Bubbling Dividends

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Abstract

Although historical asset price 'bubbles' are often attributed to irrationality, the empirical analysis of such episodes has been limited. The results presented in this paper suggest that during an historical price reversal, investors successfully incorporated forecasts of short-term dividend changes into their valuations, but were unable to predict longer-term changes. When short-term growth is controlled for, it appears that the railways were priced consistently with the non-railways for almost the entire episode. These findings may imply that investors had imperfect foresight, but that they acted consistently. (JEL G01, G11, G12, N23).

Asset price reversals have been a feature of financial markets for many centuries, with periods such as the Tulip Mania, the South Sea Bubble, and the Wall Street Crash being prominent examples. The 'Dot-Com Bubble' and 'Housing Bubble' have led to a renewed interest in such episodes, with popular commentary often associating them with irrationality and mispricing. However, economists have tended to seek explanations in terms of rational behaviour.

To analyse this issue it is helpful to differentiate between rationality which is defined in terms of expectations, and that which is defined in terms of procedure. One approach to assessing the rationality of a 'bubble' episode has been to focus on whether prices were similar to some assessment of a rational expectation, which in many cases resolves into a discussion of investors' lack of foresight, and why they regarded this time as being different.

However, it may also be insightful to consider investor behaviour in terms of procedural rationality. Given their subjective expectations, investors may be regarded as rational if they ensured that at any time each asset reflected only the sum of discounted cash flows. This would imply that each asset was priced consistently after controlling for fundamental factors such as dividends, growth and risk. By extension, assets in one industry should have been priced consistently with other industries, after accounting for such factors.

Using an historical period, known as the British Railway Mania, this paper considers both approaches to rationality. During the Railway Mania, which the *Economist* (2008) has referred to as 'arguably the greatest bubble in history', the prices of railway shares changed substantially. A new dataset has been collected from primary sources for this analysis, which consists of weekly stock price and dividend data for every railway that was listed and operating during this period, and a sample of non-railway companies. The extent of the data collection has produced a sample size which enables a greater depth of analysis than has been possible in the study of some other historical ‘bubble’ episodes.

Investor foresight is considered by analysing the relationship between share prices and future dividend growth. The results suggest that companies with a relatively low dividend yield generally went on to experience higher dividend growth during the next few years, but there is little evidence of higher longer-term growth. This may imply that investors had imperfect foresight, and were only able to forecast short-term changes in dividends.

The consistency of pricing is analysed in a series of 417 cross-sectional regressions, one for each week of the period between 1843 and 1850, relating the cross-sectional variation in dividend yields to future growth and risk. The inclusion of a dummy variable distinguishes the differences between railway stocks, which experienced a substantial price reversal, and non-railway assets, which did not. When future growth is not controlled for, the railways appear to have had significantly higher share prices than the non-railways for a total of 68 weeks. However, when several periods of future growth are controlled for, this apparent overpricing is reduced to just 4 weeks.

The results suggest that certain aspects of a ‘bubble’ can be regarded as rational, with investors showing a degree of foresight, and making an attempt to price assets consistently. However, it could also be argued that the lack of long-term foresight may be regarded as a failure of rationality, as Odlyzko (2010) does for the Railway Mania. Nevertheless, this does not necessarily imply that targeted intervention by regulators could improve upon the market solution, as this would require regulators to forecast the future better than other market participants. If they cannot, then they may find it difficult to predict substantial price declines ex-ante, supporting the arguments of Bernanke (2002, 2010) and Mishkin (2008) regarding the identification of 'bubbles'.

The finding that investors responded to dividend changes is also consistent with the arguments of Bryer (1991), regarding the Railway Mania, that an increase in dividend payments, via accounting malpractice, could have been an effective way to attract investors who could then be 'swindled'. However, this conclusion would also require evidence that dividends were raised fraudulently at this time, a suggestion which has been challenged by McCartney and Arnold (2003) and Arnold and McCartney (2003).

This paper also contributes to the literature on asset price reversals by distinguishing between when rationality is defined in terms of expectations, and when it is defined in terms of procedure. A new methodology is employed for studying historical episodes, by focussing on the cross-sectional variation in asset prices, which enables an analysis of both. Although Frehen et al. (2009) have considered the cross-section of assets during the South Sea Bubble, their focus is on what factors may have influenced investor beliefs, rather than rationality. More generally, this paper contributes to other research on historical asset price 'bubbles' such as that on the Tulip Mania of 1636 (Garber, 2001), the South Sea Bubble of 1720 (Dale et al., 2005 and Shea, 2007) the German stock market boom of 1927 (Voth, 2003), the Wall Street boom of the late 1920s (Donaldson and Kamstra, 1996), and the Nasdaq bull market of the 1990s (Pástor and Veronesi, 2006). Reinhart and Rogoff (2009) have also presented a long-term view of financial crises over a period of eight centuries.

This paper is organised as follows. Section 1 examines the related literature on the definition of bubbles, Section 2 provides a brief background to the Railway Mania, Section 3 discusses the data used, whilst Section 4 estimates the movement in stock prices and dividends during this period. Section 5 considers investor foresight, Section 6 examines the cross-sectional relationship between prices, growth and risk, Section 7 discusses robustness checks, with Section 8 being a brief conclusion.

1 Bubbles and Rationality

As noted by O'Hara (2008), there has been some ambiguity about the meaning of the term 'bubble', with previous academic literature generally using two definitions. The popular usage of the term, per Kindleberger (2000, p.16), is an 'upward price movement over an extended range that then implodes', or what Bordo and Jeanne (2002) have described as an 'asset price reversal'. By using this first definition it is relatively easy to detect and label a bubble ex-post, simply by an observation of nominal prices. As will be demonstrated below, the Railway Mania can be classed as a bubble using this criteria, as there was a considerable stock price reversal during this period.

However, the economic definition of a bubble is a deviation from fundamental value (Flood and Hodrick, 1990, p.88). As fundamental value is not necessarily observed directly, it is difficult to definitively detect irrational pricing. One approach to determining whether a certain period can be classified as an economic bubble has been to focus on the rationality of expectations, by considering whether the expectations of growth or uncertainty implied by asset prices were unrealistic (see Pástor and Veronesi, 2006, and Voth, 2003). Various econometric tests have also been proposed for the detection of bubbles, including variance bound tests (Shiller, 1981), the comparison of the 'actual' relationship and a theoretical 'constructed' relationship between prices and dividends (West, 1987), co-integration tests which determine the orders of integration of prices and dividends (Diba and Grossman, 1988) and the relationship between the dividend yield and the level of dividends (Froot and

Obstfeld, 1991). This paper considers the accuracy of investor foresight during the Railway Mania by examining the relationship between prices and future growth.

Another approach has been to consider whether investors acted rationally by pricing assets consistently. Dale et al. (2005) and Shea (2007) have debated whether several assets issued by the South Sea company were priced consistently with each other. In the context of the Railway Mania, it could be argued that if investors were rational and a bubble did not exist, the railways should have been priced consistently with the non-railways. Consistency of pricing would suggest that railway stock prices were determined by the same fundamental factors as non-railway stock prices, whilst inconsistency could suggest an irrational preference for the railways. This paper goes on to test the consistency of pricing during the Railway Mania by analysing whether railway stock prices were significantly different from other industries, after controlling for growth and risk.

2 Background to Railway Mania

The first modern passenger railway was the Liverpool and Manchester, which was promoted in 1824, authorised by Parliament in 1826, and opened in 1830. Over the subsequent decade about another sixty railways were constructed, with most of the lines projected during a minor promotion boom in 1836 and 1837. However, further promotion was subdued until the early 1840s. A period known as the Railway Mania then ensued, with share prices rising substantially from 1843 to 1845, and then falling steadily until 1850.

The initial phase of the Mania was associated with strong economic growth, and a low rate of interest, with 3 per cent Consols, government debt perpetuities, reaching par for the first time for over a century (*Economist*, April 13, 1844, p.674). A widespread reduction in fares, combined with the economic conditions, produced a rapid increase in passenger numbers and revenues for the railways. Between 1843 and 1846, first class traffic on the ten largest railways increased by 33 per cent, whilst second class and third class traffic increased by 68 per cent and 187 per cent respectively. This resulted in an overall increase in passenger receipts of 41 per cent, whilst receipts from goods traffic also increased, by 42 per cent (*Parliamentary Papers*, 1847). These increases in traffic and receipts were achieved with a relatively small increase of 25 per cent in the mileage open of the largest lines.

As the period progressed the promotion of new railway companies increased, reaching unprecedented levels in the autumn of 1845, just as railway share prices peaked. Some estimates suggested that over one thousand new railways were promoted at this time (*The Times*, November 17, 1845, p.4), although only a small number of these were ever constructed. These promotions exposed existing railways to the threat of competition, and encouraged amalgamations, often resulting in established lines purchasing newer lines which tended to earn lower returns on capital.

The downturn in asset prices, beginning in the autumn of 1845, also coincided with the discovery of a potato blight, and defective harvest, which led to an economic downturn and the Irish Famine. A financial crisis then followed in 1847, which involved distress amongst many banks and merchants, and led to a further reduction in economic growth (Evans, 1849). Receipts from traffic continued to grow during the latter half of the decade, but the mileage open on the railway network had expanded considerably, and the resulting increase in operating expenses and issue of equity reduced the returns available to investors.

The legitimacy of the dividend policy pursued by the railways during this period has been debated. During the downturn there was a suggestion in a pamphlet entitled the '*Bubble of the Age'* (Smith, 1848) that the railway companies had artificially increased their dividends by raising new capital and then using the funds to increase payouts. In testimony before a

Parliamentary committee Samuel Laing, the chairman of the Brighton railway company and former member of a Railway Board which had been set up by Parliament, said that 'dividends no doubt have been paid, which are altogether fictitious, and as long as you draw upon capital to pay them, the dividend may have no reference to the actual earning of the line,' (*Parliamentary Papers*, 1849b, p.446, q.3058).

Bryer (1991, p.456) has suggested that some companies may have stopped including depreciation in their accounts in order to raise dividends, in an attempt 'to lure the naive into investing in railways'. However, McCartney and Arnold (2003, p.841) have found that, although the number of companies using depreciation fell during the Mania, this had little material impact. Depreciation did not amount to more than 0.3 per cent of returns on equity in any year between 1838 and 1855, so the dropping of depreciation cannot explain the changes in dividends during the Mania.

The most reliable investigations of fraud were conducted by Committees of Inquiry which were set up by shareholders in 1849. There was considerable evidence of malpractice amongst companies which had been controlled by one chairman, George Hudson. In a report into the York, Newcastle and Berwick railway it was alleged that the accounts of the company had been falsified in a variety of ways since 1847, including the overstatement of traffic and the charging of expenses to capital which should have been charged to revenue (*Railway Times*, October 27, 1849, p.1086). An inquiry into the Eastern Counties found that after Hudson joined the company in October 1845 'expenses were squared to suit the dividend, and not the dividend to suit the expenses' (*Railway Times*, April 28, 1849, p.439). The York and North Midland inquiry also found some evidence of misconduct (*Railway Times*, November 3, 1849, p.1109). However, Committees of Inquiries into other companies found little evidence of any major problems, and Arnold and McCartney (2003) have argued that the perception of widespread malpractice is more myth than reality.

Regardless of whether dividend changes were at least partially affected by fraud, commentary throughout the period suggested that dividends were regarded as an important consideration in the valuation of railway stocks. For example, the *Economist* (November 8, 1845, p.1109) noted that ‘with regard to the finished and dividend paying lines, they are of course calculated so as to yield a given rate of interest which must always have some reference to the rate which other securities yield, and so far the price of shares should fluctuate with other securities.’ Similarly, an investment pamphlet entitled the *Short and Sure Guide to Railway Speculation* advised that ‘as regards the purchase of shares in the established lines we have simply to compare the market price of the share with the dividend which it pays’ (Anon., 1845, pp.5-6). It went on to note that ‘taking the value of money at four per cent, the shares in a railway which pays six per cent per annum are worth £150 each; or in one which pays ten per cent they are worth £250 each. If bought below these prices, the purchaser is receiving, *pro tanto*, a better rate than four per cent, and he will accept this better rate, in proportion to any doubt he may have with respect to the dividend being maintained.’

3 Data

To improve our understanding of the Railway Mania, a unique and comprehensive dataset has been constructed, by inputting the original share price tables published in a weekly newspaper, the *Railway Times,* between 1843 and 1850. The share price dataset was supplemented with data on dividends, collected from the *Course of the Exchange*, an official stockbroker list for the London stock market. As this paper focuses entirely on those companies which were capable of paying dividends throughout this period, only the railways in operation at the beginning of the Mania, and the firms which resulted from mergers involving these lines, are included. Campbell (2010) has already considered those projects which were initiated during the Mania.

There were 64 railways listed in the *Railway Times* in the first week of 1843. However, the *Course of the Exchange* contained dividend data on only 41 of these railways. Due to a high number of mergers and acquisitions, the number of railway companies fell throughout the sample. If an established railway, in existence at the start of 1843, participated in a merger then the new company was also treated as an established railway and it was assumed that investors in the original company went on to receive the dividend of the merged firm. By the end of 1850 there were 27 established railways listed in the *Railway Times*, and dividend data was available from the *Course of the Exchange* for 24 of these railways.

Data on the twenty largest non-railway companies by market capitalisation was also obtained from the *Course of the Exchange*. These twenty companies represented 45.2 per cent of total non-railway market capitalization at the beginning of 1843, suggesting that they give a good representation of the overall market. There are six banks, five insurance companies, three canals, three docks, two gas, light, and coke companies, and one waterworks company included. Bank of England stock and East India stock have been excluded from the non-railway sample as they were issued by companies with a strong relationship to the government.

The number of shares in issue *(N)*, the share price *(P),* the par value *(Z),* and the dividend *(D)* for each of the securities was recorded for each of the 417 weeks in the sample period. The logs of each variable are expressed in lower case letters. The par value of a share was the total amount of equity which shareholders had paid to the company for that security, and is considered as a proxy for book value. To enable the analysis of dividend changes beyond the main sample period the dividend rates of companies until 1858 were included in the dataset.

Fama and French (1992) suggest that risk dimensions can be proxied by beta, size and book-to-market variables. The beta (*B*) of each firm has been estimated for each company for each year, by regressing the weekly returns of each asset minus the risk free rate, against the weekly returns of the market portfolio minus the risk free rate. The market portfolio has been approximated by the non-railways' market index, which is likely to be more representative of a portfolio of all assets than a stock market index which is dominated by the railways. It is also consistent with the approach of Pástor and Veronesi (2009) when calculating the beta of the early US railroads. The risk-free rate has been approximated by the yield on 3 per cent Consols.

The size *(S)* of the company has been measured as the total par value of the firm, calculated as the number of shares in issue multiplied by the par value of each share, and expressed in £millions. As another measure of pricing relative to fundamentals will be used in the following analysis, namely the dividend yield, the book-to-market variable is not considered. A railway dummy variable *(R)* has also been created, which equals one when the company was a railway, and zero otherwise.

Only those companies which had been traded, and had an observable share price, could be included in the analysis, which reduced the sample size slightly, mainly in the early months of 1843. Observations where a company had a zero dividend yield are excluded, as such observations do not reveal any information about pricing. The average number of companies analysed each week in the cross-sectional regressions was 39.6, which involved a total of

16,501 observations over the sample. When periods of future dividend growth are included, these figures are reduced slightly due to data availability.

4 Movement of Stock Prices and Dividends

Weekly market indices for the established railway companies and the non-railway companies, for which share price and dividend data are available, have been constructed and are plotted in Figure 1. In each case the market return has been calculated on a weekly basis by weighting the capital gains of each company by its market capitalisation at the end of the preceding week.

<<INSERT FIGURE 1>>

The index representing the established railways rose from a base of 1,000 in January 1843 to a peak of 1,718 on August 8, 1845, but the non-railways index had risen to just 1,152 by this time. The established railway index then fell substantially, declining by 18.5 per cent by the end of November 1845, whilst the non-railways fell by 5.9 per cent during the same period. The established railway index then stabilised throughout 1846, before beginning a steady decline from January 1847 onwards, with the sample ending in 1850 with the established railway index at 727, and the non-railway index at 1,042.

Whilst the prices of railway shares changed dramatically, railway dividends also rose and fell substantially. As can be seen from Figure 2, the dividends, as a percentage of par value, paid by established railways at the beginning of 1843 averaged 4.3 per cent. They then increased steadily, reaching a peak of 7.2 per cent in July 1847, before falling to just 2.9 per cent by the end of 1850. Higher dividends were evident in almost every one of the major railways during the boom, and dividend declines were almost universal during the downturn. The dividends paid by the non-railways were much less volatile, beginning 1843 at an average of 6.4 per cent, and reaching 6.6 per cent by 1844, but they then fell slightly, ending 1850 at 6.1 per cent. The peak in railway share prices occurred almost two years before the peak in railway dividends, perhaps suggesting that investors were including estimates of future dividend changes into prices before the rates had actually changed.

<<INSERT FIGURE 2>>

The dividend/price ratios of the railway and non-railway industries are plotted in Figure 3. The railway industry dividend yield has been calculated as the total dividends paid by all the established railways as a fraction of the total market capitalisation of those railways, with the non-railways calculated in a similar manner. At the beginning of 1843 the dividend yields of the railway and non-railway industries were close, being 4.6 per cent and 4.8 per cent respectively. Although railway prices and dividends both rose and then fell during the sample period, prices seem to have moved in advance of dividends, resulting in a changing dividend yield. The railway industry dividend yield initially fell, reaching a minimum of 3.3 per cent in February 1844, but then rose substantially, reaching a peak of 7.3 per cent in October 1848. During the same period, the non-railway industry dividend yield remained between 4.2 and 5.2 per cent.

<<INSERT FIGURE 3>>

Total return indices have also been constructed, which combine both capital gains and dividends, and are shown in Figure 4. The established railways total return index reaches a peak of 1,897 in August 1845, and ends the sample at a level of 1,056, implying that even after dividends have been included the total return to investors in established railways was close to zero between 1843 and 1850. In contrast, the non-railways reached a level of 1,513 in 1850, which was the peak for the sample period.

<<INSERT FIGURE 4>>

Descriptive statistics for each of the key variables included in the subsequent regression analysis have been reported in Table 1, by industry and by year. The mean dividend yield of the railways shows more change over time than that of the non-railways, with the railways having a relatively lower yield from the end of 1843 to 1846, before a dramatic rise gave them a relatively higher yield from 1847 to 1849.

<<INSERT TABLE 1>>

For the railways, dividends grew by an average of over 20 per cent per year, for three years during the boom, but then declined by an average of 30 per cent per year, for two years during the downturn. This was much greater than the average change amongst the non-railways which never exceeded 4 per cent in any year. The standard deviation of dividend changes was also much greater amongst the railways than the non-railways in every year of the sample.

The average beta of the railways rose and fell, but remained below one throughout the period, reflecting the weakness of the relationship between the movement in railway shares and the non-railways. Due to the possibility of errors-in-variables in the beta estimate, the subsequent regression analysis has been repeated without the inclusion of the beta variable and the key results remain the same, as discussed at the end of the paper.

The size variable reveals that the average par value of railway companies was almost twice as large as that of the non-railways at the start of the period. Throughout the Mania the railways continued to expand, but the non-railways remained relatively stable, resulting in the railways ending the sample period an average of over six times as large.

5 Investor Foresight

To analyse pricing during the Railway Mania a standard asset pricing relationship is considered, based on the traditional Gordon (1962) dividend growth model. Although the relationship between dividends and price is linear in this model, the relationship with the other variables, namely the discount and growth rates, is non-linear. To avoid this problem Campbell and Shiller (1988, p. 201) have proposed the dividend ratio model, or 'dynamic Gordon model', shown in Equation 1, which is linear in logs. This expresses the log of the dividend-price ratio (δ) as the expected discounted value of future discount (r) and dividend growth rates (Δd), with several terms which can be treated as constants (c, k and ρ).

$$\delta_t \approx E_t \sum_{j=0}^{\infty} \rho^j \left(r_{t+j} - \Delta d_{t+j}\right) + \frac{c-k}{1-\rho} \tag{1}$$

The rest of this paper uses this relationship to examine both investor foresight, and the consistency of pricing, during the Railway Mania. One approach to considering the accuracy of investor foresight has been to illustrate the association between two of the variables from Equation 1, namely the dividend yield and future dividend growth, as per Campbell and Shiller (1998). Figure 5 plots the relationship between the log of the dividend yield and the dividend growth for railway companies between t and t + 1 year, for each company in the sample, with one observation per company at the end of each year of the sample. The negative correlation, of -0.654, implies that companies with a low dividend yield, meaning a relatively high price, went on to experience relatively higher growth during the subsequent year.

<< INSERT FIGURE 5 >>

Table 2 reports fixed effects panel regressions which explain future dividend growth, for a range of horizons, using the log of the dividend yield, controlling for beta and size. There is one observation for each railway company, for the end of each year. The results suggest that a low dividend yield was a significant predictor of higher growth in dividends between t and t+1, and between t+1 and t+2. For longer term changes in dividends, the effect of the dividend yield is reversed, with the dividend yield having a positive and significant relationship with dividend changes between t+3 and t+4, and t+4 and t+5, which may suggest that investors were mistaken about longer term changes in dividends. However, there also appears to be a significant and negative relationship between the dividend yield and growth from t+6 to t+7. When the total growth in dividends between t and t+n is considered there is a highly significant negative relationship between the dividend yield and future dividend growth for each period analysed, which seems to be because the results are dominated by the initial growth in the first two years.

<< INSERT TABLE 2 >>

These results suggest that investors during the Railway Mania incorporated short-term future dividend fluctuations into their valuations, but they were unable to forecast longer-term changes. These results represent a possible explanation for why the prices of railway shares rose and fell during the Railway Mania. Investors during the boom responded to expectations of short-term increases in dividends, and did not forecast the longer-term declines, leading them to raise prices. When investors eventually did revise their expectations, and began to forecast lower dividends, prices began to fall.

6 Consistency of Pricing

The previous section considered rationality in terms of expectations, and suggested that investors during the Railway Mania had imperfect foresight with regards dividend changes.

This section considers rationality in terms of procedure, and examines whether investors priced different assets consistently. A cross-sectional regression for each week of the sample is used to estimate the relationship between the variables in Equation 1 at particular times during the Railway Mania.

The log of the dividend yield (δ), is expressed as a function of future dividend growth (Δd), with differences in the discount rate approximated by the risk factors of beta (B), and size (S). The inclusion of a dummy variable for the railways (R) is also included to reveal if there was a significant difference between the railways and non-railways.

For week = t

$$\delta_{i,t} = \beta_0 + \beta_1 E_t(\Delta d_{i,t+n}) + \beta_2 B_{i,t} + \beta_3 S_{i,t} + \beta_4 R_i + \varepsilon \tag{2}$$

A cross-sectional regression is estimated for each week, with Table 3 reporting the coefficients and standard errors for regressions without the inclusion of any dividend growth variable, on selected weeks, as an example. A regression for the start of the period, the last week of each year and for the peak in prices on August 8, 1845 is shown. This analysis was repeated for each of the 417 weeks of the sample period, with the last column reporting the number of weeks during which each variable was significant.

<< INSERT TABLE 3 >>

Table 3 reveals that when the variation in the log of dividend yields are analysed, without controlling for dividend growth, the railway dummy was significant on 93 weeks. This consists of 68 weeks when the railway dummy was significantly less than zero, which in this specification implies a relatively higher price, and 25 weeks when the railway dummy was significantly greater than zero, implying a relatively lower price. Panel A of Figure 6 shows that the railway dummy was significantly negative for periods during 1844 and 1845, before rising during the latter half of the decade.

<< INSERT FIGURE 6 >>

To estimate the extent of mispricing whenever future dividend growth has been accounted for, the cross-sectional regressions have been extended by the inclusion of varying numbers of future changes in dividends. In Table 4 the number of weeks that each variable was significant when explaining the log of the dividend yield is reported. The next year of dividend growth was significant for between 300 and 345 weeks, depending on the number of future changes included, with the second year of dividend growth significant for between 229 and 256 weeks. Longer-term growth measures are significant on a relatively small number of weeks. The number of weeks that the railway dummy was significant declines from 93 weeks to between 22 and 31 weeks, when one or two years of dividend growth are controlled for.

<< INSERT TABLE 4 >>

Table 5 analyses the number of weeks that the railway dummy was significant, by year, and considers whether this implied that the railways were overpriced or underpriced, given that the other variables had been controlled for. The railways were estimated to be overpriced during a particular week when the railway dummy was significantly less than zero, and underpriced when the railway dummy was significantly greater than zero. Results are shown for the number of weeks of overpricing and underpricing when varying numbers of years of dividend growth are accounted for.

<< INSERT TABLE 5 >>

When no future dividend growth was accounted for, the railways appear to have been significantly overpriced for 68 weeks. However, when one, two or three years of dividend growth are included this apparent overpricing is substantially reduced, to between 4 and 6 weeks depending on the specification, of which between 1 and 4 weeks occurred during the boom up to the end of 1845. Panel B of Figure 6 illustrates this result, and shows that when the next two years of dividend growth are considered, the coefficient of the railway dummy remains very close to zero throughout the boom in prices, and is only significantly different from zero for a brief period.

If longer-term dividend growth is considered, the apparent overpricing of the railways reappears. For example, when variables accounting for growth up to seven years ahead are included, the railway dummy suggests that the railways had a significantly higher price than the non-railways for 88 weeks of the sample. These results imply that when short-term dividend changes are considered, the railways were priced consistently with the non-railways, but when longer-term changes are controlled for, the railways may have been overpriced for a substantial period.

7 Robustness

To ensure robustness, additional variations of the analysis have also been considered, although not tabulated separately. Due to the possibility of errors-in-variables in the estimation of beta, the analysis has been repeated without this variable. The coefficients of the dividend yield variable, from the panel regressions considering future growth as a dependent variable, all have the same sign and significance, with the exception of the regression analysing growth between t+6 and t+7, where the dividend yield becomes insignificant. From the cross-sectional regressions there still appears to have been 4 weeks of overpricing when two years of future growth are controlled for, and a slight increase to 95 weeks of overpricing when accounting for seven years of future growth.

An analysis was also carried out excluding four railways controlled by George Hudson, which were associated with allegations of fraud in the aftermath of the Mania. The coefficients of the dividend yield variable, when used to predict future growth, have the same sign and significance as the original regressions, except for the periods involving t+1 to t+2, and t+6 to t+7, which lose their significance. The cross-sectional results suggest that the remaining railways were overpriced for 9 weeks when two years of growth are controlled for, and 90 weeks when seven years of growth are accounted for. This may indicate that Hudson's companies had a slightly lower price than other railway companies during the sample period.

The cross-sectional regressions have also been repeated with the dividend growth variables expressed as total growth from t to t+n. When total growth from t to t+2 is considered, the results suggest 3 weeks of overpricing for the railways. When the total growth from t to t+7 is considered as a single variable, the regressions imply that the railways were overpriced for 158 weeks, representing almost the entire period between the start of 1844 and the end of 1846. These results tend to support the previous findings that the railways were priced consistently with the non-railways given short-term dividend growth, but were overpriced given long-term dividend growth.

8 Conclusion

Using a comprehensive dataset of share prices and dividends for the established railways and non-railways which traded during the British Railway Mania, this paper has found that investors may have had some foresight, but it was short-term in nature. An analysis of the relationship between the current dividend yield and future dividend growth suggests that investors incorporated short-term dividend changes into their valuations, but not longer-term changes.

A cross-sectional analysis, which considered whether the railways had a relatively higher price than the non-railways, suggests that when no future growth is accounted for, the railways appear to have been overpriced for a considerable period during the boom. However, when short-term future changes in dividends are included the apparent overpricing is almost entirely eliminated. When longer-term changes are considered the overpricing is evident again.

Whether or not these results imply rationality, or the presence of an economic bubble, depends upon definition. It could be argued that the use of available information, which may be predominantly short-term in nature, and the evidence of consistent pricing, support an explanation based on rationality and efficient markets. However, the inability to forecast the longer-term declines in dividends, which were related to weaker economic conditions, more competition, and decreasing economies of scale, may be interpreted by others as being evidence of irrationality, as suggested by Odlyzko (2010) for the Railway Mania. It could also be argued that the focus on short-term changes in dividends may make investors susceptible to being defrauded, as Bryer (1991) suggests occurred during this period. However, McCartney and Arnold (2003) and Arnold and McCartney (2003) have argued that there is little evidence that the dividend changes experienced at this time were due to accounting malpractice.

The importance of fundamentals such as dividend growth, and the evidence of consistent pricing, highlights the difficulties of dealing with such periods in a modern context. However, the finding that investors had imperfect foresight may suggest that regulators could successfully intervene if they had greater foresight than other market participants. Bernanke (2002) has argued that this is questionable, by suggesting that 'to declare that a bubble exists, the Fed must not only be able to accurately estimate the unobservable fundamentals underlying equity valuations, it must have confidence that it can do so better than the financial professionals whose collective information is reflected in asset-market prices. I do not think this expectation is realistic, even for the Federal Reserve.' It may therefore be impractical to expect regulators to be able to forecast and prevent financial instability ex-ante, when investors cannot.

References

Anon. 1845. *A Short and Sure Guide to Railway Speculation, a Few Plain Rules How to Speculate with Safety and Profit in Railway Shares*, Effingham Wilson.

Arnold, A.J. and McCartney,S. 2003. 'It May Be Earlier Than You Think': Evidence, Myths and Informed Debate in Accounting History, *Critical Perspectives on Accounting* 14:227–253

Bernanke, B. S. 2002. Asset-Price 'Bubbles' and Monetary Policy. Speech delivered at the New York Chapter of the National Association for Business Economics, New York, October 15.

Bernanke, B. S. 2010. Monetary Policy and the Housing Bubble. Speech delivered at the Annual Meeting of the American Economic Association, Atlanta, Georgia, January 3.

Bryer, R. A. 1991. Accounting for the 'Railway Mania' of 1845–a Great Railway Swindle?, *Accounting, Organisations and Society,* 16(5/6): 439-486.

Bordo, M. D. and Jeanne, O. 2002. Monetary Policy and Asset Prices: Does 'Benign Neglect' Make Sense? *International Finance*, 5(2):139-64.

Campbell, G. 2010. Leveraging the British Railway Mania: Derivatives for the Individual Investor, *SSRN Working Paper*.

Campbell, J.Y. and Shiller, R.J. 1988. The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors. *Review of Financial Studies* 1(3):195-228.

Campbell, J.Y. and Shiller, R.J. 1998. Valuation Ratios and the Long-Run Stock Market Outlook. *Journal of Portfolio Management* 24(2):11-26

Dale, R., Johnson, J.E.V. and Tang, L. 2005. Financial Markets can Go Mad: Evidence of Irrational Behaviour during the South Sea Bubble. *Economic History Review* 58(2):233-271.

Diba, B. and Grossman, H. 1988. Explosive Rational Bubbles in Stock Prices? *American Economic Review* 78:520-30.

Donaldson, R.G. and Kamstra, M. 1996. A New Dividend Forecasting Procedure that Rejects Bubbles in Asset Prices: The Case of 1929's Stock Crash. *Review of Financial Studies*, 9:333-383.

Economist. 2008. The Beauty of Bubbles, December 18.

Evans, D.M. 1849. *The Commercial Crisis, 1847-1848*, David and Charles, Devon.

Fama, E.F. and French, K.R. 1992. The Cross-section of Expected Stock Returns. *Journal of Finance,* 47(2): 427-465.

Flood, R.P. and Hodrick, R.J. 1990. On Testing for Speculative Bubbles. *The Journal of Economic Perspectives* 4(2), 85-101.

Frehen, R. G. P., Goetzmann, W. N. and Rouwenhorst, K. G. 2009. New Evidence on the First Financial Bubble. *Yale ICF Working Paper*, No. 09-04.

Froot, K.A. and Obstfeld, M. 1991. Intrinsic Bubbles: The Case of Stock Prices. *American Economic Review* 81(5):1189-1214.

Garber, P.M. 2001. *Famous First Bubbles, the Fundamentals of Early Manias*, MIT Press.

Kindleberger, C.P. 2000. *Manias, Panics, and Crashes: A History of Financial Crises*, John Wiley and Sons.

McCartney, S. and Arnold A. J. 2003. The Railway Mania of 1845-1847: Market Irrationality or Collusive Swindle Based on Accounting Distortions? *Accounting, Auditing and Accountability Journal* 16(5) :821-52.

Odlyzko, A. 2010. *Collective Hallucinations and Inefficient Markets: The British Railway Mania of the 1840s*, University of Minnesota.

O'Hara, M. 2008. Bubbles: Some Perspectives (and Loose Talk) from History. *Review of Financial Studies* 21(1):11-17.

Parliamentary Papers. 1847. Summary of Returns, Showing the Number of Passengers Carried on 63 railways of the United Kingdom during the Year ending 30 June 1846, the Fares of each Class, and the Receipts from each Class of Passengers, and for Goods, LXIII:179.

Parliamentary Papers. 1849a. First and second reports from the Select Committee of the House of Lords on audit of railway accounts, X:1

Parliamentary Papers. 1849b. Select Committee of House of Lords on Audit of Railway Accounts Third Report, Minutes of Evidence, Appendix, Index, X:469.

Parliamentary Papers. 1851. Railways. Return, showing the Number of Passengers Conveyed on All the Railways in England and Wales, Scotland, and Ireland, respectively, during the half-year ending the 30th June 1850, LI:229.

Pástor, L. and Veronesi, P. 2006. Was there a Nasdaq Bubble in the Late 1990s? *Journal of Financial Economics* 81(1):61-100.

Pástor, L. and Veronesi, P. 2009. Technological Revolutions and Stock Prices. *American Economic Review* 99(4):1451-1483.

Reinhart, C.M. And Rogoff, K. 2009. *This Time Is Different: Eight Centuries of Financial Folly*. Princeton University Press.

Shea, G. S. 2007. Financial Market Analysis Can Go Mad (in the Search for Irrational Behaviour During the South Sea Bubble), *The Economic History Review,* 60(4): 742-765.

Shiller, R.J. 1981. Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends? *American Economic Review* 71:421-436.

Voth, H.J. 2003. With a Bang, not a Whimper: Pricking Germany's 'Stock Market Bubble' in 1927 and the Slide into Depression. *Journal of Economic History* 63(1):65-99.

West, K. 1987. A Specification Test for Speculative Bubbles, *Quarterly Journal of Economics* 102:553-80.

Table 1: Descriptive Statistics of Companies by Industry on Selected Dates

			Jan 6, 1843	Dec 29, 1843	Dec 27, 1844	Aug 8, 1845	Dec 26, 1845	Dec 25, 1846	Dec 31, 1847	Dec 29, 1848	Dec 28, 1849	Dec 27, 1850
Number of Companies	Established Railways	N	18	22	21	21	20	19	18	22	15	18
	Non-Railways	N	20	20	20	20	20	20	19	19	20	20
Dividend Yield (D/P)	Established Railways	Mean	5.8%	3.6%	3.6%	3.3%	3.8%	4.7%	5.9%	7.2%	6.3%	3.6%
		St. Dev.	2.4%	1.3%	1.0%	1.1%	1.1%	1.3%	1.5%	2.7%	3.0%	0.9%
		Max	11.9%	7.0%	4.8%	4.9%	5.3%	8.0%	8.9%	16.8%	14.0%	5.2%
		Min	2.7%	0.9%	0.5%	0.7%	0.8%	2.4%	3.1%	3.1%	2.9%	1.1%
	Non-Railways	Mean	4.81%	4.69%	4.43%	4.30%	4.84%	5.17%	5.20%	5.64%	5.17%	4.95%
		St. Dev.	1.02%	1.03%	1.18%	1.08%	1.66%	2.27%	1.50%	2.03%	1.88%	1.65%
		Max	7.11%	7.14%	7.27%	6.86%	8.89%	11.43%	10.00%	10.97%	10.81%	10.81%
		Min	2.08%	2.98%	2.70%	2.66%	2.78%	2.53%	2.76%	2.91%	2.96%	2.84%
Dividend Growth during Subsequent Year (Δd_{t+1})	Established Railways	Mean	-11.64%	11.13%	20.88%	23.31%	23.99%	-8.40%	-11.18%	-36.12%	-36.41%	19.97%
		St. Dev.	35.50%	35.97%	55.58%	46.80%	49.26%	28.35%	23.44%	50.04%	53.55%	26.66%
		Max	40.55%	99.63%	185.63%	179.18%	179.18%	43.08%	32.85%	28.77%	14.31%	69.31%
		Min	-87.55%	-47.00%	-117.87%	-10.59%	-18.23%	-88.38%	-55.96%	-138.63%	-160.94%	-10.54%
	Non-Railways	Mean	3.79%	0.59%	-2.35%	2.08%	-1.07%	-0.81%	-1.17%	2.81%	-0.79%	-3.46%
		St. Dev.	15.49%	2.63%	7.43%	5.61%	9.75%	8.98%	5.12%	9.06%	9.76%	14.34%
		Max	69.31%	11.78%	0.00%	22.31%	10.54%	18.23%	0.00%	25.33%	28.77%	22.31%
		Min	0.00%	0.00%	-28.77%	0.00%	-40.55%	-33.65%	-22.31%	-12.52%	-22.31%	-43.08%
Beta (B)	Established Railways	Mean	0.19	0.28	0.51	1.07	1.00	0.54	0.19	-0.21	0.32	0.00
		St. Dev.	0.73	0.68	1.83	1.43	1.42	1.00	0.40	2.25	0.54	1.18
		Max	1.41	1.41	5.75	5.46	5.46	2.25	1.19	7.07	1.39	0.89
		Min	-1.27	-0.88	-2.94	-1.43	-1.43	-0.83	-0.37	-7.03	-0.40	-4.11
	Non-Railways	Mean	1.22	1.22	1.06	1.01	1.01	1.28	1.21	0.99	1.10	1.11
		St. Dev.	2.92	2.92	1.23	1.22	1.22	2.86	2.67	2.29	2.13	4.11
		Max	12.77	12.77	4.73	4.03	4.03	12.57	8.25	10.17	9.59	18.32
		Min	-0.14	-0.14	-0.32	-0.65	-0.65	-0.35	-0.89	-0.50	-0.02	-0.90
Size in £millions (S)	Established Railways	Mean	1.48	1.38	1.55	1.92	2.10	2.48	4.14	4.61	5.03	5.90
		St. Dev.	1.04	1.05	1.21	1.46	1.51	2.03	3.85	4.48	5.38	5.47
		Max	3.96	4.32	4.32	5.26	5.80	6.65	14.34	15.66	15.72	18.40
		Min	0.10	0.10	0.10	0.23	0.26	0.11	0.39	0.35	0.35	0.53
	Non-Railways	Mean	0.85	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.89	0.90
		St. Dev.	0.72	0.71	0.71	0.71	0.71	0.71	0.73	0.73	0.78	0.78
		Max	3.24	3.24	3.24	3.24	3.24	3.24	3.24	3.24	3.64	3.64
		Min	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Table 2: Yearly Entity Fixed Effects Panel Regressions using Future Growth in Dividends as Dependent Variable

	Dividend Growth between years						
	t and t+1	**t+1 and t+2**	**t+2 and t+3**	**t+3 and t+4**	**t+4 and t+5**	**t+5 and t+6**	**t+6 and t+7**
δ_t	-0.863***	-0.174*	-0.035	0.363**	0.173**	0.057	-0.122*
	(0.098)	(0.088)	(0.096)	(0.161)	(0.068)	(0.075)	(0.071)
B_t	-0.000	-0.026	-0.086***	0.007	0.041	-0.023	0.037
	(0.025)	(0.044)	(0.026)	(0.027)	(0.037)	(0.037)	(0.026)
S_t	-0.018*	-0.018	0.013	0.022*	0.029***	0.023***	0.028**
	(0.010)	(0.013)	(0.010)	(0.012)	(0.007)	(0.007)	(0.013)
Constant	-2.649***	-0.489	-0.142	0.990*	0.347	0.047	-0.525**
	(0.314)	(0.304)	(0.304)	(0.521)	(0.217)	(0.237)	(0.252)
Observations	187	162	155	146	143	137	133
Companies	47	40	39	35	35	33	31
Overall-R^2	0.549	0.037	0.049	0.166	0.126	0.042	0.060

	Dividend Growth between years						
	t and t+1	**t and t+2**	**t and t+3**	**t and t+4**	**t and t+5**	**t and t+6**	**t and t+7**
δ_t	-0.863***	-1.174***	-1.325***	-0.929***	-0.731***	-0.670***	-0.829***
	(0.098)	(0.086)	(0.152)	(0.240)	(0.199)	(0.128)	(0.090)
B_t	-0.000	-0.038	-0.105***	-0.103***	-0.103	-0.116***	-0.074**
	(0.025)	(0.037)	(0.029)	(0.035)	(0.065)	(0.034)	(0.033)
S_t	-0.018*	-0.023*	0.001	0.020	0.041**	0.058**	0.084***
	(0.010)	(0.014)	(0.019)	(0.017)	(0.020)	(0.026)	(0.023)
Constant	-2.649***	-3.592***	-4.144***	-3.055***	-2.617***	-2.539***	-3.202***
	(0.314)	(0.277)	(0.475)	(0.752)	(0.639)	(0.457)	(0.323)
Observations	187	174	163	154	151	142	140
Companies	47	46	41	38	37	33	33
Overall-R^2	0.549	0.580	0.509	0.236	0.203	0.285	0.504

Notes: δ=Log of Dividend Yield, B=Beta, S=Size. One observation per company at the end of each year of the sample. Robust standard errors in parentheses. Significance given by *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Cross-sectional Regressions on Selected Weeks using Log Dividend Yield as Dependent Variable

	Jan 6, 1843	Dec 29, 1843	Dec 27, 1844	Aug 8, 1845	Dec 26, 1845	Dec 25, 1846	Dec 31, 1847	Dec 29, 1848	Dec 28, 1849	Dec 27, 1850	Total No. of Weeks Sig.
R	0.184*	-0.382***	-0.255*	-0.376**	-0.317**	-0.134	0.033	0.221	0.199	-0.353**	93
	(0.108)	(0.134)	(0.143)	(0.155)	(0.146)	(0.120)	(0.113)	(0.140)	(0.180)	(0.132)	
B	0.001	-0.015	0.039	0.023	0.121**	0.014	0.002	-0.005	-0.026	-0.020	69
	(0.014)	(0.016)	(0.038)	(0.041)	(0.046)	(0.019)	(0.014)	(0.007)	(0.017)	(0.012)	
S	-0.073	0.046	0.047	0.060	0.036	0.047*	0.028*	0.003	-0.019	0.004	3
	(0.057)	(0.061)	(0.071)	(0.050)	(0.038)	(0.025)	(0.015)	(0.014)	(0.021)	(0.009)	
Constant	-2.999***	-3.102***	-3.229***	-3.249***	-3.229***	-3.093***	-3.019***	-2.924***	-2.965***	-3.029***	417
	(0.096)	(0.078)	(0.122)	(0.073)	(0.079)	(0.085)	(0.078)	(0.081)	(0.086)	(0.065)	
Obs.	38	42	41	41	40	39	37	41	35	38	16,501
R^2	0.084	0.197	0.125	0.189	0.274	0.063	0.129	0.118	0.077	0.237	0.057

Notes: A regression estimating Equation 2 is reported for selected weeks of the sample, with no dividend growth variable included. Robust standard errors in parentheses. Significance given by *** p<0.01, ** p<0.05, * p<0.1. The total number of weeks that a variable is significant is shown in final column. δ=Log of Dividend Yield, d=Log of Dividend, B=Beta, S=Size, R=Railway Dummy.

For week = t

$$\delta_{i,t} = \beta_0 + \beta_1 E_t(\Delta d_{i,t+n}) + \beta_2 B_{i,t} + \beta_3 S_{i,t} + \beta_4 R_i + \varepsilon \qquad (2)$$

Table 4: Number of Weeks during which Variables are Significant from Cross-Sectional Regressions

R	93	22	31	62	92	105	108	104
B	69	67	83	68	78	72	59	53
S	3	27	30	33	29	20	10	21
(Δd) t+1		300	332	345	319	323	315	342
(Δd) t+2			246	245	239	256	245	229
(Δd) t+3				188	145	158	175	164
(Δd) t+4					70	91	144	138
(Δd) t+5						103	127	110
(Δd) t+6							80	81
(Δd) t+7								45
Cons.	417	417	417	417	417	417	417	417
Ave. Obs.	39.6	36.4	34.6	33.5	32.3	31.6	30.8	30.3
Obs.	16,501	15,198	14,441	13,985	13,486	13,159	12,832	12,638
Ave. Adj R^2	0.057	0.326	0.405	0.479	0.509	0.525	0.516	0.520

Notes: A regression estimating Equation 2 was calculated for each week of the sample, with varying numbers of years of dividend growth included. The total number of weeks that a variable is significant is shown for each specification. δ=Log of Dividend Yield, d=Log of Dividend, B=Beta, S=Size, R=Railway Dummy.

For week = t (2)

$$\delta_{i,t} = \beta_0 + \beta_1 E_t(\Delta d_{i,t+n}) + \beta_2 B_{i,t} + \beta_3 S_{i,t} + \beta_4 R_i + \varepsilon$$

Table 5: Estimates of the Number of Weeks of Over and Under Pricing of Railway Shares between 1843 and 1850 using Railway Dummy from Dividend Yield regressions

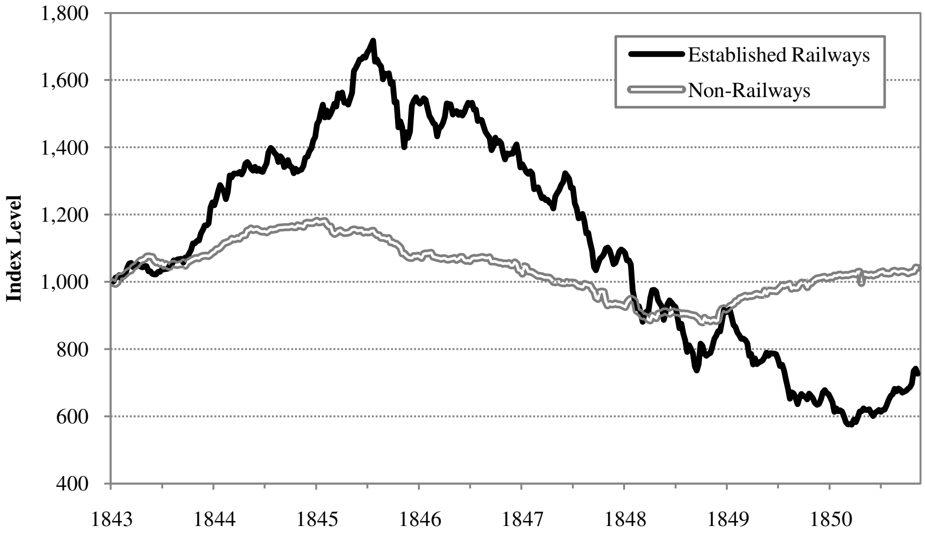
No. of Years of Future Changes in Dividends Included	Overpriced or Underpriced	1843	1844	1845	1846	1847	1848	1849	1850	Total	Relative to n=0	Total (% of sample)	Relative to n=0 (% of sample)
n = 0	Overpriced	8	19	27	8	0	0	0	6	68	-	16.3%	-
	Underpriced	0	0	0	0	0	25	0	0	25	-	6.0%	-
n = 1	Overpriced	0	1	3	0	0	0	0	0	4	-64	1.0%	-15.3%
	Underpriced	5	0	0	0	0	1	0	12	18	-7	4.3%	-1.7%
n = 2	Overpriced	0	0	1	0	3	0	0	0	4	-64	1.0%	-15.3%
	Underpriced	13	0	0	0	0	0	0	14	27	2	6.5%	0.5%
n = 3	Overpriced	0	0	1	3	2	0	0	0	6	-62	1.4%	-14.9%
	Underpriced	32	7	0	0	0	0	0	17	56	31	13.4%	7.4%
n = 4	Overpriced	0	0	2	16	10	0	0	0	28	-40	6.7%	-9.6%
	Underpriced	34	0	0	0	0	0	0	30	64	39	15.3%	9.4%
n = 5	Overpriced	0	4	11	28	2	0	0	0	45	-23	10.8%	-5.5%
	Underpriced	32	0	0	0	0	0	0	28	60	35	14.4%	8.4%
n = 6	Overpriced	0	18	25	27	5	0	0	1	76	8	18.2%	1.9%
	Underpriced	7	0	0	0	0	0	0	25	32	7	7.7%	1.7%
n = 7	Overpriced	1	20	18	32	15	1	0	1	88	20	21.1%	4.8%
	Underpriced	2	0	0	0	0	0	0	14	16	-9	3.8%	-2.2%

Notes: A regression estimating Equation 2 is calculated for each week of the sample, with varying numbers of years of dividend growth included. The railways are estimated to be overpriced during a particular week when the railway dummy (β_4) is significantly less than zero, as this implies that railways had a significantly lower dividend yield than non-railways during that week, when future dividend growth is controlled for. Conversely they are estimated to be underpriced when the coefficient of the railways dummy was significantly higher than zero. The total weeks of overpricing and underpricing for each year were then calculated. δ=Log of Dividend Yield, d=Log of Dividend, B=Beta, S=Size, R=Railway Dummy.

For week = t (2)

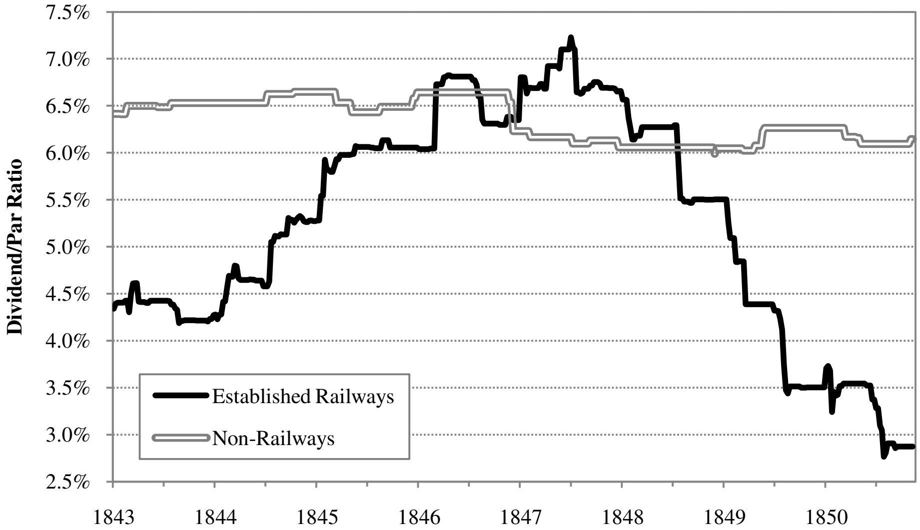
$$\delta_{i,t} = \beta_0 + \beta_1 E_t(\Delta d_{i,t+n}) + \beta_2 B_{i,t} + \beta_3 S_{i,t} + \beta_4 R_i + \varepsilon$$

Figure 1: Capital Gains Indices for Established Railways and Non-Railways, 1843-50



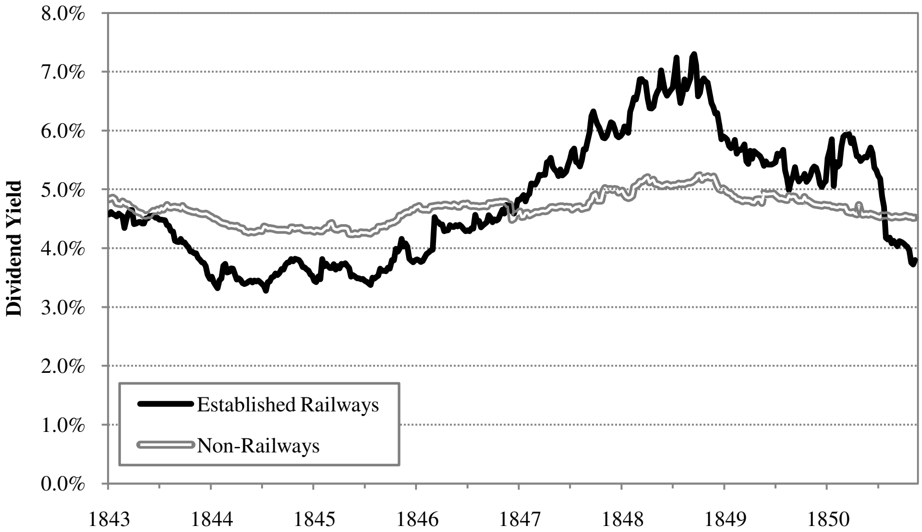
Notes: Source data for railway share prices from Railway Times (1843-50), and for non-railway share prices from Course of the Exchange (1843-50). Established railways index includes those railways which were operating before January 1843 for which share price and dividend data is available. Non-railways index includes the twenty largest non-railways by market capitalisation for which share price and dividend data is available. Capital gains for each company weighted by market capitalisation to produce market indices on a weekly basis.

Figure 2: Industry Dividend/Par Ratio Amongst Established Railways and Non-Railways, 1843-50



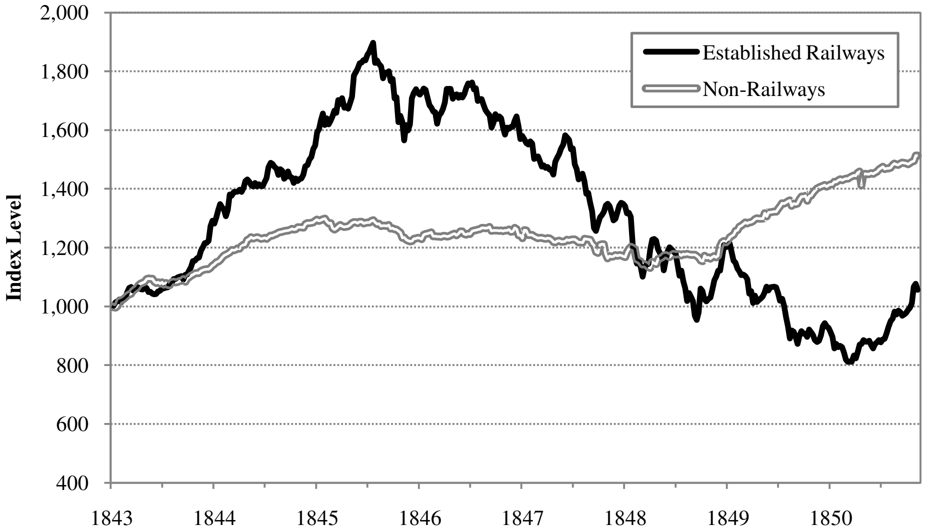
Notes: Source data for both railway and non-railway dividends from Course of the Exchange (1843-50). Par value data for railways obtained from Railway Times (1843-50), and for non-railways from Course of the Exchange (1843-50). Railway industry dividend/par ratio calculated as total dividends paid by established railway companies as a percentage of total par value of established railway companies for which share price and dividend data is available. Non-railway industry dividend/par ratio calculated as total dividends paid by non-railway companies as a percentage of total par value of non-railway companies for which share price and dividend data is available.

Figure 3: Industry Dividend Yield of Established Railways and Non-Railways, 1843-50



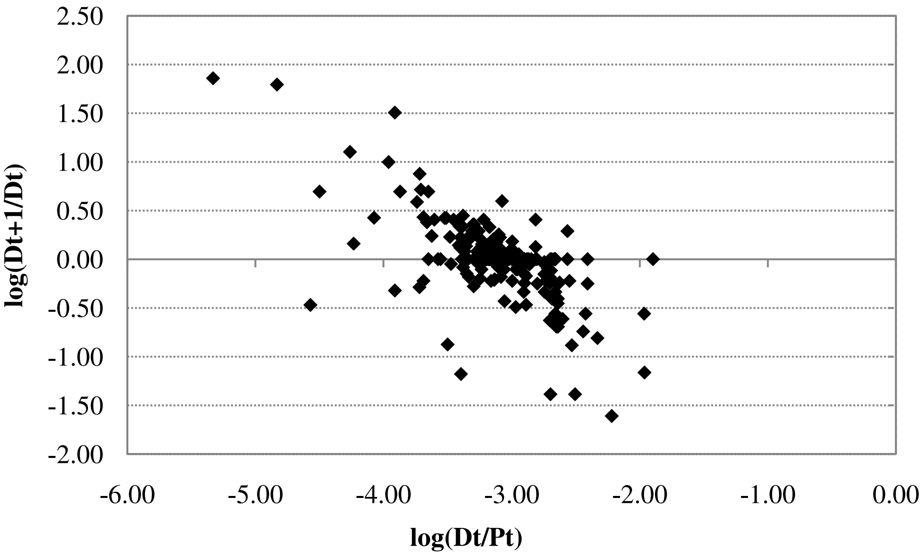
Notes: Source data for both railway and non-railway dividends from Course of the Exchange (1843-50). Share price data for railways obtained from Railway Times (1843-50), and for non-railways from Course of the Exchange (1843-50). Railway industry dividend/price ratio calculated as total dividends paid by established railway companies as a percentage of total market capitalisation of established railway companies for which share price and dividend data is available. Non-railway industry dividend/price ratio calculated as total dividends paid by non-railway companies as a percentage of total market capitalisation of non-railway companies for which share price and dividend data is available.

Figure 4: Total Return Indices for Established Railways and Non-Railways, 1843-50



Notes: Source data for both railway and non-railway dividends from Course of the Exchange (1843-50). Share price data for railways obtained from Railway Times (1843-50), and for non-railways from Course of the Exchange (1843-50). Half-yearly dividend assumed to be made in equal payments in each week. Total return, as measured by the sum of capital gains and dividends, for each company weighted by market capitalisation to produce market indices. Established railways index includes those railways which were operating before January 1843 for which share price and dividend data is available. Non-railways index includes the twenty largest non-railways by market capitalisation for which share price and dividend data is available.

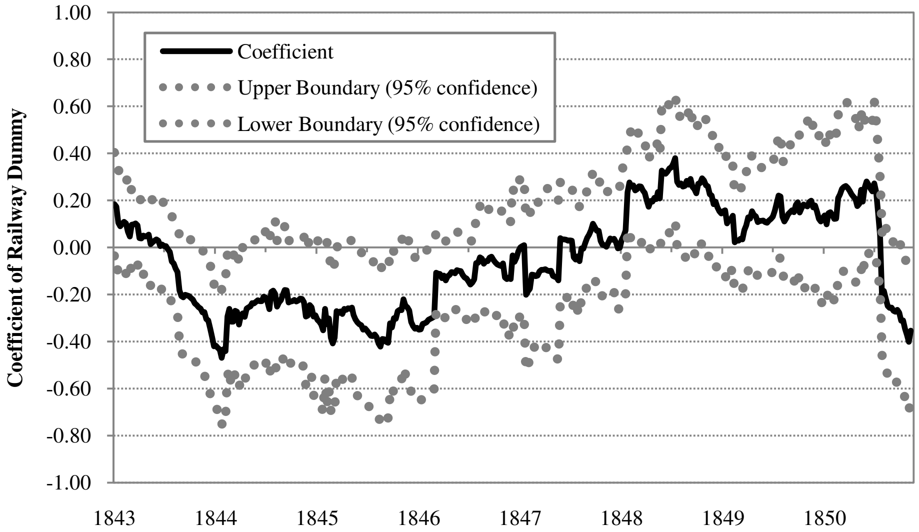
Figure 5: Correlation between Log of Dividend Yield and Dividend Growth between t and t + 1 year, for Railway Companies, 1843-50



Notes: n=188, Correlation coefficient = -0.654. Source data for dividends from Course of the Exchange (1843-58), with share price data for railways obtained from Railway Times (1843-50). One observation shown per company at end of December in each year between 1843 and 1850.

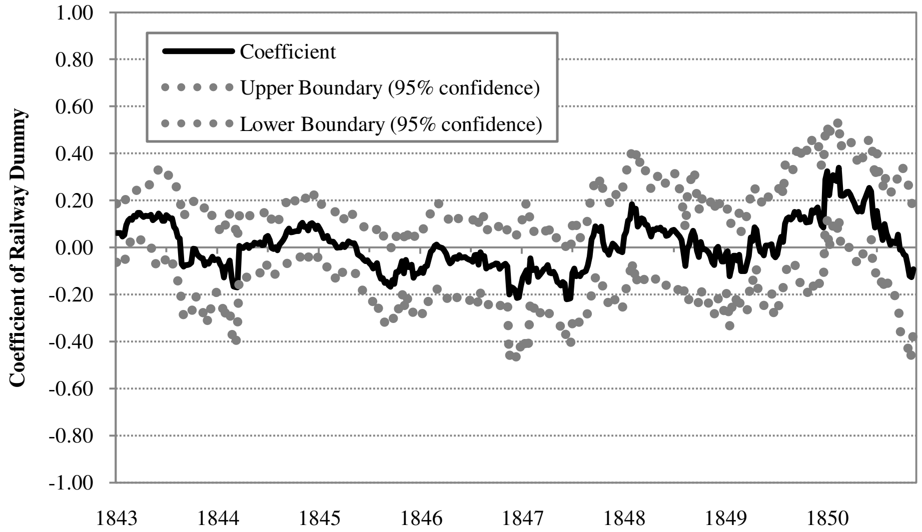
Figure 6: Impact of Railway Dummy on Log of Dividend Yield from Repeated Weekly Cross-sectional Regressions, 1843-50

Panel A: Controlling for Beta and Size



Notes: A regression estimating Equation 2 is calculated for each week of the sample. No dividend growth variable included. Value of the coefficient represents the value of β_4 from Equation 2 in any given week, with a 95 per cent confidence interval constructed using robust standard errors. δ=Log of Dividend Yield, d=Log of Dividend, B=Beta, S=Size, R=Railway Dummy.

Panel B: Controlling for Two Years of Dividend Growth, Beta and Size



Notes: A regression estimating Equation 2 is calculated for each week of the sample. Dividend growth from variables from t to t+1, and from t+1 to t+2 included in regression. Value of the coefficient represents the value of β_4 from Equation 2 in any given week, with a 95 per cent confidence interval constructed using robust standard errors. δ=Log of Dividend Yield, d=Log of Dividend, B=Beta, S=Size, R=Railway Dummy.

For week = t

$$\delta_{i,t} = \beta_0 + \beta_1 E_t(\Delta d_{i,t+n}) + \beta_2 B_{i,t} + \beta_3 S_{i,t} + \beta_4 R_i + \varepsilon \quad (2)$$