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Before the Cult of Equity: New Monthly Indices of the British Share Market, 1829-1929

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Before the Cult of Equity: New Monthly Indices of the British Share Market, 1829-1929*

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Abstract

This paper presents new monthly capital gains, dividend yield, and total return indices for common equities quoted on British stock exchanges from 1829 to 1929. As well as creating an all-share index, we create a blue-chip index of the 30 largest companies, which we splice to the Financial Times 30 index to create a near-two-century-long (1829-2018) monthly share index. We use the new indices to examine the timing of British business cycles and compare the returns on home and foreign UK investment. We also construct indices for 22 domestic sectors, and calculate CAPM betas for each sector.

Keywords: share price index, UK, business cycles, uncalled capital, economic history

JEL Codes: G10, N13, N14, N23, N24.

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1. Introduction

This paper presents new monthly capital gains, dividend yield, and total return indices for common equities quoted on British stock exchanges between 1829 and 1929.¹ The data used to calculate these indices constitute the largest, most comprehensive monthly database ever compiled on British share markets during the century prior to the onset of the Great Depression. Because of the substantial size of the database - more than 1,000,000 security-month observations on about 5,800 securities representing about 4,500 companies - we are able to use the data to construct monthly indices for 22 domestic sectors (e.g., banks, insurance, railways, manufacturing), as well as a 30-stock blue-chip index.

Stock market indices have figured prominently in the financial press and academic journals for a long time. Among the earliest and most durable historical monthly UK stock market indices are those of Bowley, Schwartz, and Smith (1931) and Smith and Horne (1934). These indices are still in use, even though they are based on small samples, exclude important sectors, employ problematic weighting schemes, and exclude dividends.² More recently, scholars have constructed a number of historical market indices³, but this is the first to provide a continuous monthly series from 1829 to 1929 for the UK, and deals with some of the issues raised by Hannah (2018) about previous estimates.

The data presented here show that the UK share market grew rapidly during the period under consideration and became increasingly international in scope. For the first 50 years of our sample period, the share market was dominated by transportation (first canals, then railways) and finance. This dominance diminished after the 1870s, but these two broad sectors

¹ This paper has substantial overlap with Grossman (2017), but completely supersedes it.

² Hills, Thomas, and Dimsdale (2015). Grossman (2002, pp.122-123) describes the shortcomings of Bowley, Schwartz, and Smith (1931) and Smith and Horne (1934).

³ For the UK, these include Dimson, Marsh, and Staunton (2002), Edelstein (1976, 2010, undated), Acheson et al (2009), and Grossman (2002, 2015). For other countries, these include Annaert, Buelens, and De Ceuster (2012), Frennberg and Hansson (1992), Le Bris and Hautcœur (2010), and Shiller (1989).

still constituted about 40 per cent of market capitalization of our sample in 1929. Much of the growth of the share market between 1879 and 1929 is accounted for by the development of new industries as well as flotations of established private firms in sectors such as brewing and iron, coal, and steel.

We construct three indices of capital appreciation from 1829 to 1929: an all-share index; a UK-share index, which is composed of domestic firms; and a blue-chip index, which consists of the largest 30 domestic stocks in each year. Our three indices of capital appreciation mostly move in tandem over the 100-year period, revealing both the substantial stock market gyrations and relatively modest capital gains during the period. When we compare our capital gains indices to existing indices, we find similar trends, although the fluctuations do not always align due to differences in both methodology and sample size.

We splice our blue-chip capital gains index with the *Financial Times* 30 (FT30) index to create a new blue-chip index that covers nearly two centuries, 1829 to 2018. By 1940, our blue-chip index is below its 1829 level, but during the next six decades it experiences an almost 80-fold increase. This index shows that there have been at least seven sharp contractions in the stock market over nearly 200 years and that most of these have been associated with major economic downturns. We use this long-run series to show that stock market indices can be useful indicators of monthly changes in UK macroeconomic conditions, demonstrating that the stock market typically has peaked about one month before the business cycle.

During our sample period, investors earned an average nominal return of about five per cent per year, which suggests the existence of a modest equity risk premium by modern standards. This indicates that the emerging phase of UK stock market development was not associated with particularly high returns. Almost all of the gains experienced by investors arose from dividends, suggesting that profitable nineteenth century firms returned their gains to shareholders via dividends, in contrast to modern firms, which are more likely to return to

shareholders through capital gains while smoothing dividends (Grossman and Shore 2006). We also use our data to revisit the work pioneered by Edelstein (1976, 1982) and examine the returns on domestic versus foreign securities.⁴ When using a standard market capitalization weighting we find that domestic stocks earned similar returns to foreign stocks from 1870 to 1913, and through to 1929, although there is evidence foreign stocks performed better in the early half of our sample.

We also find differing performance across sectors. Mines were the worst performing in terms of total returns, which is not surprising given the speculative nature of this sector. Retail, breweries, and insurance were among the best performing sectors, which perhaps reflects the growing demand for the products and services produced by these sectors. Using a Capital Asset Pricing Model, we find that mines were the riskiest sector, whereas utilities or sectors providing some form of public good were among the least risky. Contingent or uncalled capital was an important feature of early capital markets and a source of risk for investors. We find that the use of contingent capital declined over the 100-year period, remaining popular only in the financial industry by 1929.

The development of high-quality long-term stock market indices is beneficial to economic historians and financial economists alike (Turner 2016). For economic historians, such data can help assess whether the UK capital market contributed to Victorian Britain's industrial decline by channeling investment overseas rather than toward domestic industry (Chabot and Kurz 2010; Edelstein 1976, 1982; Eichengreen 1982; Goetzmann and Ukhov 2006; Grossman 2015; Kennedy 1987), account for the rise and fall of various industrial sectors (Acheson, Coyle, and Turner 2015; Grossman 1999; and Mitchell, Chambers, and Crafts 2011), or assess the impact of shareholder liability rules (Grossman 1995; Grossman and Imai 2013;

⁴ In Appendix 1, we outline our definition of domestic and foreign companies. Following the pioneering work of Edelstein (1976, 1982), we are primarily interested in where the capital was used rather than where the company was registered or where the majority of shareholders lived. Consequently, we define as foreign companies that had their operations overseas.

Hickson and Turner 2003). For financial economists, long-run stock market data can help assess the equity risk premium (Dimson, Marsh, and Staunton 2007; Goetzmann and Ibbotson 2007), market efficiency and asset pricing (Le Bris, Goetzmann, and Pouget 2014; Mirowski 1987; Ito, Noda, and Wada 2016), and asset bubbles (Shiller 1989, 2000; Frehen, Goetzmann, and Rouwenhorst 2013).

The remainder of this paper is organized as follows. In the next section, we describe the extent of the dataset. In section 3, we present data on our capital appreciation indices, and in section 4, we present a new long-run blue chip index for 1829 to 2018, which we use to examine stock market fluctuations over the business cycle. In section 5 we analyze total returns and compare the relative returns on home and foreign investment. In section 6 we present data by industry sectors, including the use of contingent (i.e., uncalled) capital and returns. Conclusions follow in section 7.

2. An Overview of the Data

The data for December 1829 to December 1868 comes from the *Course of the Exchange* (COE),⁵ whilst the data from January 1869 to December 1929 comes from the *Investor's Monthly Manual* (IMM), which has been digitized by Yale University's International Center for Finance (ICF). As the COE was a stockbroker list of the principal securities on the London market, it did not report on securities listed on the regional stock exchanges. The IMM, by contrast, published a much more extensive list of securities which included securities listed on both the London and provincial stock exchanges. A detailed explanation of how the data from the COE and IMM was cleaned and coded is included as Appendix 1, and the classification into industries is discussed in Appendix 2.

⁵ For further information on the COE data, see Acheson et al. (2009). We thank them for sharing their data with us.

Before analysing the performance of the market, it may be useful to analyse the extent of coverage provided by the COE and IMM. There are several benchmarks which could potentially be used for comparison. One possible measure is the number of companies which were legally defined as public. Essex-Crosby (1937: 74) has reported that there were 16,263 of these companies in 1930. However, this is based on a very broad definition, and the majority of these firms were rarely traded on public markets.

Another possible measure is the number of companies in the *Stock Exchange Official Year Book*. For example, Essex-Crosby (1937: 75a) implies that there were about 6,000 of these companies in 1935.⁶ However, these numbers also include a very large number of firms which were only occasionally traded on supplementary lists, and which would probably not be suitable for inclusion in a stock market index.

A more suitable benchmark may be those companies which had an official listing on any of the stock markets in Britain. An analysis by Campbell et al. (2018) suggests that there were about 2,150 companies with an official listing on the London Stock Exchange in 1929, of which the IMM included about 63 per cent. Just over 550 companies had an official listing on the Manchester Stock Exchange, although about 400 of these were cross-listed in London, with the IMM reporting on about 70 per cent.

These results suggest that the IMM's coverage was extensive, but not exhaustive, especially towards the end of the sample period. It is highly likely that the IMM tended to focus on the largest and most actively traded companies and may, therefore, have covered an even greater percentage of the market when measured by market capitalization, than by the number of companies.

⁶ Essex-Crosby (1937: 75-76) input 3,949 of these companies, but only sampled 500 of the approximately 2,500 Commercial and Industrial companies, implying about 6,000 companies overall. They exclude all companies registered in colonies, foreign countries or Northern Ireland and all UK companies not registered with the Board of Trade.

To assess this, we consider the nominal value of corporate securities listed on the Official List of the London Stock Exchange, which is reported by Michie (1999: 88, 175), based on summaries provided in the *Stock Exchange Official Intelligence*, and which are shown as point estimates in Panel A of Figure 1.⁷

[Figure 1 about here]

We then calculate the nominal value of all corporate securities included in the COE and IMM. For consistency with the Official List data, we include corporate debt and preference shares, not just ordinary equities which are the main focus of this paper. For the years 1829 to 1868, as well as our COE share data we also include other asset types provided by Global Financial Data supplemented with nominal value data from the *Railway Times* and paper versions of the IMM. For the period 1869 to 1929, we include all corporate securities which were reported by the IMM as being chiefly traded in London (i.e., excluding securities listed only on provincial markets). We do not include government bonds, city loans or Bank of England securities in any of our analysis.

The comparison between sources is still not exact, since companies chiefly traded on the supplementary list (i.e., prices for companies that did not have an official listing) in London might be included in the IMM but not in the official figures, so the IMM values might be higher than the official list. On the other hand, some companies could have had an official listing on London, but in reality, been chiefly traded elsewhere, which would result in their being included in the official figures but not reported as being traded in London by the IMM, so the IMM values might be lower than the official list.

Figure 1 shows the nominal value of all corporate securities in our dataset in each month.⁸ For the 1860s through the 1890s, our data yields higher values than were reported in

⁷ Michie (1999:175) does not report data for the last year of our sample, 1929, so we interpolate this value from the figures given for 1920 and 1933.

⁸ There was a temporary blip in nominal value during World War I when the IMM reduced its coverage of some securities to reduce the amount of paper needed for printing.

the Official List. This may be driven by the inclusion in the IMM of companies officially listed only on provincial markets but also traded in London, and more Continental European railway securities. Over time, the extent of coverage of the IMM declines, but by 1929 its value for London listings was still about 75 per cent of the nominal value of companies on the Official List.

This analysis suggests that our two sources, the COE and IMM, would not be suitable for assessing the precise changes in the size of the market over time, but because they contain a very wide range of stocks and a high proportion of the nominal value of officially listed companies, they should be suitable for assessing the performance of the British share market over the long run.

The comparisons above have included all corporate securities to give an overview of the extent of coverage of our sources. We now move on to the main focus of our paper, which concentrates entirely on ordinary (i.e., common) shares. For most companies it is clear which securities qualify for this, but for many others there are some judgement calls involved. We have decided to include deferred and deferred ordinary shares as they were the residual claimants in those companies where they existed. We do not include preference shares, or preferred ordinary, as they usually carried a maximum interest rate and had some features similar to fixed income securities. We also exclude a very small number of participating preference shares, which had rights to profits after the fixed amount had been paid, as they still had the preference component. We also exclude the shares of some small railways which leased their lines to large companies for a guaranteed rental, as these were more like fixed income securities. In Panel B of Figure 1, we show how the nominal value of all corporate securities related to the nominal value of ordinary shares in each month of the sample period.

Our dataset of ordinary shares consists of approximately 1,000,000 security-month observations from 1829 to 1929, although no observations are available during the second half

of 1914, when markets were closed around the outbreak of World War I. We also exclude December 1894, when some data is missing from the ICF's IMM data. Our dataset spans a longer time period, employs higher frequency data, and contains a wider range of common shares than those employed by Bowley, Schwartz, and Smith (1931), Chabot and Kurz (2010), Edelstein (1976, 2010, undated), Grossman (2002, 2015), and Smith and Horne (1934).⁹

Figure 2 presents data on the aggregate numbers of equities and domestic equities in each month of the sample. During the pre-1869 period, the number of monthly observations ranges from 159 in 1830 to 341 in 1865; after 1869, it ranges from a low of 801 in 1869 to a high of 1,468 in 1902. These numbers illustrate the extensive nature of our dataset, and compares favorably to the number of companies included in modern indices such as the S&P 500, the FTSE 100 or even the FTSE All-Share.

[Figure 2 about here]

There is a notable increase in the number of securities in our database in January 1869, when we move from the COE to IMM as our source. Domestic securities constituted nearly 97 per cent by the early 1830s, but the proportion then fell steadily, declining to about 70 per cent by the 1860s. This figure dipped below 65 per cent by the beginning of the 1890s, and was just over 50 per cent during and after World War I.

Indices for the overall market consist of a large number of securities, many of which would have had a small free float, concentrated ownership, and illiquid shares, which would have made them unattractive and possibly unavailable to the typical investor (Acheson et al., 2012). In order to assess returns to a portfolio of domestic equities that a typical investor would have been more likely to have owned, we construct a blue-chip index using a methodology similar to that employed by Le Bris and Hautcœur (2010) and Campbell et al. (2018). The

⁹ These datasets are described in Grossman (2015: 474).

constituents of our blue-chip index in year t were the 30 largest domestic companies at the end of year $t-1$. We include all of the issues of ordinary shares by these companies, so the number of securities included in our analysis is usually greater than 30. Appendix 3 lists the constituents of our blue-chip index.

Total market capitalization (Panel A of Figure 3) of our sample rose steadily across the sample period. Interestingly, the change in sources--from COE to IMM--is much less pronounced (i.e., compared with the number of securities) when placed in long-run context, although the growth of market capitalization becomes more rapid during the 1870s. The market capitalization of our sample rose nearly tenfold between 1869 and 1929, from slightly more than £0.52 billion in early 1869, which was about 50 per cent of UK nominal gross national product, to more than £4.94 billion at its peak in 1929, which was about 108 per cent of UK nominal GDP.¹⁰ However, it should again be noted that the IMM source that is used for these estimates is not exhaustive, so the actual ratio of market capitalization of shares to GDP for the UK was certainly greater.

[Figure 3 about here]

Domestic shares constituted over 90 per cent of the total market capitalization of our sample until the 1840s, but by the 1870s had fallen to about 65 per cent. This trend continued, declining to about 40 per cent by 1913, before reversing course and increasing to more than 50 per cent by 1929. Although the blue-chip companies were few in number, they were very large, representing more than half of the value of all domestic equities in our sample throughout almost the entire sample period.

The paid-up capitalization (Panel B of Figure 3) of our sample increased steadily from about £37 million in 1829 to about £480 million (nearly £310 million for UK firms) in 1869 to

¹⁰ UK GDP data are from Ryland Thomas and Samuel H. Williamson, "What Was the Consistent U.K. GDP Then?" MeasuringWorth, 2019, URL: <http://www.measuringworth.com/ukgdp/>

nearly £2.1 billion (£700 million for UK firms) by the outbreak of World War I. Following the post-World War I boom-bust, both total market and UK paid-up capitalization continued to increase, reaching about £2.6 billion (£1.1 billion for UK firms) by 1929.

3. Capital Gains

The returns from holding shares can be decomposed into capital gains and dividends, with the return to holding share i during month t ($R_{i,t}$) being:

$$R_{i,t} = (P_{i,t} - P_{i,t-1})/P_{i,t-1} + D_{i,t}/P_{i,t-1} \quad (1)$$

where $P_{i,t}$ equals the price of security i at the end of month t and $D_{i,t}$ is the dividend accruing to security i during month t . The first term represents the capital gain accruing to share i in month t . The second term, the dividend paid during month t divided by the price at the end of the preceding month, represents the dividend yield in month t . When aggregating returns for the overall share market and returns for individual industry sectors, we employ a market capitalization weighting scheme whereby we weight returns on share i during month t ($R_{i,t}$) by its market capitalization in month $t-1$.¹¹ It might also be worth noting more generally that our indices focus on what happened whilst stocks were in our sources. We make no attempt to examine the gains or losses from newly listing, delisting, or merging, which are major areas of research in their own right and to which we hope to return in future work.

In this section, we focus on capital gains, namely fluctuations in share prices; in subsequent sections we will construct total returns. The reason for starting with capital gains is that they tell us more about the short-term fluctuations of the share market over the business cycle. Figure 4 presents monthly capital gains indices for all equities, UK equities, and UK blue-chip equities, using a base date of January 1869. The first major rise and fall was

¹¹ Acheson et al. (2009) did not weight returns using the previous month's market capitalization, which is actuarially incorrect and has the effect of magnifying returns. Grossman (2017) makes a similar error.

associated with the Railway Mania of the 1840s. Although there were many fluctuations thereafter, share prices trended upward and, by 1929, the all-share and UK indices had more than doubled in value from their low point, although this implies only modest gains over the full sample period.

[Figure 4 about here]

Figure 4 reveals several substantial fluctuations in the capital appreciation indices. For the sake of brevity, we focus on the UK-share index. The largest percentage decline occurred during 1845-1850, following the collapse of the Railway Mania, when the index fell by 53 per cent. The next largest decline was during the post-World War I slump, from early 1920 to early 1921, when the index fell by about 39 per cent. From early 1929 through December 1929, indices fell by about 18 per cent, although the December 1929 observation occurs before the full extent of the post-1929 crash was realized. Other substantial market declines took place following the collapse of Overend, Gurney in 1866 (19 percent), the City of Glasgow Bank crisis of 1878 (11 percent), the Baring crisis of 1890 (12 percent), and the U.S. panic of 1907 (11 percent). The most dramatic market advances took place from 1842 until mid-1845 during the Railway Mania (52 percent), from 1915 to 1920 (an increase of 61 per cent), and the seven years prior to the 1929 crash (84 percent).

Three well-known monthly capital gains indices have been constructed by other researchers that cover parts of our period: the Gayer, Schwartz, and Rostow (1953) index, which runs from 1811 to 1850; the Smith and Horne (1934) index for 1867-1914; and the Bowley, Schwartz, and Smith (1931) index for 1919-1930. In Figure 5, we compare our all-share index with these three indices. We also recalculate the three indices using our methodology and weighting scheme but using their original constituents. This helps us to discern whether differences between our index and existing indices are due to construction or constituents.

[Figure 5 about here]

The Gayer, Schwartz, and Rostow (1953) index shown in Panel A of Figure 5 has several weaknesses. First, it uses a small sample of stocks which survived and were frequently quoted for most of the sample period. Second, the index is weighted by the number of shares outstanding rather than their market value. Each industry is given a weight in the index based on paid-up capital, but these weights are only changed every five years. Nevertheless, from Panel A of Figure 5 we can see that their index moves in a very similar way to ours, although they find a much more pronounced rise and fall around the boom in 1836. When we calculate an index using market capitalization weighting but their constituents, it remains similar to our index, implying that the deviation with theirs may be driven by differences in weighting.

The Smith and Horne (1934) index consists of industrial shares, the number of which varies from 25 to 77 over the sample period. This index, because it focuses on industrials, omits the largest sectors on the stock market: railways; banks; insurance; mines; and land, mortgage and financial sectors. These missing five sectors constituted 65 per cent of issues and 84 per cent of market capitalization in 1869, and 45 per cent of issues and 76 per cent of market value in 1909 (see Tables 3 and 4). The Smith and Horne index includes companies based on their shares being listed continuously for a long period of time. It is equally weighted at the base date of 1890, but weights then fluctuate based on price changes (Smith and Horne 1934, p. 3), making it act in some respects like a price-weighted index. Panel B of Figure 5 reveals that employing our methodology with Smith and Horne's constituents yields an index that is fairly similar to their original index. This suggests the differences with our all-share index arises mainly from the composition of the companies included. The Smith and Horne index is more volatile than our all-share index, which suggests that the new sector - domestic industrials - was riskier than the older, more staid sectors, such as banks and railways. Their index

outperforms our index after the mid-1890s, which may imply that domestic industrial companies, although they may have been riskier, produced a higher return for investors.

Bowley, Schwartz, and Smith (1931), sometimes referred to as the London and Cambridge Economic Service (LCES) index, consists of about 90 domestic stocks for the 1919-1929 period. This index also excludes railways; banks; insurance; mines; and land, mortgage and financial sectors, which in 1929 still accounted for 37 per cent of issues and 49 per cent of market value (see Tables 3 and 4). Each industry in the index is given a weight based on the importance of the sector in the Census of Production, each firm within each industry is weighted by its market capitalization in 1924, and a geometric mean is used. Panel C of Figure 5 shows that the fluctuations of our all-share index are fairly similar to those of Bowley, Schwartz, and Smith (1931). However, their constituents, even when using our methodology, tend to outperform the all-share index, which may suggest that the rapidly developing industrial companies that they included outperformed the overall market during this period.

4. A Monthly Long-Run Capital Gains Index, 1829-2018

The IMM ceased as a publication in 1930 and our indices therefore stop at this point. However, another index known as the FT30 runs from that era to the current day. The FT30 is not ideal, as it uses the geometric average of each company's return to calculate the return of the index. This stands in contrast to the now-standard approach of weighting each company's return by its market capitalization at the start of each period. The methodology adopted by the FT30 means that it tends to understate returns, and it has risen by considerably less in absolute terms than the FTSE 100, which is calculated in the standard way, since the introduction of the latter in 1984. However, it does not seem to be biased in terms of the direction of price movements. The correlation between the monthly capital gains of the FT30 and the FTSE 100 has been

about 92 per cent during the period 1984-2018, so there is no reason to believe that its behavior is not representative of the direction and magnitude of monthly price fluctuations.

The FT30 originated as the *Financial News* 30 or FN30, which was a daily index of 30 leading stocks produced by the *Financial News* from 1920 onwards. This index was superseded by the FT30 index in 1935, which has been produced continually by the *Financial Times* up to the present day. The constituents of the index have always been chosen by journalists at the *Financial Times* on an annual basis based on how popular the shares were with investors. The constituents of the FT30 changed infrequently – there have been just over 100 constituents in over 80 years. Financial firms were not included until the 1980s and railways and mines have never been part of the index.

Despite the deficits in construction, the FT30 is closest, in terms of constituents, to our blue-chip index. We therefore splice our end-of-month blue-chip index on to the end-of-month values of the FN30 and FT30, to create a monthly blue-chip index for the UK stock market from 1829 to 2018, which is shown in Figure 6.

[Figure 6 about here]

Although by 1940 the blue-chip index had fallen below where it stood in 1829, it then began an upward trajectory that persisted until 1999. This 60-year-period witnessed a near-80-fold increase in the blue-chip index. It is notable that Goetzmann et al. (2001: 4) find a similar pattern for the United States. Three things may account for this performance. First, companies in the modern era have paid out smaller dividends and investors have received more of their returns via capital gains (Grossman and Shore 2006). Second, the demise of the gold standard and then the Bretton Woods arrangement resulted in much higher inflation in the post-1940 world, which translates into higher nominal returns. Third, companies, and therefore their equities, simply performed better in the six decades after 1940.

There have been at least seven sharp contractions in the stock market from 1829 to 2018 according to our blue-chip index – 1845-1849, 1920-21, 1929-1932, 1937-1940, 1972-1974, 2000-2002, and 2008-2009. All the contractions have been associated with major economic downturns, except for those of 1845-49 and 2000-02, which were associated with the ends of new technology booms on the stock market, i.e., railways and the internet.

Paul Samuelson is famously quoted as having said that “The stock market has correctly called nine of the last five recessions.”¹² Can the stock market indices presented here be used to understand British macroeconomic fluctuations over the long run? To test the ability of the indices to shed light on the timing of British business cycles, we use Chadha, Janssen, and Nolan’s (2000) catalogue of business cycle peaks and troughs from 1857 to 1954, and the OECD indicators on reference turning points from 1955 to 2018.¹³

We construct business cycle diagrams in the style of Burns and Mitchell (1946). For each of the business cycles we rebase the blue-chip index to be 100 at the cycle peak, and then focus on the four-year period around this point. We then take the average value of the rebased index each month across all of the business cycles. The results are presented in Figure 7.

[Figure 7 about here]

The capital gains index of blue-chip companies appears to be a good bellwether of macroeconomic behavior. During the two years prior to the business cycle peak, the index increases by an average of 10.7 per cent. The index peaks one month before the peak of the business cycle, and then declines steadily thereafter. The index bottoms out 20 months following the cyclical peak, losing an average of about 7.0 per cent from its peak value.

¹² Jeff Sommer, “An ugly forecast that has been right before,” *New York Times*, October 8, 2011. <http://www.nytimes.com/2011/10/09/your-money/a-recession-forecast-that-has-been-reliable-before.html>

¹³ OECD, <http://www.oecd.org/sdd/leading-indicators/oecdcompositeleadingindicatorsreferenceturningpointsandcomponentseries.htm>

5. Returns

Although capital gains are a useful measure of share price fluctuations, investors are most interested in total returns, that is, capital gains plus dividends. Table 1 presents data on average annual capital gains, dividend yield, and total return for the entire 100 years, the two main subperiods in terms of sources (i.e., 1830-1868 and 1869-1929), and across the decades. The total return for the 100-year period averaged 5.4 per cent per year for all equities, 5.3 per cent for UK equities, and 4.9 per cent for the blue-chip UK equities, with almost all of this coming from dividends.

Inflation during this period averaged just under 0.4 per cent per year¹⁴, so real returns would have been about 5.0 per cent. The average return on prime bills during this period was about 3.5 per cent,¹⁵ so the equity premium was just over 1.9 per cent. For Consols, including both coupon payments and price changes, the average return was about 2.8 per cent,¹⁶ implying an equity premium over long-term bonds of about 2.6 per cent. These are quite modest compared to recent experience: between 1968 and 2017, real returns were 6.4 per cent and the equity premium over bills was 4.8 per cent, and over bonds was 2.5 per cent (Dimson, Marsh and Staunton, 2018: 35).

The slightly lower return on UK blue chip firms (4.9 per cent) compared to the overall UK index (5.3 per cent) raises the possibility that there may be a size premium. To analyze this further we examined the returns on UK medium-sized firms, outside the blue chip 30 but larger than the median, and found that they earned an average return of about 5.8 per cent over the full period. UK firms smaller than the median earned average returns of about 6.7 per cent. This suggests that a fully comprehensive estimate of the equity premium for all UK companies,

¹⁴ Calculated from Gregory Clark, "What Were the British Earnings and Prices Then? (New Series)" MeasuringWorth, 2018. URL: <http://www.measuringworth.com/ukenrcpi/>

¹⁵ The discount rate on prime bills in Britain is obtained from Parliamentary Papers (1857) for 1829 to 1855, from Nishimura (1971) for 1856 to 1869, and from Capie and Webber (1985) from 1870 to 1929.

¹⁶ Calculated from COE and IMM.

controlling for additional small firms which are not included in our sample, would likely be somewhat higher than our calculated result.

We also examine the periods 1830-1868, where we use the COE, and 1869-1929, where we use the IMM as our source. Both periods are similar, but capital gains and dividend yields are slightly higher in the latter period, producing higher returns.

[Table 1 about here]

The early decades of the sample period (i.e. the 1830s and 1840s) have amongst the lowest capital gains, dividend yields, and total returns. The early years of the modern share market, given their frequent boom and busts, were not remunerative for investors. However, investors that were still in the market during the 1850s enjoyed the highest capital gains and total returns of any decade. Returns were quite low around the start of the twentieth century, but the next two decades had the largest dividend yield of any decade and slightly above average total returns.

How do our new estimates of annual returns compare to existing indices? Dimson, Staunton and Marsh (2002, 2010) have calculated annual returns from 1900 onwards. For the period of overlap with our sample, 1900-1929, they calculate an annual average geometric return of 5.4 per cent, which is very similar to our all-share index of 5.3 per cent, and UK index of 5.2 per cent, and the correlation in annual returns with these indices are 88 per cent and 96 per cent respectively. Moore (2012) has used annual data to calculate average geometric returns for the 1900-1925 period of 5.6 per cent, which are just slightly higher than our estimates of 5.5 per cent for both the all-share and UK-share indices for that period, with correlations in annual returns of 94 per cent and 84 per cent respectively.

For the earlier period, Mitchell et al. (2012) have calculated that the average return on ordinary shares of some of the leading railways was 4.3 per cent over the period from 1870 to 1913. Smith and Horne's (1934) estimates imply about a 1.1 per cent capital gain per year on

industrial shares between 1867 and 1914, and Gayer suggests essentially zero percent capital gain between 1830 and 1850, so almost all of the returns would have come from dividends, which is consistent with our findings.

The new indices can be used to compare the relative returns on British home and foreign investment. The performance of British securities markets is alleged to have played a part in Victorian Britain's industrial decline by channeling investment overseas rather than toward domestic industry (Chabot and Kurz 2010; Edelstein 1976, 1982; Eichengreen 1982; Goetzmann and Ukhov 2006; Grossman 2015; Kennedy 1987). Such a calculation may help determine to what extent capital outflows were the result of differing returns on home and foreign investment, rather than inefficiencies in UK securities markets. Although a full-scale examination of the role of UK securities markets in Victorian decline is beyond the scope of this paper, we use the data developed here to replicate Edelstein's (1976) classic study of the returns of home and foreign investment.

Edelstein (1976, 1982) calculates annual returns on a sample of 566 home and overseas shares, preference, and debenture securities drawn from the IMM. The common share component of Edelstein's database consists of about 190 domestic and 130 foreign shares. He uses equally-weighted returns, which weights small companies the same as very large companies. This methodology also implies that at the end of each year some of the winning stocks are sold, and more of the losing stocks are bought, so that the portfolio goes back to being equally weighted. He concludes that foreign equities outperformed domestic equities, with the annual geometric average return for foreign equities for the period 1870-1913 being 8.3 per cent and that for domestic equities being 6.4 (Edelstein, 1976: 294).

We replicate Edelstein's calculations with monthly data on all shares listed in the IMM.¹⁷ We also use market-capitalization weighted returns to see whether this weighting

¹⁷ We do not include data on preference or debenture issues, and so do not replicate Edelstein's work fully.

scheme changes his findings. In addition, using the COE, we are able to extend Edelstein's analysis backwards in time to the 1830s. The results are presented in Table 2.

[Table 2 about here]

The first thing to note from Table 2 is that when we apply Edelstein's weighting methodology to the population of securities in the IMM, the average annual geometric return on foreign securities is 9.0 per cent, whilst that for domestic securities is 6.8 per cent. These are similar to Edelstein's figures, but slightly higher, possibly due to different sample sizes and our use of monthly data, which would imply rebalancing winners and losers more often. Interestingly, the dividend yield using Edelstein's methodology is almost the same for domestic and foreign stocks, but the capital gains are much higher for the latter.

The second thing to note is that when we weight our indices by market capitalization, for the period 1870-1913, the average annual total return for domestic stocks was 5.1 per cent and that for foreign stocks was 5.2 per cent. This suggests almost no benefits to investors from sending their money overseas. This pattern remains similar when the period from 1869 to 1929 is considered as a whole. Prior to 1869, however, the benefits from investing overseas were much greater. In 1850-1859, foreign stocks produced the highest return of any decade, which was driven by very substantial increases in the value of the French railways after the establishment of the Second French Empire in 1852.¹⁸

6. Industry Indices

Given the extensive size of our sample, we are also able to divide our domestic securities into industrial sectors. Tables 3, 4 and 5 report the average number of securities, market capitalization, and paid-up capitalization of each sector for the years on a decadal basis starting

¹⁸ Although the French railways may have been predominantly traded in Paris, they were also quoted in London and included in the *Course of the Exchange*.

in 1829. Again, it should be noted that our sources are not exhaustive, meaning they do not cover all of the equities listed in the UK.

[Tables 3, 4 and 5 about here]

From Tables 3, 4 and 5 we can see that in 1829 the share market was dominated by canals and insurance, which constituted 64 per cent of issues and 83 per cent of market capitalization. By 1869, transportation and finance still dominated the market, but railways replaced canals in transport, and banks joined insurance companies as the most important finance stocks. At this time railways, banks and insurance firms constituted 46 per cent of issues and 81 per cent of market capitalization. After 1879, the dominance of these three sectors declined so that by 1929, they only constituted 15 per cent of issues and 39 per cent of market capitalization. Much of the growth of the share market between 1879 and 1929 is accounted for by the development of new industries (oil; chemicals; food, drink and tobacco) and the stock market flotations of established private firms (coal, iron, steel and metals; breweries; spinning and weaving; manufacturing).

Table 6 presents data on the average market capitalization of firms in different sectors at decadal dates. Canals and docks, railways, insurance, and banks were the largest firms in 1829 and this remained the case until 1869. However, by 1869, railways had increased almost eightfold, and banks more than doubled in size. By 1929, banks and railways were joined (and exceeded) by oil; food, drink and tobacco; chemicals; and insurance companies among the larger-than-average capitalization category.¹⁹

[Table 6 about here]

During the late nineteenth and early twentieth centuries shares were often issued with only a portion of their authorized “amount” paid in, leaving shareholders with contingent liability, which could be demanded by the firm at its discretion or, in the case of bank’s reserve

¹⁹ Only one firm is represented in the oil category, Shell Transport and Trading.

liability under the 1879 Banking Act, when the company entered bankruptcy.²⁰ It is important to consider this feature when thinking about risk and return on equities in this era because the contingent liability was a risk borne by shareholders that they would face calls on their personal assets should the firm in which they were a shareholder enter bankruptcy. As with any risk, shareholders should have demanded compensation in the form of higher returns for bearing this risk.

Grossman and Imai (2013) find that British banks with higher levels of contingent liability during 1878-1912 undertook less risk than firms with less contingent liability and speculate that firms held higher contingent capital when they were highly leveraged or where capital was meager or inaccessible to creditors.

Table 7 presents decadal averages on the ratio of uncalled to nominal capital for all companies and by sector. That is, if a firm's share was issued with a nominal value of £100, of which £80 was paid in, the ratio of uncalled to nominal capital would be 0.20 (£20/£100). Figure 8 illustrates the times series of the same ratio for all firms, UK firms, and the finance sector (banks, insurance companies, and trusts).

[Table 7 and Figure 8 about here]

The data in Table 7 and Figure 8 confirm that the ratio of uncalled to paid-in capital was highest in the financial sector: banks; insurance companies; land, mortgage, and finance companies; and trusts. These are sectors in which firms may have high contingent liabilities (e.g., insurance) or leverage (e.g., banks, land, mortgage, and finance), or where the assets may be inaccessible to creditors or subject to large market fluctuations (e.g., trusts). This finding mirrors Grossman's (2015) finding on non-UK equities. Uncalled capital was a minor component of the share capital of other sectors.

²⁰ Acheson, Turner, and Ye (2012), Grossman and Imai (2013), Hickson and Turner (2003), Jefferys (1938).

The ratio of uncalled to nominal capital declined across the board from the late nineteenth century onward, and particularly in the finance sector, suggesting either that there were institutional changes that lessened the requirement for uncalled capital, or that the risks perceived as generating the need for holding uncalled capital declined during the period. This decline may have been the result of a reduction in “market capital” requirements (Berger, Herring, and Szegő 1995), which could have resulted from an improvement in information flows and, hence, an amelioration of the information asymmetry that characterizes less mature financial systems.²¹

The fluctuations in the usage of uncalled capital are most apparent prior to the early 1880s. The two periods of railway promotion - the mid-1830s and mid-1840s - both exhibit a marked increase in the usage of uncalled capital and a subsequent decline. The reason for this is the way in which railways were financed in these two booms. Shareholders paid up a small proportion of capital initially and as the railway line was constructed they paid up regular calls (Acheson et al. 2012; Campbell 2013). By the time the railway line was constructed, all the uncalled capital would have been called up. The liberalization of incorporation law in the early 1860s, saw a lot of new companies coming to the market that followed the railway financing model and many new finance companies with uncalled capital. This explains the rise in uncalled capital during the 1860s. The increase in uncalled capital after 1878 was largely due to unlimited liability banks converting to limited liability companies with large amounts of uncalled capital in the wake of the City of Glasgow Bank failure. After this time, average uncalled capital followed an inexorable downwards path.

We then move on to examine differences in capital gains, dividends, and returns between industries. Figure 9 presents capital appreciation indices weighted by market

²¹ Berger, Herring, and Szegő (1995: 402) illustrate the decline in the average capital-to-asset ratio of US banks during 1840-1993. See also Grossman (2010: 145-149).

capitalization for several important domestic sectors: Panel A presents data on industries within the transportation sector; Panel B on a variety of industrial sectors; and Figure C on financial sectors. The boom in shipping during and just after World War I is clearly visible in Panel A, as is the steep decline it suffered during the post-war recession. Panel A also reveals the poor performance of canals over the sample period in contrast to railways, which came to replace them. However, after the 1860s, railways experienced relatively little capital appreciation.

Amongst industrial equities (Panel B), breweries and coal, iron and steel both experienced substantial runups in the 1890s, followed by post-1900 declines. Breweries had neither the large run up nor decline following the post-World War I boom that characterized other industrial sectors, but continued to rise strongly through 1929. Among financial firms (Panel C), insurance companies were the star performer, with capital appreciating by about eight times between 1869 and the 1929 peak. The post-war boom and crash of insurance stocks is also of note. Banks and trusts, by contrast, enjoyed much weaker capital appreciation over the sample period.

The three panels of Table 8 present decadal calculations on capital gains, dividends, and total returns for our 22 industrial sectors. By far the worst performing sector over the full period was mining, which in some decades produced large negative returns. High-performing sectors include retail, breweries, banks, and insurance.

[Table 8 about here]

To assess the risk of all 22 industrial sectors in a systematic way, we use the framework of the Capital Asset Pricing Model (CAPM).²² To do so, we run a regression of the following form:

$$R_{s,t} - R_{F,t} = \alpha + \beta(R_{M,t} - R_{F,t}), (2)$$

²² Sharpe (1964), Lintner (1965).

where $R_{s,t}$ is the total return on the portfolio of equities from sector s in month t , $R_{F,t}$ represents the risk-free rate in month t , being the discount rate on prime bills,²³ and $R_{M,t}$ is the monthly return on all common equities, including both foreign and domestic issues. The coefficient β is interpreted as systematic risk, or the extent to which the excess returns (over the risk-free rate) of the sectoral indices covary with those of a market benchmark, in this case the sample of all common equities. The results are presented in Table 9.

[Table 9 about here]

The results in Table 9 suggest that mines were the riskiest sector, with a beta of 1.34. This is unsurprising given the variation in returns presented in Table 8. Foreign mines in particular were notorious for their risk exposure. However, four other sectors had betas well in excess of one: coal, iron, steel and metals; oil; land, mortgage and financial; and railways. Oil was an inherently risky sector given its newness and the geopolitical risk it faced. Land, mortgage, and financial was mainly focused on property and land development and financing in British colonies and foreign countries and was therefore, by its nature very risky. The high beta of railways is somewhat surprising, but their prices did rise and fall by more than the overall index, not only during the early booms, but also later in the nineteenth century. Railways also had a high R^2 against the market, given that they represented a substantial percentage of any market capitalization weighted index.

Five sectors stand out in Table 9 as having low risk: canals and docks; electricity, gas, light, water; insurance; banks; and breweries. These sectors, apart from breweries, can be considered as utilities or providing a public good, for which demand would have been growing steadily. The low beta on the breweries arises not from a lack of volatility, but because their prices tended to move differently from the market, as shown by the low R^2 .

²³ The discount rate on prime bills in Britain is obtained from Parliamentary Papers (1857) for 1829 to 1855, from Nishimura (1971) for 1856 to 1869, and from Capie and Webber (1985) from 1870 to 1929.

7. Conclusion

In this paper we have constructed capital gains and total return indices for equities listed in the UK during the period from 1829 to 1929. This was an era when the British Empire reached its peak, and Britain had the largest financial market in the world. It also includes episodes of war and peace, growth and recession, booms and crises. The data underlying the indices presented here dwarf in scale and scope those used to construct other stock market indices for this period, with more than 1,000,000 security-month observations on common shares.

We use two main sources, the *Investor's Monthly Manual* (IMM), and the *Course of the Exchange* (COE). Although the digitization of the IMM data by the ICF has been hugely helpful, the data must be analyzed with considerable care, as we have outlined in Appendix 1.²⁴ We have also addressed issues with the weighting scheme used by Acheson et al. (2009) on the COE data and added foreign railways listed in the COE to their data on domestic companies. The indices presented here should represent the most complete monthly indices for nineteenth and early twentieth century British share markets created to date.

The indices are included in the Appendix, and the data presented here suggest a rich agenda for future research in economic history and financial economics. We have used these data to assess the extent of share price fluctuations in the long-run and over the business cycle. We have also used them to calculate total returns in different time periods, and the relative performance of domestic and foreign equities. We have also examined the trends and fluctuations in a range of industrial sectors over this period of industrial change.

Further potential applications include an analysis of the relationship between share market performance and real economic activity, in particular the consequences of the cost and availability of share financing on individual industrial sectors. In conjunction with data on foreign firms listed both in the UK and on their home markets, the indices can be used to assess

²⁴ See also Grossman (2018).

the extent and progress of market integration during the first era of globalization. The underlying firm-level data can be used in an event-study framework to assess how market participants reacted to political and economic events, such as wars or major economic legislation. The data can also be used to examine how firms decided how much uncalled capital to hold and the consequences of those decisions for firm risk-taking.

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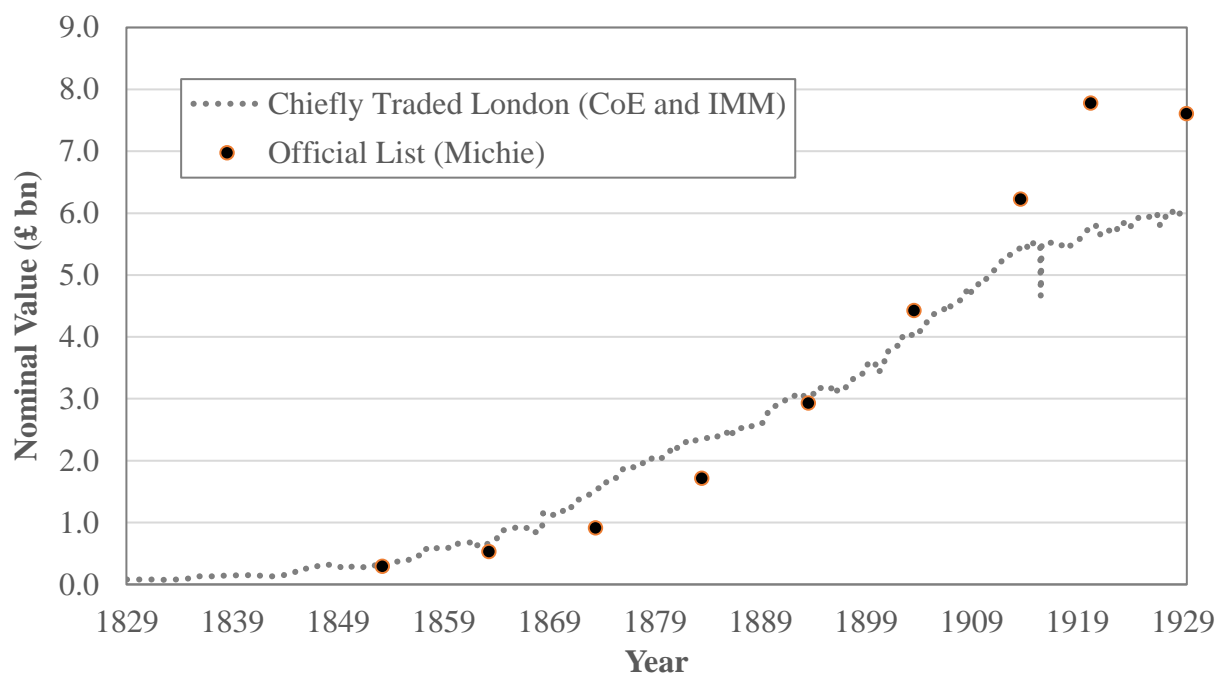
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FIGURE 1

PANEL A

Nominal Value of All Corporate Securities on London on Official List vs
Course of the Exchange and Investor's Monthly Manual, 1829-1929



PANEL B

Nominal Value of Common Equities and All Corporate Securities from
Course of the Exchange and Investor's Monthly Manual, 1829-1929

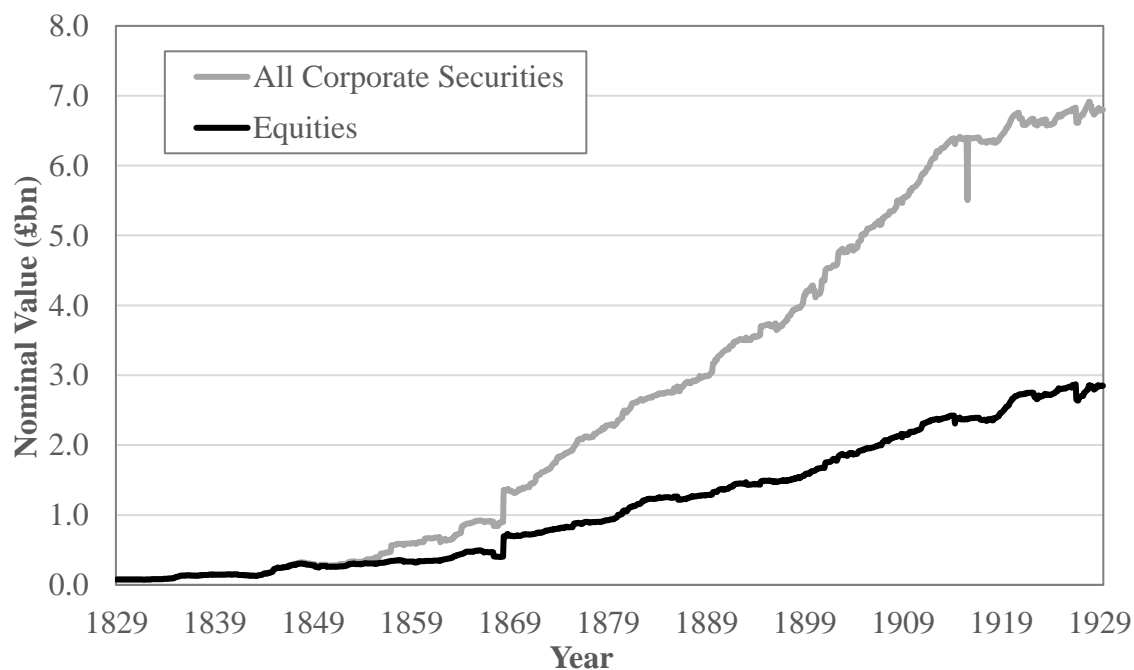
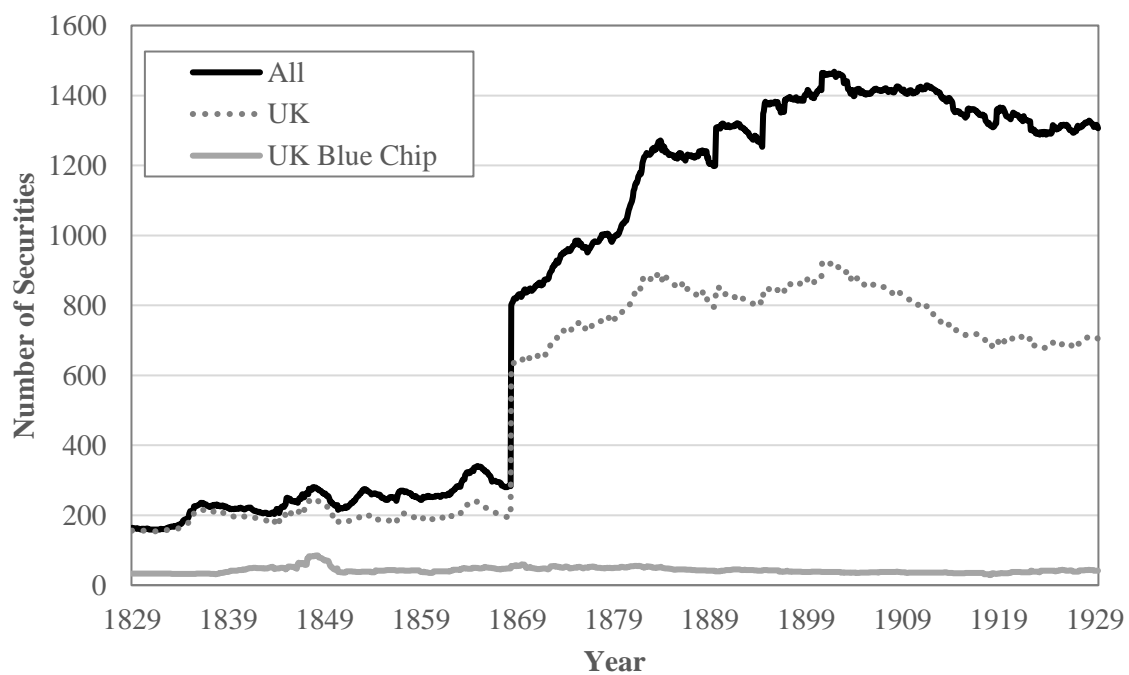


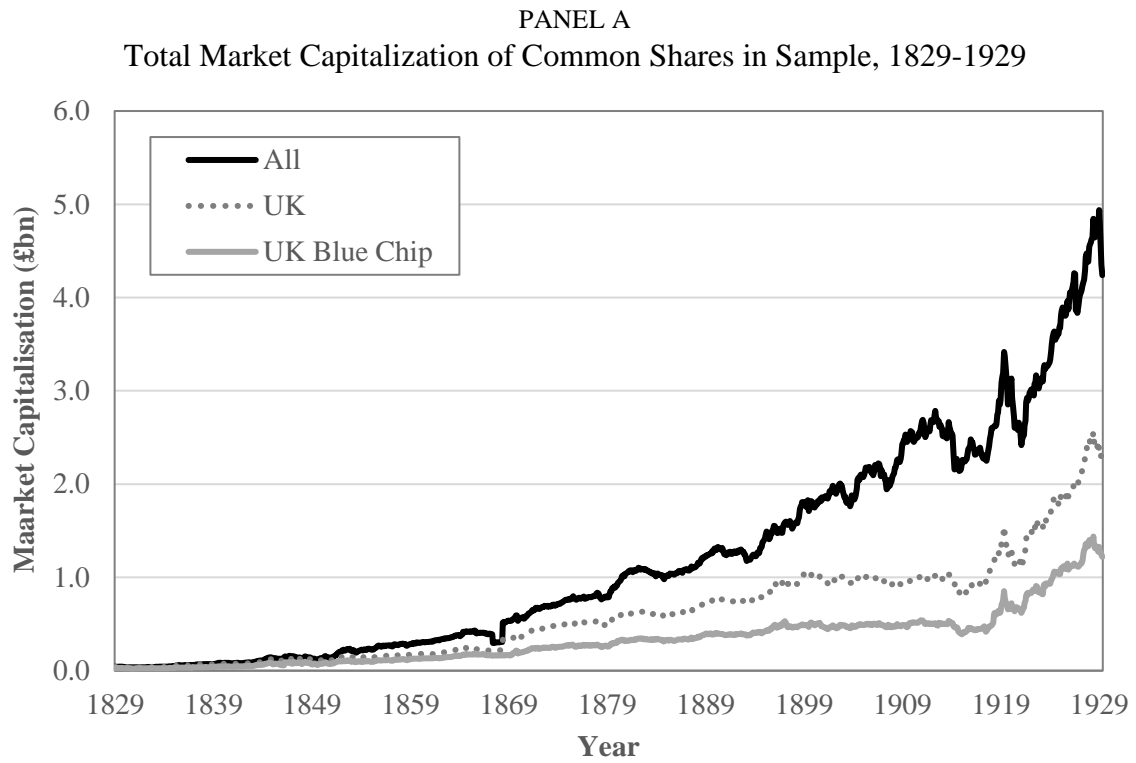
FIGURE 2

Number of Common Shares in Sample Dataset, 1829-1929

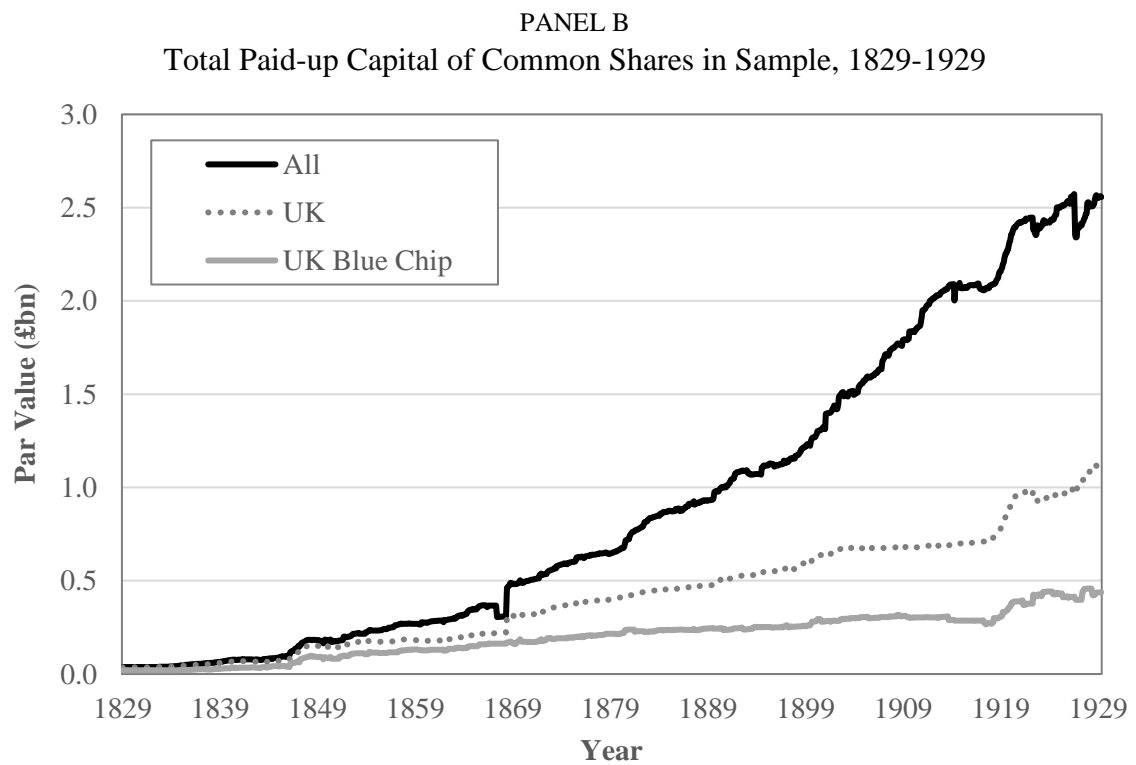


Sources: See text.

FIGURE 3
Capitalization of Common Shares in Sample, 1829-1929

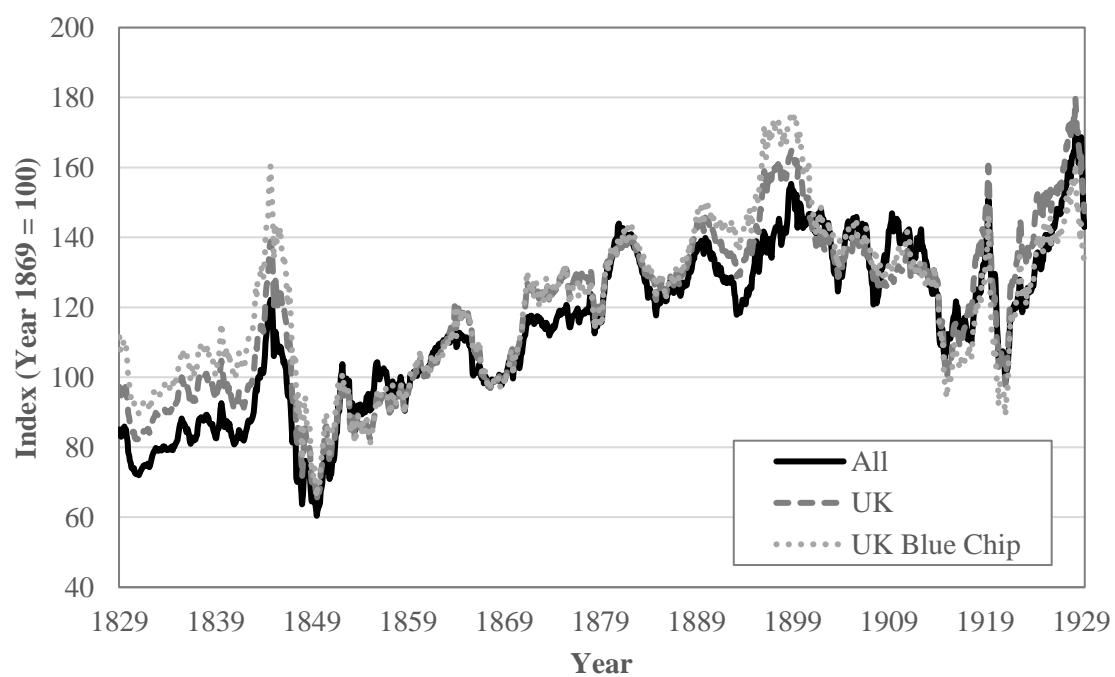


Sources: See text.



Sources: See text.

FIGURE 4
Capital Gains Indices, 1829-1929

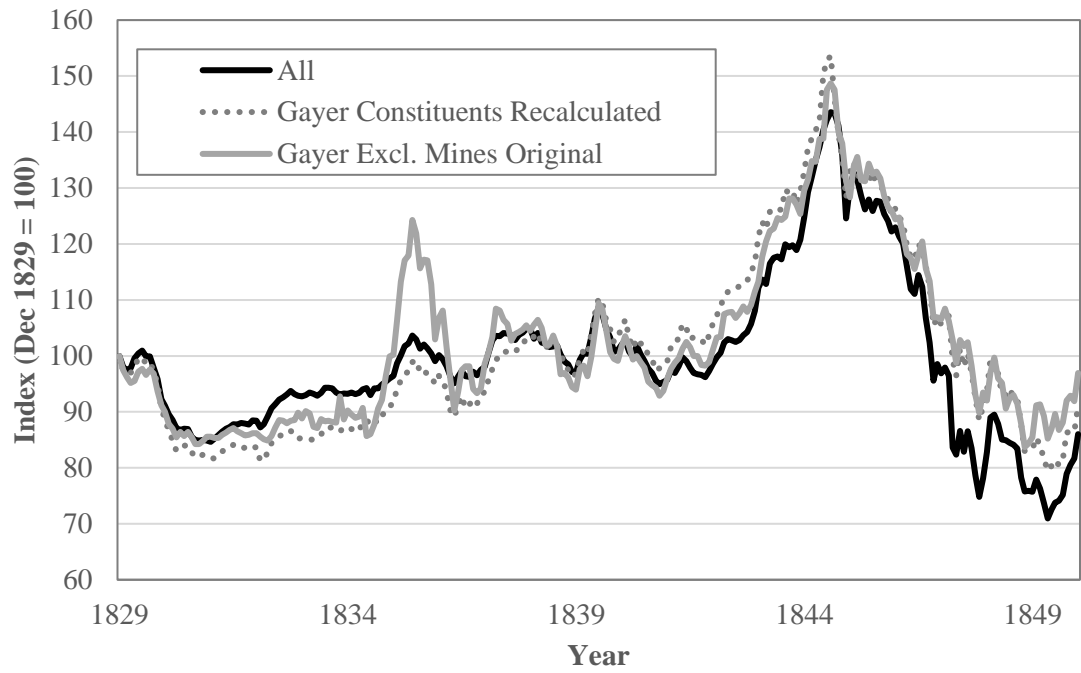


Sources: See text.

FIGURE 5
Comparison with Existing Indices

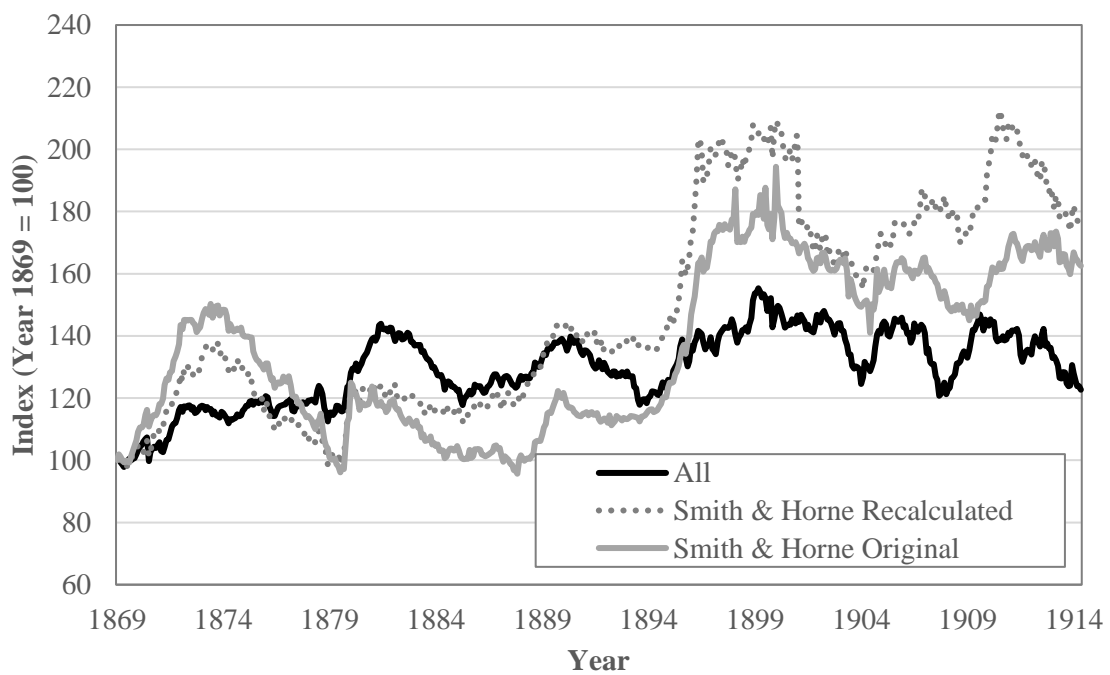
PANEL A

Gayer, Schwartz and Rostow, 1829-1850



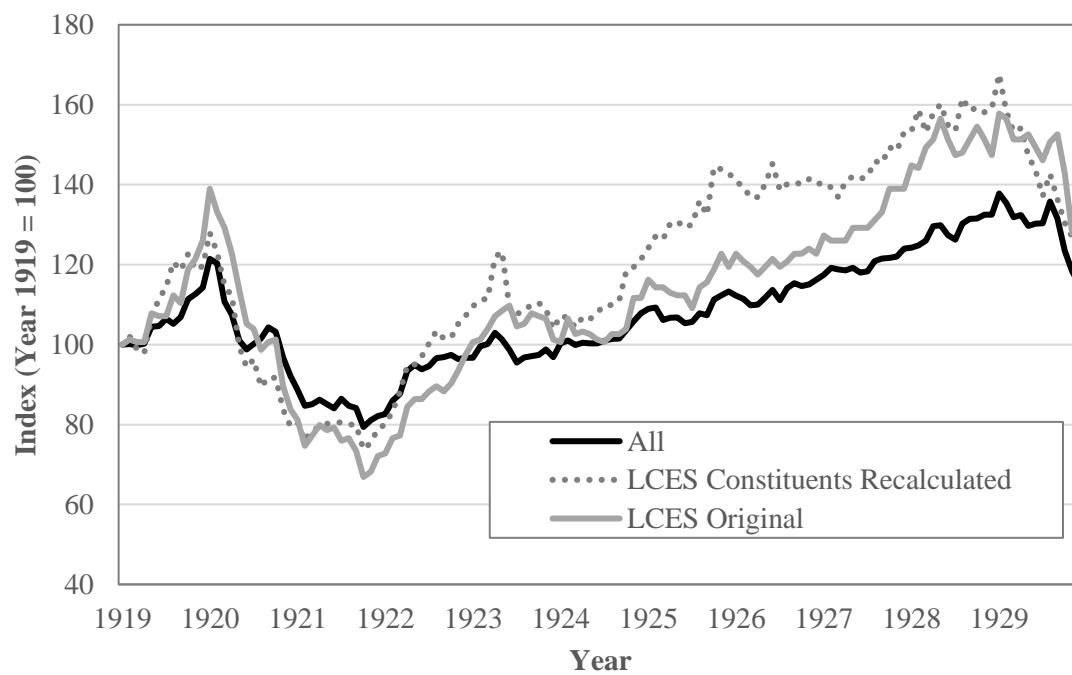
PANEL B

Smith and Horne, 1869-1914



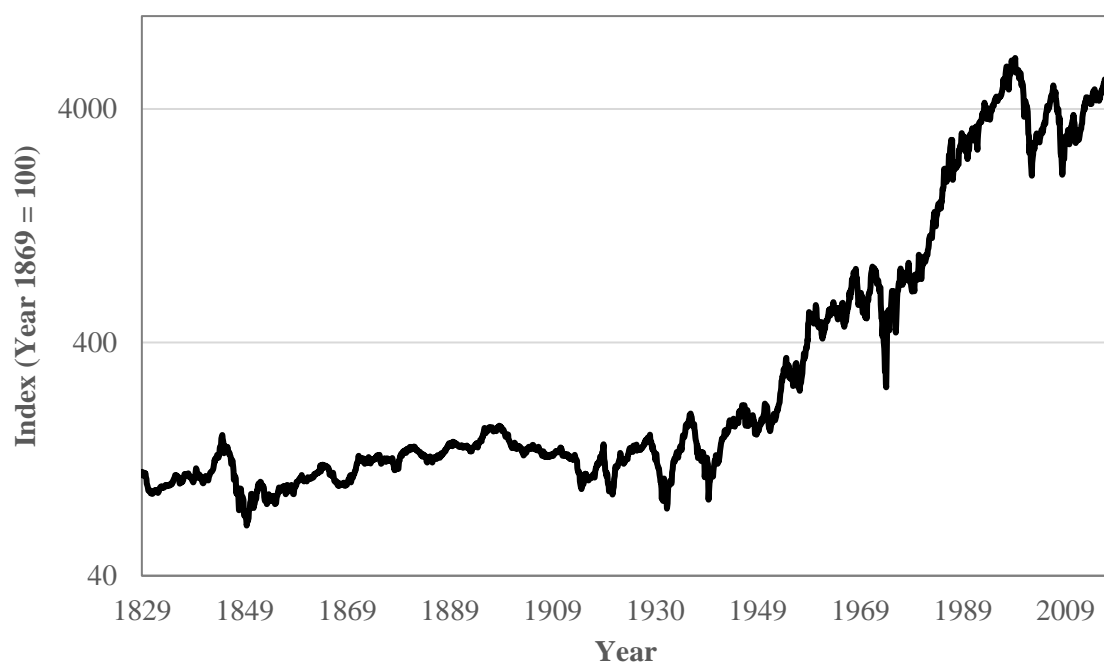
PANEL C

Bowley, Schwartz and Smith, 1919-1929



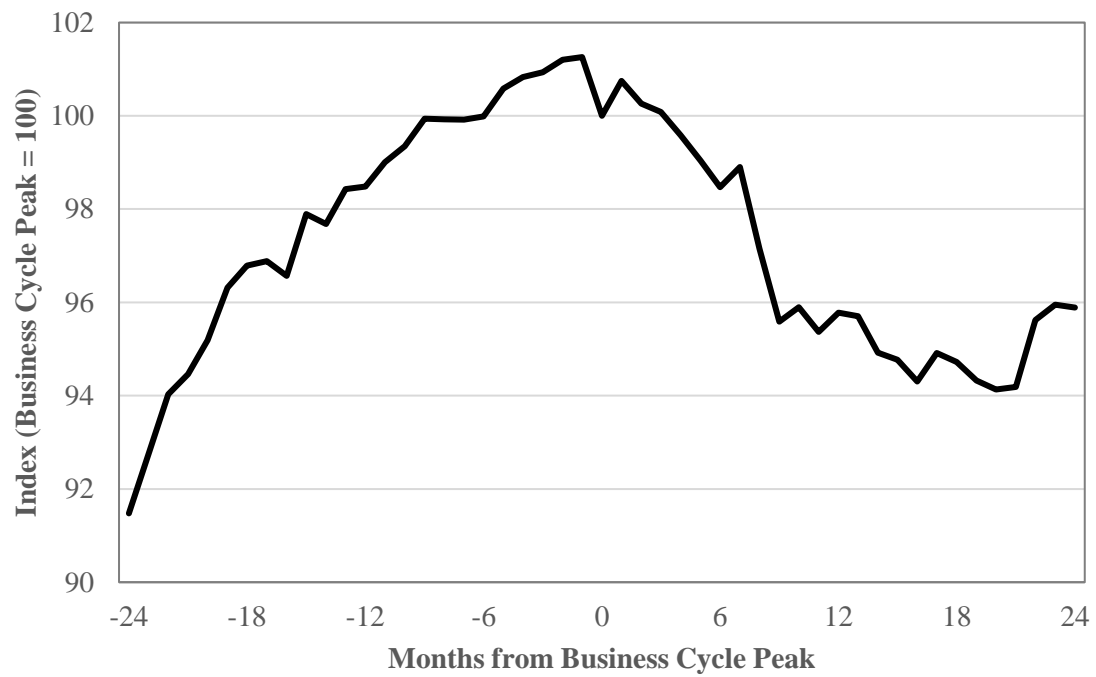
Sources: See text and Bowley, Schwartz and Smith (1931), Smith and Horne (1934), and Gayer, Rostow and Schwartz (1953).

FIGURE 6
Monthly Blue-Chip Capital Gains Index, 1829-2018



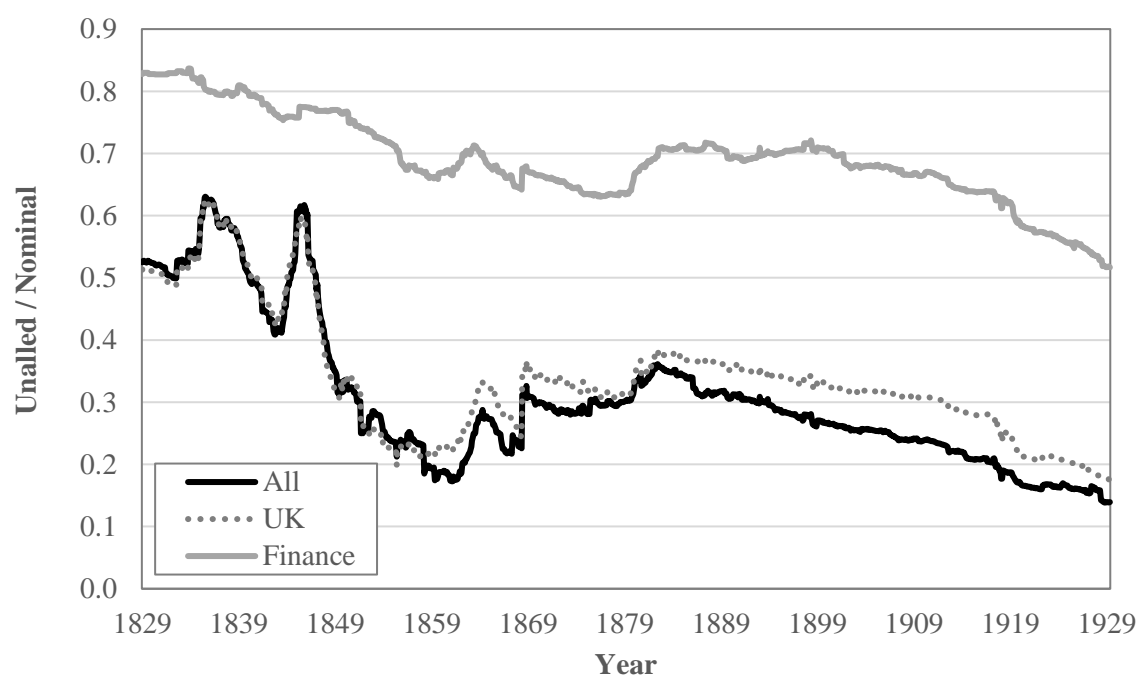
Sources: See text and FT30 is from Global Financial Data.

FIGURE 7
Blue Chip Index Performance over the Business Cycle, 1857-2018



Sources: See text

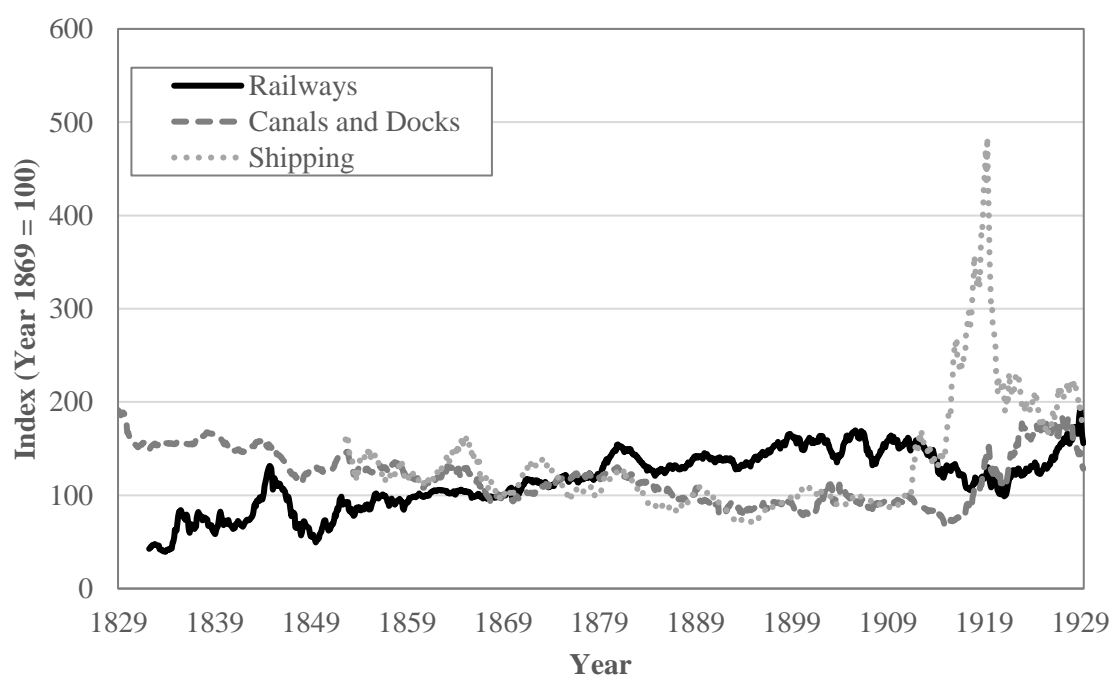
FIGURE 8
Ratio of Uncalled Capital to Nominal Value, 1829-1929



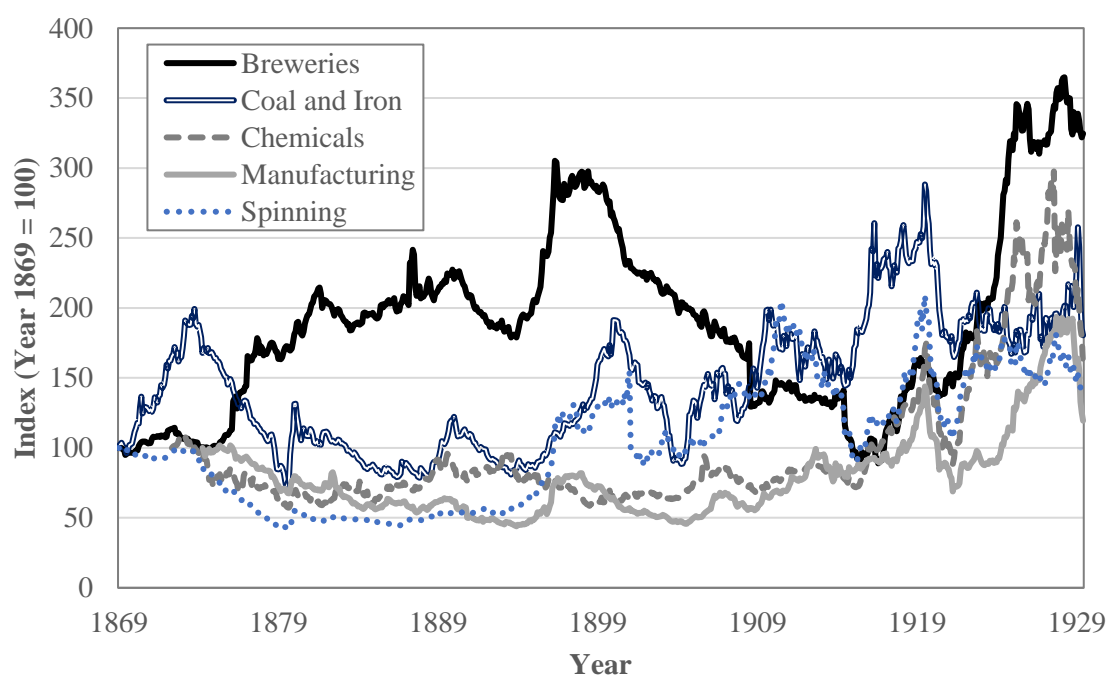
Sources: See text

FIGURE 9

PANEL A
Capital Gains Indices for Transport Sectors, 1829-1929

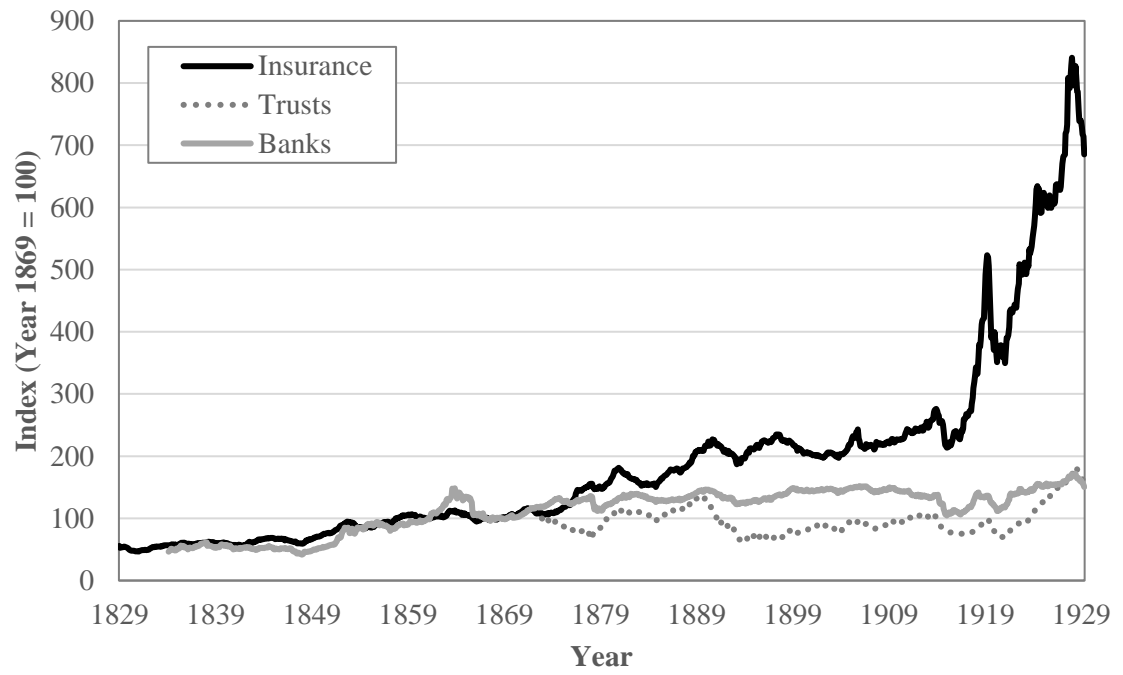


PANEL B
Capital Gains Indices for Industrial Sectors, 1829-1929



Sources: See text.

PANEL C
Capital Gains Indices for Financial Sectors, 1829-1929



Sources: See text.

TABLE 1
Average Annual Returns, 1830-1929

	1830- 1929	1830- 1868	1869- 1929	1830- 1839	1840- 1849	1850- 1859	1860- 1869	1870- 1879	1880- 1889	1890- 1899	1900- 1909	1910- 1919	1920- 1929
PANEL A: Capital gains													
All equities	0.5%	0.3%	0.6%	-0.4%	-2.5%	4.2%	-0.2%	1.9%	1.1%	0.3%	0.3%	-0.2%	0.0%
UK equities	0.4%	0.1%	0.6%	-0.4%	-2.6%	3.5%	0.0%	1.8%	1.4%	0.8%	-1.8%	1.7%	-0.3%
Blue chip equities	0.2%	-0.2%	0.5%	-1.0%	-3.0%	3.4%	-0.3%	1.5%	1.7%	1.1%	-1.9%	0.3%	-0.3%
PANEL B: Dividend yield													
All equities	5.0%	4.8%	5.1%	4.3%	4.6%	4.9%	5.4%	5.0%	4.5%	4.3%	4.6%	6.1%	5.9%
UK equities	4.8%	4.6%	5.0%	4.3%	4.5%	4.6%	4.9%	5.0%	4.5%	4.2%	4.7%	5.9%	5.7%
Blue chip equities	4.7%	4.6%	4.7%	4.3%	4.5%	4.6%	4.9%	4.7%	4.2%	3.8%	4.3%	5.6%	5.6%
PANEL C: Total return													
All equities	5.4%	5.1%	5.7%	3.8%	2.0%	9.3%	5.2%	7.0%	5.7%	4.6%	4.9%	5.8%	5.9%
UK equities	5.3%	4.7%	5.7%	3.9%	1.8%	8.2%	4.9%	6.9%	6.0%	5.0%	2.8%	7.7%	5.4%
Blue chip equities	4.9%	4.3%	5.2%	3.3%	1.4%	8.2%	4.5%	6.4%	6.0%	5.0%	2.3%	5.9%	5.3%

Sources: See text.

Notes: Uses geometric averages. Throughout the table $(1+\text{CapGains}) \times (1+\text{Dividend}) = (1+\text{Returns})$. These figures are based on securities where both capital gains and dividend data is available.

TABLE 2
Domestic vs Foreign Stocks Comparison, 1830-1929

Years		UK			Foreign		
Start	End	Cap Gains	Dividend	Returns	Cap Gains	Dividend	Returns
1830	1839	-0.4%	4.3%	3.9%	7.2%	1.3%	8.6%
1840	1849	-2.6%	4.5%	1.8%	-0.6%	5.4%	4.8%
1850	1859	3.5%	4.6%	8.2%	6.8%	5.6%	12.8%
1860	1869	0.0%	4.9%	4.9%	-0.7%	6.1%	5.4%
1870	1879	1.8%	5.0%	6.9%	2.0%	5.1%	7.2%
1880	1889	1.4%	4.5%	6.0%	0.8%	4.6%	5.3%
1890	1899	0.8%	4.2%	5.0%	-0.4%	4.4%	3.9%
1900	1909	-1.8%	4.7%	2.8%	2.3%	4.4%	6.8%
1910	1919	1.7%	5.9%	7.7%	-1.5%	6.2%	4.7%
1920	1929	-0.3%	5.7%	5.4%	-0.1%	6.1%	6.0%
1830	1868	0.1%	4.6%	4.7%	3.2%	4.6%	7.9%
1869	1929	0.6%	5.0%	5.7%	0.5%	5.1%	5.7%
Market Cap Methodology 1870-1913		0.5%	4.6%	5.1%	0.5%	4.7%	5.2%
Edelstein Methodology 1870-1913		2.1%	4.8%	6.8%	4.2%	4.9%	9.0%

Sources: See text.

Notes: Uses geometric averages. For the market cap methodology used throughout the table $(1 + \text{CapGains}) * (1 + \text{Dividend}) = (1 + \text{Returns})$. These figures are based on securities where both capital gains and dividend data is available. Edelstein (1976, 1982) used an equal weighting methodology rather than weighting returns by market capitalization.

TABLE 3
Number of Companies in Sample by Sector on a Decadal Basis, 1829-1929

	1829	1839	1849	1859	1869	1879	1889	1899	1909	1919	1929
All Companies	155	206	201	234	704	881	1082	1280	1293	1263	1221
Equities per Company	1.05	1.07	1.29	1.08	1.18	1.14	1.11	1.10	1.09	1.07	1.07
Canals and Docks	75	65	37	15	27	27	29	19	11	11	9
Railways	3	26	87	65	112	146	173	169	146	140	94
Insurance	24	32	29	30	70	92	96	86	68	47	37
Banks	2	21	14	26	140	157	156	128	100	67	54
Electricity, Gas, Light, Water	30	33	19	25	65	59	61	71	81	71	76
Mines	11	15	8	49	87	77	99	159	162	176	169
Land, Mortgage and Financial	3	6	4	12	49	63	105	103	103	102	95
Shipping	1	2	2	5	24	30	43	33	32	22	22
Food, Drink, Tobacco					7	9	23	33	41	41	40
Oil					1	5	7	9	16	25	24
Coal, Iron, Steel, Metals					21	56	57	83	109	88	82
Breweries					6	7	29	74	62	66	60
Chemicals		1		1	4	9	21	26	37	40	26
Trusts					3	11	23	47	51	56	82
Manufacturing					23	36	34	47	50	53	53
Spinning and Weaving					6	17	28	40	45	30	36
Tea, Coffee and Rubber		1			9	16	14	45	65	122	154
Retail						3	8	23	25	26	31
Building	1	1			6	7	10	14	16	10	14
Paper and Publishing					1	2	7	15	13	11	16
Services	5	3	1	3	25	32	37	34	37	37	34
Telegraphs				3	18	20	22	22	23	22	13

Sources: See text.

Notes: Table is sorted by importance in 1839 and 1929. Based on values at end of December in the given year.

TABLE 4
Total Market Capitalization of Sample by Sector on a Decadal Basis (£m), 1829-1929

	1829	1839	1849	1859	1869	1879	1889	1899	1909	1919	1929
All Companies	42.6	70.6	129.0	297.8	542.0	850.1	1254.0	1712.0	2518.0	3194.0	4240.0
Canals and Docks	26.6	21.1	15.9	12.9	13.7	18.6	17.9	10.9	3.0	5.5	6.8
Railways	1.0	18.9	86.9	214.6	307.7	493.7	688.3	748.8	1151.0	915.5	984.7
Insurance	8.5	10.4	10.5	18.4	25.4	45.0	67.5	70.0	70.7	150.5	243.4
Banks	0.6	9.1	7.6	27.2	104.9	149.5	209.5	250.7	307.5	292.4	433.2
Electricity, Gas, Light, Water	4.4	6.5	4.6	9.4	33.4	37.8	56.7	88.4	81.8	65.3	148.7
Mines	0.8	2.6	1.2	4.0	5.9	12.9	43.2	204.1	309.5	251.9	262.4
Land, Mortgage and Financial	0.1	1.4	0.8	4.3	12.6	17.8	36.9	63.7	84.6	87.4	132.8
Shipping	0.1	0.5	1.3	4.4	8.4	15.1	18.3	15.8	18.8	72.4	38.8
Food, Drink, Tobacco					1.9	3.8	4.9	11.6	15.0	159.1	482.1
Oil					0.1	1.2	1.1	2.9	11.5	307.2	378.5
Coal, Iron, Steel, Metals					5.6	14.4	23.4	60.6	175.8	297.5	263.9
Breweries					0.9	1.0	14.5	36.8	33.2	48.9	146.1
Chemicals		0.1		0.5	0.5	1.6	10.7	15.9	26.3	73.3	142.9
Trusts					0.8	5.6	13.8	15.8	25.1	34.5	117.4
Manufacturing					3.3	5.0	7.8	12.6	29.2	80.5	111.3
Spinning and Weaving					2.7	4.6	6.4	36.1	59.0	87.7	88.9
Tea, Coffee and Rubber		0.0			0.5	2.1	1.4	8.0	19.6	63.5	80.2
Retail						0.4	1.5	10.5	12.2	25.7	63.6
Building	0.0	0.0			0.4	0.9	1.6	4.8	3.9	8.4	31.5
Paper and Publishing					0.1	0.2	1.2	2.9	5.3	4.0	28.8
Services	0.2	0.1	0.2	0.4	2.9	3.9	4.7	8.8	6.3	13.8	27.2
Telegraphs				1.7	10.4	15.0	22.9	31.9	68.3	148.9	26.8

Sources: See text.

Notes: Table is sorted by importance in 1839 and 1929. Large decline in Telegraphs in 1929 is because AT&T no longer listed in IMM. Based on values at end of December in the given year.

TABLE 5
Total Par Value of Sample by Sector on a Decadal Basis (£m), 1829-1929

	1829	1839	1849	1859	1869	1879	1889	1899	1909	1919	1929
All Companies	36.9	65.3	182.3	269.6	482.1	652.7	934.7	1224.0	1797.0	2197.0	2556.0
Canals and Docks	21.5	19.6	18.3	14.2	16.7	18.0	23.5	20.6	9.8	9.9	10.8
Railways	0.7	19.0	140.0	207.5	303.3	402.0	607.9	720.4	1030.0	1116.0	962.1
Insurance	5.9	7.2	6.3	8.2	12.5	16.3	16.7	17.0	15.4	13.3	19.7
Banks	0.8	7.3	7.3	15.8	60.2	77.1	85.8	90.2	123.8	134.0	195.4
Electricity, Gas, Light, Water	4.5	5.4	4.6	8.0	24.5	24.0	29.1	54.9	64.9	75.0	120.3
Mines	2.4	4.5	3.2	5.3	6.8	12.8	29.5	73.8	104.5	142.5	164.3
Land, Mortgage and Financial	0.4	1.4	1.3	3.7	17.7	16.7	26.9	56.3	61.8	71.8	91.1
Shipping	0.3	0.3	1.2	3.4	9.3	14.7	17.3	15.2	28.5	23.2	30.0
Food, Drink, Tobacco					1.4	2.3	4.1	11.8	12.7	52.4	128.7
Oil					0.4	1.2	0.9	2.5	5.6	34.3	159.0
Coal, Iron, Steel, Metals					7.8	17.5	22.0	32.3	153.2	208.7	226.4
Breweries					0.9	0.7	7.4	22.6	22.4	26.8	53.8
Chemicals		0.2		0.7	1.1	2.3	5.9	13.2	19.2	33.7	87.1
Trusts					0.9	6.0	11.9	20.6	24.3	31.7	60.0
Manufacturing					2.8	5.0	6.8	12.4	16.1	27.1	49.2
Spinning and Weaving					1.7	4.5	5.6	12.2	19.9	29.4	54.1
Tea, Coffee and Rubber		0.1			1.6	2.2	1.8	6.8	10.2	24.1	48.3
Retail						0.3	1.1	4.4	6.1	10.6	31.0
Building	0.0	0.0			0.4	2.1	2.0	3.0	6.1	7.0	12.6
Paper and Publishing					0.2	0.1	0.7	2.1	3.2	3.1	14.0
Services	0.5	0.3	0.1	1.2	5.0	5.4	5.9	6.5	7.5	9.7	17.1
Telegraphs				1.7	6.9	21.2	22.1	25.2	51.7	112.9	21.4

Sources: See text.

Notes: Table is sorted by importance in 1839 and 1929. Large decline in Telegraphs in 1929 is because AT&T no longer listed in IMM. Based on values at end of December in the given year.

TABLE 6
Average Market Capitalization per Company by Sector (£m), 1829-1929

	1829	1839	1849	1859	1869	1879	1889	1899	1909	1919	1929
All Companies	0.27	0.34	0.64	1.27	0.77	0.96	1.16	1.34	1.95	2.53	3.47
Canals and Docks	0.35	0.33	0.43	0.86	0.51	0.69	0.62	0.57	0.28	0.50	0.76
Railways	0.35	0.73	1.00	3.30	2.75	3.38	3.98	4.43	7.88	6.54	10.48
Insurance	0.36	0.32	0.36	0.61	0.36	0.49	0.70	0.81	1.04	3.20	6.58
Banks	0.32	0.43	0.55	1.04	0.75	0.95	1.34	1.96	3.08	4.36	8.02
Electricity, Gas, Light, Water	0.15	0.20	0.24	0.38	0.51	0.64	0.93	1.24	1.01	0.92	1.96
Mines	0.08	0.17	0.15	0.08	0.07	0.17	0.44	1.28	1.91	1.43	1.55
Land, Mortgage and Financial	0.05	0.23	0.21	0.36	0.26	0.28	0.35	0.62	0.82	0.86	1.40
Shipping	0.11	0.26	0.63	0.88	0.35	0.50	0.43	0.48	0.59	3.29	1.76
Food, Drink, Tobacco					0.28	0.42	0.21	0.35	0.37	3.88	12.05
Oil					0.06	0.25	0.16	0.33	0.72	12.29	15.77
Coal, Iron, Steel, Metals					0.27	0.26	0.41	0.73	1.61	3.38	3.22
Breweries					0.14	0.15	0.50	0.50	0.54	0.74	2.44
Chemicals		0.07		0.48	0.12	0.18	0.51	0.61	0.71	1.83	5.50
Trusts					0.27	0.51	0.60	0.34	0.49	0.62	1.43
Manufacturing					0.14	0.14	0.23	0.27	0.58	1.52	2.10
Spinning and Weaving					0.44	0.27	0.23	0.90	1.31	2.92	2.47
Tea, Coffee and Rubber		0.05			0.06	0.13	0.10	0.18	0.30	0.52	0.52
Retail						0.12	0.19	0.46	0.49	0.99	2.05
Building	0.02	0.01			0.07	0.13	0.16	0.34	0.24	0.84	2.25
Paper and Publishing					0.11	0.11	0.18	0.19	0.41	0.36	1.80
Services	0.05	0.05	0.16	0.15	0.11	0.12	0.13	0.26	0.17	0.37	0.80
Telegraphs				0.56	0.58	0.75	1.04	1.45	2.97	6.77	2.06

Sources: See text.

Notes: Table is sorted by importance in 1839 and 1929. Large decline in Telegraphs in 1929 is because AT&T no longer listed in IMM. Based on values at end of December in the given year.

TABLE 7
Average Ratio of Uncalled Capital to Nominal Value

Industry	1829	1839	1849	1859	1869	1879	1889	1899	1909	1919	1929
All Companies	0.52	0.56	0.34	0.20	0.31	0.30	0.31	0.27	0.24	0.18	0.14
Canals and Docks	0.01	0.00	0.00	0.00	0.00	0.04	0.03	0.00	0.00	0.00	0.00
Railways	0.00	0.40	0.25	0.04	0.04	0.11	0.02	0.01	0.00	0.00	0.00
Insurance	0.83	0.83	0.83	0.78	0.84	0.81	0.83	0.81	0.79	0.77	0.66
Banks	0.75	0.78	0.68	0.52	0.58	0.57	0.69	0.72	0.68	0.64	0.57
Electricity, Gas, Light, Water	0.47	0.29	0.14	0.15	0.06	0.03	0.03	0.01	0.00	0.00	0.00
Mines	0.43	0.40	0.17	0.08	0.21	0.08	0.08	0.00	0.03	0.03	0.00
Land, Mortgage and Financial	0.85	0.64	0.60	0.60	0.55	0.53	0.62	0.32	0.29	0.21	0.14
Shipping	0.13	0.08	0.34	0.30	0.19	0.19	0.17	0.12	0.03	0.00	0.00
Food, Drink, Tobacco					0.47	0.27	0.00	0.02	0.08	0.00	0.00
Oil					0.20	0.10	0.15	0.03	0.02	0.00	0.00
Coal, Iron, Steel, Metals					0.33	0.22	0.15	0.11	0.06	0.03	0.01
Breweries					0.30	0.34	0.07	0.03	0.03	0.01	0.00
Chemicals		0.00		0.00	0.06	0.09	0.08	0.04	0.01	0.01	0.00
Trusts					0.52	0.27	0.23	0.22	0.05	0.00	0.00
Manufacturing					0.33	0.30	0.19	0.15	0.14	0.02	0.00
Spinning and Weaving					0.33	0.31	0.27	0.11	0.05	0.01	0.00
Tea, Coffee and Rubber		0.90			0.31	0.18	0.00	0.05	0.19	0.00	0.00
Retail						0.17	0.37	0.11	0.00	0.00	0.00
Building	0.88	0.90			0.34	0.00	0.01	0.00	0.01	0.00	0.00
Paper and Publishing					0.25	0.00	0.08	0.15	0.03	0.00	0.00
Services	0.13	0.00	0.00	0.00	0.42	0.29	0.17	0.14	0.09	0.06	0.01
Telegraphs				0.16	0.14	0.00	0.01	0.00	0.00	0.00	0.00

Sources: See text.

TABLE 8

Average Annual Returns by Sector, by Decade, 1829-1929

PANEL A
Capital Gains

	1830- 1929	1830- 1868	1869- 1929	1830- 1839	1840- 1849	1850- 1859	1860- 1869	1870- 1879	1880- 1889	1890- 1899	1900- 1909	1910- 1919	1920- 1929
All Companies	0.5%	0.3%	0.6%	-0.4%	-2.5%	4.2%	-0.2%	1.9%	1.1%	0.3%	0.3%	-0.2%	0.0%
Canals and Docks	-0.4%	-1.7%	0.5%	-1.4%	-2.5%	-0.8%	-2.0%	1.9%	-2.7%	-1.5%	0.9%	5.0%	-0.7%
Railways	1.3%	2.2%	0.8%	4.5%	-0.4%	5.3%	-0.1%	2.6%	0.9%	0.9%	0.4%	-2.9%	2.4%
Insurance	2.4%	1.2%	3.2%	0.7%	1.1%	3.5%	-0.5%	3.8%	3.4%	-0.1%	0.6%	9.3%	2.7%
Banks	1.1%	2.1%	0.5%	2.0%	-0.8%	6.6%	0.5%	1.5%	1.7%	0.0%	0.3%	-1.0%	0.9%
Electric, Gas, Light, Water	1.3%	1.2%	1.3%	2.0%	0.0%	1.0%	1.9%	2.5%	2.3%	0.5%	-0.5%	-3.3%	5.9%
Mines	-3.6%	-4.6%	-2.9%	0.7%	-4.4%	-8.9%	-5.8%	-3.6%	-1.3%	-1.8%	-1.2%	-5.0%	-4.1%
Land, Mort. and Financial			-1.1%			1.8%	-4.5%	0.2%	0.9%	-6.3%	0.3%	-1.2%	-0.7%
Shipping			1.1%			-2.4%	-1.7%	1.4%	-0.5%	-1.2%	-0.8%	19.2%	-8.9%
Food, Drink, Tobacco			0.7%					3.8%	-0.4%	-6.7%	0.1%	5.6%	2.9%
Oil			-3.9%					11.5%	-7.4%	-11.1%	-1.6%	9.2%	-7.1%
Coal, Iron, Steel, Metals			0.9%					0.0%	0.5%	3.4%	1.8%	2.8%	-3.5%
Breweries			1.7%					5.2%	1.8%	1.6%	-6.5%	1.8%	7.4%
Chemicals			0.4%					-6.1%	1.0%	-3.4%	1.3%	8.3%	0.5%
Trusts			0.6%					-0.7%	2.5%	-5.5%	2.1%	-0.1%	5.4%
Manufacturing			0.3%					-4.6%	-2.4%	1.0%	0.5%	7.7%	-1.8%
Spinning and Weaving			1.0%					-6.5%	0.2%	9.2%	5.0%	2.8%	-3.7%
Tea, Coffee and Rubber			0.0%					7.8%	-6.3%	0.2%	1.0%	3.9%	-4.2%
Retail			1.9%						7.6%	5.4%	-2.4%	2.5%	-1.5%
Building			-1.2%					-10.8%	1.2%	-0.4%	-7.2%	7.0%	5.2%
Paper and Publishing			1.0%						-1.9%	-0.3%	0.3%	5.5%	1.2%
Services			-1.4%					-3.0%	-1.9%	-1.5%	-5.2%	3.6%	0.3%
Telegraphs			1.7%					-1.9%	3.6%	1.3%	1.4%	-0.4%	4.0%

PANEL B
Dividend Yields

	1830- 1929	1830- 1868	1869- 1929	1830- 1839	1840- 1849	1850- 1859	1860- 1869	1870- 1879	1880- 1889	1890- 1899	1900- 1909	1910- 1919	1920- 1929
All Companies	5.0%	4.8%	5.1%	4.3%	4.6%	4.9%	5.4%	5.0%	4.5%	4.3%	4.6%	6.1%	5.9%
Canals and Docks	4.6%	5.2%	4.3%	4.9%	5.5%	5.1%	5.3%	4.7%	4.2%	4.1%	3.7%	4.0%	4.9%
Railways	4.5%	4.1%	4.6%	1.8%	4.0%	4.9%	5.2%	4.6%	4.0%	3.6%	3.9%	5.6%	6.2%
Insurance	4.3%	3.9%	4.6%	4.0%	4.0%	3.6%	3.8%	5.3%	4.7%	3.9%	4.2%	5.1%	4.4%
Banks	5.4%	5.5%	5.3%	3.6%	5.1%	5.8%	6.8%	5.8%	5.4%	4.8%	4.7%	5.6%	5.7%
Electric, Gas, Light, Water	5.1%	5.2%	5.0%	4.9%	4.5%	5.9%	5.6%	5.2%	4.8%	4.4%	4.7%	5.2%	5.9%
Mines	5.9%	4.9%	6.6%	2.2%	7.4%	5.9%	4.2%	6.3%	5.7%	6.4%	5.6%	7.8%	7.9%
Land, Mort. and Financial			4.7%			3.7%	6.3%	4.1%	4.9%	4.5%	3.8%	5.2%	5.7%
Shipping			5.7%			5.3%	5.9%	6.1%	5.4%	5.5%	5.8%	5.8%	5.2%
Food, Drink, Tobacco			6.2%					6.6%	5.9%	5.8%	6.3%	7.1%	5.7%
Oil			5.8%					7.3%	5.7%	5.0%	7.0%	6.1%	5.2%
Coal, Iron, Steel, Metals			6.0%					6.5%	4.9%	6.1%	6.1%	7.5%	4.9%
Breweries			6.5%					7.1%	6.7%	5.5%	5.7%	6.8%	7.1%
Chemicals			5.8%					4.4%	5.8%	6.6%	6.5%	6.2%	5.3%
Trusts			5.9%					5.9%	5.5%	5.8%	5.4%	6.5%	6.5%
Manufacturing			5.9%					6.1%	5.5%	5.2%	6.6%	7.0%	5.2%
Spinning and Weaving			5.7%					6.4%	6.1%	5.2%	5.1%	5.1%	6.0%
Tea, Coffee and Rubber			6.4%					6.5%	5.2%	6.4%	5.6%	7.6%	7.2%
Retail			5.9%						5.5%	5.2%	5.4%	6.7%	6.5%
Building			6.2%					6.2%	5.6%	6.4%	5.9%	5.8%	7.0%
Paper and Publishing			6.2%						4.9%	5.4%	5.7%	7.1%	7.5%
Services			6.0%					5.3%	5.1%	5.7%	5.9%	6.9%	7.3%
Telegraphs			5.5%					4.5%	5.8%	4.7%	5.5%	6.4%	6.1%

PANEL C
Total Returns

	1830- 1929	1830- 1868	1869- 1929	1830- 1839	1840- 1849	1850- 1859	1860- 1869	1870- 1879	1880- 1889	1890- 1899	1900- 1909	1910- 1919	1920- 1929
All Companies	5.4%	5.1%	5.7%	3.8%	2.0%	9.3%	5.2%	7.0%	5.7%	4.6%	4.9%	5.8%	5.9%
Canals and Docks	4.2%	3.4%	4.8%	3.5%	2.8%	4.2%	3.2%	6.7%	1.5%	2.5%	4.6%	9.2%	4.2%
Railways	5.8%	6.4%	5.5%	6.4%	3.7%	10.4%	5.1%	7.3%	5.0%	4.5%	4.3%	2.6%	8.7%
Insurance	6.9%	5.1%	8.0%	4.8%	5.1%	7.2%	3.3%	9.3%	8.2%	3.8%	4.9%	14.8%	7.2%
Banks	6.6%	7.8%	5.9%	5.7%	4.3%	12.8%	7.4%	7.3%	7.2%	4.7%	5.0%	4.5%	6.6%
Electric, Gas, Light, Water	6.4%	6.4%	6.4%	6.9%	4.5%	6.9%	7.6%	7.7%	7.2%	4.9%	4.1%	1.8%	12.1%
Mines	2.1%	0.1%	3.5%	2.9%	2.6%	-3.5%	-1.9%	2.4%	4.3%	4.4%	4.3%	2.5%	3.5%
Land, Mort. and Financial			3.5%			5.6%	1.5%	4.3%	5.9%	-2.1%	4.0%	3.9%	4.9%
Shipping			6.8%			2.8%	4.1%	7.6%	4.9%	4.3%	5.0%	26.0%	-4.2%
Food, Drink, Tobacco			6.9%					10.6%	5.4%	-1.3%	6.4%	13.1%	8.8%
Oil			1.7%					19.5%	-2.1%	-6.7%	5.2%	15.9%	-2.2%
Coal, Iron, Steel, Metals			7.0%					6.5%	5.4%	9.7%	8.0%	10.5%	1.3%
Breweries			8.3%					12.6%	8.6%	7.2%	-1.2%	8.7%	15.0%
Chemicals			6.2%					-2.0%	6.8%	3.0%	7.9%	14.9%	5.8%
Trusts			6.6%					5.2%	8.1%	0.0%	7.6%	6.3%	12.3%
Manufacturing			6.2%					1.3%	3.1%	6.3%	7.1%	15.1%	3.3%
Spinning and Weaving			6.7%					-0.5%	6.4%	14.9%	10.3%	8.0%	2.1%
Tea, Coffee and Rubber			6.4%					14.8%	-1.4%	6.6%	6.6%	11.8%	2.8%
Retail			7.9%						13.5%	10.9%	2.9%	9.3%	4.9%
Building			4.9%					-5.3%	6.9%	6.0%	-1.7%	13.1%	12.6%
Paper and Publishing			7.3%						2.9%	5.0%	6.0%	12.9%	8.9%
Services			4.6%					2.1%	3.2%	4.1%	0.4%	10.7%	7.6%
Telegraphs			7.3%					2.5%	9.6%	6.1%	6.9%	6.0%	10.3%

Sources: See text.

Notes: Uses geometric averages. Throughout the table $(1+\text{CapGains}) \times (1+\text{Dividend}) = (1+\text{Returns})$. These figures are based on securities where both capital gains and dividend data is available. These figures are based on securities where both capital gains and dividend data is available. Capital gains, dividend yields and returns only calculated for an industry decade where more than five companies were listed continuously.

TABLE 9
Betas by Sector

Sector Index	Beta	Std. Error	N	R-squared
Canals and Docks	0.362	0.042	1195	0.104
Railways	1.267	0.028	1156	0.700
Insurance	0.397	0.036	1195	0.190
Banks	0.514	0.032	1133	0.304
Electricity, Gas, Light, Water	0.301	0.034	1195	0.128
Mines	1.341	0.096	1195	0.231
Land, Mortgage and Financial	1.167	0.069	948	0.350
Shipping	0.753	0.070	913	0.178
Food, Drink, Tobacco	0.738	0.079	725	0.202
Oil	1.220	0.137	596	0.123
Coal, Iron, Steel, Metals	1.367	0.086	725	0.380
Breweries	0.445	0.065	725	0.076
Chemicals	0.978	0.080	685	0.200
Trusts	0.696	0.047	671	0.317
Manufacturing	0.934	0.086	662	0.280
Spinning and Weaving	0.666	0.080	725	0.139
Tea, Coffee and Rubber	0.692	0.094	725	0.081
Retail	0.748	0.085	563	0.209
Building	0.684	0.105	725	0.104
Paper and Publishing	0.410	0.080	563	0.060
Services	0.580	0.047	725	0.199
Telegraphs	0.664	0.062	725	0.198

Sources: See text.

APPENDIX 1: COURSE OF THE EXCHANGE AND INVESTOR'S MONTHLY MANUAL

The data underlying the indices from December 1829 to December 1868 come from the *Course of the Exchange* (COE) which was input by Acheson et al. (2009) and supplemented with data from the COE on foreign railways for this study. The data for January 1869 to December 1929 come from the *Investor's Monthly Manual* (IMM), as collected and reported by the International Center for Finance (ICF) at Yale University.²⁵ These are both extremely useful resources, which include very detailed data. However, as with any datasets, there are some issues which need to be considered when using them.

The COE data was made available to us in a format where it was structured into a single file, with all of the key variables included. The ICF provides the IMM data in two formats. The first format is accessible via a web-based interface, and allows the researcher to select individual securities, a date range, and to choose from many of the variables reported in the IMM. This format is highly consistent with the original IMM formatting, including any additional notes which were reported at the time. A second format was subsequently made available on demand, which compiles the entire dataset into a single download, and which adds some coding in terms of the industry sector and country of operations for each security. However, the major disadvantage of this second format is that it does not include all of the original notes, which are often very important. This lack of notes seems to be the main explanation for the issues which Hannah (2018) has identified in previous studies, such as Grossman (2015)²⁶. In this paper, we have therefore focused on collecting all of the data from the standard web interface, and making adjustments based on notes where required. We use the second format as a cross-check, particularly with regards industry, country of operations and share types.

²⁵ <http://som.yale.edu/faculty-research/our-centers-initiatives/international-center-finance/data/historical-london> includes both the digitized data, as well as scanned versions of IMM issues.

²⁶ See also Grossman (2018).

To calculate the market capitalization of each share we use information on the ‘number of shares’ or ‘amount of stock’ issued, and it is important to distinguish between these two variables. A security with 100,000 shares outstanding and a price of £90 would have had a market capitalization of £9,000,000. A security with a quoted amount of stock equal to £100,000 and a market price of £90, would have had a market capitalization of £90,000.²⁷ In the original COE and IMM pages, the data for most industries was typically provided in terms of “Number of Shares”. However, individual securities within these columns could have their total par value expressed in terms of “Stock”, with the value shown with a £ sign (or a \$ sign for some US companies). This is one example of why having access to the notes via the web version of the IMM is very important, as it makes it possible to distinguish these. In some cases the £ symbol may be missing for a few months, but it is usually possible to resolve ambiguities by looking forward and backward in the time series.²⁸ In other situations, particularly for the railways, the entire column within the IMM is reported in terms of stock, as can be seen from the column headings of “Capital Subscribed £”, which is again reflected in the different columns shown via the web version.

We convert any quotations in dollars, usually US railroads, to British Pounds. On the London Stock Exchange, before 1874, there were always 4.44 ‘dollars’ equivalent to one British Pound, and after 1874 there were 5.00 ‘dollars’ to one British Pound.²⁹ US dollar shares were always quoted per share, whilst US dollar bonds were always quoted per cent of 100³⁰ (although the bonds are not included in this paper as the focus is on equities). There are only a small number of securities reported in other currencies, which we exclude from our study.

²⁷ The assertion in Grossman (2002) that all securities listed as “stock” were debt is incorrect.

²⁸ We attempted to discover when stocks are misrepresented by IMM or ICF by checking for large month-to-month jumps in market capitalization. As noted above, stocks and shares with the same figures in the “number of shares or amount of stock” could have had wildly differing market capitalizations.

²⁹ Sylla, Wilson and Wright (2006, p. 622). This is also noted in the *Stock Exchange Yearbook* for American railroads, 1900, p.145, and 1930, p.294. This system of not using the market exchange rate forced publications such as the *Financial Times*, when reporting prices on the New York Stock Exchange, to report both the US dollar price in New York and the ‘English Equivalent’.

³⁰ *Stock Exchange Yearbook*, 1900, p.145, and 1930, p.294

The COE and IMM published extensive data on different types of securities³¹ but they did not provide separate tables for debt, ordinary shares or preference shares, so an important step in constructing indices is to categorize securities by type. This can be done by examining both the company description and security description. In the COE and IMM, companies in most industries had their ordinary shares listed first, with other types of assets listed underneath. However, for the railways in the IMM it was often preference shares or bonds which were listed first, and therefore the company description may be shown in that form, e.g., Great Western debenture stock, 4%. It is therefore necessary to also consult the security description (e.g., Do. Cons. Ord. Stock.) to determine the share type for that security. As it was common for companies to issue multiple securities, we also used this information to create an identifier for each company, so that we could calculate the overall market value of an entire firm.

The COE and IMM both classified securities by industry sector. However, in the web interface for the IMM only a broad distinction is made between banks, railways and miscellaneous. Nevertheless, the order in which the data is input reflects the industry in which it appeared, so it is possible to manually tag companies by referring back to the pages of the IMM and using their industry classification. The categorization used in the COE and IMM (and other sources such as the *Stock Exchange Yearbook*) is generally very useful, but it includes a very broad category often referred to as ‘Commercial and Industrial’ or just ‘Miscellaneous’. For the IMM in the second data format provided by the ICF, a coding has been added for each company which provides a SIC code, although no detail is provided on how this was determined. Our approach is to maintain the original COE and IMM classifications for all

³¹ Although many of the securities quoted in the IMM were listed solely on the London Stock Exchange, others were listed on London, provincial, and/or foreign exchanges. The IMM did not claim to publish exhaustive listing for London or provincial exchanges; further, it is possible that the extent to which IMM listing were representative of the London exchange changed over time. Implying that the IMM data is representative of the London Stock Exchange (e.g., Grossman 2015) is incorrect.

industries except for the ‘Commercial and Industrial’, which we break down into several other sectors using the company names and the additional SIC codes.

The COE and IMM did not classify companies by region, except for some of the railways. However, it was common for company names to refer to particular cities, countries or regions. We have manually gone through each name and inferred where it operated, and assumed that other companies without a foreign name were likely focused on the UK. The second format of the IMM provided by the ICF does include additional coding in terms of region, and we use this to cross-check our categorization.

From both the COE and IMM, we collect data on the authorized nominal “amount”, which represents the maximum that prospective shareholders could have been required to pay for a share, at its original issue. The figure “paid-in” (sometimes called “par”) represents the amount actually invested. For example, a share listed with an “amount” of £100, of which £60 was “paid-in”, would have meant that an investor could be called upon by the firm to pay in an additional amount of as much as £40.³² Any such payments would have increased the share’s paid-in value and reduced the attached contingent liability. Capital calls arose when firms were successful and required additional funds for expansion, or when they were unsuccessful and in need of funds to stave off failure or satisfy creditor in bankruptcy proceedings.³³

The COE was published twice per week, and the last price reported each month is recorded. The IMM was published monthly with the closing price being variously referred to as Latest, Last Day, or Last Business Done. Some prices (and par values) were reported in pounds, shillings and pence which was expressed using / separators, e.g., 0/5/0, so we have converted these to pounds. A number of prices were reported with the suffix “d.” This could

³² The total amount of paid-in capital, often referred to as “paid-up capitalization,” consists of the par amount per share multiplied by the total number of shares outstanding. Because paid-up is both correlated with firm size and not often changed, it is sometimes used to weight stock market indices from this period. See Acheson et al (2009) and Grossman (2002, 2015).

³³ Grossman and Imai (2013), Hickson and Turner (2003), Jefferys (1938).

potentially have represented pence, since d is the standard abbreviation of the British penny; however, for months in which high and low prices were reported with this suffix, the number preceding d in the low price typically exceed the number preceding it in the high price, suggesting that d represents a discount from par. Because of uncertainty surrounding this designation, we set to missing any prices that had the suffix of “d,” “dis,” “pm,” and “p” (presumably representing premium over par).

Other anomalies in price data (e.g., those exhibiting large one-month price or market capitalization movements), par values, and nominal values, were examined and corrections made where the inputted value appears to be an aberration. If the data on a security’s price, par value or number of shares/amount of stock was missing for a particular month we assumed that it was the same as the previous month’s value. Where information on any of these variables was missing, and data from previous months were not available, we dropped the observation from our analysis.

We calculated capital gains for each security on a monthly basis, being the percentage change in price of that security. We set the capital gains to missing for securities which underwent a change in par value for the month in which it takes place. Similarly, we set the capital gains to missing for entries marked by stock splits in the month that they occur, and for the small number of prices from the IMM which had the suffix “xr” implying a rights issue. We do some robustness tests setting returns around these events to zero, and calculating returns controlling for changes in par, but the results remain very similar. Much of the data from December 1894 is missing, presumably because the Yale library’s copy (and the scanned version on the ICF web site) of the IMM is missing those pages, so we have excluded this month from our analysis.

We based dividends where possible on the column reported in the original IMM which calculated ‘Last year’s divs. yield at latest price %’. The December value of this for each year

was then used, with the price data, to infer the dividend per share during that year. However, this column was only introduced in 1879. Before this date, for both the COE and IMM, and for other cases after this date where the dividend yield was missing, we used the December figures reported on the 'Dividend Rate as a percentage of Par', and information on when these were paid, to infer the dividend per share. There are a smaller number of occasions when dividend per share is reported directly. When there is information that dividends were 'nil', or no dividend information at all is reported, we record the dividend per share as being zero for that year.

By using December figures, we are able to calculate the total dividend per share over the calendar year, and we assume that this was spread equally over the entire year. However, if there was a stock split during the year, or the stock was only traded for part of the year this may not be accurate. In these situations, we take the yield reported in the IMM for each month, based on a rolling 12 month window, and infer the dividend per share from this. Using this information on dividends per share, and the calculations on capital gains, we can then determine the total returns earned by investors.

APPENDIX 2. INDUSTRY SECTORS

When classifying companies into industry sectors we generally rely on the COE and IMM categorization. However, these sources also tended to include a large number of companies in a miscellaneous category, so we divide these firms into some additional groups. Our industry sectors are:

Banks. We use the COE and IMM banks section.

Breweries. We use the IMM breweries and distilleries section.

Building was not an IMM category, and consists mostly of building supplies, including plate glass, asphalt, cement, linoleum, home furnishings and furniture.

Canals and Docks. The COE and IMM category also includes canal navigation, harbors, dock railways, tug boats, bridges, coastal shipping and transportation.

Chemicals was not an IMM category, and includes soda, alkali, pharmaceuticals, sulphur, nitrate, guano, phosphate, asbestos, fertilizers, animal feed, and salt.

Coal, Iron, Steel, Metals. This category consists of the IMM's iron, coal, and steel category, and some related companies such as those involved in aluminium.

Electricity, Gas, Light, Water is based on COE and IMM categories, although electricity was a late addition. The category includes public utilities, irrigation companies, and those in the electrical industries, including the manufacture of cables.

Food, Drink, Tobacco was not an IMM category, and includes dairies, mills, food and tobacco manufacturers, meat processors, restaurants, and ice.

Insurance. We use the COE and IMM insurance sections.

Land, Mortgage, and Financial is an IMM category, which seems to include financial companies and also land, timber, and exploration companies.

Manufacturing, which was not an IMM category, encompasses a wide variety of firms, including arms, engineering, tires, boots, shoes, china, coffins, dental supplies, watches, goldsmiths, silversmiths, sporting goods, luggage, rubber belting, leather, and matches. The IMM had a Wagons category, which later was expanded to include automobiles and bicycles. We include this category in Manufacturing.

Mines. Includes everything from the COE and IMM's section devoted to mining. The category includes gold, silver, copper, diamonds, tin, and lead mining, but not coal mining (see above). The names of several of the companies indicate that they engaged in both mining and smelting.

Oil. The IMM oil category did not begin until 1910, but remained consistent subsequently. Oil companies that pre-date 1910 are included.

Paper and publishing was not an IMM category, and includes paper, printing, book and newspaper publishing and equipment (linotype machines, pens, stationary), ink, and photography.

Railways is based on the COE and IMM railways section. This was sometimes subdivided into British, Colonial, American, and Foreign in later years, and includes metropolitan railways. We also include tramways in this industry sector even though they had their own IMM category. They were relatively small companies so it makes little sense in assigning them to their own sector.

Retail was not an IMM category. It includes department stores.

Services was not an IMM category, and includes advertising, hotels, commercial properties, residential properties, and cemeteries, warehouses, delivery companies.

Shipping includes ship owners and shipping lines. The IMM shipping category sometimes included shipbuilding.

Spinning and Weaving. This IMM category also includes drapery, clothes, dying, spinning equipment, sewing machines, sacks, and some warehouses that were also involved in spinning and weaving.

Tea, Coffee, Rubber includes the IMM categories on Tea, Coffee and Rubber which were sometimes combined, and sometimes reported separately.

Telegraphs is based on the IMM telegraph section, which was also subsequently expanded to include telephones. It included firms that constructed, as well as operated, communications lines.

Investment Trusts is based on the IMM trusts section. These were investment companies formed to purchase certain types of securities (e.g., securities of firms in a particular industry or region of the world), although the type of security was frequently unclear.

APPENDIX 3. COMPONENTS OF THE BLUE-CHIP INDEX

Industry	Company Name	MinYear	MaxYear
Banks	Bank of Scotland	1870	1894
Banks	Barclay and Co.	1903	1929
Banks	British Linen Company	1870	1911
Banks	Capital and Counties	1907	1910
Banks	Commercial Bank of Scotland	1870	1878
Banks	Consolidated	1864	1866
Banks	Liverpool	1837	1838
Banks	Lloyds Bank Limited	1891	1929
Banks	Lloyds Barnetts and Bosanquets	1890	1890
Banks	London and County	1864	1909
Banks	London and Midland	1899	1899
Banks	London and Westminster	1835	1909
Banks	London City and Midland	1900	1918
Banks	London County and Westminster	1910	1918
Banks	London County Westminster and Parrs	1919	1923
Banks	London Joint City and Midland	1919	1923
Banks	London Joint Stock	1839	1893
Banks	Manchester	1836	1838
Banks	Manchester and Liverpool	1836	1839
Banks	Manchester and Liverpool District Banking	1875	1916
Banks	Midland Bank Limited	1924	1929
Banks	National	1865	1885
Banks	National Bank of Scotland	1870	1912
Banks	National Provincial of England	1861	1929
Banks	Northern and Central	1837	1839
Banks	Parrs Bank	1897	1918
Banks	Provincial of Ireland	1830	1869
Banks	Royal Bank of Scotland	1870	1899
Banks	Union Bank of Scotland	1870	1875
Banks	Union of London	1852	1892
Banks	Union of London and Smiths Bank	1903	1918
Banks	Westminster Bank Limited	1924	1929
Breweries	Arthur Guinness and Co.	1888	1929
Breweries	Buchanan-Dewar	1925	1925
Breweries	Distillers Limited	1903	1929
Breweries	S. Allsopp and Sons	1888	1888
Canals and Docks	Birmingham	1846	1867
Canals and Docks	Commercial	1830	1833
Canals and Docks	Coventry	1830	1835
Canals and Docks	East India	1830	1832
Canals and Docks	Ellesmere and Chester	1830	1830
Canals and Docks	Forth and Clyde	1830	1843
Canals and Docks	Grand Junction Canal	1830	1846
Canals and Docks	Kennet and Avon	1830	1840
Canals and Docks	Leeds and Liverpool	1830	1860
Canals and Docks	London	1830	1864
Canals and Docks	London and St. Katharine	1865	1882
Canals and Docks	Monmouthshire	1830	1835
Canals and Docks	Oxford	1830	1844
Canals and Docks	Regent's	1830	1833
Canals and Docks	Rochdale	1830	1840
Canals and Docks	St. Katharine	1830	1859
Canals and Docks	Stafford and Worcester	1830	1836
Canals and Docks	Trent and Mersey	1830	1845
Canals and Docks	West India	1830	1838

Canals and Docks	Worcester and Birmingham	1830	1836
Chemicals	Brunner Mond and Co.	1893	1927
Chemicals	Courtaulds Limited	1916	1929
Chemicals	Imperial Chemical Industries	1928	1929
Chemicals	Nobel Industries	1923	1927
Chemicals	Nobels Explosives Co.	1918	1919
Coal, Iron, Steel, Metals	Armstrong Mitchell and Co.	1896	1896
Coal, Iron, Steel, Metals	Armstrong Sir W. G. and Co.	1897	1919
Coal, Iron, Steel, Metals	Babcock and Wilcox	1924	1929
Coal, Iron, Steel, Metals	Bolckow Vaughan and Co.	1874	1882
Coal, Iron, Steel, Metals	Guest Keen and Nettlefolds	1921	1928
Coal, Iron, Steel, Metals	Ocean Coal and Wilsons	1921	1922
Coal, Iron, Steel, Metals	Vickers Sons and Maxim	1900	1924
Electricity, Gas, Light, Water	East London	1830	1869
Electricity, Gas, Light, Water	Gas Light and Coke	1900	1929
Electricity, Gas, Light, Water	Imperial	1832	1869
Electricity, Gas, Light, Water	Imperial Continental	1863	1869
Electricity, Gas, Light, Water	Imperial Gas	1870	1876
Electricity, Gas, Light, Water	Lambeth Waterworks	1886	1886
Electricity, Gas, Light, Water	Phoenix	1830	1834
Electricity, Gas, Light, Water	South Metropolitan Gas	1883	1915
Electricity, Gas, Light, Water	United General	1834	1834
Electricity, Gas, Light, Water	West Middlesex	1830	1847
Electricity, Gas, Light, Water	Westminster Chartered	1830	1844
Food, Drink, Tobacco	British-American Tobacco	1913	1929
Food, Drink, Tobacco	Carreras	1928	1929
Food, Drink, Tobacco	Imperial Tobacco	1919	1929
Food, Drink, Tobacco	Maypole Dairy	1921	1922
Food, Drink, Tobacco	United Tobacco	1927	1927
Insurance	Alliance Assurance	1907	1929
Insurance	Alliance British and Foreign	1830	1860
Insurance	British Fire	1830	1843
Insurance	Commercial Union Assurance	1912	1929
Insurance	Globe	1830	1855
Insurance	Guardian	1830	1855
Insurance	Indemnity Marine	1857	1864
Insurance	Liverpool and London Fire and Life	1868	1920
Insurance	London and Lancashire Fire	1920	1929
Insurance	London Insurance	1861	1868
Insurance	London Ship	1830	1840
Insurance	North British and Mercantile Fire and Life	1887	1929
Insurance	Phoenix Assurance Limited	1921	1929
Insurance	Prudential Assurance	1914	1929
Insurance	Rock Life	1831	1864
Insurance	Royal	1887	1929
Insurance	Royal Exchange	1830	1879
Land, Mortgage and Financial	London and Globe Finance	1898	1898
Land, Mortgage and Financial	National Discount Company	1865	1869
Manufacturing	Dunlop Rubber	1919	1929
Manufacturing	Met. Carriage Wagon and Finance	1918	1919
Mines	British Iron	1834	1841
Mines	Mond Nickel Co.	1929	1929
Mines	Rio Tinto	1881	1929
Mines	Tharsis Sulphur and Copper	1873	1884
Oil	Shell Transport and Trading	1911	1929
Paper and Publishing	Associated Newspapers	1927	1929
Railways	Birm. Wolv. and Dudley	1851	1851
Railways	Birmingham and Gloucester	1841	1847
Railways	Birmingham and Oxford	1849	1850
Railways	Bristol and Exeter	1843	1877

Railways	Buckinghamshire	1851	1851
Railways	Caledonian	1847	1913
Railways	Chester and Holyhead	1847	1852
Railways	East Lancashire	1848	1859
Railways	Eastern Counties	1845	1862
Railways	Edinburgh and Glasgow	1842	1865
Railways	Furness	1879	1883
Railways	Glasgow and South-Western	1852	1897
Railways	Grand Junction	1836	1846
Railways	Great Eastern	1863	1917
Railways	Great North of England	1845	1850
Railways	Great Northern	1848	1909
Railways	Great Northern and Western of Ireland	1877	1904
Railways	Great South and Western	1849	1902
Railways	Great Western	1837	1929
Railways	Hull and Selby	1846	1851
Railways	Lancashire and Yorkshire	1848	1922
Railways	Lancaster and Carlisle	1847	1860
Railways	Liverpool and Manchester	1830	1845
Railways	London and Birmingham	1834	1846
Railways	London and Brighton	1841	1847
Railways	London and Greenwich	1836	1836
Railways	London and North Western	1847	1922
Railways	London and North-Eastern	1923	1925
Railways	London and South Western	1848	1919
Railways	London and Southampton	1838	1849
Railways	London Midland and Scottish	1923	1929
Railways	London, Brighton, and South Coast	1848	1914
Railways	London, Chatham and Dover	1881	1881
Railways	Manchester and Birmingham	1841	1846
Railways	Manchester and Leeds	1839	1847
Railways	Manchester, Sheffield and Lincolnshire	1857	1881
Railways	Metropolitan (Ext.)	1865	1906
Railways	Midland	1840	1922
Railways	Newcastle and Berwick	1847	1847
Railways	Newcastle and Carlisle	1851	1852
Railways	Newcastle and Darlington	1845	1846
Railways	Norfolk	1847	1847
Railways	North British	1847	1892
Railways	North Eastern	1855	1922
Railways	North London	1868	1895
Railways	North Midland	1839	1844
Railways	North Staffordshire	1847	1894
Railways	North Union	1846	1850
Railways	Northern and Eastern	1844	1844
Railways	South Eastern	1849	1900
Railways	South Wales	1851	1863
Railways	South-Eastern and Dover	1844	1850
Railways	Southern Railway	1923	1928
Railways	Stockton and Darlington	1861	1863
Railways	Taff Vale Aberdare	1886	1895
Railways	Wilts, Somerset and Weymouth	1851	1851
Railways	Windsor, Staines and South Western	1850	1850
Railways	York and North Midland	1842	1854
Railways	York, Newcastle, and Berwick	1848	1854
Services	Crystal Palace	1854	1854
Shipping	Cunard Steamship	1917	1920
Shipping	Furness Withy and Co	1920	1920
Shipping	P. and O. Steam Nav.	1917	1924
Shipping	Royal Mail Steam	1851	1856

Spinning and Weaving	Coats (J. and P.)	1896	1929
Spinning and Weaving	Fine Cotton Spinners and Dblrs Association	1920	1926
Spinning and Weaving	John Crossley and Sons Limited	1871	1874
Spinning and Weaving	Rylands and Sons	1897	1897
Telegraphs	Anglo-American Telegraph	1874	1876
Telegraphs	Eastern Telegraph Limited	1873	1923
Telegraphs	Electric and International Telegraph	1870	1870
Telegraphs	Marconis Wireless Telegraph ord	1929	1929
Telegraphs	Submarine	1869	1869

APPENDIX 4. CAPITAL GAINS INDICES

Each index has a base = 100 in January 1869

Month	Year	All	UK	UK Blue Chip
12	1829	85.1	97.3	111.5
1	1830	83.4	95.3	108.1
2	1830	83.0	94.8	107.3
3	1830	83.3	95.1	107.3
4	1830	84.8	96.8	108.9
5	1830	85.5	97.6	109.9
6	1830	85.9	98.0	110.6
7	1830	85.1	97.0	109.4
8	1830	85.1	97.2	109.6
9	1830	83.3	95.1	106.4
10	1830	81.6	93.2	103.7
11	1830	78.5	89.6	99.0
12	1830	77.6	88.5	98.2
1	1831	76.2	87.0	96.2
2	1831	75.4	86.0	94.5
3	1831	74.2	84.6	92.6
4	1831	73.9	84.2	92.7
5	1831	74.1	84.5	93.2
6	1831	74.0	84.4	93.1
7	1831	72.8	82.9	91.3
8	1831	72.4	82.4	90.4
9	1831	72.3	82.3	90.4
10	1831	72.4	82.5	90.5
11	1831	72.2	82.3	90.1
12	1831	72.1	81.9	89.6
1	1832	72.6	82.3	90.1
2	1832	73.1	82.9	91.1
3	1832	73.6	83.4	91.7
4	1832	74.0	83.9	92.2
5	1832	74.3	84.0	92.3
6	1832	74.8	84.7	93.0
7	1832	74.7	84.5	92.7
8	1832	74.9	84.7	92.8
9	1832	74.9	84.8	92.6
10	1832	74.7	84.7	92.4
11	1832	75.3	85.3	92.9
12	1832	75.3	85.2	92.7
1	1833	74.3	84.1	90.4
2	1833	74.8	84.5	91.0
3	1833	75.9	85.7	92.1
4	1833	77.2	87.1	93.9
5	1833	77.8	87.6	94.7
6	1833	78.5	88.3	95.8
7	1833	78.9	88.6	95.8
8	1833	79.3	89.2	96.1
9	1833	79.8	89.9	96.7
10	1833	79.3	89.5	96.2
11	1833	79.1	89.2	95.3
12	1833	79.0	89.2	95.5
1	1834	79.2	89.3	95.2
2	1834	79.6	89.4	95.1
3	1834	79.4	89.4	95.6
4	1834	79.1	89.3	95.7
5	1834	79.5	89.9	96.5
6	1834	80.3	90.8	97.8
7	1834	80.3	90.8	97.7

8	1834	80.2	91.0	97.9
9	1834	79.6	90.3	97.3
10	1834	79.3	90.0	96.9
11	1834	79.4	90.4	97.9
12	1834	79.4	90.2	97.6
1	1835	79.6	90.2	97.2
2	1835	79.3	90.0	96.9
3	1835	79.5	90.2	97.4
4	1835	80.1	90.8	98.2
5	1835	80.3	91.0	98.7
6	1835	79.2	90.3	97.7
7	1835	80.2	91.4	98.9
8	1835	80.2	91.4	98.6
9	1835	80.8	92.3	100.1
10	1835	81.2	92.5	99.0
11	1835	81.7	93.1	100.0
12	1835	82.1	93.5	100.7
1	1836	84.0	95.6	103.0
2	1836	85.2	96.9	103.8
3	1836	86.7	98.7	104.8
4	1836	87.0	98.9	105.7
5	1836	88.2	100.1	108.0
6	1836	87.7	99.8	107.9
7	1836	86.2	98.1	106.6
8	1836	86.9	98.5	107.6
9	1836	86.3	97.9	107.2
10	1836	85.5	97.4	106.9
11	1836	84.3	96.3	105.8
12	1836	85.3	97.2	106.4
1	1837	84.6	96.6	105.8
2	1837	83.6	95.3	103.7
3	1837	82.0	93.1	100.7
4	1837	81.0	92.1	99.4
5	1837	82.0	93.2	101.0
6	1837	82.9	94.3	102.6
7	1837	82.0	93.3	100.2
8	1837	81.9	93.3	100.4
9	1837	82.8	94.1	101.7
10	1837	82.2	93.4	101.0
11	1837	83.0	94.3	102.2
12	1837	83.5	94.8	103.1
1	1838	85.6	97.4	105.7
2	1838	87.5	99.5	107.7
3	1838	88.2	100.1	109.2
4	1838	88.1	99.9	108.7
5	1838	88.6	100.2	109.1
6	1838	88.5	100.1	108.7
7	1838	88.3	100.1	108.9
8	1838	87.6	99.3	107.3
9	1838	88.3	100.1	108.0
10	1838	88.7	100.5	108.6
11	1838	89.3	101.0	109.7
12	1838	89.3	101.0	109.8
1	1839	87.8	99.2	106.6
2	1839	88.6	100.2	107.6
3	1839	87.2	98.7	105.8
4	1839	87.0	98.4	105.6
5	1839	86.5	97.8	105.1
6	1839	86.6	97.9	105.1
7	1839	86.7	98.1	105.7
8	1839	85.3	96.5	104.4
9	1839	84.3	95.4	102.1

10	1839	83.8	94.9	101.5
11	1839	82.7	93.6	100.6
12	1839	82.6	93.7	100.9
1	1840	84.5	95.9	103.7
2	1840	85.6	97.2	105.6
3	1840	85.5	97.0	105.6
4	1840	88.0	99.8	109.0
5	1840	90.8	102.8	112.6
6	1840	92.6	104.8	115.5
7	1840	91.4	103.4	113.8
8	1840	89.2	100.8	110.1
9	1840	87.9	99.3	108.7
10	1840	85.7	96.7	105.3
11	1840	86.0	97.1	106.0
12	1840	86.9	98.1	107.2
1	1841	87.5	98.8	108.6
2	1841	85.8	97.0	106.4
3	1841	85.0	95.9	104.4
4	1841	86.8	97.8	107.2
5	1841	85.4	96.0	104.7
6	1841	84.4	94.9	104.3
7	1841	83.2	93.6	102.6
8	1841	82.6	92.8	102.1
9	1841	81.4	91.5	100.3
10	1841	80.8	90.8	99.5
11	1841	81.2	91.3	100.0
12	1841	81.5	91.4	100.7
1	1842	82.9	93.5	103.8
2	1842	82.6	93.1	103.5
3	1842	83.6	94.3	104.8
4	1842	84.9	96.0	107.0
5	1842	84.4	95.1	106.1
6	1842	83.3	93.8	104.2
7	1842	82.6	92.9	104.1
8	1842	82.3	92.4	103.4
9	1842	82.2	92.2	103.1
10	1842	81.9	91.4	102.3
11	1842	82.8	92.5	104.0
12	1842	83.9	93.5	105.9
1	1843	84.9	95.0	107.8
2	1843	85.6	95.7	108.8
3	1843	87.2	97.2	110.4
4	1843	87.7	97.8	111.1
5	1843	87.5	97.7	111.1
6	1843	87.3	97.8	111.5
7	1843	87.6	98.2	112.2
8	1843	88.3	99.1	113.1
9	1843	88.8	99.9	114.0
10	1843	90.0	101.3	115.6
11	1843	92.0	103.4	117.8
12	1843	95.5	107.4	123.1
1	1844	96.8	108.9	125.9
2	1844	96.1	108.1	123.5
3	1844	99.2	111.2	127.8
4	1844	100.1	112.0	128.3
5	1844	100.3	112.2	128.4
6	1844	99.8	112.0	128.4
7	1844	102.1	114.8	132.1
8	1844	101.7	114.6	131.0
9	1844	102.0	114.6	130.7
10	1844	101.3	113.0	128.2
11	1844	102.8	114.7	130.5

12	1844	106.2	118.0	134.6
1	1845	110.1	123.0	140.9
2	1845	112.4	126.1	143.3
3	1845	114.9	127.4	144.1
4	1845	116.9	128.7	145.6
5	1845	119.5	134.7	154.8
6	1845	121.1	137.7	158.9
7	1845	122.2	138.9	160.4
8	1845	122.1	137.7	155.0
9	1845	120.2	134.8	149.7
10	1845	115.7	130.1	144.2
11	1845	106.1	120.3	133.8
12	1845	110.9	126.1	141.6
1	1846	113.0	127.7	143.8
2	1846	111.9	125.6	140.2
3	1846	109.5	122.9	138.1
4	1846	107.4	120.5	138.7
5	1846	109.0	122.9	140.8
6	1846	107.2	121.3	139.6
7	1846	108.7	124.1	142.9
8	1846	108.6	123.8	138.9
9	1846	106.8	121.3	136.1
10	1846	105.7	120.0	136.1
11	1846	104.1	118.4	132.6
12	1846	104.7	119.1	134.1
1	1847	103.3	117.3	131.2
2	1847	102.3	116.0	129.6
3	1847	98.8	112.2	125.0
4	1847	95.3	108.5	120.4
5	1847	94.6	108.1	121.0
6	1847	97.4	111.0	125.2
7	1847	95.6	109.3	123.3
8	1847	90.9	104.0	116.8
9	1847	87.2	100.3	112.6
10	1847	81.4	92.0	103.1
11	1847	83.9	94.4	107.1
12	1847	82.5	93.0	105.2
1	1848	83.4	94.3	106.6
2	1848	82.1	92.9	104.4
3	1848	71.2	83.3	92.1
4	1848	70.1	81.3	89.9
5	1848	73.7	85.6	95.6
6	1848	70.6	81.4	89.0
7	1848	73.7	84.3	93.0
8	1848	71.1	81.1	88.6
9	1848	66.9	75.9	82.0
10	1848	63.7	71.5	76.4
11	1848	66.5	75.2	81.7
12	1848	70.5	79.0	86.9
1	1849	75.8	85.4	94.6
2	1849	76.2	85.5	94.4
3	1849	74.8	82.8	90.6
4	1849	72.4	79.9	86.5
5	1849	72.3	79.9	86.7
6	1849	71.9	80.2	87.3
7	1849	71.7	79.9	86.7
8	1849	71.0	78.5	84.5
9	1849	66.6	72.5	76.2
10	1849	64.5	70.1	72.5
11	1849	64.6	70.1	72.5
12	1849	64.5	69.6	71.8
1	1850	66.3	71.7	74.6

2	1850	65.0	69.8	72.0
3	1850	62.7	67.4	68.8
4	1850	60.4	64.7	65.6
5	1850	61.8	66.5	67.9
6	1850	62.8	67.5	69.4
7	1850	63.1	67.1	68.7
8	1850	64.0	68.3	70.6
9	1850	67.2	72.5	75.9
10	1850	68.6	74.0	77.1
11	1850	69.5	75.3	77.8
12	1850	73.2	78.7	82.3
1	1851	73.8	79.6	83.6
2	1851	77.7	84.7	89.6
3	1851	79.1	85.7	89.7
4	1851	79.1	86.1	89.8
5	1851	76.2	82.7	86.5
6	1851	74.0	79.7	83.1
7	1851	73.3	78.5	81.6
8	1851	71.0	75.5	78.1
9	1851	72.0	77.3	80.3
10	1851	72.2	77.8	81.2
11	1851	75.4	81.4	85.2
12	1851	76.6	81.3	85.6
1	1852	76.2	80.4	84.6
2	1852	77.5	81.4	85.8
3	1852	81.4	85.2	89.7
4	1852	85.4	88.4	93.1
5	1852	84.1	87.2	91.7
6	1852	88.7	91.8	96.5
7	1852	92.0	94.3	99.3
8	1852	90.2	91.1	95.5
9	1852	95.2	93.2	97.4
10	1852	99.9	95.3	98.9
11	1852	101.5	96.1	99.4
12	1852	103.8	98.8	101.1
1	1853	98.3	98.1	100.5
2	1853	98.0	94.8	95.8
3	1853	99.7	96.0	96.9
4	1853	99.4	95.8	96.8
5	1853	99.7	97.0	97.8
6	1853	98.4	95.6	96.2
7	1853	98.8	95.5	96.2
8	1853	99.1	94.4	94.7
9	1853	91.5	87.6	86.8
10	1853	89.7	85.0	83.8
11	1853	92.0	87.7	87.0
12	1853	92.6	88.7	87.8
1	1854	88.4	85.9	84.7
2	1854	89.2	88.1	87.9
3	1854	84.6	82.8	81.2
4	1854	85.1	83.0	81.8
5	1854	87.5	84.6	83.9
6	1854	91.2	88.0	87.7
7	1854	92.0	89.3	89.5
8	1854	91.2	88.1	88.1
9	1854	91.2	87.4	87.0
10	1854	92.2	87.7	87.4
11	1854	89.8	85.6	84.9
12	1854	89.4	85.0	83.6
1	1855	91.6	87.7	87.4
2	1855	90.4	86.3	85.6
3	1855	90.7	86.0	85.5

4	1855	90.0	84.8	84.1
5	1855	93.0	86.8	86.5
6	1855	94.5	88.4	88.0
7	1855	93.9	87.4	86.8
8	1855	95.3	86.7	85.6
9	1855	91.7	82.9	81.4
10	1855	90.5	82.4	81.2
11	1855	90.9	82.8	81.6
12	1855	91.0	82.9	81.8
1	1856	93.6	85.4	85.0
2	1856	95.7	87.1	87.0
3	1856	96.9	88.2	88.3
4	1856	99.7	89.6	89.5
5	1856	102.9	91.7	91.8
6	1856	104.1	93.8	93.9
7	1856	104.4	95.2	95.5
8	1856	103.0	93.9	94.0
9	1856	100.1	92.1	91.9
10	1856	99.4	91.9	92.0
11	1856	101.0	93.8	94.8
12	1856	101.7	94.0	95.1
1	1857	101.4	94.1	95.1
2	1857	102.1	94.9	95.9
3	1857	102.6	94.7	95.4
4	1857	102.0	94.8	95.7
5	1857	101.0	94.7	96.1
6	1857	101.6	95.7	97.2
7	1857	100.1	95.1	96.5
8	1857	98.4	93.0	94.0
9	1857	96.1	91.6	92.4
10	1857	94.6	90.6	91.9
11	1857	91.9	88.5	89.3
12	1857	93.6	89.4	90.5
1	1858	97.8	95.1	97.5
2	1858	98.9	95.8	97.9
3	1858	97.2	93.4	94.7
4	1858	96.5	92.7	93.6
5	1858	95.4	93.0	94.0
6	1858	94.4	91.7	92.1
7	1858	95.2	93.0	93.7
8	1858	97.0	93.6	94.4
9	1858	98.1	93.4	94.2
10	1858	98.1	94.4	95.5
11	1858	98.8	94.6	95.4
12	1858	100.1	97.0	98.1
1	1859	98.4	96.6	97.2
2	1859	97.4	95.7	96.0
3	1859	97.7	95.7	95.8
4	1859	91.8	91.0	89.7
5	1859	90.5	90.7	89.5
6	1859	92.6	92.7	92.1
7	1859	95.2	95.3	95.7
8	1859	95.5	95.7	96.2
9	1859	95.8	95.3	95.9
10	1859	97.5	96.7	97.3
11	1859	97.3	97.1	97.8
12	1859	100.5	99.8	101.0
1	1860	100.5	99.6	100.9
2	1860	100.5	99.8	101.0
3	1860	100.7	99.8	101.0
4	1860	101.6	100.3	101.6
5	1860	101.5	100.8	102.1

6	1860	101.6	101.3	102.7
7	1860	101.3	102.2	104.5
8	1860	100.4	101.2	103.2
9	1860	101.3	102.1	104.5
10	1860	101.8	103.0	105.4
11	1860	102.5	102.6	105.0
12	1860	104.2	105.3	108.0
1	1861	102.5	103.2	105.6
2	1861	101.7	101.7	103.8
3	1861	102.0	101.3	103.2
4	1861	101.8	101.1	102.8
5	1861	100.8	100.2	101.4
6	1861	100.8	100.8	102.2
7	1861	101.7	101.1	102.7
8	1861	102.6	101.5	103.2
9	1861	102.1	100.4	101.7
10	1861	102.7	101.0	102.4
11	1861	103.2	101.0	102.0
12	1861	102.1	100.2	101.3
1	1862	104.5	103.1	104.4
2	1862	106.0	104.5	105.8
3	1862	106.5	104.2	105.0
4	1862	107.1	103.8	104.5
5	1862	107.4	104.0	104.7
6	1862	107.7	103.5	104.0
7	1862	108.4	104.8	105.3
8	1862	107.8	103.8	104.0
9	1862	107.8	104.2	104.1
10	1862	108.5	105.2	104.7
11	1862	109.5	106.2	106.0
12	1862	109.3	106.5	106.1
1	1863	109.8	106.8	106.1
2	1863	109.8	107.3	106.4
3	1863	109.5	106.5	105.4
4	1863	110.0	107.4	106.5
5	1863	110.7	110.0	109.3
6	1863	110.6	109.7	108.7
7	1863	110.2	110.1	109.1
8	1863	110.1	109.8	108.7
9	1863	110.9	110.6	108.9
10	1863	111.9	112.2	110.6
11	1863	110.2	111.3	109.4
12	1863	110.1	112.6	110.7
1	1864	109.9	112.8	110.5
2	1864	110.9	114.2	111.5
3	1864	110.9	113.2	110.1
4	1864	113.0	115.8	112.7
5	1864	112.3	115.7	112.5
6	1864	111.6	116.1	113.1
7	1864	113.9	120.6	118.7
8	1864	111.7	117.6	115.8
9	1864	108.6	113.5	111.8
10	1864	109.1	115.1	115.1
11	1864	112.6	119.3	118.8
12	1864	112.6	120.0	119.5
1	1865	112.8	120.0	119.4
2	1865	111.8	118.1	117.4
3	1865	111.3	117.0	115.8
4	1865	112.1	118.5	118.2
5	1865	111.2	117.6	117.0
6	1865	111.2	119.2	118.7
7	1865	110.5	118.5	117.3

8	1865	110.9	118.1	117.6
9	1865	111.5	118.7	117.3
10	1865	110.6	118.0	116.9
11	1865	111.0	118.3	117.8
12	1865	110.6	117.3	116.8
1	1866	109.0	115.5	115.3
2	1866	109.5	116.2	116.3
3	1866	108.2	114.6	113.9
4	1866	106.9	113.3	113.8
5	1866	101.0	107.3	108.4
6	1866	100.5	107.6	108.7
7	1866	101.7	108.0	109.0
8	1866	101.1	107.0	107.9
9	1866	101.8	106.7	107.5
10	1866	101.6	106.5	108.0
11	1866	101.3	105.5	107.0
12	1866	102.3	107.1	109.0
1	1867	103.6	108.6	110.6
2	1867	103.1	106.3	108.0
3	1867	101.3	102.1	103.6
4	1867	99.7	100.8	101.7
5	1867	100.7	101.3	101.7
6	1867	100.2	101.9	102.1
7	1867	98.3	99.8	100.5
8	1867	100.1	100.8	101.9
9	1867	100.3	100.9	101.5
10	1867	99.7	100.6	101.2
11	1867	98.4	98.5	98.9
12	1867	97.7	97.4	97.4
1	1868	97.8	97.7	98.1
2	1868	97.9	97.6	98.1
3	1868	97.0	96.9	97.1
4	1868	98.6	98.6	98.9
5	1868	99.4	99.4	99.6
6	1868	99.3	99.1	98.7
7	1868	99.3	99.4	98.9
8	1868	98.8	98.8	98.2
9	1868	99.0	99.3	99.0
10	1868	99.1	99.0	98.5
11	1868	99.4	99.4	99.1
12	1868	99.2	99.1	98.9
1	1869	100.0	100.0	100.0
2	1869	100.8	100.3	100.3
3	1869	99.4	98.6	97.3
4	1869	98.6	98.4	97.3
5	1869	97.9	98.1	97.1
6	1869	98.8	99.0	98.3
7	1869	99.8	99.3	98.6
8	1869	100.5	99.8	99.4
9	1869	99.9	99.3	97.9
10	1869	100.6	100.2	99.6
11	1869	100.7	100.9	100.5
12	1869	102.0	102.4	102.5
1	1870	103.2	103.5	103.3
2	1870	104.3	104.2	103.6
3	1870	105.0	104.6	103.8
4	1870	106.0	106.4	106.7
5	1870	106.9	107.5	107.7
6	1870	107.4	108.1	108.0
7	1870	99.7	102.8	100.4
8	1870	102.8	104.2	103.6
9	1870	103.7	105.2	105.1

10	1870	104.4	106.0	105.9
11	1870	104.0	105.6	105.2
12	1870	104.8	106.8	106.8
1	1871	105.8	108.4	108.9
2	1871	103.1	108.9	109.0
3	1871	102.6	109.8	110.0
4	1871	104.2	111.7	112.3
5	1871	106.5	113.0	113.6
6	1871	106.8	113.2	113.7
7	1871	108.5	115.7	116.8
8	1871	110.8	118.2	120.8
9	1871	111.7	119.3	120.9
10	1871	112.0	120.1	122.7
11	1871	113.5	122.0	124.7
12	1871	116.1	125.6	129.9
1	1872	117.2	127.0	130.4
2	1872	115.6	125.2	127.4
3	1872	117.3	125.8	127.4
4	1872	116.9	124.8	125.9
5	1872	117.6	125.7	126.9
6	1872	117.6	126.3	127.2
7	1872	116.3	125.0	125.0
8	1872	117.0	126.2	127.6
9	1872	115.2	123.4	123.3
10	1872	115.5	123.7	124.4
11	1872	116.2	124.5	125.9
12	1872	117.2	125.4	127.0
1	1873	117.5	125.7	126.8
2	1873	117.3	124.7	124.7
3	1873	116.2	122.5	120.5
4	1873	117.1	124.1	123.5
5	1873	116.3	124.0	123.2
6	1873	116.5	124.5	123.9
7	1873	114.7	123.1	122.3
8	1873	115.7	124.4	124.8
9	1873	114.5	122.6	121.6
10	1873	114.1	123.1	123.0
11	1873	113.7	123.5	124.2
12	1873	115.6	126.4	128.9
1	1874	115.2	125.9	127.6
2	1874	114.2	124.2	125.1
3	1874	113.4	123.0	123.6
4	1874	111.9	121.4	121.1
5	1874	113.2	123.3	123.8
6	1874	113.0	123.2	123.5
7	1874	113.3	123.6	124.5
8	1874	113.7	123.9	125.0
9	1874	114.7	124.9	126.4
10	1874	114.2	124.4	125.2
11	1874	114.5	125.0	125.8
12	1874	115.9	125.1	125.3
1	1875	116.7	125.8	126.5
2	1875	117.5	126.3	127.2
3	1875	117.5	125.9	126.0
4	1875	118.9	127.3	127.7
5	1875	119.1	128.4	129.5
6	1875	117.9	127.4	128.6
7	1875	118.9	128.7	130.9
8	1875	118.8	128.3	130.5
9	1875	118.4	127.7	128.7
10	1875	119.4	129.6	131.3
11	1875	118.6	128.9	129.7

12	1875	119.5	129.7	131.0
1	1876	120.7	130.9	131.9
2	1876	120.3	129.7	129.8
3	1876	117.4	126.2	124.3
4	1876	115.9	125.3	123.6
5	1876	114.3	123.0	120.8
6	1876	114.3	123.2	121.4
7	1876	115.6	125.7	125.3
8	1876	117.0	126.5	125.8
9	1876	117.5	126.5	125.5
10	1876	117.7	127.4	126.8
11	1876	117.8	128.4	126.9
12	1876	117.9	128.6	126.5
1	1877	118.8	129.4	127.0
2	1877	119.0	129.7	127.2
3	1877	119.7	130.2	127.1
4	1877	116.0	127.3	122.8
5	1877	115.7	127.1	123.3
6	1877	117.1	128.7	125.6
7	1877	117.4	129.4	126.8
8	1877	118.2	129.7	127.4
9	1877	118.1	128.6	125.1
10	1877	118.7	129.1	125.9
11	1877	118.3	128.6	125.0
12	1877	118.2	127.7	124.1
1	1878	119.2	128.6	125.1
2	1878	119.2	128.7	125.6
3	1878	119.5	128.3	124.8
4	1878	119.1	128.2	125.4
5	1878	118.6	127.0	123.3
6	1878	122.3	129.4	125.7
7	1878	123.9	130.8	127.7
8	1878	123.0	129.5	125.9
9	1878	121.3	127.1	122.7
10	1878	116.8	122.7	119.1
11	1878	115.2	120.4	117.2
12	1878	112.5	116.7	113.5
1	1879	115.3	119.4	117.0
2	1879	115.4	118.7	116.5
3	1879	114.5	116.9	114.0
4	1879	115.4	117.6	115.7
5	1879	117.6	120.2	119.3
6	1879	117.5	119.5	117.8
7	1879	116.0	117.1	115.3
8	1879	115.7	116.9	115.8
9	1879	116.1	116.6	114.9
10	1879	119.7	120.1	119.0
11	1879	123.6	125.6	125.0
12	1879	123.9	125.8	124.5
1	1880	128.2	130.9	130.2
2	1880	129.5	132.2	131.1
3	1880	129.2	131.6	130.8
4	1880	131.1	133.2	133.5
5	1880	128.7	131.1	130.3
6	1880	129.9	131.7	131.3
7	1880	131.0	133.0	133.5
8	1880	132.9	135.2	136.4
9	1880	133.7	134.3	134.6
10	1880	134.6	134.9	135.7
11	1880	136.1	135.6	135.7
12	1880	137.8	137.2	137.7
1	1881	138.9	137.0	136.2

2	1881	139.5	136.9	136.7
3	1881	138.4	135.1	134.3
4	1881	139.8	136.4	136.9
5	1881	143.4	138.4	139.8
6	1881	143.9	138.4	139.0
7	1881	142.2	138.4	139.6
8	1881	142.1	137.8	138.5
9	1881	142.4	136.9	137.4
10	1881	141.4	137.2	138.1
11	1881	142.7	139.2	141.0
12	1881	142.5	140.2	142.5
1	1882	140.2	139.3	140.8
2	1882	138.4	137.4	138.7
3	1882	139.8	137.4	139.2
4	1882	140.9	139.4	142.2
5	1882	140.7	139.7	142.7
6	1882	138.8	137.7	139.7
7	1882	139.1	137.5	140.0
8	1882	139.9	138.1	141.8
9	1882	141.0	138.7	142.3
10	1882	140.6	139.3	143.1
11	1882	138.2	138.7	141.8
12	1882	137.9	138.8	142.0
1	1883	137.0	138.3	140.7
2	1883	137.1	137.3	139.6
3	1883	136.9	136.3	137.9
4	1883	137.1	136.5	138.5
5	1883	134.9	134.7	136.8
6	1883	135.1	135.5	138.1
7	1883	133.7	134.6	137.1
8	1883	132.6	134.1	136.5
9	1883	132.4	133.0	135.2
10	1883	131.5	132.5	134.4
11	1883	129.8	131.9	133.5
12	1883	130.0	133.2	135.8
1	1884	128.9	131.7	133.6
2	1884	127.4	129.5	131.0
3	1884	127.2	129.4	131.7
4	1884	127.5	130.2	132.6
5	1884	125.8	129.9	132.3
6	1884	122.7	127.7	129.4
7	1884	124.7	129.3	132.3
8	1884	125.4	129.5	132.4
9	1884	125.0	129.5	131.9
10	1884	123.7	128.5	130.2
11	1884	123.7	128.5	130.7
12	1884	123.3	128.5	130.5
1	1885	122.4	127.8	129.3
2	1885	122.7	127.0	128.4
3	1885	119.6	123.1	123.2
4	1885	117.7	122.1	122.4
5	1885	119.9	125.7	127.4
6	1885	120.5	126.3	127.9
7	1885	121.2	126.0	127.4
8	1885	122.4	126.8	129.0
9	1885	121.2	125.7	126.7
10	1885	121.8	125.5	126.4
11	1885	124.3	128.3	129.8
12	1885	123.6	127.1	127.9
1	1886	123.8	126.6	127.0
2	1886	123.8	125.8	125.8
3	1886	122.7	124.7	123.8

4	1886	121.7	123.6	122.2
5	1886	121.9	124.4	123.9
6	1886	123.5	125.5	125.1
7	1886	124.0	126.3	126.2
8	1886	124.9	126.9	127.4
9	1886	126.8	128.2	129.1
10	1886	127.7	128.9	129.0
11	1886	127.6	128.6	128.7
12	1886	126.6	128.1	128.1
1	1887	125.6	128.1	128.3
2	1887	124.1	126.2	126.4
3	1887	126.3	128.2	129.8
4	1887	126.9	128.6	130.0
5	1887	127.1	129.6	131.3
6	1887	126.8	129.6	130.8
7	1887	125.6	128.6	129.8
8	1887	124.4	126.8	128.1
9	1887	124.0	126.3	128.2
10	1887	123.3	126.1	128.1
11	1887	123.8	127.1	129.3
12	1887	126.1	129.9	132.7
1	1888	127.1	131.0	133.8
2	1888	125.9	129.1	130.8
3	1888	126.9	130.7	133.1
4	1888	126.9	130.6	132.8
5	1888	126.2	130.4	132.8
6	1888	126.4	131.5	134.8
7	1888	127.9	132.4	135.6
8	1888	128.5	132.6	135.0
9	1888	131.5	135.5	138.4
10	1888	131.0	134.9	136.5
11	1888	130.0	135.1	136.5
12	1888	130.9	136.5	138.7
1	1889	133.0	138.3	140.5
2	1889	134.4	139.5	141.7
3	1889	133.9	139.6	141.4
4	1889	135.7	141.1	143.3
5	1889	136.6	142.6	145.3
6	1889	135.9	142.5	144.9
7	1889	136.7	144.5	147.7
8	1889	138.0	144.5	147.0
9	1889	137.7	143.1	144.6
10	1889	137.9	143.2	144.4
11	1889	138.5	144.7	146.8
12	1889	139.0	145.6	148.6
1	1890	138.3	144.5	146.1
2	1890	137.0	143.2	145.3
3	1890	135.3	141.8	143.6
4	1890	136.9	142.8	145.7
5	1890	139.8	145.7	149.9
6	1890	138.9	145.0	148.8
7	1890	137.8	144.5	148.2
8	1890	138.7	144.8	149.1
9	1890	138.5	144.7	148.4
10	1890	136.3	143.1	146.5
11	1890	134.7	142.5	146.8
12	1890	133.8	142.0	146.0
1	1891	135.4	143.0	147.3
2	1891	135.3	142.0	145.8
3	1891	134.5	141.5	145.6
4	1891	133.8	140.6	144.7
5	1891	131.5	139.5	143.2

6	1891	130.3	138.7	142.8
7	1891	129.5	139.0	144.1
8	1891	129.9	138.3	144.1
9	1891	132.1	138.6	143.3
10	1891	131.0	138.5	143.6
11	1891	129.3	137.7	143.3
12	1891	131.3	138.8	145.2
1	1892	130.0	138.4	145.0
2	1892	128.5	136.4	142.5
3	1892	127.8	135.4	141.7
4	1892	127.2	134.9	141.4
5	1892	128.5	136.4	143.5
6	1892	128.5	136.2	142.9
7	1892	127.0	135.6	142.4
8	1892	127.8	135.6	143.2
9	1892	127.2	134.7	142.1
10	1892	128.3	135.0	142.2
11	1892	128.1	134.9	142.0
12	1892	127.0	134.6	141.9
1	1893	128.6	136.4	144.6
2	1893	127.1	134.5	141.5
3	1893	127.0	134.3	142.2
4	1893	127.0	134.6	142.6
5	1893	123.6	132.9	140.7
6	1893	123.2	133.3	141.7
7	1893	119.4	131.3	140.0
8	1893	117.9	128.8	136.6
9	1893	118.9	129.5	136.9
10	1893	119.6	129.4	136.5
11	1893	119.6	129.8	137.4
12	1893	118.4	129.2	136.5
1	1894	120.2	131.9	140.4
2	1894	120.6	132.3	140.6
3	1894	122.1	132.9	141.4
4	1894	122.1	132.9	141.7
5	1894	121.8	133.7	143.2
6	1894	121.2	133.7	143.4
7	1894	120.9	134.0	144.0
8	1894	123.5	135.5	145.7
9	1894	125.1	136.9	146.5
10	1894	123.4	135.3	144.0
11	1894	124.1	136.0	145.1
1	1895	125.9	138.8	148.3
2	1895	125.2	137.4	146.1
3	1895	125.5	134.8	141.6
4	1895	128.8	136.2	144.4
5	1895	129.9	138.2	146.7
6	1895	130.9	138.7	147.7
7	1895	132.6	139.9	148.5
8	1895	136.6	141.6	150.8
9	1895	138.9	143.4	152.8
10	1895	137.1	142.6	151.4
11	1895	133.0	141.7	150.5
12	1895	130.2	141.5	150.5
1	1896	131.9	145.1	155.8
2	1896	136.8	148.2	158.8
3	1896	135.3	147.9	157.0
4	1896	138.0	151.9	162.1
5	1896	139.1	154.6	165.8
6	1896	141.7	157.3	169.5
7	1896	141.2	159.0	171.9
8	1896	140.6	157.5	169.6

9	1896	137.9	153.2	162.7
10	1896	135.7	153.4	163.7
11	1896	137.0	155.2	166.4
12	1896	137.0	156.0	167.3
1	1897	139.5	159.0	171.0
2	1897	135.9	156.6	167.1
3	1897	135.1	156.3	167.4
4	1897	134.1	156.7	168.5
5	1897	138.3	159.5	172.0
6	1897	140.3	160.2	172.6
7	1897	141.4	160.6	173.5
8	1897	142.1	159.1	171.2
9	1897	142.9	159.8	171.7
10	1897	142.7	160.3	172.2
11	1897	142.5	160.0	171.2
12	1897	143.1	160.7	172.1
1	1898	145.4	162.3	173.3
2	1898	143.8	160.7	170.8
3	1898	140.5	158.6	167.5
4	1898	137.8	156.4	165.8
5	1898	139.5	156.7	166.6
6	1898	140.5	157.8	168.5
7	1898	141.9	159.0	170.5
8	1898	142.1	157.8	168.8
9	1898	142.8	157.8	168.1
10	1898	141.3	156.8	166.6
11	1898	143.7	158.7	169.5
12	1898	145.7	160.3	171.9
1	1899	151.5	162.2	173.2
2	1899	153.7	162.9	173.2
3	1899	153.9	163.4	174.1
4	1899	155.3	164.5	175.5
5	1899	154.1	165.1	175.8
6	1899	152.4	164.5	175.3
7	1899	153.4	164.4	175.4
8	1899	152.3	162.5	173.4
9	1899	148.0	161.1	172.2
10	1899	151.5	161.3	173.2
11	1899	152.2	162.0	172.5
12	1899	142.8	157.3	166.7
1	1900	145.5	159.5	169.3
2	1900	148.7	159.3	168.5
3	1900	149.7	159.7	169.4
4	1900	149.1	158.3	166.7
5	1900	147.1	156.8	165.1
6	1900	145.3	154.5	162.8
7	1900	142.7	151.5	158.9
8	1900	143.3	150.5	157.5
9	1900	143.7	151.1	158.0
10	1900	143.6	150.8	158.3
11	1900	145.4	151.5	159.5
12	1900	145.1	151.0	159.6
1	1901	144.0	151.4	161.6
2	1901	146.6	150.6	160.8
3	1901	144.5	145.5	152.3
4	1901	146.8	145.3	152.0
5	1901	145.8	144.7	150.8
6	1901	144.8	143.1	148.9
7	1901	142.2	141.5	146.9
8	1901	143.6	140.6	146.3
9	1901	141.9	139.6	143.5
10	1901	141.5	139.9	144.5

11	1901	141.1	137.5	140.7
12	1901	143.2	138.7	143.5
1	1902	146.7	140.7	146.1
2	1902	146.3	140.2	144.9
3	1902	144.4	138.0	142.0
4	1902	147.2	140.3	146.2
5	1902	148.1	141.7	148.8
6	1902	146.7	141.1	147.3
7	1902	145.2	138.9	143.8
8	1902	145.2	137.8	142.3
9	1902	144.1	136.6	139.8
10	1902	142.6	136.4	139.5
11	1902	140.4	137.4	141.4
12	1902	143.1	138.2	142.5
1	1903	144.0	139.4	143.2
2	1903	144.1	140.0	143.8
3	1903	141.8	138.4	141.3
4	1903	141.6	139.5	143.3
5	1903	138.9	139.6	143.1
6	1903	137.0	138.4	142.3
7	1903	134.1	137.8	141.6
8	1903	134.0	136.3	140.4
9	1903	130.4	134.3	137.6
10	1903	129.5	133.2	137.4
11	1903	130.2	132.2	135.4
12	1903	129.9	131.3	134.1
1	1904	129.2	132.0	135.6
2	1904	124.6	128.7	131.1
3	1904	126.7	129.0	132.0
4	1904	131.7	133.8	139.1
5	1904	130.4	133.9	138.6
6	1904	130.1	133.8	138.5
7	1904	128.7	132.0	136.0
8	1904	130.1	130.7	134.4
9	1904	132.2	131.6	136.1
10	1904	136.5	133.8	138.8
11	1904	140.5	134.6	139.3
12	1904	141.6	136.0	141.5
1	1905	140.8	136.5	141.8
2	1905	143.8	137.4	142.8
3	1905	144.6	137.3	142.5
4	1905	143.7	136.3	140.5
5	1905	140.3	136.2	140.7
6	1905	139.8	135.9	140.2
7	1905	141.5	135.5	139.6
8	1905	143.3	136.4	140.5
9	1905	145.6	139.0	142.7
10	1905	144.9	140.8	144.0
11	1905	144.5	141.4	145.4
12	1905	145.2	141.3	145.3
1	1906	145.9	141.5	144.5
2	1906	142.7	139.1	140.6
3	1906	143.4	138.8	140.7
4	1906	140.7	137.5	139.3
5	1906	140.9	137.6	139.3
6	1906	137.9	136.9	139.7
7	1906	139.3	136.4	139.4
8	1906	144.0	136.8	139.1
9	1906	142.3	135.8	137.8
10	1906	141.4	135.4	137.7
11	1906	142.8	136.9	140.1
12	1906	143.6	138.8	142.8

1	1907	142.8	139.2	142.8
2	1907	140.9	136.8	139.7
3	1907	134.4	134.5	137.0
4	1907	135.8	134.6	137.3
5	1907	131.5	134.0	136.8
6	1907	131.0	133.4	136.4
7	1907	130.9	132.0	134.0
8	1907	127.0	130.4	132.2
9	1907	125.9	129.5	130.7
10	1907	120.8	128.1	130.5
11	1907	121.4	129.2	134.0
12	1907	123.4	130.9	136.6
1	1908	125.0	130.9	135.4
2	1908	121.2	127.7	130.3
3	1908	122.8	127.4	130.7
4	1908	123.3	126.2	129.2
5	1908	126.3	127.7	131.6
6	1908	126.8	128.3	132.6
7	1908	127.7	126.4	130.3
8	1908	131.1	126.6	130.4
9	1908	131.3	126.8	130.0
10	1908	131.8	126.3	129.0
11	1908	134.0	127.0	130.3
12	1908	135.0	127.3	131.0
1	1909	134.1	126.5	129.4
2	1909	133.0	126.1	129.0
3	1909	135.5	126.2	129.4
4	1909	138.4	127.6	131.1
5	1909	142.0	128.5	132.4
6	1909	141.8	128.2	132.1
7	1909	143.4	128.1	132.4
8	1909	144.6	128.9	132.8
9	1909	146.9	128.1	130.9
10	1909	145.0	128.2	131.3
11	1909	141.7	127.3	130.7
12	1909	145.3	128.9	133.5
1	1910	143.5	129.7	134.0
2	1910	143.3	129.3	133.0
3	1910	145.3	130.7	135.0
4	1910	144.0	131.3	135.6
5	1910	144.6	131.8	137.2
6	1910	139.3	131.0	135.6
7	1910	138.2	130.8	135.9
8	1910	139.1	130.9	136.4
9	1910	138.8	130.4	135.4
10	1910	139.9	130.7	135.8
11	1910	138.6	130.4	135.3
12	1910	138.9	131.0	135.9
1	1911	141.0	132.6	137.1
2	1911	140.2	134.0	138.4
3	1911	141.7	135.8	141.0
4	1911	141.8	136.2	141.7
5	1911	141.6	135.5	140.5
6	1911	142.3	135.2	140.6
7	1911	140.2	133.0	137.6
8	1911	133.9	129.0	132.0
9	1911	131.7	128.1	130.6
10	1911	133.2	129.2	132.3
11	1911	135.1	129.7	132.6
12	1911	135.5	131.3	133.2
1	1912	135.3	131.6	132.7
2	1912	134.0	130.4	130.5

3	1912	137.7	131.9	132.1
4	1912	139.9	132.9	132.3
5	1912	138.2	131.6	130.9
6	1912	137.7	130.9	130.8
7	1912	136.7	129.9	129.8
8	1912	140.5	132.6	132.6
9	1912	142.3	133.1	132.2
10	1912	136.8	129.9	128.4
11	1912	137.7	131.0	128.9
12	1912	136.0	131.5	129.6
1	1913	136.2	132.3	130.4
2	1913	132.9	129.9	126.6
3	1913	133.3	130.4	128.2
4	1913	132.2	130.9	128.9
5	1913	130.4	130.3	128.6
6	1913	126.6	127.6	126.2
7	1913	126.3	127.4	126.4
8	1913	128.4	128.5	127.4
9	1913	128.3	128.5	127.4
10	1913	124.8	126.6	125.5
11	1913	123.8	126.6	125.7
12	1913	124.1	126.7	125.6
1	1914	130.6	131.5	131.9
2	1914	127.9	130.7	129.8
3	1914	125.5	128.2	126.6
4	1914	123.8	128.1	126.2
5	1914	123.8	127.6	125.7
6	1914	122.7	126.3	124.4
7	1914	113.4	120.2	116.0
1	1915	110.3	116.6	113.6
2	1915	109.2	114.8	110.9
3	1915	110.5	114.5	110.0
4	1915	113.9	116.0	111.9
5	1915	110.6	114.1	109.6
6	1915	107.2	107.6	101.4
7	1915	105.3	104.9	99.6
8	1915	106.5	102.1	96.1
9	1915	107.0	101.2	95.5
10	1915	110.0	99.8	94.1
11	1915	112.3	102.5	97.7
12	1915	112.1	103.0	97.7
1	1916	112.0	105.4	100.4
2	1916	111.1	104.4	98.6
3	1916	111.9	105.0	100.2
4	1916	112.3	106.4	101.3
5	1916	115.0	108.6	103.6
6	1916	117.1	113.7	109.5
7	1916	117.6	115.0	109.3
8	1916	118.4	115.0	108.7
9	1916	121.8	115.6	109.1
10	1916	120.2	113.1	105.9
11	1916	120.1	113.1	105.6
12	1916	116.9	111.8	105.7
1	1917	115.8	109.7	103.3
2	1917	113.2	108.9	102.6
3	1917	113.4	108.7	102.7
4	1917	115.1	111.2	105.4
5	1917	115.1	111.2	104.5
6	1917	116.1	112.6	105.0
7	1917	116.3	113.7	105.6
8	1917	117.0	114.1	104.6
9	1917	115.4	115.3	105.3

10	1917	113.6	116.3	106.5
11	1917	112.4	118.1	107.1
12	1917	110.9	117.8	106.8
1	1918	112.2	120.4	109.2
2	1918	112.9	120.3	107.5
3	1918	111.5	119.4	105.8
4	1918	110.1	117.6	105.3
5	1918	112.9	120.3	108.1
6	1918	115.0	123.6	112.4
7	1918	117.6	127.7	115.9
8	1918	120.0	129.2	115.3
9	1918	121.3	133.0	117.8
10	1918	125.2	134.6	121.2
11	1918	124.0	133.2	118.5
12	1918	123.9	134.8	120.9
1	1919	124.3	136.5	121.8
2	1919	124.5	137.9	123.3
3	1919	124.0	134.4	120.6
4	1919	124.6	134.6	121.2
5	1919	129.8	141.3	129.1
6	1919	130.0	142.4	129.7
7	1919	132.3	141.6	129.7
8	1919	130.7	140.7	127.2
9	1919	132.8	143.6	129.7
10	1919	138.4	148.3	135.0
11	1919	139.9	148.8	134.5
12	1919	142.0	151.7	137.8
1	1920	150.9	160.6	146.2
2	1920	149.5	156.3	137.3
3	1920	137.6	145.0	126.2
4	1920	133.5	139.6	122.7
5	1920	125.5	130.4	113.6
6	1920	122.8	127.5	112.4
7	1920	124.5	125.3	110.6
8	1920	126.1	120.8	106.8
9	1920	129.6	123.0	110.3
10	1920	128.2	120.6	108.4
11	1920	120.3	114.7	101.4
12	1920	114.5	109.6	98.5
1	1921	110.2	109.3	98.0
2	1921	105.2	103.0	91.9
3	1921	105.8	105.9	96.3
4	1921	107.1	107.3	98.2
5	1921	105.7	107.2	97.8
6	1921	104.4	105.6	96.6
7	1921	107.4	105.4	96.0
8	1921	105.3	104.4	95.4
9	1921	104.6	102.7	92.9
10	1921	98.7	97.9	89.1
11	1921	100.8	99.8	91.2
12	1921	102.0	104.1	95.8
1	1922	102.6	105.3	96.1
2	1922	106.8	111.3	103.6
3	1922	108.9	115.1	106.9
4	1922	116.0	123.5	113.8
5	1922	118.0	127.3	117.5
6	1922	116.6	125.6	115.1
7	1922	117.6	127.5	118.4
8	1922	120.1	127.7	117.9
9	1922	120.3	127.4	117.6
10	1922	121.0	127.8	117.4
11	1922	119.7	130.2	119.5

12	1922	120.2	132.8	122.6
1	1923	120.2	133.2	122.2
2	1923	123.7	136.7	125.5
3	1923	124.4	138.2	126.9
4	1923	127.9	145.1	134.4
5	1923	125.9	144.1	133.4
6	1923	122.6	139.7	127.3
7	1923	118.6	135.1	122.5
8	1923	120.2	135.9	124.6
9	1923	120.7	137.0	125.0
10	1923	121.1	137.7	126.3
11	1923	122.8	137.0	125.5
12	1923	120.3	133.1	120.6
1	1924	124.7	135.4	125.0
2	1924	125.5	137.1	125.8
3	1924	124.1	134.5	123.1
4	1924	124.9	137.4	127.0
5	1924	124.7	136.9	126.1
6	1924	124.6	137.1	126.7
7	1924	125.4	137.2	126.1
8	1924	126.0	138.2	126.2
9	1924	126.2	138.0	126.1
10	1924	128.7	142.8	131.9
11	1924	131.5	145.9	132.6
12	1924	134.0	148.7	135.9
1	1925	135.3	151.3	138.4
2	1925	135.8	152.4	140.7
3	1925	131.9	149.4	137.8
4	1925	132.6	150.9	140.4
5	1925	132.7	149.9	139.6
6	1925	130.9	146.7	137.1
7	1925	131.3	145.7	136.8
8	1925	134.0	148.8	139.0
9	1925	133.4	145.8	135.5
10	1925	138.2	153.2	143.8
11	1925	139.6	154.1	144.4
12	1925	140.8	153.7	144.6
1	1926	139.5	153.0	143.1
2	1926	138.5	151.2	141.7
3	1926	136.5	148.9	139.3
4	1926	136.7	149.4	140.7
5	1926	138.9	152.2	144.3
6	1926	141.3	153.7	145.8
7	1926	138.1	147.6	137.3
8	1926	141.9	150.6	140.3
9	1926	143.4	150.7	139.4
10	1926	142.5	151.9	139.8
11	1926	142.9	152.4	139.4
12	1926	144.5	152.9	140.3
1	1927	146.0	153.8	140.1
2	1927	148.2	154.4	141.0
3	1927	147.7	152.4	138.3
4	1927	147.4	154.7	140.6
5	1927	148.2	155.4	141.7
6	1927	146.6	154.0	140.6
7	1927	147.0	153.9	140.4
8	1927	150.2	156.5	142.3
9	1927	151.0	157.4	142.9
10	1927	151.2	159.9	144.5
11	1927	151.6	159.6	144.3
12	1927	154.1	162.4	147.6
1	1928	154.4	163.8	147.5

2	1928	155.1	166.4	151.2
3	1928	156.6	165.8	147.6
4	1928	161.0	171.4	153.0
5	1928	161.4	172.0	153.6
6	1928	158.3	169.8	151.5
7	1928	156.8	167.8	149.7
8	1928	161.9	173.4	156.5
9	1928	163.3	173.9	155.2
10	1928	163.5	174.9	156.8
11	1928	164.6	173.5	155.4
12	1928	164.7	174.7	156.9
1	1929	171.2	179.8	161.0
2	1929	168.4	174.4	153.2
3	1929	163.9	170.0	149.1
4	1929	164.6	170.2	150.3
5	1929	161.2	166.4	145.5
6	1929	161.8	163.8	143.1
7	1929	162.0	158.6	138.9
8	1929	168.7	163.8	144.3
9	1929	163.5	158.7	138.7
10	1929	153.4	154.7	136.7
11	1929	147.1	150.7	135.2
12	1929	142.9	147.5	132.5