Measures of Stock Market Value and Returns for the US Nonfinancial Corporate Sector, 1900-2002: Extended Version

Stephen Wright*
Birkbeck College
University of London
London WC1 E7HX
e-mail: s.wright@bbk.ac.uk

February 18, 2004

Abstract

This paper describes a new dataset of annual time series relating to the US nonfinancial corporate sector: its market value, and the major underlying stocks and flows that are valued by financial markets. The data cover the entire twentieth century, and thus fill a significant gap in the documentation of financial and real economy linkages. Previously available data cover either shorter periods, or a more restricted sample of quoted companies. A range of series are constructed on a consistent basis: returns; dividend yields (both in standard form, and an alternative "cashflow" measure); earnings yields; and "q", on a range of definitions; as well as corporate leverage measures. The main features are: the relative long-run stability of both q and the cashflow (but not unadjusted) dividend yield; the systematic tendency for q to be less than unity; and the ambiguous picture presented by alternative measures of corporate leverage.

*I am grateful to Andrew Smithers and Derry Pickford for extremely helpful discussions and suggestions; to Rochelle Antonimowiecz, Elizabeth Fogler and Michael Palumbo of the Federal Reserve Board's Flow of Funds Section for their help in clarifying their statistical methodology; to the editor and an anonymous referee for helpful comments; and to Ashwin Vasan and Ravi Arulanantham for valuable research assistance.

1. Introduction

This paper describes a new dataset of annual time series relating to the US non-financial corporate sector[1] over the course of the twentieth century: its market value, and the major underlying stocks and flows that are valued by bond and stock markets. As such it is intended to fill a significant gap in the documentation of financial and real economy linkages over long historical samples. While long time series are available, and have been widely used, that relate to the performance of the stock market (eg, the Cowles(1938)/S&P index, as used by Shiller (2000) and many others, is available from 1871; data from Ibbotson & Associates are available from 1925; Siegel's (1994) series on returns dates from 1801), these sources all relate to a subset of quoted companies. As such they cannot be related directly to macroeconomic time series derived from the national accounts. As a result, fundamentals-based analysis of the stock market has been largely restricted to the analysis of dividends and (imperfect measures of) corporate earnings. The dataset described here, in contrast, can be linked to national income data, allowing analysis of a much wider range of series - both stocks and flows - with a sounder basis in economic theory.

The immediate impetus in constructing the dataset was to analyse the interaction of stock market value and returns with three key fundamentals.

The first of these, Tobin's q, relates the total value of the corporate sector to the value of its tangible assets. While time series for q have been constructed in a number of papers (*eg*, Blanchard et al, 1993; Brainard, Shoven & Weiss, 1980; Bernanke et al, 1988; Hall, 2001; Laitner & Stolyarov, 2003), none have been over such a long sample. It can also be shown that a number of past estimates have significantly mis-measured both numerator and denominator of q. The dataset also allows comparison of alternative measures of q, depending on whether the numerator measures the total value of corporate liabilities ("Tobin's q" - with alternative measures of debt in net or gross terms), or only of corporate equities ("equity q"): all three measures turn out to have similar properties. An advantage of "equity q" is that in principle it can be constructed from less data, and can for this reason also be constructed for the subset of quoted companies for a longer sample starting in 1871.

A puzzling feature is that all resulting series for q have an apparently stable

[1] Strictly, for the non-farm, non-financial corporate sector, but since the corporate farm sector is very small, the shorter term will for convenience be used throughout except where a distinction needs to be drawn in descriptions of data sources.

historic mean that is significantly less than unity.[2] If systematic mis-pricing over the course of a century is ruled out, the most likely explanation (for which some circumstantial supporting evidence is presented) would appear to be a systematic tendency to over-estimate the replacement value of the physical capital stock, due to underestimation of depreciation.

A second time series that can be examined using this dataset is a measure of total cash transferred to shareholders: ie, the sum of dividends and net non-dividend cashflows (repurchases plus cash M&A minus new issues). This measure closely captures the income flow, which, in discounted terms, must equal the stock market value of the corporate sector, in contrast to the standard measure of dividends per share on reported stock indices.[3] This paper shows that the resulting "cashflow yield" provides an interesting comparison with the standard dividend yield, being distinctly more volatile in the short term, but also apparently more stable over the longer term.

The third series that can be analysed is a series for nonfinancial profits, consistent with the national accounts. It is common (see, for example, Shiller, 2000) to use the price-earnings multiple as an indicator of stock market value. In principle the profits series enables calculation of a P/E multiple for the nonfinancial sector as a whole; however, since national accounts measures of profits were negative in two years, 1932-3, during the Great Depression, the implied ratio in turn goes negative. For this reason, the paper focusses instead on the earnings yield. Consistent measures of profits, and corporate liabilities and net worth, also allow comparison of alternative measures of both profits (adjusting for the distortions due to inflation) and corporate retentions.

Although the dataset was primarily set up to address the above issues, it also includes a number of underlying data series that may be of independent interest. In particular, alternative measures of corporate leverage can be constructed. Additionally, a consistent output series, plus alternative measures of general price movements are included, together with a number of constituent series that are

[2]Note that this feature is in stark contrast to the series constructed by Laitner & Stolyarov (2003) for the business sector as a whole, which has a mean above unity over the shorter sample they examine (1953-2000). I show in a separate paper (Wright, 2004) however that this feature of their dataset is a result of a number of errors in calculating q. When these are corrected the resulting series for the total business sector also has a mean well below unity. See Section 7.1 for a brief comparison.

[3]Miller and Modigliani's (1961) original critique of the Gordon Growth Model on these grounds has been widely ignored in most of the literature, although there have been important exceptions (see, for example Mehra, 1998; Allen & Michaely, 2002; Ackert & Smith, 1993).

used in constructing aggregate stocks and flows. For the period from 1929 onwards, the dataset will also provide a complement to the extensive flow data for the nonfinancial corporate sector already published by the Bureau of Economic Analysis.

It should be stressed that this paper does not attempt to engage in any direct measurement of the underlying time series; but instead simply collates data from a range of previously published sources, and attempts to construct time series on as consistent a basis as possible over the course of the twentieth century. This task is a relatively easy one for the period from 1945 onwards, given the existence of the Federal Reserve's Flow of Funds tables (Federal Reserve, 2003), which provide virtually all the required series, either explicitly or implicitly. Before 1945 it is a considerably more complex task, with the caveats relating to data quality increasing, the earlier back in the century the data are taken.

A particular problem in the period before Fed flow of funds data become available in 1945 is the lack of a published series for the market value of nonfinancial equities. This paper introduces a new approach to the construction of estimates of this series in this earlier period , which, at a minimum, acts as a control for the rather crude "grossing-up" method frequently applied in previous studies, but which can also be shown to be superior on statistical grounds. This competing estimate, while broadly consistent with the standard method for most of the first half of the twentieth century, produces interesting, and quite significantly different estimates for the first decade or so of the century.

It is hoped that the dataset will provide a basis for research on a wide range of topics: downloading of the data is actively encouraged.

The structure of the paper is as follows. Section 2 presents a summary of the main features of the data, and provides charts of a number of key ratios that can be constructed therefrom, with a comparison, where relevant, with equivalent series for one of the most commonly used indices of quoted stocks, the Cowles/S&P Index (as in Shiller, 2000). The remainder of the paper is devoted to the details of the data construction methodology. Section 3 describes the key data definitions, and data construction methods for the period after 1945. Section 4 describes data construction for earlier years. Sections 5 and 6 describe deflators used to construct real returns, and procedures to convert book value liabililities data to market value. Section 7 provides a comparison of measures of both q and the "cashflow yield" with alternative datasets that have attracted particular attention in past research. Appendices provide a comparison of the statistical properties of the two equity market value measures; and a full listing of all series in the dataset.

2. A Summary of the Key Features of the Dataset

2.1. Overview of the Dataset

Appendix B provides a full listing of the series in the dataset. Most of the series relate to the non-financial sector, but some series are also included for the S&P/Cowles index, as a basis for comparison.[4] Figure 2.1 provides a summary of the principal series, but a number of constituent elements, alternative definitions, and other key ratios are also provided.

Principal Components of the Dataset	
Type of Variable	Description
Flows	Earnings
	Dividends
	Net New Issues
	Total Cashflow to Shareholders
	Net Interest Payments
	Output (Nonfinancial Corporate GDP)
Stocks	Market Value of Equities
	Market Value of Net Debt
	Tangible Assets (Capital Stock),of which:
	Structures
	Plant, Machinery & Software
	Inventories
	Land
	Financial Assets
	Liabilities at Market Value, of which:
	Bonds & Mortgages at Market Value
	Net Worth at Market Value
Prices and Returns	Stock Price
	Nonfinancial Return
	Nonfinancial Cumulative Return Index
	Output Price (NFC GDP deflator)
	Consumer Price
Key Ratios	Dividend Yield
	Cashflow Yield
	Earnings Yield
	Tobin's q
	Equity q
	Leverage

Figure 2.1:

In the rest of this section, after a brief summary of data sources and quality in Section 2.2, the features of a number of key series are discussed in relation to a number of charts, in Sections 2.3 to 2.9.

[4] All underlying series can be downloaded from www.econ.bbk.ac.uk/faculty/wright

2.2. Primary Sources and Data Quality

As noted in the introduction, for the period from 1945 onwards, virtually all series in the dataset either come directly, or can be constructed, from original series in the Federal Reserve's Flow of Funds tables (Federal Reserve, 2003).

For the earlier periods, there are distinct sub-periods worth noting, roughly represented by the 1st and 2nd quarters of the twentieth century.

In the second of these, National Income and Product Accounts flow data run from 1929; and Bureau of Economic Analysis fixed tangible assets data run from 1925, so that series derived from these sources clearly have the mark of quality associated with officially published series. However a number of financial series for this sub-period are derived from incomplete data, drawing on Goldsmith's (1955) balance sheets , as well as Standard & Poor's data for quoted companies (also running from1925).

For the first quarter of the twentieth century, there are very few officially published series to draw on. The principal sources used in this earliest period are Goldsmith (*op cit*) (for balance sheet and some flow data); Kuznets (1941) (for flow data); Cowles (1938) (for stock price and return data and some limited information on corporate dividends); *Historical Statistics* (new issues and aggregate price data); and the *Commercial and Financial Chronicle* (various issues), for new issues data in the first decade of the century.

In all applied work there is a clear tradeoff between the additional information provided by longer samples, and the associated fall-off in data quality in earlier periods. Clearly data for the first 45 years of the twentieth century (and more especially, the first 25) cannot be regarded as of the same quality as for the period thereafter, since their construction involves some degree of imputation from incomplete and less than consistent data sources (although it should be noted that even after 1945, the Fed and BEA statisticians themselves are not immune to this problem). But, on the positive side, the longer data sample does provide a number of important insights, particularly into the degree of stability of a number of financial ratios, that would be lacking if only published data from 1945 were used.

Probably the best resolution of the tradeoff is the fairly obvious one: to proceed with caution. Those wishing to make use of the dataset in econometric work would be wise to be aware of the caveats attached to the series used in earlier periods. In particular, there might well be good reason, on grounds of exogenous information about data quality, to test for evidence of structural breaks at points where there are major shifts in data sources: in particular, in 1925, 1929 and 1945.[5]

2.3. Dividend Yields

There is a vast literature that treats dividends per share on quoted stock price indices as the underlying "fundamental" that is deemed to be valued by stock markets. The ratio between dividends per share (normally a trailing one-year average) and the stock price, the "dividend yield" is normally taken to have a stable long-run average: it is often asserted that high(low) values of the dividend yield predict high (low) future returns (on the implicit assumption that expected returns also have a stable mean).[6]

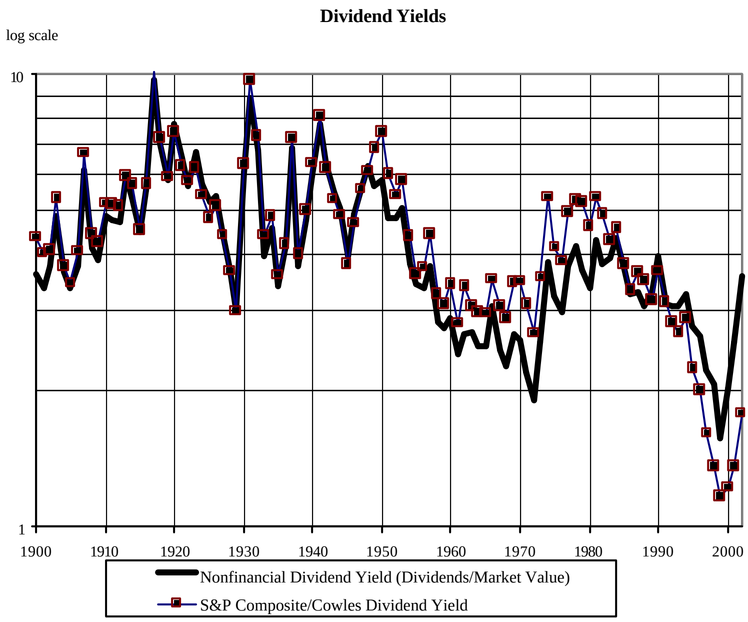

Figure 2.2:

Figure 2.2 shows the estimated dividend yield (constructed as total annual

[5] Econometric work carried out in companion papers (Robertson & Wright, 2003; 2004) has not, however, pointed thus far to any evidence of structural shifts at these points.

[6] For a comprensive survey see Campbell, Lo and MacKinlay (1997). For more recent critiques, see Goyal & Welch (2002); Ang & Bekaert (2003)

dividends/ end-year market value of equities[7]) for the non-financial corporate sector, alongside the equivalent figure for the S&P Cowles index over the full sample, 1900-2000. Reassuringly, and indeed unsurprisingly, the two series are strongly correlated. Sections 4.3, 4.1, 4.3 and 4.3 detail the data construction methodology. Put simply, there is an independent source of data for dividends throughout the sample, but construction of a series for the market value of equities, while independently derived from 1945 onwards, is at least partially dependent on information from the S&P Cowles index before that point. Two alternative, and and least partly independent methodologies are used to construct alternative estimates of market value - for most of the sample period these produce reassuringly similar results. All charts in Section 2 use a compromise estimate of stock market value, derived as a simple geometric average of the two alternative measures.

Perhaps the most striking aspect of Figure 2.2, visible in both measures of the dividend yield, is the apparent lack of a stable mean throughout the sample period. The downward drift in the dividend yield (only partially reversed in the last to years of the sample) is however considerably more marked for the S&P index in recent years.[8] Robertson & Wright (2003) show that it is impossible to reject the hypothesis of a unit root in this series (a similar result is found by Goyal & Welch, 2002, for the yield on quoted stocks) - a finding that appears to undermine much of the predictability literature based on the dividend yield. However, as detailed below, the downward drift in the dividend yield appears at least in part to be due to a distinct shift in the patterns of net new issues.

2.4. Net New Issues

Chart 2.3 shows the nonfinancial dividend yield alongside a series showing net new issues of equities as % of the total market value of equities. The chart shows that the downward drift in the dividend yield in part broadly mirrors a similar pattern in net new equity issues (constructed by the Federal Reserve as new issues less repurchases, less cash-financed mergers and acquisitions). In the earliest third of the century, net new issues ran at 1% to 2% of market value on average, before virtually disappearing during the Great Depression, and for significant periods during the early post-war era. But the most striking shift was in the 1980s and

[7] Strictly speaking this commonly used definition does not correspond precisely to that on quoted indices, but in practice the difference from a precisely comparable definition (in terms of dividends per share) is trivial. See Section 3.1 for more detail.

[8] The higher yield for the nonfinancial sector is attributed by the BEA to the tax treatment of small corporations, which encourages full payout policies.

1990s, when the shift to significant levels of stock buybacks and (in a number of years, more crucially) cash M&A, implied that net new issues were significantly negative.

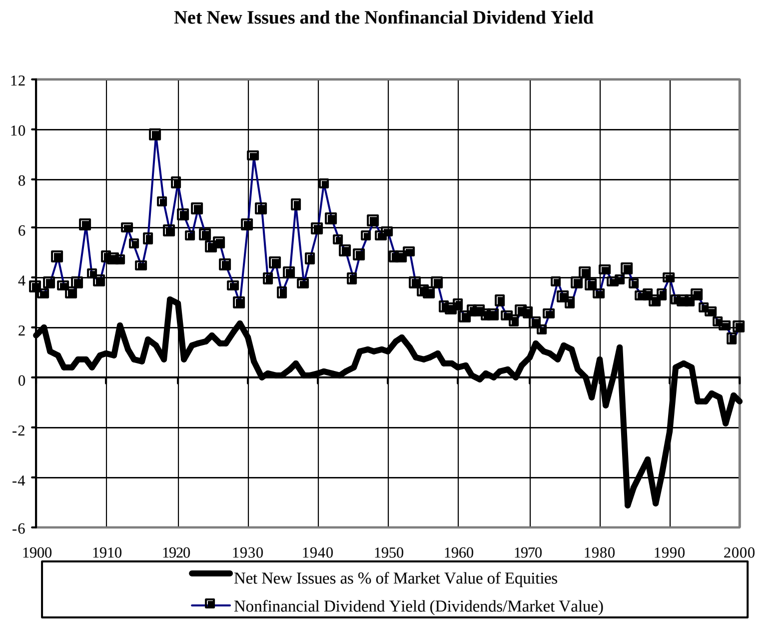

Figure 2.3:

In the context of this shift, the downward drift in the dividend yield appears at least in part explicable. Miller & Modigliani's (1961) seminal paper on share valuation states clearly that the crucial series that markets should be valuing is the total flow of cash between corporations and shareholders, not simply dividends; but this crucial point has typically been ignored in most quantitative analysis[9] - partly, of course, because the data are only available for the corporate sector as a whole, rather than for quoted indices. The chart suggests strongly that the downward drift in the dividend yield has been in large part explicable in terms of a shift towards significant transfers of cash to shareholders via non-dividend mechanisms.

[9] Recent exceptions being however Ackert & 1993; Mehra, 1998; Allen & Michaely, 2002; Robertson & Wright, 2003)

2.5. The Cashflow Yield

Figure shows, alongside the conventional measure of the dividend yield, an alternative measure in which dividends are replaced by a measure of total cashflow to shareholders (ie treating net new issues as a deduction from dividends - see Section 3.1 for precise definitions).

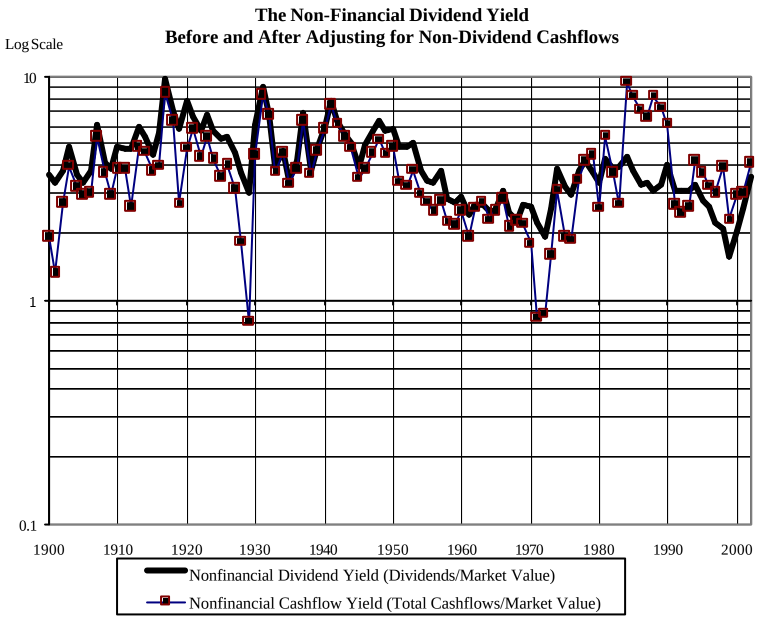

Figure 2.4:

A number of features of the resulting "Cashflow Yield" are worth noting. First, it is distinctly more volatile than the standard dividend yield: as Figure 2.3 showed, net new issues have shown considerably greater variation than dividends.. Second, until the recent low point, previous local lows in the unadjusted dividend yield were very much accentuated in the cashflow yield (1929 being the most obvious example); but, interestingly, never by enough to result in a negative cashflow yield (though this would not be ruled out in principle). Third, the downward drift in the unadjusted yield is not present in the cashflow yield. In particular, and in marked contrast to the unadjusted yield, the cashflow yield did not look far from its historic mean at the peak of the stock market in 1999.

During the sharp falls in the market thereafter it did not rise so markedly as the unadjusted yield, since total cashflow to shareholders also fell very sharply.[10]

2.6. Real Stock Returns

Section 3.1 describes how both an implied price index and an implied return series can be derived for the nonfinancial sector, consistent with both flow and stock figures. Figure 2.5 compares the resulting real return series with the equivalent series for the Cowles/S&P index.

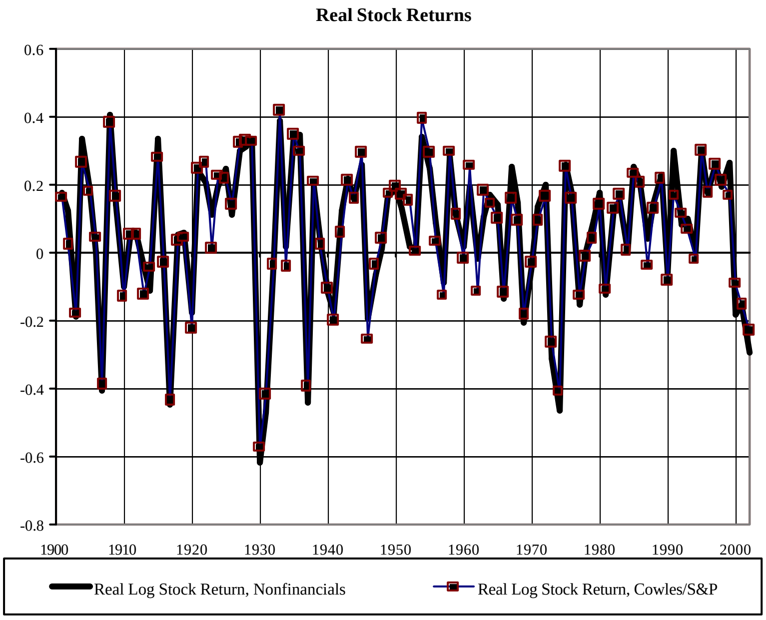

Figure 2.5:

The chart shows that the two return series look very similar. This is reassuring, since they are derived largely independently, especially after 1945; though there is some dependence in the earlier period (see Section 4.3) It would of course be expected that there would be a very strong correspondence, since the S&P/Cowles index is sufficiently diversified that its return should look very like the return

[10]See Section 7.3 for a comparison with other investigations of non-dividend cashflows, and some evidence of the breakdown of non-dividend cashflows into its constituent elements.

on the whole market.[11] Means and variances of returns are also very close (see discussion in Sections 3.1 and 4.3). It is worth noting, however that at some points the differences between the two return series are by no means trivial in absolute terms (eg, in the most recent observations), even when they are small relative to the underlying variances.

2.7. Corporate Earnings, Payout Ratios and Retentions.

Thus far the dataset shows considerable similarity between series for published indices and all nonfinancial corporations, at least on directly comparable measures,. This is not entirely surprising, albeit reassuring. One series where differences are rather more significant however is corporate profits. To give a basis for comparison, Figure 2.6 plots price-earnings multiples (end year market value/annual earnings) for the nonfinancial sector against the same series for the S&P Cowles index. The profits figures used for the nonfinancial series, derived from the National Income and Product Accounts (NIPA), are described in Sections 3.2 and 4.4.

Figure 2.6 omits observations of the nonfinancial series in two years, 1931 and 1932 when NIPA measures of profits were negative. In contrast, S&P earnings remained positive throughout this period. Figure 2.7 includes all observations by plotting the series in their reciprocal forms, as earnings yields. In this form, negative observations are more readily interpretable, and, as the chart shows, the implied yields, while negative, are not implausibly so.

One problem with earnings series both for quoted companies and for the nonfinancial sector as a whole is that they are distorted by the impact of inflation, since nominal interest payments are treated as a deduction. The distortion arises because, in conditions of inflation, net liabilities are eroded, thus raising true economic profits (and vice versa under conditions of deflation). Given data for corporate liabilities, discussed below, it is relatively easy to construct measures of inflation-adjusted earnings (see Section 3.2 below for precise definitions). There are interesting differences in the implied series: in the early 1930s, when both S&P and unadjusted earnings were artificially boosted by deflation, compared to true underlying profits; and, in contrast, in the inflationary 1970s, and, more briefly during the First World War, when the inflation adjustment implies that underlying earnings yields should be adjusted upwards. It is also interesting to

[11] This is indeed the basis for one of the approaches (Method 2) to the measurement of market value before 1945, described in Section 4.3.

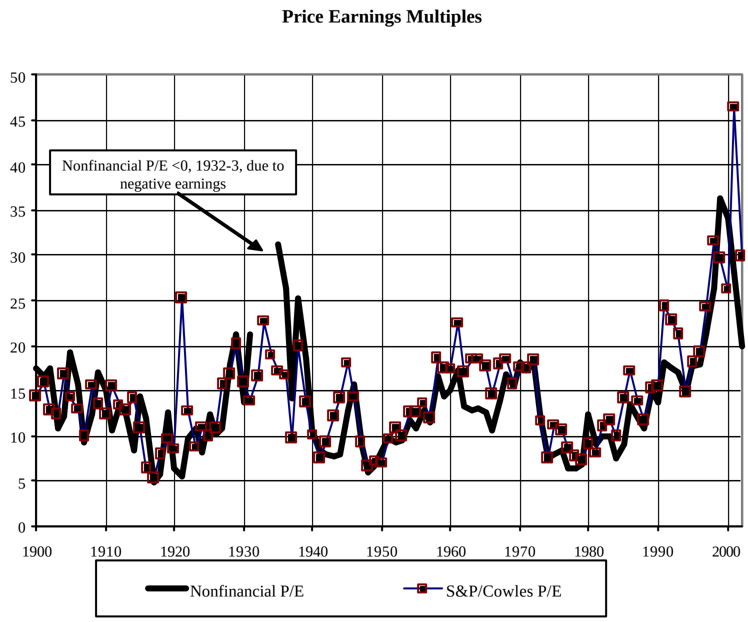

Figure 2.6:

note that during the 1970s the yield implied by published earnings was higher, and closer to the inflation-adjusted nonfinancial yield than to the unadjusted series. - raising the possibility that, to the extent that corporate accountants had discretion to massage reported profits in the short term, they may implicitly have adjusted reported profits series for the distortions of inflation.

The inflation adjustment also serves to accentuate the feature, evident in the unadjusted series, of greater apparent variability in aggregate corporate profits in the first half of the century, compared to the second. The difference in variability of earnings is, however, less marked in the S&P/Cowles series. There are several possible, and probably complementary explanations that might be worthy of investigation. First, it is possible that the difference may be due in part to larger companies having a greater degree of protection from aggregate shocks, as is commonly asserted (though it is unclear why this difference should have been so much more marked in the early part of the century). Second, the difference may in part reflect a degree of creative acounting in P&L accounts of quoted companies; in contrast, NIPA profits are derived primarily from Internal Revenue Service data,

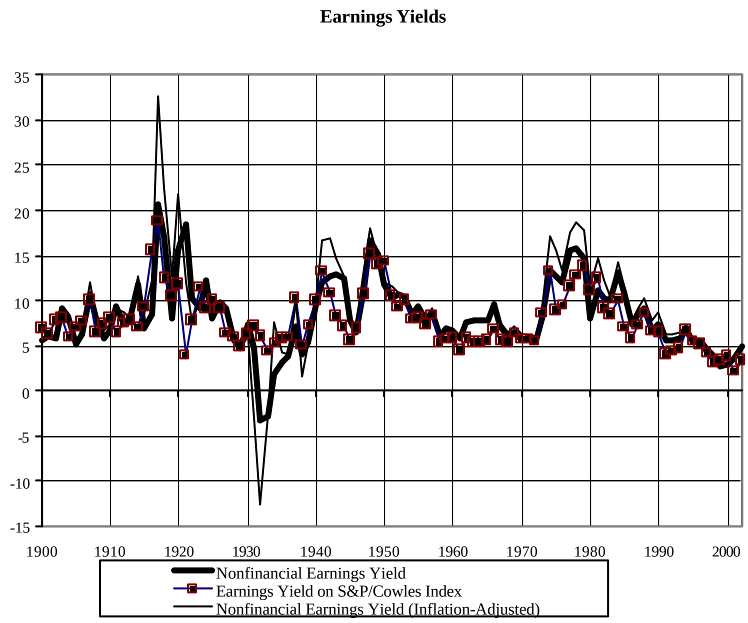

Figure 2.7:

and thus are derived from a 100% sample of companies. NIPA data also include adjustments to eliminate a range of distortions, and are, of course, constrained to be consistent with the rest of the national income accounts.[12] A third, related explanation is that there is also a similar difference in variability across the century in other national accounts aggregates, which it has been argued may possibly be attributable to differences in sampling techniques (*cf* Romer, 1998).

Figure 2.8 compares implied corporate payout polices, both on the basis of dividends alone (where a direct comparison between the total and quoted companies is possible) and total cashflow to shareholders (for which no direct comparison can be made). The chart displays some interesting contrasts between the three series.

[12] These differences between sources may also provide some explanation of a much later period, the 1990s. Data for quoted companies may have included an "Enron effect" whereby recorded profits were boosted by pushing loss-making activities off balance sheet. These losses however ultimately turned up in the 100% sample of companies used to construct NIPA estimates, thus depressing nonfinancial profits relative to S&P profits.

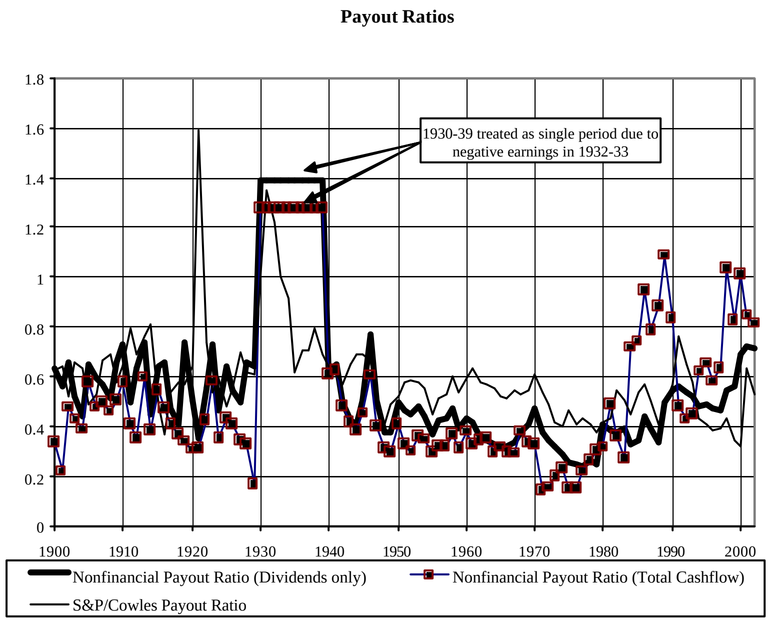

Figure 2.8:

In most of the first half of the century, the two dividend-only payout ratios were at very similar levels; the only exception being the early 1930s, when, as noted above, total nonfinancial earnings were negative in 1932-33. Even if the entire decade 1930-1939 is treated as a single observation, as in the chart, payout ratios were well above 100% on a sustained basis; whereas S&P companies only had reported payout ratios above 100% in four years (1930-34). But a more sustained, and puzzling divergence between the two series opened up during the 1950s-1970s, with S&P companies having distinctly higher payout policies.

The comparison with the ratio based on total cashflow also offers interesting contrasts, and some further puzzles. For most of the twentieth century this measure was systematically lower than the dividend-only measure, since firms were typically making new issues, but was distinctly higher in the last two decades of the century, as firms made significant non-dividend transfers. In part this mirrors the pattern already seen in the two alternative yield measures; but a distinct contrast is that, whereas the pattern of non-dividend cashflows appears on average to result in a more stable yield in total cashflow terms, it appears to result in a *less* stable pattern in payout ratios. This is particularly marked at the end of the sample. Dividend-only payout ratios were roughly at historic average levels for the subsample of the S&P companies, and not especially high (given cyclical conditions) for the nonfinancial sector as a whole; but the total payout ratio was at extremely high levels compared to its mean, with two observations above 100%.[13] This feature can only readily be explained in one of two ways: either firms were pursuing exceptionally generous (and possibly unsustainable) dividend policies, given their degree of profitability, or national accounts measures of profits were underestimating true earnings during this period. This latter explanation would in principle be consistent with some research (Hall, 2001; Laitner & Stolyarov, 2003) that has claimed that there is significant under-recording of corporate assets, and hence, by implication, of corporate saving.[14]

One piece of evidence that also casts some light on this question (though it does not resolve it) is the comparison between corporate retentions and changes in corporate net worth. If net worth and corporate profits were measured in a fully consistent manner - i.e., on a "Hicksian" measure of true profits - the two should be identical; but differences both in data sources and methodology will cause the two series to diverge. Figure 2.9 shows the contrast between the two series, both scaled by end-year net worth. "Hicksian" retained earnings are measured by:

$$\text{Change in Net Worth} - \text{ Inflation } \times \text{Net Worth in Previous Year}$$

thus adjusting the change in net worth for the element therein that simply tracks changes in the general price level. Flow retained earnings are defined on as consistent a basis as possible, as inflation-adusted earnings less total cashflow to shareholders. Figure 2.9 shows that the Hicksian retentions series is distinctly more volatile; but for most of the sample, the two series look reasonably consistent. The chart also shows a smoothed version of the Hicksian series, which for most of the sample tracks the flow series fairly well; and both have very similar mean values.[15]

[13] There were also total payout ratios near or above 100% in the late 1980s, but these are more readily explicable, since they occurred during a period of very strong M&A activity. Much of this was financed by debt, such that the total payout ratio to equity-holders and bondholders combined was not particularly exceptional. No such explanation can be found in the data for the end of the 1990s and the start of the new millennium.

[14] But see the discussion of these claims, in relation to alleged evidence of significant intangible assets, in Section 7.1.

[15] The flow seres has a mean of 3.0% per annum, the Hicksian series a mean of 3.2%.

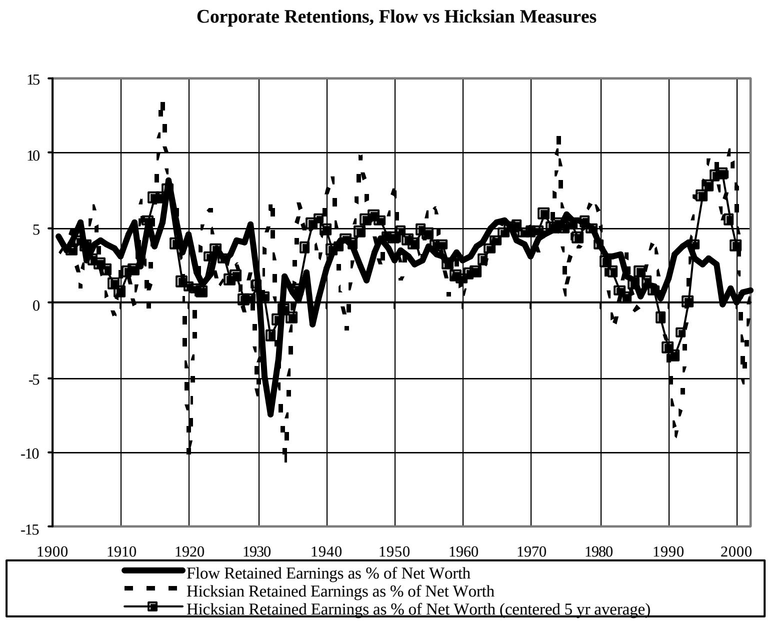

Figure 2.9:

The last decade of the century represents an exception, however, when the two series diverged to a much greater extent, and even smoothed Hicksian earnings were significantly higher than flow retained earnings. The explanation for the discrepancy is that the Fed's corporate balance sheet measures of net worth[16] were giving a distinctly more positive implied picture of profitability than that given by flow measures. The necessity of making the flow of funds add up, however, implied that the counterpart to this was a significant build-up in unidentified debt (discussed further below, in Section 2.9).

2.8. Alternative Measures of "q"

Use of nonfinancial flow data derived from the national accounts allows consideration of a range of associated balance sheet data that are not available (or at least not on a reliable, and mutually consistent basis) for quoted indices. The analysis here will focus especially on measures of "q"

[16] Originally from *Statistics of Income*

The standard definition, following Tobin, and hence usually termed "Tobin's q" or "Tobin's average q" is:

$$q_T = \frac{\text{market value of equities} + \text{liabilities}}{\text{total assets}}$$

An alternative definition, which can be termed "equity q"is defined by:

$$q_E = \frac{\text{market value of equities}}{\text{net worth}}$$

where net worth = total assets - liabilities. For both Tobin's q and equity q liabilities need to be measured at market value (see Sections 3.4 and 6), and on a basis that reflects the ownership of both numerator and denominator.

Both measures have positive and negative features as indicators of aggregate stock market value. Under Miller-Modigliani conditions, the total market value of the firm should be invariant to the method of funding of a given level of capital; and evidently Tobin's q has the desirable feature that it is similarly unaffected. In contrast, equity q is not invariant to methods of funding; however, for values of equity q (and hence Tobin's q) close to unity the impact will be relatively small.[17]

On the other hand, equity q has the advantage that it is immune to changes in the definition of capital. Tobin's q is usually defined in terms of narrow physical capital (of which two competing measures are discussed below, in Section 3.3). This requires an adjustment for the ownership of the physical capital stock, since this is owned by the "domestic nonfinancial corporate sector" - namely, US and overseas corporations operating in the domestic market. The market value of equities and debt, however, are those of US corporations alone, and include the market's valuation of US companies' overseas assets. The numerator can however be put on a comparable basis to the denominator by subtraction of the value of net overseas direct investment (see Section 3.4 for details). In practice it turns out that this correction makes little difference to the resulting ratio.

In principle, Tobin's q can also be defined in terms of total corporate assets and liabilities (since the very existence of corporate financial assets casts doubt on the standard implicit assumption that they can simply be netted off liabilities as if assets and liabilities were perfect substitutes). Here ownership issues do not arise, because both numerator and denominator relate to the value of US corporations only, from all operations.

[17] Define $q_E = \frac{V}{K-L}$, where V =value of equities, K = capital; L debt. Hence $\frac{dq_E}{dL}|_{dK=0} = \frac{1}{K-L}(q_E - 1)$, since $dq_E = \frac{1}{K-L}dV + \frac{V}{(K-L)^2}dL$, and $dK = 0 \rightarrow dV = -dL$.

In contrast changes in the definition of capital have no impact on net worth, and hence on equity q since, for consistency with the flow accounts, they must also imply corresponding adjustments to liabilities. As shown below this also implies the advantage that measures of equity q can in principle be constructed without recourse to capital stock data.

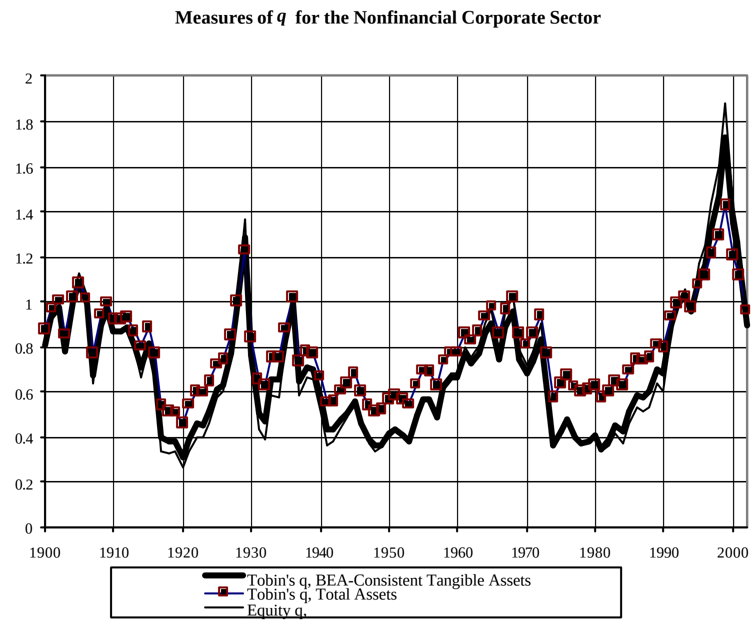

Figure 2.10:

Figure 2.10 compares three alternative measures of q. The first measure of Tobin's q uses only tangible assets in the denominator, and thus includes only the market value of net liabilities in the numerator (and also corrects for net overseas direct investment); the second uses total assets in the denominator, and hence gross liabilities in the numerator. All three use the same estimate of the market value of equities.[18] The chart makes clear that all three measures have very similar characteristics, and are very strongly correlated; however, as might be expected,

[18]Section 3.3 discusses alternative alternative treatments of fixed capital and land within tangible assets. Ths however has only a small impact on the measure of Tobin's q using tangible assets in the denominator has no impact at all on the other measures.

equity q is the most volatile, and Tobin's q based on total assets the least. A number of features of all three series are worthy of note.

The first is that, both on the basis of visual inspection and more formal statistical testing (see Robertson and Wright, 2004), there appears to be a reasonably strong tendency to mean reversion. Robertson and Wright show that this property is indeed to be expected, since the there are strong *a priori* grounds for expecting the mean value of q to be invariant to shifts in most structural parameters in the economy.[19] In this respect, q has an advantage over the dividend yield, which may, in principle be subject to permanent shifts in mean.[20] This is most likely to be the case for the unadjusted dividend yield, which, as noted above, in Section 2.3 does indeed appear to display a tendency to drift over time. As such, Robertson and Wright assert that the predictability literature is both more empirically robust, and more readily interpretable, if re-interpreted in terms of q.

The second, and more puzzling feature (especially in relation to the previous point) is that, for all three series, the apparently stable mean value to which q appears to revert is significantly below unity.[21] Standard macro theory would hold that, in the absence of systematic mis-pricing, the mean value of q should either be unity, or if anything slightly above.[22] One possible explanation for lower mean values is some systematic form of measurement error. Since the numerator of q is derived largely from quoted market statistics, the most likely source of any measurement error must be the denominator, implying some systematic historic over-estimation of capital. Since BEA capital data are constructed by the perpetual inventory method from (presumably reliable) gross investment figures, minus estimated depreciation, this must in turn that these latter figures are underestimated. Hence, by implication, any presumed overestimation of capital also

[19] This result holds even allowing for a range of factors that may drive a wedge between Tobin's q and unobservable "marginal q" (Hayashi, 1982)

[20] The mean level of the cashflow yield may vary if "deep" underlying structural parameters (such as intertemporal preference or risk aversion parameters) change; additionally, the unadjusted yield may shift if there are permanent shifts in net new issues (as Figure 2.3 shows has fairly clearly been the case). See Robertson and Wright (2003) for more detailed discussion of this latter issue.

[21] There is an apparently puzzling contrast here with a time series for q for the total business sector, in a recent paper by Laitner & Stolyarov (2003), which has a mean well *above* unity. However, as discussed in Section 7.1 below, the puzzle is more apparent than real: Laitner & Stolyarov simply get their data wrong, mainly by omitting important elements of tangible assets from the denominator of their q estimate.

[22] See Robertson & Wright (2004) for a more detailed discussion of this issue.

implies overestimation of profits, net of depreciation.[23]

There are two pieces of supporting evidence for this explanation.

The first is that alternative methods of constructing fixed capital series to those used by the BEA can result in signficantly lower resulting estimates. As discussed at greater length below in Section 4.5, estimates of corporate capital for the first half of the century from Goldsmith (1955), derived originally from balance sheet, rather than perpetual inventory estimates, while strongly correlated with BEA measures over a common sample, are significantly lower in level terms (and roughly speaking consistently with the deviation of the mean value of q from unity). Gordon (1990) also suggests that BEA capital data are significantly overstated.

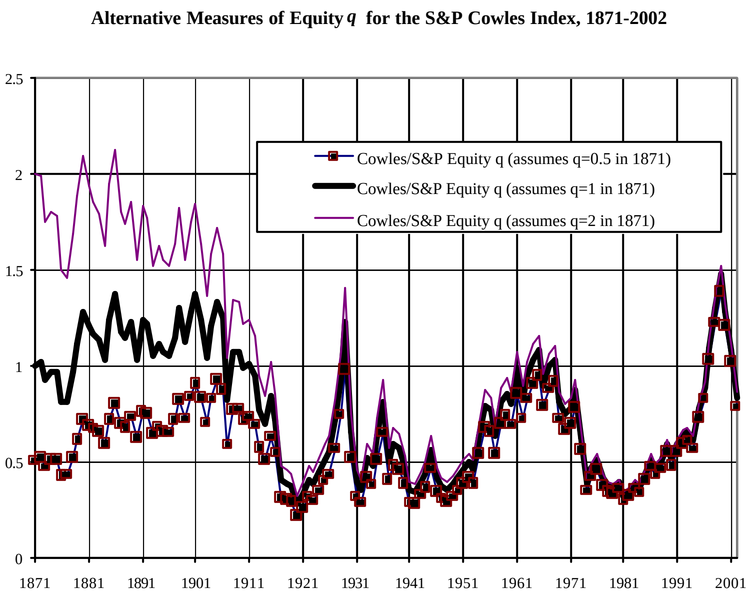

Figure 2.11:

The second element of supporting evidence for this explanation is more indirect, and comes from data for quoted companies. Given some assumed initial estimate of real net worth per share, a measure of equity q for the Cowles/S&P

[23] The necessary link between the two measurement errors is most evident in equity q, since in this case the denominator is simply an accumulation of retained profits.

Index can be derived by cumulating real retained profits per share.[24] Figure 2.11 shows that, starting this process from the first available observation for the Cowles index, in 1871, while differences in the assumed starting level of net worth per share imply, unsurprisingly, very significant differences in the implied estimates of equity q for a number of years, trend growth in real net worth per share means that the impact of the initial assumption becomes increasingly less significant, such that, for most of the twentieth century the three alternative estimates of equity q for the Cowles/S&P index are fairly similar (and, of course, increasingly so as the century progresses).

Furthermore, as the table below shows, the various alternative measures of equity q all share the property of average values well below unity, even allowing for the very different starting values.[25]

Mean Values of Alternative Estimates of "Equity q"

	1900-2002	1945-2002	1871-2002
Nonfinancial Equity q	0.63	0.64	n/a
Cowles/S&P Equity q (if=0.5 in 1871)	0.52	0.56	0.55
Cowles/S&P Equity q (if=1 in 1871)	0.63	0.63	0.71
Cowles/S&P Equity q (if=2 in 1871)	0.71	0.67	0.86

Given reasonably reliable dividends data, the above figures thus suggest that profits figures for quoted companies are systematically overstated (or, strictly speaking, are valued by markets as if they were). The degree of correspondence between the estimates for quoted companies, and the mean values of all three measures of q for nonfinancial companies, derived from balance sheets, would appear to be strong circumstantial evidence that the source of this overstatement lies in under-depreciation of capital.

2.9. Corporate Leverage Ratios

As a by-product of producing measures of q, the database also allows construction of a range of measures of corporate leverage, over a longer continuous sample period than previously available (*cf* Holland & Myers, 1984; Miller, 1963). In contrast to the fairly consistent pattern shown by by differnt q measures, Figure

[24] I am greatly indebted to Derry Pickford for suggesting this approach.

[25] A very similar (and even more marked) feature is evident in data for the United Kingdom (Smithers, 2003).

2.12 shows that, depending on which leverage measure is used, and on whether allowance is made for possible under- or over-statement of corporate debt, strikingly different pictures of leverage can be constructed. The list of measures shown is by no means exhaustive, but is intended simply to demonstrate how wide a range of estimates of leverage can be derived from available data. The variation between different measures is particularly marked at the end of the sample, when it would have been possible to claim that, depending on which measure was used, leverage was either near its record high, or near its record low.

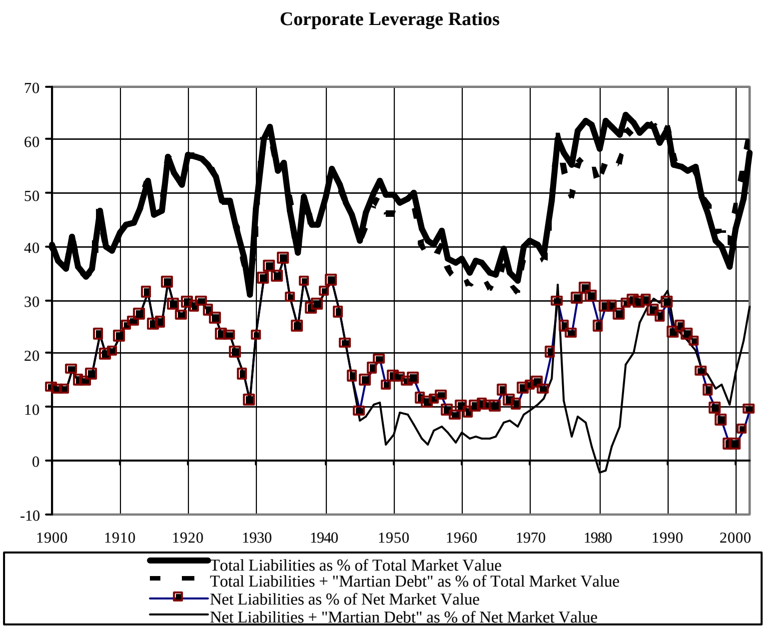

Figure 2.12:

All leverage measures shown are calculated as the ratio of some measure of nonfinancial corporate debt to total market value, itself measured as the sum of the market value of corporate equities and the relevant debt measure.[26]

The first key distinction is between gross and net measures of corporate liabilities. The latter measure is perhaps more commonly used, partly because net liabilities are frequently inferred indirectly by "grossing-up" net interest payments

[26] All debt measures are measured at market prices. Where some elements of debt are not available from Fed or other sources on this basis an adjustment is made, described in Section 6.

(as, for example, in Holland & Myers (*op cit*), Bernanke et al, 1988)[27]; here however, debt figures are taken directly from balance sheet data (see Sections 3.4 and 4.3) so the comparison can be carried out on both definitions, both of which provide insight.

Clearly, as might be expected, net and gross leverage have very different average values; though equally clearly they have been hit by similar shocks (not least the swings in the other element of total market value, the value of the stock market). A striking feature of both series is that, despite significant fluctuations, both appear, if not necessarily stationary, at least to move within certain bounds. Gross leverage appears to have been mainly within a range of ten percentage points either side of 50% of total market value; net leverage has typically moved in a range around 20%.

Towards the end of the sample, the two series, as calculated on the basis of recorded assets and liabilities, presented distinctly different pictures of corporate indebtedness. Both fell very sharply during the 1990s, largely due to the sharp rise in the value of the stock market during this period. The net measure was quite widely used to argue that the corporate debt burden was an historically low level in relation to total corporate value. Both measures then rose quite sharply after the stock market peaked; but whereas the recorded gross measure recovered to levels that were fairly high in relation to historical norms, the net measure remained quite low in historical terms.

However, there are some reasons for scepticism about the net measure, that relates to the discrepancy between flow and "Hicksian" measures of retentions, derived from balance sheet growth in net worth shown in Figure 2.9 above. This chart showed that in recent years there has been a growing discrepancy between the two measures of reentions. If net worth had grown in line with flow measures of retained profits, consistent with the national accounts, clearly growth of net worth would have been significantly more muted (indeed, would have been close to zero in recent years). By implication, for any given measure of the capital stock, the implied figures for net liabilities would have grown even more rapidly. To reconcile the two figures, the Fed include what is in effect a balancing item in miscelleaneous assets and liabilities, that include significant unidentified elements.

Nor is the nonfinancial corporate sector the only area where discrepancies have been significant. It is possible to construct a time series for what might be termed

[27] An approach that can lead to quite serious mis–measurement of net liabilities - see discussion in Section 7.2.

"Martian" debt: the gap between total identified assets and total liabilities[28] of all sectors, including the overseas sector Figure 2.12 shows the impact on the two recorded measures of leverage on the (admittedly extreme) assumption,that all of "Martian debt" is in reality unrecorded debt of the nonfinancial corporate sector. The chart shows that the effect on gross leverage is relatively limited, though it does suggest that recent values are much closer to previous peak levels. There is however a much more dramatic impact on the recent pattern of net leverage. Instead of being at a near-record low, the adjusted series is not far off previous historic peaks in the1930s, and very close to its postwar peak. Interestingly, the adjusted series also suggests that net corporate indebtedness in the late 1970s and early 1980s was much *lower* than as shown by the unadjusted ratio, since during this period Mars was effectively a net lender to terrestrial sectors; but it then rose very sharply. This does seem more consistent with the rapid growth of the "junk bond" market in the 1980s, than the published series.

None of these series can be regarded as providing the definitive picture of nonfinancial corporate leverage: what they do clearly convey is that apparently reasonable and sensible calculations can yield distinctly contradictory pictures - especially in recent data. Empirical investigations into the predictive power of the alternative measures might possibly help in deciding which is the most practically useful indicator.[29]

---

[28] Measured in the broadest possible definition: see Section 3.4 for details.

[29] Section 3.4 also details the construction of an adjustment to net liabilities to offset the impact of a distinct change in the Fed's treatment of tangible assets from the late 1980s onwards. This adjustment also suggests distinctly higher corporate leverage at the end of the sample.

3. Data Definitions, 1945-2002

From 1945 onwards data for the non-farm, non-financial corporate sector are derived almost entirely from a single source: Federal Reserve (2001) *Flow of Funds for the United States* March 2001 edition, Tables B102 (balance sheets); R102 (reconciliation of changes in net worth); and F102 (flows). The only series not so derived are price deflators, for which see below, Section 5, and two series derived from the National Income and Product Accounts.

3.1. Price Indices, Dividends, and Total Returns

3.1.1. Standard Definitions

The definition of the stock price index that is consistent with standard methodology (*eg* that used to construct Standard & Poor's indices) is to derive the implied stock price for the sector by:

$$\frac{P_t}{P_{t-1}} = \frac{MV_t - NI_t}{MV_{t-1}} = \frac{MV_t}{MV_{t-1}}\left(1 - \frac{NI_t}{MV_t}\right) \tag{3.1}$$

where MV_t = market value of equities outstanding (Table B102, line 34); NI_t = net nonfinancial corporate equity issues (Table R102, line 11) since standard stock price indices are constructed by dividing market value by an index of the number of shares outstanding, E_t, (both chain-weighted) on an individual share basis, adjusting for new issues (defined net of repurchases and cash M&A). Thus, ignoring intra-period price changes,

$$\frac{NI_t}{MV_t} = \frac{P_t(E_t - E_{t-1})}{P_t E_t} = 1 - \frac{E_{t-1}}{E_t} \tag{3.2}$$

yielding (3.1) above. The price index is set equal to unity in 1945 (the start-point for Fed data) as a convenient normalisation.

The implied index of the number of shares outstanding is defined simply by:

$$E_t = \frac{MV_t}{P_t} \tag{3.3}$$

it is thus implicitly normalised to equal market value in 1945

Total dividend payments, DIV_t for the non-farm, non-financial corporate sector come from Table F102, line 3. Following the timing convention of Miller-Modigliani (1961) they can be divided by E_{t-1} to derive dividends per share,

DPS_t (since dividends are deemed to be paid out at the end of the period to those who held shares at the start of the period). Hence the dividend yield can be defined consistently with published indices by:

$$DY_t = \frac{DPS_t}{P_t} = \frac{DIV_t/E_{t-1}}{MV_t/E_t} = \frac{DIV_t}{MV_t}\frac{E_t}{E_{t-1}} \tag{3.4}$$

This timing convention is however frequently ignored, at very little cost in terms of accuracy of the data, by using the simpler approximated defintion (as shown in Figures 2.2 and 2.3)

$$DYM_t = \frac{DIV_t}{MV_t} \tag{3.5}$$

since the ratio E_t/E_{t-1} is typically very close to unity.

The total return (again, consistent with S&P methodology) is given by:

$$1 + R_t = \frac{P_t + DPS_t}{P_{t-1}} = \frac{P_t}{P_{t-1}}(1 + DY_t) \tag{3.6}$$

3.1.2. Alternative definitions using total cashflow to shareholders.

Following Miller & Modigliani(1961) and Mehra (1988), dividends, and net non-dividend cashlows to shareholders can all be treated as equivalent. Thus define total adjusted cashflow, as in Mehra (1998), Robertson & Wright (2003) as:

$$\widetilde{DIV}_t = DIV_t - NI_t \tag{3.7}$$

The corresponding yield (the "cashflow yield") is given by

$$\widetilde{DY}_t = \frac{\widetilde{DIV}_t}{MV_t}$$

(where there is no required adjustment for the number of share outstanding, since in a counterfactual world in which all cashflows were paid out as dividends, the equity issue would be constant) and the corresponding return is

$$1 + \widetilde{R}_t = \frac{MV_t + \widetilde{DIV}_t}{MV_{t-1}} \tag{3.8}$$

which is the return earned by a representative investor who owns the entire market, since the denominator and numerator of the last expression on the right-hand side are the total wealth of the representative investor at the beginning and end of the period, respectively. But, following Miller & Modigliani, this must (using (3.1) (3.3) and the definition of DPS_t) be equal to the "per share" return as defined in (3.6):

$$1+\widetilde{R}_t = \frac{MV_t + DIV_t - NI_t}{MV_{t-1}} = \frac{P_t}{P_{t-1}} + \frac{DIV_t}{MV_{t-1}} = \frac{P_t + DPS_t}{P_{t-1}} = 1 + R_t$$

3.2. Corporate Earnings

A measure of corporate profits, or earnings, is constructed from national income data as follows:

$$\begin{aligned} EARN_t &= \text{Nonfinancial profits before tax from domestic operations (1.16 line 28)} \\ &\quad + \text{Overseas profits} \\ &\quad - \text{Profits tax liability(1.16 line 29)} \\ &\quad + \text{Inventory Valuation Adjustment (1.16, line 33)} \\ &\quad + \text{Capital Consumption Adjustment (1.16, line 34)} \\ &\quad \text{ where} \\ \text{overseas profits} &= \text{Income from foreign corporations to US corporations (8.25 line 15)} \\ &\quad - \text{Corporate Profits after Tax, Payments to rest of world (6.19B/C line} \end{aligned}$$

(All references are to tables in the National Income and Product Accounts (NIPA)).

The adjustment for overseas profits adjusts published nonfinancial profits data from NIPA Table 1.16, to include earnings from overseas subsidiaries, but to exclude profits earned by overseas companies operating in the USA. The adjustment attributes all overseas corporate earnings to nonfinancials *faute de mieux*. The two further adjustments bring the measure of earnings closer to a measure of true economic profits, consistent with output figures.[30]

The implied earnings yield is calculated as:

[30] Note that this measure of profits includes corporate farm income, data for which are not available on a consistent basis before 1987. The implied discrepancy is however extremely small. Profits due abroad are also not available before 1948, but are extrapolated back as a constant share (just under 2%) of total domestic profits after tax.

$$EY_t = \frac{EARN_t}{MV_t} \tag{3.9}$$

Note that the reciprocal of this series gives the implied price-earnings multiple - a measure more commonly used with quoted indices. However, negative earnings in two years, 1932 and 1933 result in both ratios being negative, at which points the earnings yield is arguably more easily interpreted.

The inflation-adjusted earnings yield (discussed in Section 2.7 above) is constructed as follows:

$$EYINFLADJ_t = \frac{EARN_t + NLM_{t-1}(PGDP_t/PGDP_{t-1} - 1)}{MV_t} \tag{3.10}$$

where NLM_t is net liabilities (see Section 3.4).

3.3. Tangible Assets

Two alternative measures of tangible assets are constructed. The two measures only differ from 1990 onwards, due a distinct discontinuity in the Fed's data construction methods from that date onwards.

Total tangible assets, $KFED_t$ comes straight from Table B102, (line 2). The discontinuity in the construction of this series arises from the Fed's treatment of land.[31] From 1956 to 1989, the Fed add estimates of corporate land values, which are smooth interpolations of five-yearly observations derived from census data on taxable property values, to BEA capital stock figures (see below) to arrive at total tangible assets. Before 1956 land values are constructed by the Fed as a pure extrapolation, as a fixed share of tangible assets. Beyond 1989, the Fed's methodology changes radically. The stock of real estate (ie, structures plus land) is then assumed to evolve according to the following equation:

$$Stock_t = Stock_{t-1}.\,(REP_t/REP_{t-1}) + \textit{BEA Net Investment in Structures}$$

where REP is an index of corporate real estate prices.[32]

[31] I am grateful to Rochelle Antonimowiecz and Elizabeth Fogler of the Federal Reserve's Flow of Funds section for advice on their methodology.

[32] The real stock of land is thus implicitly assumed constant.

Hence until 1989 Fed estimates of land data in the flow of funds are independently derived, and simply added to BEA capital stock figures (see below); thereafter they are a residual. Since there is no overlap between the real estate price index and the previous source for land values, it is impossible to check the impact of this change in methodology, but there is a distinct impact on the behaviour on the implicit figures for land, which in some years since 1989 were close to turning negative. Figure 3.1 shows that there is a very marked discontinuity in the implied land figures.

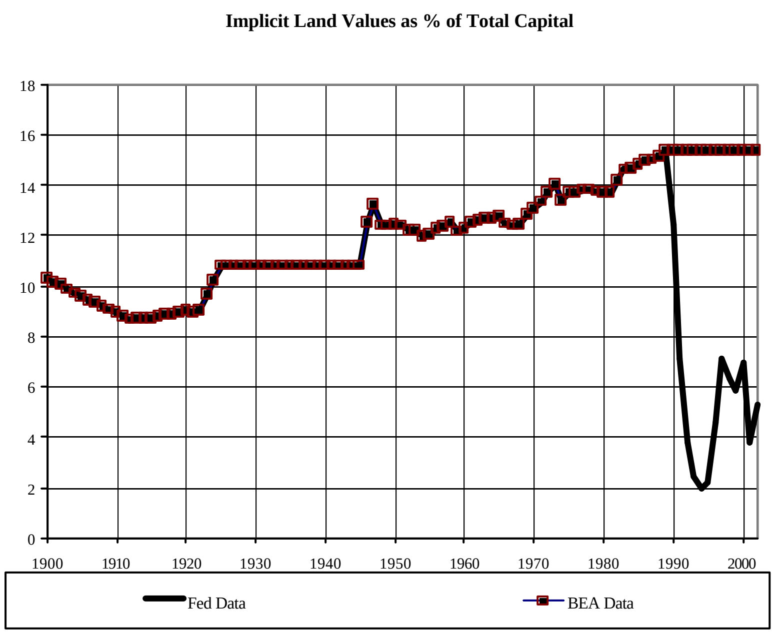

Figure 3.1:

For greater consistency with the previous treatment, an alternative measure of tangible assets, $KBEA_t$ can be constructed. This is identical to the Fed measure until 1989, but thereafter is constructed using effectively the same methodology as previously employed by the Fed. Thus, the series is derived from its constituent parts as:

$$
\begin{aligned}
KBEA_t &= KX_t + LANDBEA_t \\
KX_t &= KFIX_t + KINV_t \\
&\quad \text{where} \\
KFIX_t &= \text{replacement value of residential structures (line 32)} \\
&\quad +\text{replacement cost value of nonresidential structures (line 33)} \\
&\quad + \text{equipment and software (line 4)} \\
KINV_t &= \text{inventories (line 5)} \\
LANDBEA_t &= KFED_t - KX_t \text{ until 1989} \\
&= \text{proportional to } KX_t \text{ after 1989}
\end{aligned}
$$

Thus from 1989 onwards land is again assumed to be a fixed share of total tangible assets. It is also consistent with the (necessary) assumption for all data before 1956, given the absence of reliable data on land values. Figure 3.1 compares the implicit figures for land, in relation to total tangible assets, implied by the two alternative methodologies: the BEA-consistent figure, that simply projects land data after 1989, appears distinctly more consistent with past data.[33]

3.4. Financial Assets and Liabilities

In order to arrive at an estimate of the total market value of nonfinancial corporations, it is necessary to add an estimate of the market value of liabilities to the market value of equities. Flow of funds figures can be used to construct a measure of net liabililities from two series for financial assets and liabilities, both of which are recorded mainly at book value, thus:

$$
\begin{aligned}
NLB_t &= LB_t - A_t \\
\text{where } LB_t &= \text{liabilities (line 20)} \\
A_t &= \text{financial assets(line 6)}
\end{aligned}
$$

The market value of financial assets is assumed to equal book value, where adjustments are not already made by the Fed (as shown in Flow of Funds Table R102).

[33] This alternative measure of tangible assets implies an adjustment to net liabilities to leave net worth constant (see next section).

The Fed make regular revaluation adjustments to some elements of liabilities; however, two significant elements, corporate bonds (line 24) and mortgages (line 27) are recorded at book value. I construct an adjustment to these two elements to revalue the implied bonds (which are all implicitly priced at par) to their market value (see below Section 6), thus producing an estimate of net liabilities at market value:

$$\begin{aligned} NLM_t &= NLB_t + BM_t - BB_t \\ \text{where } BB_t &= \text{corporate bonds + mortgages at book value} \\ BM_t &= \text{corporate bonds + mortgages at market value} \end{aligned}$$

In order to ensure that use of the alternative measure of tangible assets, discussed in the previous section, does not change net worth figures, an alternative, consistent, measure of net liabilities is constructed:

$$NLMBEA_t = NLM_t + KBEA_t - KFED_t$$

This is consistent with Fed methodology, whereby “other miscellaneous assets” (Table L102, line 19) and “other miscellaneous liabilities” (Table L102, line 39) include a balancing item to reconcile net worth figures with the sum of its constituent components, that come from a variety of sources All of the adjustment is assumed to apply to financial assets, thus gross liabilities figures, as well as net worth figures are unaffected.

The stock of net overseas direct investment, $NODI_t$ is measured as the difference between lines 15 and 37 of Table L102.

3.5. Adjustments for Data Discontinuities

Adjustments are made for a distinct data discontinuity in net liabilities data.

In 1975 there is a sharp jump in both financial assets and liabilities, due to a change in data sources (the impact of which shows up in a sharp jump in the catch-all category of “miscellaneous” assets and liabilities). To maximise consistency with the primary source, these levels are retained both from 1975 onwards, and in data up until 1970; however adjustments are made to liabilities due to an apparent inconsistency in the timing of the changes to assets and liabilities that result in a sharp drop.in the unadjusted data for net liabilities in 1974. This fall is not visible in the Fed’s own flow data, which otherwise generally correspond very closely over this period. For this reason, in the years 1971 to1974 inclusive, Fed data for total liabilities are replaced by adding cumulated flows since 1970 to the level in 1970. This technique would result in a figure for 1975 which is very close to the recorded figure, hence from this point onwards the unadjusted data are used. The required adjustment $LBADJ_t$ is included in the dataset for completeness, to enable use of the published data if desired.

3.6. Unidentified Liabilities (or "Martian Debt")

Unidentified liabilities (or "Martian Debt") can be derived from Flow of Funds Table L5 as

$$\begin{aligned} MDEBT_t &= \text{Line 33 (Total identified assets, all sectors)} \\ &\quad -\text{Line 20 (Total Liabilities, all sectors)} \\ &\quad -\text{Sum of Lines 21 through 23 (Financial Assets not included in Liabilities)} \end{aligned}$$

it can also be defined as the negative of the sum of sectoral (or instrument) balancing items. Before 1945 this series is not available and is therefore set to zero.

4. Data Definitions, 1900-1945

Before 1945 there is no single, mutually consistent source of data. However, those data sources that do exist are mainly available for at least some of the period after 1945 as well, so it is possible to assess the degree of correspondence with flow of funds data, which is generally good.

The most significant series that is lacking is for the market value of equities. I rely upon two competing methodologies, which fortunately produce very similar results for most of the sample: the final estimate is derived as a simple (geometric) average of the two alternative estimates.

4.1. Dividends

A fairly reliable series for total nonfinancial dividend payments, DIV_t, can be constructed from the start of the century.

From 1929 to 1945 the NIPA series, from Table 1.16, is used for the dividend payments of nonfinancial corporations. In the overlapping year of 1946 this series is identical to the Fed series excluding corporate farms, implying that the distinction before this point is immaterial.

From 1919 to 1928 I use data from Kuznets (1941), Table 54 (total dividend payments less finance).

From 1900 to 1918 I use data from Goldsmith (1955), For the period 1900-1915 I follow Blanchard *et al* (1993) in constructing (gross) nonfinancial dividend payments as total payments less 1.6 times payments by commercial banks (Table C-6).[34] For the period 1916-1918 I use data for net payments (total less finance) from Table C-31. Table C-29 provides data for both gross and net payments for the overlap year of 1916, allowing a rescaling of the gross series before that point.

In all cases, overlapping data are available, and there is a close correspondence between the series from different sources. I extrapolate backwards using percentage changes, to avoid breaks in series, but use of the unadjusted component series would give almost identical results.

The only adjustment made to the dividend series is at the very start of the sample, in the three years 1900-02 only. Goldsmith's (*op cit*) sources for dividend data for this period were highly restricted. His only source of independent data for the largest single industrial sector, manufacturing, was a shifting sample of corporations, rising from only eight in 1900 to 39 in 1902, but stabilising at around 50-60 corporations from 1903 onwards. Goldsmith's sample showed a very significantly more rapid growth of both earnings and dividends during this period than his only alternative source, Cowles's (1938) indices of prices, dividends and earnings. Goldsmith appears to have recognised the limitations of his independent estimates, by constructing his final series as a complex weighted average of his own data and equivalents from Cowles. However, even after these adjustments, significant discrepancies remain, resulting in a very marked divergence over the course of the first three years of the twentieth century. These would also accentuate the differences between the two competing estimates of market value, and hence returns (further discussion of this aspect is provided below, in section.4.3) As a result, a further, rather *ad-hoc* further adjustment is made to Goldsmith's series in the three years 1900-02 only: the growth rate of dividends is assumed to be a simple weighted average of the growth rate of his unadjusted series, and the growth of dividends per share implied by the Cowles (1938) index.

[34] The scaling factor reflecting their estimate of the share of banks in financial corporations.

4.2. New Issues

A range of sources is used to construct a series for net new issues, NI_t before Fed data become available. The quality of the data is almost certainly distinctly lower than in the post-1945 period, although it should be noted that the series itself is, in most years, relatively small (averaging at most around 1%-2% of market value). Indeed during the course of the 1930s and early 1940s the series essentially fell to zero. There is also a reasonable overlap with Fed data from 1946 onwards.

For all but ten years of the pre-1945 sample, data are only available (or can be constructed by proxy) for new issues by all corporations(NIT_t), as opposed to nonfinancials (NI_t).

NI_t, is constructed as follows:

1920-1930; 1946-1956: $NI_t =$ Issues of preferred and common stock for new money, utilities + industrial corporations (source: Miller, 1963, Table V-A3);

1900-1919; 1931-1945: $NI_t = k_1 NIT_t$, where $k_1 = 0.87$ is the geometric mean of NI_t/NIT_t over the two samples 1920-1930 and 1946-1951 - a ratio which appears fairly stable; and NIT_t is constructed as follows:

1919; 1931-1956: $NIT_t =$ Securities flotations for new money, preferred + common stock, all corporations (source: Miller (*op cit*), Table V-A1, columns 10+11));

1910-1918: $NIT_t = k_2 NITG_t$, where

$NITG_t =$ New issues (including refunding), common + preferred stock (source: *Historical Statistics* series X-514+X-515), and

$k_2 = 0.94 =$ geometric mean of $NIT_t/NITG_t$ over period 1919-1925;

1900-1909: $\Delta \ln NIT_{t+1} = \Delta \ln NITNY_{t+1}$, where

$NITNY_t =$Listings of stocks on New York Stock Exchange, for new capital (Sources: *Commercial and Financial Chronicle* , 14 January 1911, page 83, and 10 January, 1903, page 73, col 1)[35]

Figure 4.1 shows the various underlying, but non-continuous data sources over the period 1920-1956: the correspondence is generally good.

4.3. Market Value of Equities and the Stock Price

There is no independent source of equity market value data before 1945. Two alternative procedures are used to construct the data. Neither is entirely satisfac-

[35] The single overlapping observation from this source is for 1910, in which year (total) stock listings in New York were roughly three quarters of total stock listings for the United States as a whole, as given in *Historical Statistics*.

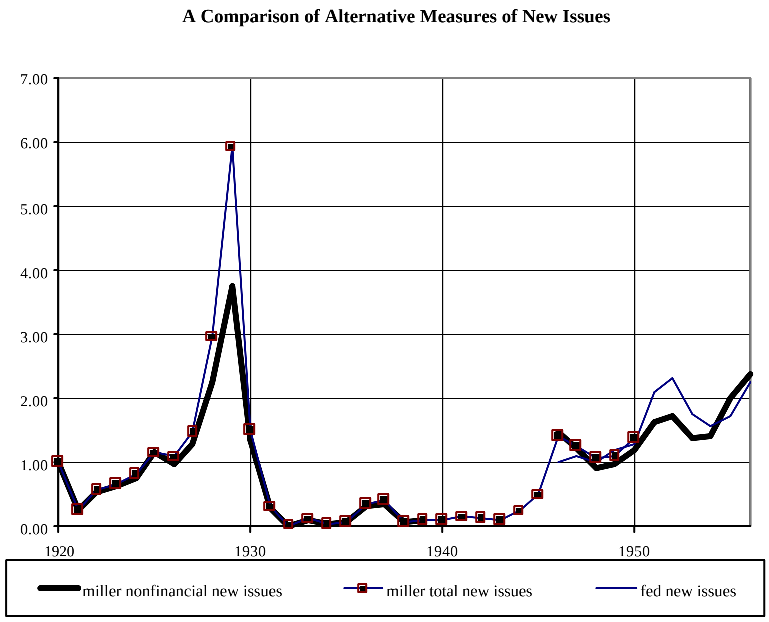

Figure 4.1:

tory, but since the procedures are largely independent, they provide a cross-check, and for most of the sample the correspondence between the two resulting series is very good. A final series for market value is constructed as an unweighted geometric average of the two alternative estimates.[36]

Both methods depend on one of two series associated with an index of quoted stock prices (hence a restricted sample of corporations compared to the nonfinancial sector as a whole): these are end-year data for the price and dividend yield on the S&P Composite Index, extrapolated backwards before 1925 using data from Cowles (1938).[37] The S&P series has the defect that the index includes some financial corporations; however, the alternative S&P Industrials Index, which excludes financial corporations, also excludes firms such as utilities that should be included for comparability with the total nonfinancial sector. Before 1925 this

[36] Market value and related series using both methods are however included in the dataset (the two approaches are identical from 1945 onwards).

[37] The full series was downloaded from Robert Shiller's website, and is consistent with the series used in Shiller (2000)

issue is not relevant, since Cowles's index includes no financial corporations.

4.3.1. Method 1: Equating the Dividend Yield to the S&P/Cowles series

This approach is very commonly used (see, for example, Blanchard *et al* (1993); Holland and Myers (1984), Miller, 1963,[38] Bernanke *et al*, 1988) Define market value by:

$$MV_{1t} = \frac{DIV_t}{DY_t^s} \tag{4.1}$$

where DY_t^s is the dividend yield on the S&P Composite/ Cowles index (dividends per share are annual average figures, consistent with standard practice, given the use of end-year stock price figures). Relatively small discrepancies between the true, but unobservable dividend yield and the assumed yield can thus in principle imply significant differences in market value. As shown in Section 7.2, if applied in the post-1945 period, this approach generates major differences from the Fed data in some periods. There is also strong evidence (discussed in Appendix A) that the implied measurement error has a unit root, so that the method becomes increasingly unreliable, the further back in time it is used.

Given new issues data, the implied figure for the change in the stock price, and hence returns, drop out by identity from definition (3.1). The properties of the resulting series, and that for returns, provide a helpful cross-check on the properties of the market value series.

4.3.2. Method 2: Equating Returns to the S&P/Cowles Index

An alternative procedure is to generate market value by assuming that the return for all nonfinancial companies was equal to the return on the S&P/Cowles index before 1945. In the common sample, from 1945 onwards, the correspondence between the two return series is, as might be expected, fairly good (see discussion of Figure 2.5). Mean log returns for all nonfinancials and for the S&P were, respectively, 0.1220 and 0.1163, with a correlation coefficient of 0.94449, and a root mean squared prediction error of 0.0497 in logs (or 5.1%). . The slightly higher mean of the former presumably reflects the inclusion of smaller firms, which are

[38] Though note that Miller expresses doubts as to the validity of this approach, but uses it "*faute de mieux*"

well-known to have outperformed larger stocks in the postwar era. The difference between means is however not statistically significant (with a p-value of 0.4), so it was not taken into account in backward extrapolation.

Given this assumption, (3.6), which defines the total return can be inverted to derive the implied change in price. Given figures for new issues, this in turn implies a series for market value, MV_{2t} by inverting (3.1). Since (3.1) determines the change in market value, rather than its level, it is clear that prediction errors from this method will again cumulate up, the further back in time it is applied.

4.3.3. A comparison of the two methods

Appendix A provides a formal comparison of the statistical properties of the two alternative estimates. This suggests strongly that, given the sample length used, implied standard errors for Method 2 are well below those for Method 1.

Despite the *ex ante* case for the superiority of Method 2, the two methods do provide some form of control for each other. Figure 4.2 compares the results by examining implied dividend yields in the period 1900-1944.

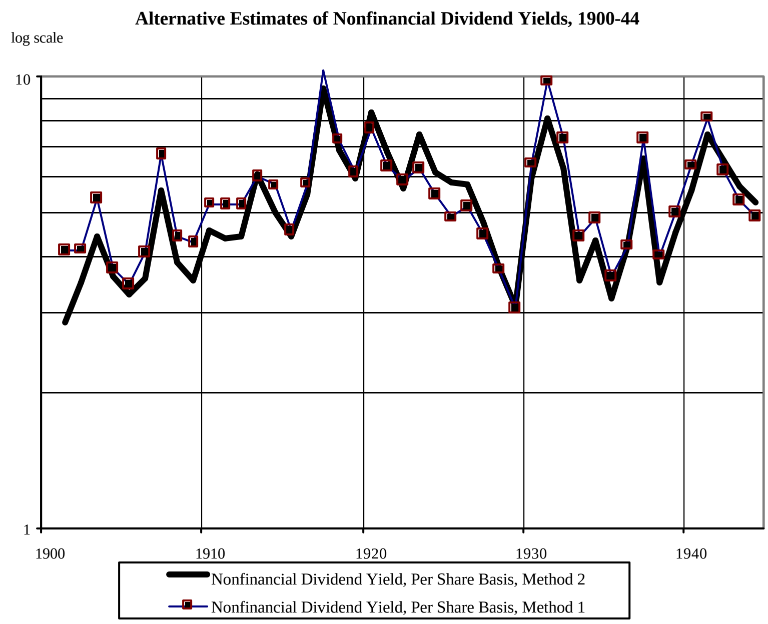

Figure 4.2:

The dividend yield implied by method 1 is, by construction, identical to the yield on the S&P index. The yield implied by method 2 is derived by dividing total dividends DIV_t by MV_{2t}. For most of the early years of the century, the charts suggest that the results are reassuringly consistent. While this might be expected for short-term fluctuations (which will be dominated by price movements), the series could easily drift apart over time, given the assumed unit roots in both measurement errors, but for most of the sample they do not.[39]

The exception to this general feature is in the first decade of the century, when the two yields do drift apart to quite a signficant extent, with the divergence increasing towards the start of the sample: in 1900 method 1 implies a yield around 1 1/2 times that of method 2: by implication the market values (and hence implied figures for (equity) q) differ in the same proportion. The source of this divergence can be seen in the behaviour of aggregate dividends. As noted above, in Section 4.1, these, on Goldsmith's (*op cit*) data grew sharply in the first few years of the century, whereas dividends per share on the (then) Cowles index grew at considerably more modest rates.. Since the yield on Cowles stock index was fairly stable during this period, Method 1 implies rapid growth of market value. Taking new issues data as given, this in turn implies exceptionally rapid stock price rises and returns: indeed, using the unadjusted version of Goldsmith's dividends series, Method 1 would imply that the return in one year, 1902 was the highest in the entire twentieth century, at over 60% - a movement not matched at all by the Cowles index, and hence by the implied return from Method 2. By implication, the return on non-Cowles companies would need to have been even more exceptional. There is an equivalent impact on the alternative implied estimates of market value: using the unadjusted Goldsmith dividend series Method 1 would imply a figure only slightly more than half that implied by Method 2.

Given the scale of this divergence, the final data incorporate a degree of informal "balancing". First, as noted above, in Section 4.1, the dividends series is adjusted during the period in which Goldsmith's sources appear somewhat less reliable. Second, the final market value series is derived as a simple geometric average of the implied figures from the two approaches:

$$MV_t = MV_{1t}^{0.5} MV_{2t}^{0.5} \tag{4.2}$$

Implied figures for prices and returns are then derived, as in the post-1945

[39] One possible explanation is that the assumption of a unit root measurement error is too pessimistic, if, for example dividend yields for the non-quoted and quoted sectors cannot drift too far apart over time (ie, may have been close to cointegrated).

period, from (3.1) and (3.6). The resulting series have fairly plausible properties, compared to those for the Cowles index. Returns are somewhat, but not spectacularly higher in the early years of the century, reflecting still significantly more rapid growth of dividends; the counterpart to this more rapid growth is a lower initial value for the dividend yield (as shown in Figure 2.2).

4.4. Corporate Earnings

For the period 1929-1944, the series used is the same as that used in the post-1945 period (see Section 3.2).

Before 1929, the series is extrapolated backwards using profits for all corporations derived from Goldsmith (1955) and Kuznets (1941), as follows:

$$\begin{aligned}
\Delta \log EARN_t &= \Delta \log EARNALLC_t \\
\text{where} &: \\
EARNALLC_t &= \text{Adjusted corporate saving (Goldsmith Table C-1)} \\
&\quad +GDIV_t \\
\text{where} &: \\
GDIV_t &= \text{ Gross Dividends(Goldsmith Tables C-6, C-29); } t = 1900 - 1922; \\
\Delta \log GDIV_t &= \Delta \log KDIV_t;\ t = 1923 - 1929 \\
\text{where} &: \\
KDIV_t &= \text{Total Dividends (Kuznets, Table T-54)}
\end{aligned}$$

Gross, rather than net dividend payments are used for consistency with the definition of corporate saving (ie, retained profits) used by Goldsmith. Goldsmith's "adjusted" saving measure is also used since this brings profits closer conceptually to the NIPA profits series constructed from 1929 onwards, as described in Section 3.2.

4.5. Tangible Assets

Tangible assets figures for the period 1900-1945 are derived by building up the components of total tangible assets from its constituent components

$$KBEA_t = KFED_t = KX_t + LAND_t \quad (4.3)$$

where

$$KX_t = KFIX_t + KINV_t \quad (4.4)$$

For the sample 1925-1944, figures for two of the three constituent series of $KFIX_t$,(non-residential structures + equipment) for the non-farm non-financial sector are available from the Bureau of Economic Analysis website: in the period since 1945 these series are virtually identical to the equivalent figures in lines 32 and 33 of Table B102 of the flow of funds. During this period residential structures (less than 2% of total tangible assets in 1945) and land (around 11% in 1945) are assumed to be a fixed proportion of the total.

From 1900 to 1924, proxies for $KFIX_t$ and for total non-financial tangible assets, excluding inventories ($KFED_t - KINV_t$) are constructed using data from Goldsmith (1955). Data construction proceeds in two stages. His Table W-31 provides balance sheets for the nonfinancial sector for 1900, 1912, 1922, 1929, 1933, 1939, 1945 and 1949, from which figures for ($KFED_t - KINV_t$), can be derived. Table W-30 provides a more detailed breakdown of assets for all corporations for the same years: non-financials' share of fixed non-residential assets in the total is assumed to be the same as for all corporations, thus giving estimates of $KFIX_t$. To construct annual series, the nearest available proxy, a series for total (ie, not just corporate) non-farm fixed capital, is derived from his Table W-1, as the sum of total non-farm, non-residential structures (Column 5) and producer durables (Column 11). Both $KFIX_t$ and the series for ($KFED_t - KINV_t$) are constructed by interpolation between available observations using annual percentage changes in the proxy series, such that the final interpolated series is constrained to pass through available data from Goldsmith. Finally, both series are projected backwards from available BEA data assuming equal percentage changes.

For inventories, $KINV_t$, for the period 1928-1944, data are from Holland and Myers (1984), Table 2B3a, Column 2 (which the authors note were derived from unpublished series produced by the Bureau of Economic Analysis). For the period 1900-1927 data are from Goldsmith (1955), Tables P-20 and P-25, and W-31. Figures for non-financial inventories from the latter table are interpolated using figures for all corporations from the other two tables. Again, the series is projected backwards from breakpoints using percentage changes.

The series for $KFIX_t$ implied by the Goldsmith figures can be constructed up until 1945, and can be directly compared with the BEA series over this sample. In one respect the comparison is reassuring: the correlation between percentage changes is 0.97, and the ratio between the series also remains relatively stable. However, of more concern is a very marked difference in levels terms: the equivalent Goldsmith series averages only around 0.6 times the BEA series. While it is well-known that perpetual inventory techniques, as employed by the BEA, can produce quite significant differences from the census-style techniques employed by Goldsmith, the discrepancy is nonetheless striking, especially given the observation, noted above, in Section 2.8, that the mean value of q would appear to suggest either systematic overestimation of the capital stock, or systematic mis-pricing. It is perhaps worth noting that, assuming Goldsmith's techniques were to imply a similar ratio if applied over the entire century, the resulting average value for Tobin's q would be very close to unity.

4.6. Financial Asset and Liabilities

Financial assets and liabilities are also derived from Goldsmith (*op cit*) Table W-31. Although this only provides two overlapping observations with Flow of Funds data, both the totals and constituent elements in the total correspond very closely (unsurprisingly, since both are derived primarily from a common primary source, *Statistics of Income)*. The only adjustment made is to financial assets, which are extrapolated using Goldsmith's total "intangible assets"[40], less holdings of corporate stocks. Both financial assets and liabilities are (log-linearly) interpolated between available observations.

Data for bonds and mortgages are derived for the same year, from the same table. For the sample 1926-1945 these are interpolated using annual data from Miller (*op cit*) Table V-A6, with the implied interpolation error smoothed across intervening observations. Before 1926 this series is also loglinearly interpolated.

As in the Flow of Funds balance sheets, both financial assets and liabilities are initially measured at book value, with a market value adjustment to the stock of bonds and mortgages, as described in Section 6.

[40] Note that Goldsmith does not use this term in its modern form, to capture unmeasurable assets such as goodwill.

5. Deflators

The key ratios in the paper are all defined using nominal magnitudes, hence for these, use of deflators is immaterial. Calculation of real returns,however, as discussed in Section , requires price indices, as do the two adjustments towards "Hicksian" measures of earnings, discussed in Section 2.7. For the calculation of real returns, the consumer price index is appropriate; for earnings adjustments, however, the deflator for non-financial GDP is used.

5.1. The Consumer Price Index

From 1913-2000 the consumer price index, measured for consistency, on an end-year basis ($PCEY_t$), is the Bureau of Labor Statistics Consumer Price Index - All Urban Consumers, downloaded from Robert Shiller's website, and consistent with Shiller (2000)). Before 1913 Shiller (*op cit*) uses a series from Pearson and Warren (1935). However, due probably to rounding errors, this series proves highly volatile: a problem to be found in a number of long-run price series. Instead a simple geometric average of four series, E-183 - 186 taken from *Historical Statistics* (1977) is used.

5.2. The Nonfinancial GDP Deflator

The implicit deflator for nonfinancial GDP, ($PGDP_t$) is derived from NIPA Table 1.16, defined as the ratio of nonfinancial GDP (line 19) to its constant price value (line 36)). Before 1929 the underlying series are not available; I use the implied deflator for total GNP as the closest available proxy, using data from *Historical Statistics* (1977): series F-1 and F-3.

6. Book-to-Market Adjustments

Given the aggregate nature of the data, and the long sample involved, any attempt to derive market valuations of liabilities involves a number of fairly heroic assumptions. However, the resulting adjustments turn out to be fairly minor in comparison with the volatility of other underlying series.

The methodology involved broadly follows that of Brainard, Shoven and Weiss (1980). When the book value of debt is rising, corporations are assumed to issue 20-year bonds at par, on a rolling basis, where the coupon at the time of issue is set equal to the Moody's BAA rate in the relevant year (data for which were dowloaded from http://bos.business.uab.edu/charts/ from 1919 onwards; extrapolated back before 1919 with series X-476 from *Historical Statistics* (1977) (unadjusted index of yields of American railroads)). Thus,the book value of corporate bonds and mortgages is assumed to evolve by:

$$\Delta BB_t = GNI_t - GNI_{t-20};\ \text{if } \Delta BB_t > 0$$

Following Brainard *et al* (*op cit*), when the book value of debt falls, early retirements/defaults, are assumed to be proportional across all maturities.

At any point in time, therefore, if book value has risen in each of the preceding 20 years, the book value of corporate debt is assumed to equal the sum of the book values of a porfolio of 20 corporate bonds with maturities from 1 to 20 years, where the relative weight on the bond of maturity m is proportional to gross new issues $20 - m$ years previously. When book value falls, book value is scaled down proportionately, but the relative weights of each are unchanged.

To derive the market value of this implied portfolio, each of these representative bonds, with coupon $c_t(m)$ is repriced in each period, assuming that the appropriate yield is given by $y_t(m)$, using the formula:

$$\begin{aligned} P_t(m) &= \frac{c_t(m)}{1+y_t(m)} + \frac{c_t(m)}{(1+y_t(m))^2} + ... \frac{1+c_t(m)}{(1+y_t(m))^m} \\ &= \frac{c_t(m)}{y_t(m)} + \frac{1-\frac{c_t(m)}{y_t(m)}}{(1+y_t(m))^m} \end{aligned}$$

hence when $y_t(m) = c_t(m)$ the bond is at par, with a price of unity.

The required yields are approximated by a piecewise linearly-interpolated yield curve, where the long end ($m \geq 10$) is set equal to the Moody's Baa rate; and the short end is set to the short-term interest rate from Shiller (*op cit*) plus a default premium, set equal to the premium of the Baa rate over the long-term government bond yield (yield on US Treasury bonds with maturity over 10 years). The coupon rate for a bond of residual maturity m is assumed to be given by

$$c_t(m) = y_{t-m}(20)$$

Figure 6.1 shows the implied adjustment, to bonds and mortgages, which lies within a relatively narrow range. The implied adjustment to net liabilites lies within a somewhat wider range (since in a number of periods net liabilities are less than bonds and mortages); hence there is a non-trivial impact on measures of net leverage. However, the impact on measures of gross leverage, and of q is very small.

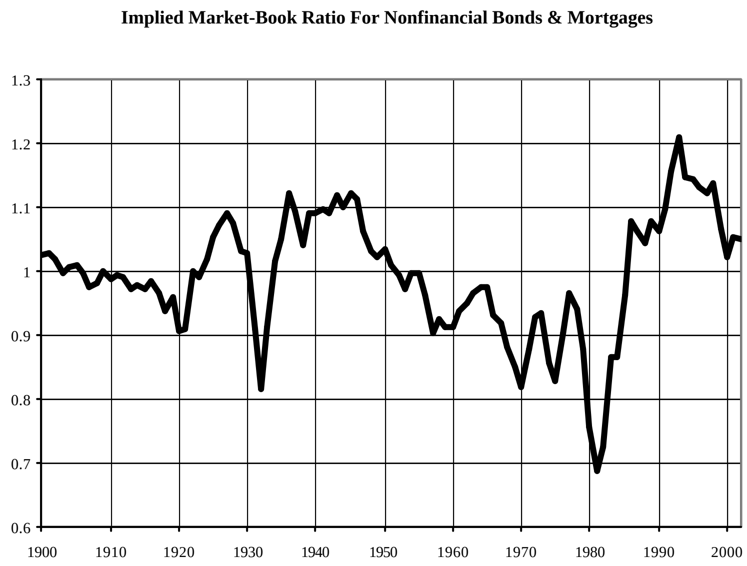

Figure 6.1:

7. A Comparison of the Dataset with Some Past Research

7.1. Laitner and Stolyarov's (2003) q estimates

In a recent paper, Laitner & Stolyarov (2003) construct an estimate of Tobin's q for the total business sector over the period 1953-2000. They motivate their theoretical and empirical analysis by noting that, in their dataset, Tobin's q has usually been well above 1 - a feature that, like Hall (2001), they attribute to intangible assets (they focus particularly on proprietary applied knowledge), since the denominator of q only measures tangible assets.

The key feature of their dataset, that q is usually well above unity, is not however visible in the dataset described in this paper. Indeed, as Section 2.8 notes, quite the contrary is the case, with a mean value of q for the nonfinancial corporate sector over the same period (as in the entire sample period) of around 0.6. Since the nonfinancial corporate sector is such a large part of the total business sector (in 2000 it was 56% of the total by market value) this discrepancy appears on the face of it to be a serious puzzle.

In fact, on closer examination, there is not much to puzzle over: Laitner & Stolyarov simply get their data wrong. In a detailed comparison Wright (2004) shows that they both overestimate the numerator and underestimate the denominator of their q estimate. The latter error is most significant: the primary factor being the omission of significant elements of tangible (rather than intangible) assets, from the denominator (the most important of which omissions were residential capital and land). When the calculation is carried out correcting for these errors the resulting q series for the business sector as a whole turns out also to have a mean well below unity, consistent with the equivalent series for the nonfinancial corporate sector described in this paper.

Figure 7.1, reproduced from Wright (2004) shows the impact of these corrections

7.2. Bernanke, Bohn and Reiss's (1988) q estimates

A much cited time series for q, constructed for an econometric study of investment, is found in Bernanke, Bohn and Reiss (1988). This series is conceptually rather different from the series constructed here, since it is an attempt to derive a series for *marginal* q from data on Tobin's (average) q, corrected for changes in tax rates, and tax breaks on investment, etc. Nonetheless it is of interest to compare the techniques applied in constructing the average q figures that feed into that

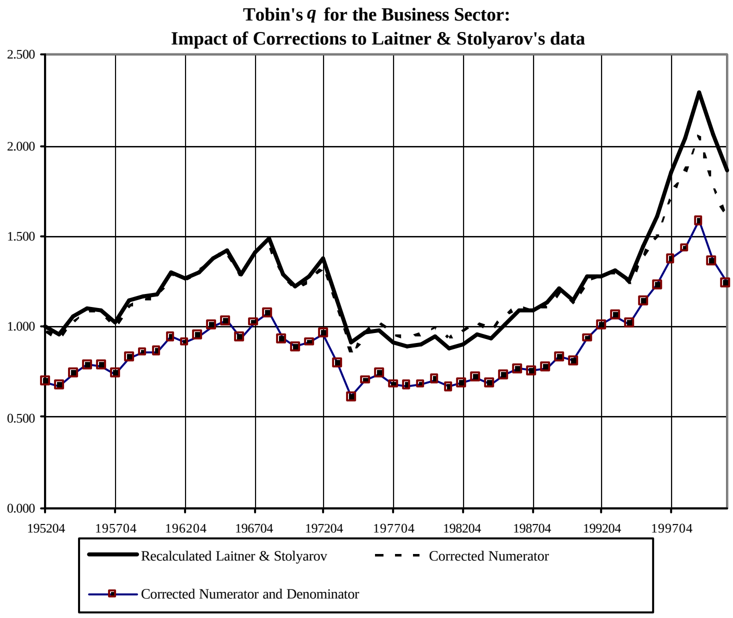

Figure 7.1:

estimate with the methodology used here.

Figure 7.2 shows three series: first, the series for tax-adjusted q as given in Bernanke *et al*[41]; second, the preferred series for Tobin's q as calculated in this paper; third an equivalent series on the same basis that replicates the figure for Tobin's q that fed into Bernanke *et al*'s marginal q calculations.

A first point to note is that, in the common sample, all three series have fairly similar properties in terms of percentage changes (since the chart is on a log scale). Note however that in the (relatively short) sample used by Bernanke *et al* the mean-reverting property of q was much less clearly visible - the series being essentially composed of a single upswing and a single downswing. The *level* of the Bernanke *et al* series is however well above unity, in contrast to both the raw figures for average q. The similarities between the latter over this period imply that the difference from the tax-adjusted measure is almost entirely explained by

[41] Or strictly, fourth quarter values of the series given in Table 8 (p323), plus one, for comparability with measures in thies paper.

Comparison with Bernanke et al (1988): *q*

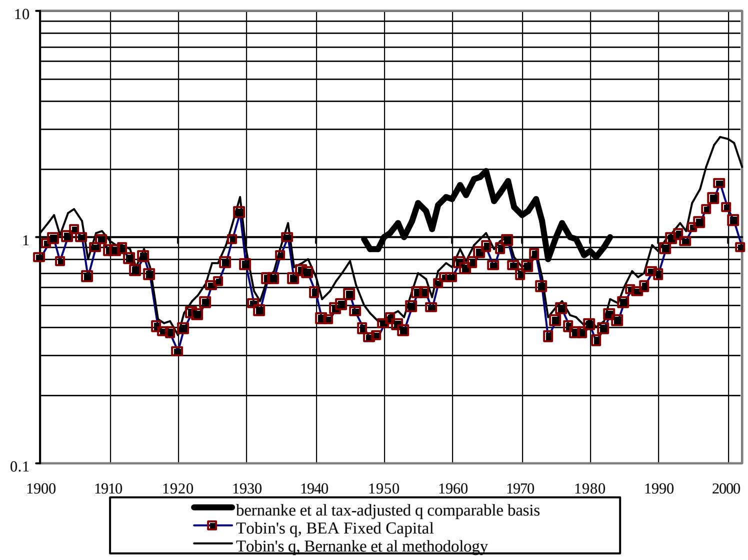

Figure 7.2:

the various adjustments for tax treatment.[42]

It is worth noting, however, that if the Bernanke *et al* methodology is extended forwards beyond their original sample, the two average q series diverge quite substantially. The primary explanation is that Bernanke *et al* did not make any use of published Fed balance sheet data on the value of equities and debt, but instead used a rather crude "grossing-up" approach to both. The first is derived by dividing NIPA dividends by the dividend yield on the S&P 500 (ie, precisely as in "Method 1" as applied in the pre-1945 period in this paper); the second by dividing NIPA net interest by the BAA corporate bond rate. The pitfalls of this approach to deriving the market value of equities, when applied to post-1945 data, have already been described in Section 4.3.3. There are even more severe problems with the latter.

Figure 7.3 shows that the implied market value of equities and debt series

[42] Note that in the common data period, and thereafter the two average q series are entirely defined in terms of published series, and do not depend on any of the approximations used in this paper for earlier periods.

are compared with the equivalent Fed series, they diverge, at times by very large amounts - most notably in the last ten years of the sample. In the case of equities, this was the period in which implied dividend yields for the nonfinancial sector and the S&P diverged quite markedly, as discussed above in Section 2.3, resulting in the grossing-up technique overstating equity market value by a factor of up to two. But the divergence is even more significant in terms of debt, which is overstated by anything up to fivefold towards the end of the sample (though the impact of the two overstatements on q are roughly comparable, given the relatively lower weight of (net) debt in total market value).

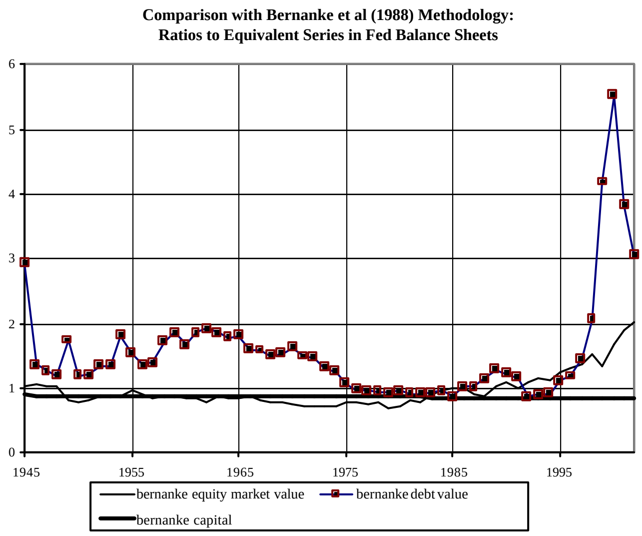

Figure 7.3:

In Bernanke *et al*'s original sample the mis-valuation of debt and equities was not so severe a problem. There were also offsetting errors for much of the time, with debt being typically overstated, but equities understated, compared to Fed data.

An additional problem with the Bernanke *et al* approach, shown in Figure 7.3, is that, in similar fashion to Laitner & Stolyarov (*op cit*) there is a systematic *under*statement of capital in the denominator of their Tobin's q measure, since they only include reproducible capital[43] and thus exclude the value of land. However

[43] It is unclear from Bernanke *et al*'s description whether they include corporate residential

the chart shows that, in comparison, this is a relatively more minor problem, at least in quantitative terms.

Overall, the lesson to be learned from this comparison is that those who wish to follow the Bernanke *et al* approach in deriving an estimate of tax-adjusted marginal q should take greater care to ensure that the the average (Tobin's) q measures that feed in are consistent with Fed data.

7.3. Alternative Estimates of Non-Dividend Cashflows

Most recent discussions of adjustments to dividends to allow for the impact of non-dividend cashflows (eg, Fama & French (2001); Grullon & Michaely (2002); Liang & Sharpe (1999)) have focussed on the role of repurchases. While these have grown very rapidly over the past decades, their impact has frequently been swamped in the recent past by the impact of cash-financed acquisitions, that are, in effect, negative new issues, since they withdraw stock from non-corporate ownership, in exchange for a cash payment (the "liquidating dividend"). Flow of funds data on net new issues take full account of these transactions (as well as taking account of more conventional new issues, that have been very small in the recent past, but were quantitatively much more important in earlier periods).

The importance of cash-financed acquisitions in payout policy has received relatively little attention (exceptions are Shoven (1986); Bagwell & Shoven (1989); Ackert and Smith (1993); and Allen & Michaely (2002)), but to the extent that it has, all the above authors are unanimous in agreeing that, from the perspective of the corporate sector in aggregate, such flows are rightly regarded as cash distributions to equity holders. Allen & Michaely's (op cit) recent comprehensive review article on corporate payout policy notes that, although, at times these flows have dwarfed all other forms of cash distribution, there have thus far been barely any attempts to engage in empirical investigations that measure aggregate cash distribution taking these flows into account (the only exceptions appear to be Ackert and Smith, *op cit;* Mehra, *op cit*; Robertson and Wright, 2003).

Given the differences in definition, the cashflow yield series described in Sections 2.3 and 3.1 cannot be directly compared with estimates, such as those of Liang & Sharpe (*op cit*) that only correct for repurchases. It is however possible to make a comparison with figures in Allen & Michaely (*op cit*), that provide fig-

capital within fixed assets; but any such omission would be of very minor importance, in contrast to the Laitner & Stolyarov estimates (which are for the total business sector, and thus include the non-corporate sector, that has a much larger share of residential capital).

ures on the three elements of cash distribution -dividends, repurchases and (net) cash M&A - over the sample 1977-1998. Although the authors do not explicitly construct an implied cashflow yield by using the sum of these figures, it is possible to construct such a measure, and compare it with the cashflow yield in this dataset. Figure 7.4 illlustrates.

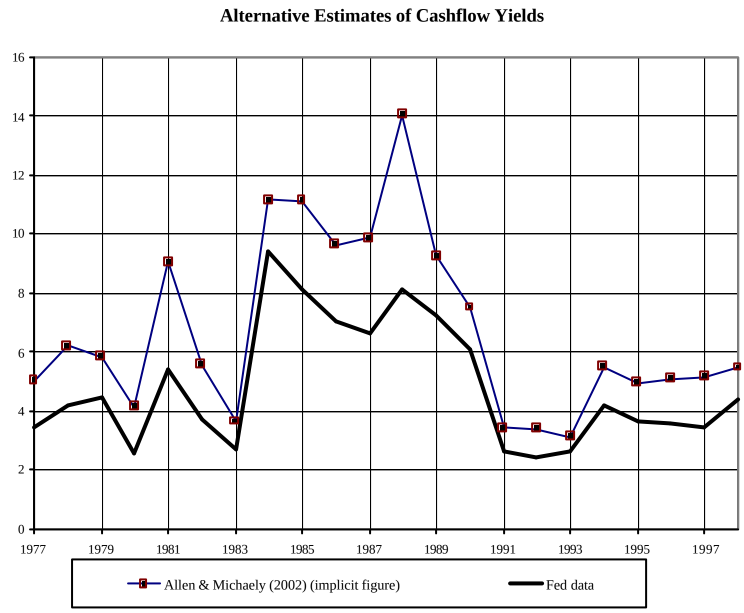

Figure 7.4:

While the general patterns in the two series are quite similar, there are some important differences: the Allen & Michaely (implicit) series is consistently higher, and is even more volatile in the 1980s. But these differences appear to be readily explicable.

First, there are some differences in coverage. Fed data relate to all (quoted and non-quoted) nonfinancial companies; Allen & Michaely's relate to all (i.e., including financial) quoted companies. Non-dividend payouts for unquoted companies are likely to be small thus a higher ratio for quote companies would be expected. Second, and possibly more crucially, in terms of explaining the generally (and in some years significantly) higher implied yields, it may well be that simply adding up all three of the Allen & Michaely series results in some element of double counting. The M&A figures they use come from a different source to their other data. While they do engage in comparisons in their discussions they do not explicitly add the figures, as in the chart. In contrast, the Fed statisticians are always extremely careful to avoid double counting.

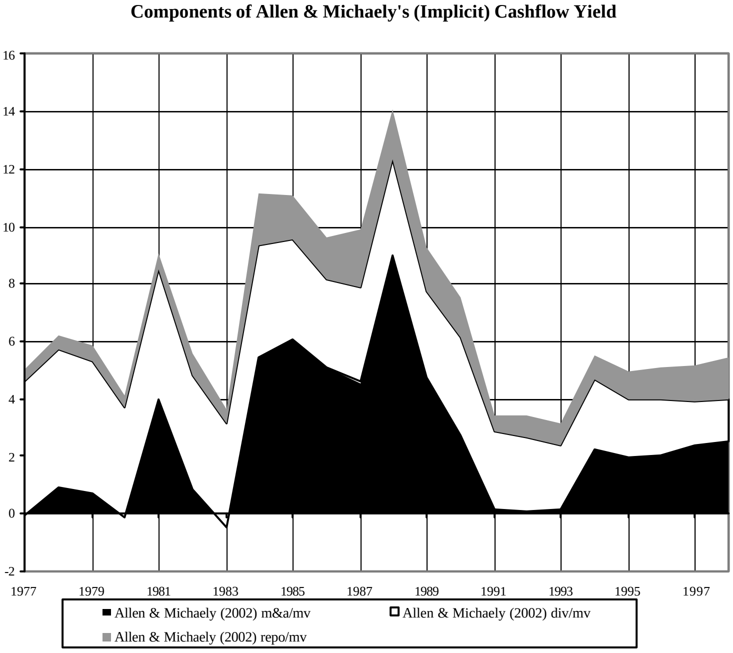

Figure 7.5:

The Fed do not provide any breakdown of net new issues into its constituent components. However, to the extent that Allen & Michaely's data can be treated as mutually consistent, they can be used to derive such a breakdown, as shown in Figure 7.5. This shows that while repurchases have grown significantly since 1977, to a level almost equal to dividends at the end of their sample, movements in both repurchases and dividends have at times been dwarfed by those in cash-financed acquisitions. In particular, these were the dominant element in the sharp upswing in the cashflow yield during the 1980s.

APPENDIX

A. A Comparison of the Statistical Properties of Alternative Methods of Back-Projecting Equity Market Value Data

A.1. One Period Backcasting

One way to compare the two methods is to compare one-period-backward prediction errors in difference terms over the post-1945 sample, since, if dividend and new issues data are taken as known, both methods can be directly compared as backward predictors of changes in the stock price. It is reasonable to treat both as backcasting methods for the change in the share price.[44] On this restrictive basis, and on this sample, it can be shown that Method 2 clearly dominates.

Thus there are two implied backward prediction equations:

$$\text{Method 1} \quad : \quad \Delta(dps_t - p_t) = \Delta(d_t^s - p_t^s) + \varepsilon_{1t-1} \tag{A.1}$$

$$\text{Method 2} \quad : \quad \Delta p_t = \Delta p_t^s + \log\left(\frac{1 + DY_t^s}{1 + DY_t}\right) - \varepsilon_{2t-1} \tag{A.2}$$

where lower case letters denote logarithms of upper case series, and the sign and dating of the error term reflects the use of the prediction equations as backcasting, rather than forecasting equations: *ie*, to predict values for the unknown true stock price in period $t-1$, given information in period t. The prediction equations can thus be re-written as:

$$\begin{aligned} \text{Method 1} \quad &: \quad p_{t-1} = p_t - \Delta p_t^s - \Delta(dps_t - dps_t) + \varepsilon_{1t-1} \\ \text{Method 2} \quad &: \quad p_{t-1} = p_t - \Delta p_t^s + z_t + \varepsilon_{2t-1} \end{aligned}$$

where $z_t = \log\left(\frac{1+DY_t^s}{1+DY_t}\right)$, and Δdps_t can both be treated as known in backcasting one period, if both dividends and new issues are treated as known, since, given (3.2), the percentage change in the number of shares, E_t over its previous value is determined solely by $t-$dated information.

[44] Although Method 1 is carried out in levels term there is strong evidence from the post-1945 sample that the associated measurement error has a unit root, so a difference specification is appropriate.

On this basis, Method 2 clearly dominates in one-period backcasting - with the implied difference in variance being quite significant: it has a root mean squared one-period prediction error in logs of 0.0491, compared to 0.0772 for Method 1.

A.2. Multi-Period Backcasting

This method of comparison does however bias the case against Method 1 over longer periods of backcasting, if the primary objective is not to backcast the stock price, but the *relative* value of the stock price compared to dividends per share, or, equivalently, market value compared to total dividends.[45] Iterating Method 1 back i periods in terms of the dividend yield,

$$\begin{aligned}
\Delta_i(div_t - mv_{1t}) &= \Delta_i(dps_t - p_t^s) + \sum_{j=1}^{i} \varepsilon_{1t-j} \\
&\Longrightarrow div_{t-i} - mv_{1t-i} = div_t - mv_{1t} - \Delta_i(dps_t - p_t^s) + \omega_{1t-i} \\
\text{where } \omega_{1t-i} &= \sum_{j=1}^{i} \varepsilon_{1t-j} \\
&\Longrightarrow var(\omega_{1t-i}) = i \; var(\varepsilon_{1t-1})
\end{aligned}$$

Thus Method 1 does not depend on backcasts of the equity issue, e_{t-i}, since it nets out of the dividend yield.

The long-period backcast variance implied by Method 2 is less straightforward to derive, since it does involve uncertainty in backcasting the equity issue. However, it can be shown that under some simplifying assumptions,

$$var(\omega_{2t-i}) \approx \mathrm{var}(\varepsilon_{2t}) \sum_{j=1}^{i} \left[1 + \frac{NI_t}{MV_t}(i-j) \right]^2 \tag{A.3}$$

where ω_{2t-i} is the prediction error in backcasting the dividend yield i periods using Method 2. For some i, Method 1 must ultimately dominate Method 2 in backcasting the log dividend yield, since, the implied forecast variance in A.3 is ultimately $O(i^3)$. However, since $\frac{NI_t}{MV_t}$ is a small fraction (around 1%), the

[45] The error in predicting q can be expressed as the error in predicting the ratio of dividends to capital, less liabilities (or net worth), minus the error in predicting the dividend yield. Since the former ratio can be treated as known, backcasting errors in q and the dividend yield are equivalent.

backcasting horizon over which this is relevant turns out to be longer than the 45 year horizon used here.

The table below shows approximate root mean squared backcast errors (RMSBE) for the two methods, and for the compromise estimate (an equal weighted average of the two estimates). The table also shows the implied RMSBE for an alternative averaging method that chooses the weight on Method 1 to minimise backcast variance at any horizon.[46] Since Method 1 has higher variance throughout the sample, it always receives a lower weight in this approach. The resulting RMSBE is always strictly lower than either of the two RMSBEs, but due to the positive correlation between the two methods (a correlation coefficient of 0.53 between ε_{1t} and ε_{2t}), the gain in precision is not very great.

Root Mean Squared Backcast Errors for log Dividend Yield					
Backcast Horizon	Method 1	Method 2	Compromise	Minimum Variance	*Memo: Weight on Method 1*
5	0.17	0.11	0.13	0.11	*0.11*
10	0.24	0.16	0.18	0.16	*0.12*
20	0.35	0.24	0.26	0.24	*0.16*
30	0.42	0.31	0.32	0.30	*0.20*
45	0.52	0.41	0.41	0.39	*0.27*

There is no escaping the conclusion that implied confidence intervals in the early part of the sample are quantitatively very large, suggesting a very large degree of uncertainty about the true value of the dividend yield (and hence of q).This is however probably overly pessimistic. The assumption of a unit root measurement error errs deliberately on the side of pessimism: if, for examplke, there is some even weak tendency for nonfinancial and quoted company dividend yields to move together (ie, if they are nearly, or actually cointegrated), the increase in backcast variance as the horizon lengthened would be significantly reduced, or even eliminated - providing one possible rationale for the equal weighting in the compromise method, rather than the unequal weights that would result from a minimum variance approach.

[46] An expression for the backcast variance of any linear weighting of the two estimates is given in the next section.

A.3. Derivation of (A.3)

To simplify the analysis, assume that Method 2 equates price changes, rather than returns.[47] If this is the case,

$$\begin{aligned} \text{Method 2} \quad &: \quad \Delta_i p_t = \Delta_i p_t^s - \sum_{j=1}^{i} \varepsilon_{2t-j} \\ &\Longrightarrow \quad \Delta_i (dps_t - p_t) = \Delta_i (div_t - e_t - p_t^s) + \sum_{j=1}^{i} \varepsilon_{2t-j} - \upsilon_{2t-i} \end{aligned}$$

where υ_{2t-i} is the error in backcasting e_{t-i} using Method 2, since, while E_t can be treated as known for one-period backcasting, over more than one period it is unknown.[48]

An approximate expression can be derived for ν_{2t-1} can be derived as follows. Write (3.1) as an expression for market value:

$$\begin{aligned} MV_t &= MV_{t-1} \frac{P_t}{P_{t-1}} + NI_t \\ &\quad \text{which, iterating backwards } i-1 \text{ periods, yields} \\ MV_t &= MV_{t-i} \frac{P_t}{P_{t-i}} + \sum_{j=0}^{i-1} NI_{t-j} \frac{P_t}{P_{t-j}} \end{aligned}$$

dividing through by P_t implies that this expression can be rewritten in terms of E_t, as:

$$\frac{E_t}{E_{t-i}} = 1 + \frac{E_t}{E_{t-i}} \sum_{j=0}^{i-1} N_{t-j} \frac{P_t}{P_{t-j}}$$

[47] In the commonly used Campbell-Shiller (1988) approximation, $r_t \approx \Delta p_t + \lambda(d_t - p_t)$ where $\lambda \approx \exp\overline{(d-p)}$ is a small fraction.

[48] As actually applied, there is an additional error due to the need to predict the difference in dividend yields. But, on the assumption that there is a stable relationship between returns, any such error will be offset by an error in predicting price changes, so the additional source of uncertainty should be stationary. This is borne out to a limited extent in the post-1945 data: the correlation between returns is somewhat stronger than between price changes.

where $N_{t-j} = \frac{NI_{t-j}}{MV_t}$ can be treated as known at time t, given known data for NI and for MV in period t. In log terms,

$$
\begin{aligned}
e_t - e_{t-i} &= \log\left[1 + \exp(e_t - e_{t-i}) \sum_{j=0}^{i-1} N_{t-j} \exp(p_t - p_{t-j})\right] \\
&= f\left(e_t - e_{t-i}; \{N_{t-j} - N_t\}_{j=0}^{i-1}; \{p_t - p_{t-j}\}_{j=1}^{i-1}\right)
\end{aligned}
$$

where there is one more term in N than in p, since the first term in p is zero. Approximating around $(0; N_t; 0)$

$$
\begin{aligned}
e_t - e_{t-i} &\approx \log(1 + iN_t) + \frac{iN_t}{1 + iN_t}(e_t - e_{t-i}) \\
&\quad + \frac{1}{1 + iN_t} \sum_{j=0}^{i-1} (N_{t-j} - N_t) + \frac{N_t}{1 + iN_t} \sum_{j=1}^{i-1} (p_t - p_{t-j}) \\
&\approx \kappa(i, N_t) + \sum_{j=0}^{i-1} (N_{t-j} - N_t) + N_t \sum_{j=1}^{i-1} (p_t - p_{t-j}) \\
\text{where } \kappa(i, N_t) &= \log(1 + iN_t)(1 + iN_t) \approx iN_t + i^2 N_t^2
\end{aligned}
$$

Treating data for N_{t-j} as known, the approximate backcasting error in predicting E_{t-i} will therefore be given by:

$$
\begin{aligned}
\nu_{t-i} &= e_{t-i} - e_{t-i|t} \approx -N_t \sum_{j=1}^{i-1} (p_{t-j} - p_{t-j|t}) \\
&\quad \text{where} \\
p_{t-j|t} - p_t &= p_{t-j}^s - p_t^s = \sum_{k=1}^{j} \varepsilon_{2t-k}, \text{ hence} \\
\nu_{t-i} &\approx -N_t \sum_{j=1}^{i-1} \sum_{k=1}^{j} \varepsilon_{2t-k} \\
&\approx -N_t \sum_{j=1}^{i-1} (i - j) \varepsilon_{2t-j}
\end{aligned}
$$

Hence the total forecasting error in backcasting the log dividend yield i periods using Method 2 will be given approximately by:

$$\begin{aligned} \omega_{2t-i} &\approx \sum_{j=1}^{i} f_t(i,j)\varepsilon_{2t-j} \text{ where } f_t(i,j) = 1 + N_t(i-j) \\ &\Longrightarrow var(\omega_{2t-i}) \approx \text{var}(\varepsilon_{2t}) \sum_{j=1}^{i} f_t\,(i,j)^2 = \text{var}(\varepsilon_{2t})g(i) \\ \text{where } g(i) &= i + N_t(i^2 - i) + \frac{N_t^2}{6}\left(2i^3 - 3i^2 + i\right) \end{aligned}$$

which is ultimately $O(i^3)$.

A.4. Backcast Error Variance of Weighted Estimates

Assume some linear weighting of the two estimates, where the weight on Method 1, $\alpha(i)$ may in principle vary with the backcast horizon. The backcast error of this weighted estimate will be given by

$$\alpha(i) \sum_{j=1}^{i} \varepsilon_{1t-j} + (1 - \alpha(i)) \sum_{j=1}^{i} f_t(i,j)\varepsilon_{2t-j}$$

and hence its variance will be given by

$$\begin{aligned} &\alpha(i)^2 i\text{var}(\varepsilon_{1t}) + (1-\alpha(i))^2 g(i)\text{var}(\varepsilon_{2t}) + 2(1-\alpha(i))\alpha(i)h(i)\text{cov}(\varepsilon_{1t}, \varepsilon_{2t}) \\ \text{where } h(i) &= \sum_{j=1}^{i} f_t(i,j) \end{aligned}$$

The compromise estimate sets $\alpha(i) = 0.5$ for all i. The minimum variance estimate uses numerical techniques to find values of $\alpha(i)$ that minimise backcast variance at horizon i.

References

[1] Ackert, L and Smith, B (1993) "Stock price volatility, ordinary dividends, and other cash flows to shareholders", *Journal of Finance* 48 (4) 1147-1160

[2] Ang, A and Bekaert, G (2003), "Stock Return Predictability: Is it There?" Columbia University, *Mimeo*

[3] Allen, F and Michaely, R (2002), "Payout Policy", in Constantinides, G, Harris, M, and Stulz, R (eds) North-Holland *Handbook of Economics*

[4] Bagwell, L and Shoven, J (1989) "Cash Distributions to Shareholders", *Journal of Economic Perspectives*, 3 (3) pp 129-140

[5] Bureau of Economic Analysis (1992) *National Income and Product Accounts of the United States, Volume 2, 1929-1958*, Department of Commerce, Washington DC

[6] Bureau of Economic Analysis (1977) *Historical Statistics of the United States, Colonial Times to 1970*

[7] Bernanke, B, Bohn, H and Reiss, P (1988) "Alternative Non-Nested Specification Tests of Time-Series Investment Models" *Journal of Econometrics* 37, 293-326

[8] Blanchard, O J, Rhee C and Summers L (1993), "The Stock Market, Profit and Investment" *Quarterly Journal of Economics*, February 1993

[9] W Brainard, J Shoven and L Weiss (1980), "The Financial Valuation of the Return to Capital", *Broookings Papers on Economic Activity* 2: 1980, pp 453-502

[10] Campbell, J, Lo, A and MacKinlay, A (1997) *The Econometrics of Financial Markets*, Princeton University Press, Princeton NJ

[11] Campbell, J and Shiller, R (1988) "The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors", *Review of Financial Studies,* 1, 195-227

[12] Cowles, A C (1938) *Common-Stock Indices* Principia Press, Bloomington Indiana

[13] Fama, E and French, K (2001) "Disappearing Dividends: Changing firm characteristics or lower propensity to pay?", *Journal of Financial Economics*, 60, pp 3-43

[14] Federal Reserve(1943), *Banking and Monetary Statistics*, Board of Governors of the Federal Reserve System, Washington DC

[15] Federal Reserve (2003) *Flow of Funds for the United States* March 2003

[16] Goldsmith, R W (1955) *A Study of Saving in the United States*, Vol I, Princetion University Press, Princeton, New Jersey

[17] Gordon, R J (1990) "The measurement of durable goods prices" National Bureau of Economic Research Monograph series Chicago and London: University of Chicago Press.

[18] Goyal, A and Welch I (2002) "Predicting the Equity Premium with Dividend Ratios", NBER Working Paper 8788

[19] Grullon, Gustavo, and Michaely, Roni (2002), "Dividends, Share Repurchases and the Substitution Hypothesis", *Journal of Finance*, Vol 57, No 4, pp 1649-1684

[20] Hall, R (2001) "The Stock Market and Capital Accumulation," *American Economic Review* 91:1185-1202

[21] Hayashi, F(1982), "Tobin's Marginal q and Average q: A Neoclassical Interpretation", *Econometrica*, 50(1), Jan. 1982, pages 213-24.

[22] Holland, DM and Myers, SC (1984), "Trends in Corporate Profitability and Capital Costs in the United State", in Holland, D M (ed) *Measuring Profitability and Capital Costs*, Gower Publishing Co

[23] Kuznets, S (1941) *National Income and Its Composition, 1919-1938* Vol I, National Bureau of Economic Research, New York

[24] Laitner, J and Stolyarov, D (2003), "Technological Change and the Stock Market", *American Economic Review,* vol. 93, no. 4 1240-67

[25] Liang, J N and Sharpe, S A (1999) "Share Repurchases and Employee Stock Options and their Implications for S&P 500 Share Retirements and Expected Returns", Board of Governors of the Federal Reserve System Discussion Paper.

[26] Mehra, R (1998) "On the volatility of stock prices: an exercise in quantitative theory" *International Journal of Systems Science*, Vol 29, 11, pp 1203-1211

[27] Miller, M H (1963) "The Corporation Income Tax and Corporate Financial Policies" in Commision and Money and Credit *Stabilization Policies*, Prentice-Hall, Englewood Cliffs, NJ

[28] Miller, M H and Modigliani, F, (1961), "Dividend policy, growth, and the valuation of shares", *Journal of Business*, 34, pp 411-433.

[29] F A. Pearson and G F. Warren (1935), *Gold and Prices* (New York: John Wiley and Sons, 1935).

[30] Robertson, D and Wright, S (2003), "Dividends, Total Cashflows to Shareholders and Predictive Return Regressions", *mimeo*, University of Cambridge and Birkbeck College

[31] Robertson, D and Wright, S (2004), "Tobin's q and the Stock Market" *mimeo,* University of Cambridge and Birkbeck College

[32] Romer, C (1999) "Changes in Business Cycles: Evidence and Explanations" *Journal of Economic Perspectives* v13, n2 (Spring 1999): pp 23-44

[33] Shoven, J (1986) "The Tax Consequences of Share Repurchases and Other Non-Dividend Cash Payments to Equity Owners", in Summers, L (ed) *Tax Policy and the Economy* Vol I Cambridge MA; NBER and MIT Press, pp 29-54

[34] Siegel, J (1994) *Stocks for the Long Run*, Burr Ridge, Illinois, Irwin Professional.

[35] Smithers, A (2004) "Valuing the UK Stock Market", Smithers & Co Report no. 205, January 2004

[36] Smithers A, and Wright S (2000) *Valuing Wall Street* McGraw-Hill, New York

[37] Shiller, R (2000) *Irrational Exuberance*

[38] Wright, S (2004) "Technological Change and the Stock Market: A Comment" Birkbeck College, *mimeo*