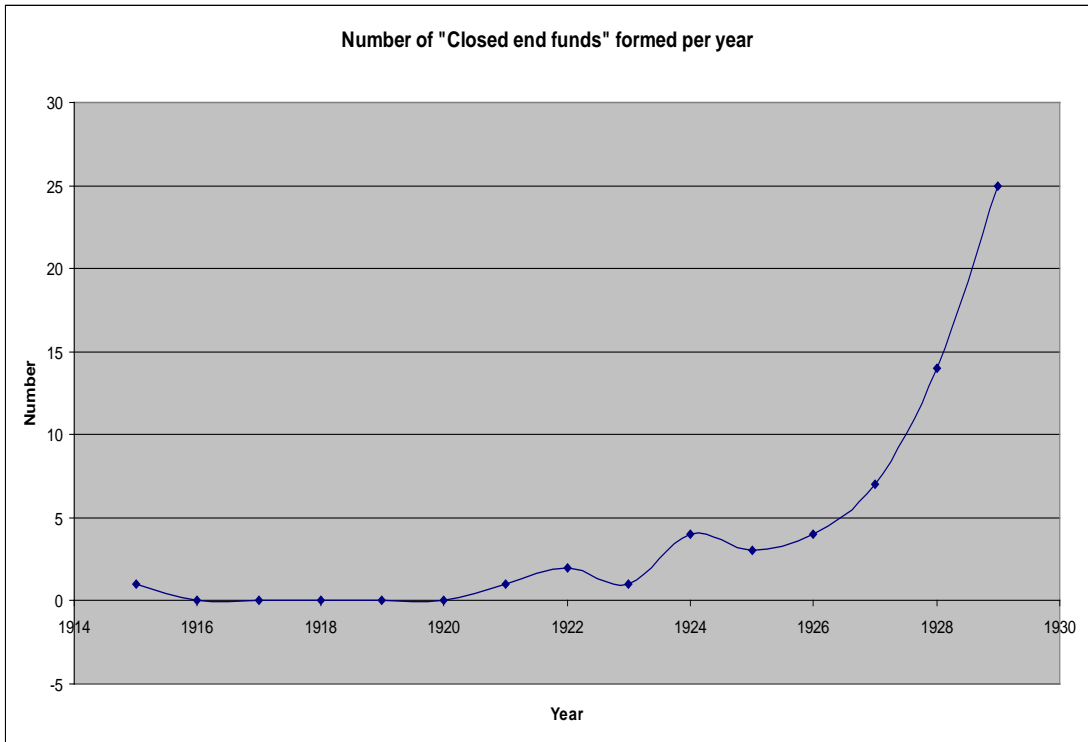


Fig 3: Source: Bullock (1959)

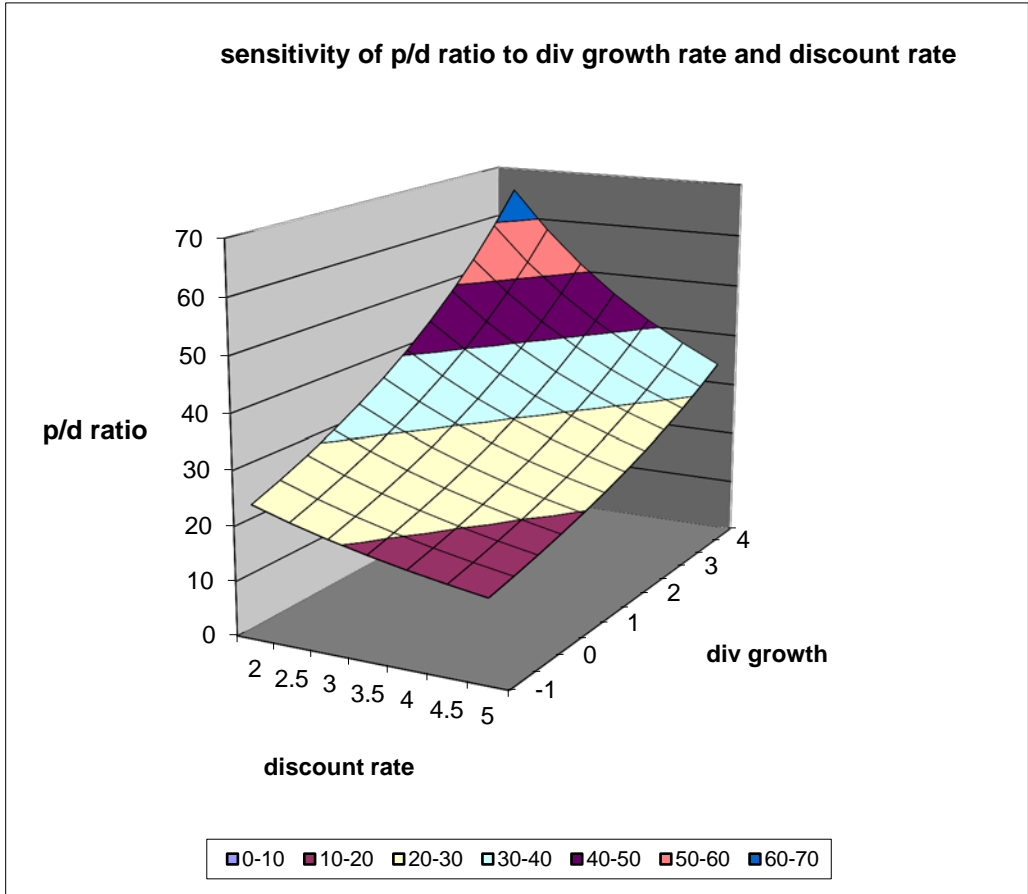


Fig 4: Sensitivity Test of Model (3)

Appendix

General method of our modeling approach (See II, b)

Following from the technological advances of the Second Industrial Revolution, dated from the 1870s the US economy displayed a sustained long-term economic growth path, with Real GDP growing at an annualised geometric rate of 2.9% up to 1929. We assume that such a long term growth path allows the inference that such a growth rate could have been expected to continue over the long-term future from the perspective of investors in the late 1920s. Our models are therefore all based on the long-term growth path of the USA repeating⁵⁸.

We use inflation adjusted historical dividend growth rates from 1900-1929 for the market portfolio of large common stocks. For historical validity to be assured we needed to be sure that such data was available and could have been calculated by investors. We already know the method of calculation including “bonus” stock and “stock splits” and the adjustment of nominal to real growth rates using a price index was known. We also needed to be sure that a return on a comparable asset class, such as the long term “real” or inflation adjusted return to corporate bonds, as a discount factor was known. Moody’s (1930), Smith (1924) and Fisher (1906) contain data and theory to make such calculations possible in the 1920s.

We assume expected timescales of dividend income from Common stock holdings could be measured using data from Moody’s Manuals and simple life tables.⁵⁹

We also assume that in order to capture long-term risks to common stock dividends an adjustment for severe recession or other risks not captured by the 1900-1929 data was, carried out by investors. However, our use of Cowles (1938) data in performing the function is an unavoidable ex-post source. What is known is that such an adjustment was advocated as early as Fisher (1906) and historical data were available to investors.

(Goetzmann and Ibbotson, 2006)

Our ability to control for the effects of debt levels and inflation on real dividend growth rate expectations of investors is taken from Shiller (2012) data on the real dividend growth rates from Cowles (1938) from 1900-1929. Data from E.Clark (1933) and L.Kuvin (1938) indicate long-term debt levels were not excessive relative to national income. Therefore within the

⁵⁸ We therefore also exclude increased growth rates from increases in US Productivity.

⁵⁹ Fisher (1906) and Macauley (18xx)

general context of debt to income ratios we assume that investors did not need to adjust for this factor.

The reasons why these assumptions are made are to test a simple theory of whether the models used by investors were reasonable given their level of knowledge of the workings of the economy and knowledge of financial theory.

It would have been possible to use data on stocks from the 1870s directly for our calculation but given that a much smaller number of common stocks existed in the 1870s and the nature of those firms being heavily skewed toward textiles and railroads, we use a larger sample of only commercial and industrial common stocks from 1900-29.

On this basis, we can generate the ex ante observed dividend return growth rate over the long term and use these data with various Dividend Discount Models to determine forward looking Price/Dividend ratios for a Closed end fund in 1929.

Long term Government bond returns (1870-1929)

Over the 59 years from 1870 to 1929 the total real return to investment in Long term Govt bonds was 2.9%⁶⁰

Our estimate of 2.9% was found by:

i)

- Taking the long term Government bond yield in 1870 (4.0%)⁶¹
- Deflating by the Consumer Price index from 1871-1900 (1.5% annual deflation)
- Therefore the expected return was 5.5%

ii)

- For 1900-1929, taking the 3% 30 yr Govt Bond yield to maturity in 1900, and deflating by the Consumer Price Index (2.7% inflation)
- 0.3% return

The return over the entire period was therefore:

⁶⁰ Our estimate using a 4% 30 yr return under the refunding act of 1870 and consumer price inflation from Shiller (2009)

⁶¹ Data from Homer and Sylla “A History of Interest Rates”

$$(5.5+0.3)/2= 2.9\%$$

Our figure of 2.9% for Inflation adjusted Gov. Bond returns over the long term indicates

- A Long term Gov Bond / Long term Corp Bond return spread: 0.6%.
- The spread from 1926-1974 : 0.4% (Goetzmann and Ibbotson, 2006)

The 3.5% long term risk and inflation adjusted Corporate Bond return expectation from (Goetzmann and Ibbotson 2006) is therefore used as a benchmark discount rate in our models.

Formulae for alternate Dividend Discount models (See III, b)

Model 1) 30 year DDM

$$PV = \sum_{t=1}^{30} \frac{D_t}{(1+k)^t}$$

$$D_t = \left(1 + \Omega^{LcompDR}\right)^t, t = 1, \dots, 30$$

Model 2) 50 yr DDM

$$PV = \sum_{t=1}^{50} \frac{D_t}{(1+k)^t}$$

$$D_t = \left(1 + \Omega^{LcompDR}\right)^t, t = 1, \dots, 50$$

Model 3) An 80 year DDM with a monotonic decline in dividends to zero from year 30-80

$$PV = \sum_{t=1}^{30} \frac{D_t}{(1+k)^t} + \sum_{t=31}^{80} \frac{D_t}{(1+k)^t}$$

$$D_t = \begin{cases} (1+\Omega^{LcompDR})^t, & t=1, \dots, 30 \\ (1+\Omega^{LcompDR})^{30} * (1-0.06)^{t-30}, & t=31, \dots, 80 \end{cases}$$

Model 4) 50 yr DDM with zero dividend growth from yr 30-50

$$PV = \sum_{t=1}^{30} \frac{D_t}{(1+k)^t} + \sum_{t=31}^{50} \frac{D_t}{(1+k)^t}$$

$$D_t = \begin{cases} (1+\Omega^{LcompDR})^t, & t=1, \dots, 30 \\ (1+\Omega^{LcompDR})^{30}, & t=31, \dots, 50 \end{cases}$$

Model 5) An 80 DDM with a monotonic decline in dividends from yr 30-80 to 30% of initial dividends in year 80

$$PV = \sum_{t=1}^{30} \frac{D_t}{(1+k)^t} + \sum_{t=31}^{80} \frac{D_t}{(1+k)^t}$$

$$D_t = \begin{cases} (1+\Omega^{LcompDR})^t, & t=1, \dots, 30 \\ (1+\Omega^{LcompDR})^{30} * (1-0.03)^{t-30}, & t=31, \dots, 80 \end{cases}$$

Where in all models,

PV= P/D ratio

D = The dividends at time t

k = Discount rate

Formulae for Composite growth rate (See II, b)

$$\Omega^{LcompD} = W_1 \Omega^{LSEC1} + W_2 \Omega^{LSEC2} + W_3 \Omega^{LSEC3} + W_4 \Omega^{LSEC4} + W_5 \Omega^{LSEC5}$$

where,

$$W_1 = W_2 = W_3 = W_4 = W_5 = \frac{1}{5}$$