The Big Bang: Stock Market Capitalization in the Long Run *

Dmitry Kuvshinov and Kaspar Zimmermann†

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Abstract

This paper presents new annual long-run stock market capitalization data for 17 advanced economies. Going beyond benchmark year estimates of Rajan and Zingales (2003) reveals a striking new time series pattern: over the long run, the evolution of stock market size resembles a hockey stick. The ratio of stock market capitalization to GDP was stable between 1870 and 1980, tripled with a "big bang" in the 1980s and 1990s, and remains high to this day. We use novel data on equity returns, prices and cashflows to explore the underlying drivers of this sudden structural shift. Our first key finding is that the big bang is driven almost entirely by rising equity prices, not quantities. Net equity issuance is sizeable but relatively constant over time, and plays very little role in the short and long run dynamics of market cap. Second, this price increase is explained by a mix of higher dividend payments, and a higher valuation – or a lower discount rate – of the underlying dividend stream. Third, high market capitalization forecasts low subsequent equity returns, outperforming standard predictors such as the price-dividend ratio. Our results imply that rather than measuring financial efficiency, stock market capitalization is best used as a "Buffet indicator" of investor risk appetite.

Keywords: Stock market capitalization, financial development, financial wealth, equity valuations, risk premiums, return predictability

JEL classification codes: E44, G10, N10, N20, O16

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†Department of Economics, University of Bonn (dmitry.kuvshinov@uni-bonn.de, kaspar.zimmermann@uni-bonn.de).

1. Introduction

How has the stock market evolved since the late 19th century, and which forces drive its long-run evolution? The consensus in existing literature centers around the "great reversals" hypothesis of Rajan and Zingales (2003): that stock markets were large at the turn of the 20th century, stagnated between 1913 and 1980, and have regained their importance today. The explanations for this trend largely relate to changes in quantities of listed equity, with the ultimate drivers, in turn, relating to institutions and political economy considerations (La Porta, Lopez-de-Silanes, Shleifer, and Vishny, 1997; Rajan and Zingales, 2003). The data underpinning this consensus are, however, relatively scant. Existing long-run market capitalization estimates are limited to several selected benchmark years, with little information on what happens in-between, and comparability issues plaguing the comparisons across countries and time.

This paper introduces a comprehensive annual dataset on the long-run evolution of stock market capitalization in advanced economies. The data cover 17 countries over the period 1870–2016, and are constructed from a wide range of primary and secondary historical sources, with many of these previously unused or newly compiled using hand-collected archival data. Together with the extensive documentation in the Data Appendix, these series provide a new resource for researchers to study the development of the stock market, equity finance, and capital structure throughout the last 145 years. Our paper uses these data to make two further contributions. First, we sketch out the main trends and patterns in the market capitalization data, mapping out the long-run evolution of stock market size at a higher frequency and for a broader sample than was previously possible. Second, we combine the capitalization data with additional information on stock returns, fundamentals and discount rates from Jordà, Knoll, Kuvshinov, Schularick, and Taylor (2019a), to re-assess the main drivers of secular movements in stock market cap. Our analysis reveals a series of new facts which are materially at odds with the current consensus.

First, the evolution of stock market size over time resembles a hockey stick. The ratio of stock market capitalization to GDP was flat at around one-third between 1870 and 1985 before undergoing a rapid, sustained and historically unprecedented expansion in the 1980s and 1990s. This structural increase – the "big bang" – leaves today's market capitalization to GDP ratios at around 1, three times the historical norm. Second, the time variation in stock market size is almost entirely driven by changes in prices, rather than quantities. The recent big bang is a sharp and persistent price appreciation, and historical swings of market cap typically track the developments in the stock price index. Third, much of the variation in stock market size is driven by cyclical and secular movements in the equity risk premium, with the recent big bang coinciding with a sharp decline in the dividend-price ratio. Furthermore, the market cap to GDP ratio predicts future equity returns, outperforming standard metrics such as the dividend-price ratio, and sharp run-ups in stock market cap share many characteristics with stock market bubbles. This suggests that rather than being associated with political norms and financial efficiency, stock market capitalization serves as a "Buffet indicator" of investor risk appetite.

The implications of our findings go far beyond the topics of financial structure and stock market development. The stock market constitutes an important component of national wealth, and one that is held by the relatively rich. Our analysis for listed equities can, therefore, be seen as a laboratory for understanding the broader trends in wealth-to-income ratios and wealth inequality, which have been subject to much recent debate (Alvaredo, Atkinson, and Morelli, 2018; Piketty, 2014; Saez and Zucman, 2016). Our findings suggest that these trends may be driven by changes in asset returns and valuations, rather than the pace of capital accummulation or labour income growth – a finding that also emerges from recent work by Bach, Calvet, and Sodini (2016) and Kuhn, Schularick, and Steins (2017). Indeed, the structural increase in market capitalization during the big bang marks a turning point towards an upward trend in national wealth and inequality. The importance of time varying risk premia in driving equity capitalization further suggests that insights from the asset pricing literature can help explain the broad macro-financial trends in the level and distribution of aggregate wealth. Finally, the fact that market capitalization predicts future equity returns shows that variation in wealth can have important implications for asset prices and risk premia, echoing Lettau and Ludvigson (2002)'s earlier findings on the predictive power of the consumption-wealth ratio.

We establish these and other related findings in four parts. First, we document the evolution of stock market capitalization across countries and time. The hockey-stick big bang pattern is a robust feature of the data: the recent expansion in stock market cap took place in every country in our sample, and in the vast majority of countries, the current level of stock market size far exceeds anything observed before the 1980s. At individual country level, market capitalization shows some correspondence to legal norms and initial capitalization levels. The long-run trends also underscore a rise in the global importance of the US equity market at the expense of those in the UK and France: while all three countries enjoyed a roughly equal share of the global market in the early 20th century, by the mid-20th century the US was clearly dominant, with its market accounting for close to 70% of the total 17-country capitalization.

The second part of our paper assesses whether variation in stock market cap is primarily driven by prices or quantities. We decompose changes in the market cap to GDP ratio into capital gains, GDP growth and net equity issuance using the methodology employed by Piketty and Zucman (2014) to decompose changes in wealth-to-income ratios into savings and price effects. We find that net equity issuance is sizeable – around 4% of market capitalization, or 1% of GDP – but relatively constant over time, and plays very little role in the short, medium and long-run swings in stock market cap. Instead, most of the cyclical and structural variation in capitalization is accounted for by stock price movements. We show that if stock price growth after 1985 had equalled its historical average, there would have been no big bang. On the contrary, if we set net issuance to its pre big bang average, the counterfactual evolution of stock market cap closely tracks actual observed data. The big bang, therefore, has little to do with changes in capital market entry, financial development, or physical accumulation of corporate equity. Rather, it is simply a sharp equity price increase that happened at a similar time across all advanced economies.

The third part of our paper looks into the factors which underpin the upsurge in equity prices during the big bang. Since firm valuations ultimately equal the discounted sum of future post-tax cashflows, the structural increase can be attributed to higher dividend payments, lower discount rates, or lower taxes. We explore the time trends in these three metrics and their correlation with the structural and cyclical movements in market cap in order to evaluate the likely contribution of each of these drivers.

We find that the structural increase in equity prices during the 1980s and 1990s is driven by a combination of higher dividends accruing to shareholders, and a higher valuation – or a lower discount rate – of the underlying dividend stream. Total dividend payments increased from 1% of GDP in 1985 to 2.5% of GDP in 2015. At the same time, the dividend-price ratio – a proxy for the rate at which these dividends are discounted – has fallen from a historically stable average of 4.5% to less than 3%. Together, these two developments can explain close to the entirety of the big bang.[1] Taxation, on the other hand, seems to be of only second-order importance. Corporate and income taxes did fall between the 1980s and today, but their levels have remained much higher than in the first half of the 20th century, a time when stock market capitalization was close to its historical average. These findings are confirmed by running cross-country explanatory regressions. Dividends to GDP and the dividend-price ratio are strongly correlated with market capitalization across different time horizons and historical periods, while changes in taxes are not.

What lies behind the recent trends in cashflows and discount rates? Some of the increase in cashflows is likely attributable to greater market power – and hence higher profitability – of larger firms, which also tend to be listed (De Loecker and Eeckhout, 2017). Discount rates can fall either because of a lower safe rate, or a lower equity risk premium. But despite a recent decline (Holston, Laubach, and Williams, 2017), safe rates are currently close to their long-run average levels, while market capitalization is not. This suggests that much of the recent decline in the discount rate is attributable to a structurally lower equity risk premium driven, for example, by lower macroeconomic risk (Bianchi, Lettau, and Ludvigson, 2016; Lettau, Ludvigson, and Wachter, 2008) or higher investor demand for advanced-economy risky assets (Bernanke, 2005).

In the final part of the paper, we show that the link between risk premia and market capitalization goes far beyond the long-run structural trends discussed above. The stock market cap to GDP ratio turns out to be a reliable measure of the time varying risk premium in the equity market. High market capitalization predicts low equity returns, and low – rather than high – cashflows. In fact, market cap substantially outperforms the standard price-dividend ratio variable as an equity return predictor. We show that this superior performance is driven by two factors. First, GDP is a better measure of the underlying corporate fundamentals than dividends, being, for example, relatively unaffected by changes in dividend policy. Second, capitalization is a better valuation metric, because it includes information on quantities as well as prices, which allows it to better capture the time

[1] In the data, stock market capitalization increased by 80% of GDP during the big bang. A back-of-the-envelope calculation suggests that if dividends increase by 1.5–2% of GDP, and this increase is discounted at 2%–3% per year, valuations should increase by between 50% and 100% of GDP.

variation in factors such as investor sentiment.[2] The data lend support to both of these claims. On the first, we show that the ratio of stock prices to GDP does a better job at predicting returns than the ratio of stock prices to dividends, suggesting that GDP is more informative about firm fundamentals than dividends. On the second, we show that net issuance predicts future returns, even when controlling for the current price-dividend ratio.

Taking this analysis further reveals that rapid increases in stock market capitalization share many characteristics with stock market bubbles: they are accompanied by high returns and rising equity valuations, and followed by low equity returns and a higher risk of an equity market crash. These results connect nicely with parallel evidence on sectoral stock market run-ups and subsequent crashes in the United States (Greenwood, Shleifer, and You, 2018). Warren Buffet called stock market capitalization "the best single measure of where valuations stand at any given moment" (Buffett and Loomis, 2001). Taken together, our findings underscore the high relevance of the "Buffet indicator" for the return predictability literature.

Our work is related to three strands of existing literature. The first strand seeks to document the evolution of stock market size, with the earliest estimates dating back to occasional surveys of stock market activity commissioned by wealthy financiers and by stock exchanges (Burdett, 1882; Green, 1887). More recently, economic historians have provided more extensive estimates of market capitalization for individual countries (Hoffmann, 1965; Roe, 1971; Waldenström, 2014). When it comes to cross-country data, Goldsmith (1985) and Piketty and Zucman (2014) have constructed estimates of national wealth which include listed equities, and Rajan and Zingales (2003) – of the stock market capitalization itself, albeit with much of this analysis limited to selected benchmark years. Our paper is the first to compile long-run cross-country market capitalization data at annual frequency. The paper is complemented by an extensive Data Appendix which contains a detailed discussion of the various quality checks and comparisons with other existing capitalization estimates.

The second strand seeks to understand the drivers of stock market size and equity wealth. A number of papers, including Atje and Jovanovic (1993), Levine and Zervos (1996), La Porta et al. (1997) and Musacchio (2010), have equated stock capitalization with financial development and equity issuance, and sought to link market capitalization movements to legal norms and broader market-friendly regulations. Other authors have, however, instead focussed on changes in stock valuations, with McGrattan and Prescott (2005) attributing the recent increase in equity wealth of US corporations to lower corporate taxes, and De Loecker and Eeckhout (2017) emphasising the role of higher mark-ups. Our findings support this second, valuation-based view on stock market wealth. We further show that the importance of valuation changes goes far beyond the recent US data, and that a substantial part of these changes is attributable to time varying risk premia.

A third strand of literature has documented the importance of time variation in the risk premium on equities through return predictability regressions. A number of studies have shown that US

[2] Baker and Wurgler (2000) show that if investors time the market to issue equity when pricing conditions are relatively favourable, periods of elevated investor sentiment should be accompanied by increases in both share prices and quantities.

equity returns can be predicted by the dividend-price ratio, and that this expected return or discount rate variation explains most of the changes in equity values (Campbell and Shiller, 1988; Cochrane, 2008). A number of alternative return predictors have also been explored, with Lettau and Ludvigson (2002) documenting the predictive power of the consumption-wealth ratio, Rangvid (2006) – of the stock price to GDP ratio, Cooper and Priestley (2008) – of the output gap, and Baker and Wurgler (2000) – of equity issuance. We show that market cap to GDP captures some of the additional informational content of these alternative predictors, and is therefore able to outperform the price-dividend ratio. The fact that much of the superior power comes from using GDP instead of dividends, and quantities as well as prices, points towards importance of factors such as dividend smoothing (Chen, Da, and Priestley, 2012) and investor sentiment (Baker and Wurgler, 2000) for the empirical predictability relationships.

Stock markets today are larger than at any point in recent history. This, however, does not mean that financial markets are substantially more developed. Rather, this means that stock valuations are unusually high, and have been so for the best part of the last three decades. These high valuations could harbour positive news about high future corporate profitability or low levels of risk. But our analysis suggests that the rise of the stock market entails a darker side. Much of the increase in valuations is driven by a low equity risk premium – a factor that tends to fluctuate substantially over time and can quickly mean-revert, inducing large swings in stock prices, capitalization and household wealth. Indeed, the structural increase in market capitalization during the big bang has been accompanied by higher volatility, with several large surges in market cap followed by reversals to the structurally higher post-1980 mean.

2. A new dataset on historical stock market capitalization

This paper introduces a new dataset on the historical size of stock markets in advanced economies. The data consist of statistics on total stock market capitalization, on an annual basis, in 17 countries, from 1870 to today. The countries included are Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. Our data measure the total market value of all ordinary shares of domestic companies listed on the domestic exchanges at the end of each calendar year.

We use a wide range of primary and secondary sources to construct the data series, many of these new and previously unused. The secondary sources consist of financial history books and research articles, and publications of stock exchanges, statistical agencies, central banks and trade bodies. Where reliable secondary sources were not available, we construct the capitalization measure by aggregating the total market values of individual stocks, using data on stock prices and number of shares or listed capital value from stock exchange bulletins and gazettes, stock exchange handbooks and companies' published accounts. Most of these primary source data were newly compiled through a series of archival visits to the respective countries' stock exchanges, central banks and national libraries, while some were also helpfully shared with us by other researchers.

We generally produce annual estimates of capitalization, but for instances where these were not available, we obtain capitalization data for benchmark years and construct the annual series using changes in the book capital of listed companies and share prices. An extensive Data Appendix, Tables D.1–D.17 and Figures D.1–D.17 detail the sources used for each country, and compare our estimates to others in the existing literature. For the decomposition and predictability analysis in Sections 4–6, we complement these data with statistics on equity prices, returns, and dividends from Jordà, Knoll, Kuvshinov, Schularick, and Taylor (2019a) and Kuvshinov (2019), and data on taxes and corporate profits, much of it sourced from the work of Piketty and Zucman (2014).

The main challenge in constructing stock market capitalization indices is getting appropriate coverage of all ordinary shares listed on domestic stock exchanges, that are issued by domestic firms. This means that, first of all, the series should only include ordinary shares and exclude preferred shares and other securities listed on the stock exchange, such as preference shares and bonds (Hannah, 2018, offers a discussion of these issues in the early London Stock Exchange data). Some of the earlier statistical estimates bundle these different securities together, or sometimes only provide figures for both unlisted and listed equity liabilities. We therefore ensure that our estimates capture ordinary shares only, by where necessary constructing our own benchmark year estimates, or using supplementary stock exchange data and research publications to make this distinction.

The second challenge is that the capitalization measure should sum the securities listed on all domestic stock exchanges, net of any cross listings. Wherever possible, we therefore rely on data that cover all the major stock exchanges in the country, constructing our own estimates from microdata when necessary, as in the case of the pre World War 1 German stock market cap (see Appendix Table D.7). It is, however, not always possible to obtain information on the capitalization of smaller stock exchanges, especially one that goes beyond benchmark years. For most countries in our sample, the bias from excluding smaller exchanges is small because by the late 19th century, stock markets in many countries were already quite centralised, and many securities that were chiefly traded on smaller markets were often also quoted on the main stock exchange. The potential for bias is the greatest for early US data, where several large stock exchanges and an active curb market were in operation (Sylla, 2006). For the US and several other countries we, therefore, rely on benchmark year estimates to proxy the size of regional and curb exchanges relative to the main market.

The third challenge relates to excluding foreign stocks. For most of our estimates, the foreign stock share is either well measured (e.g. in recent data) or small (as for most of the mid-20th century data), so the measurement issues mainly concern the large international stock exchanges in the early 20th century, in particular the London stock exchange. We rely on a mixture of secondary sources and own estimates to adjust the equity market capitalization for foreign stocks, such that the remaining biases should be small, with the most likely direction leading us to slightly overstate the domestic stock market capitalization in the financial center countries during the early 20th century.

The Data Appendix contains a detailed discussion of the various quality checks and comparison with other existing capitalization estimates. In general, our data are in line with previous country-specific estimates constructed by financial historians and statisticians. When it comes to cross-country

estimates of Goldsmith (1985) our estimates are typically below his national balance sheet data, because the Goldsmith (1985) estimates often include unlisted stocks, preference shares or bonds in the capitalization total, whereas ours focus on listed ordinary shares only. Our estimates are sometimes above and sometimes below those of Rajan and Zingales (2003), depending on the specific country and time period. For example, our estimates of the early 20th century US market capitalization are higher than those of Rajan and Zingales (2003), while those for the UK are lower, which goes towards addressing the criticisms of the Rajan and Zingales (2003) data raised by Sylla (2006), relating to the inclusion of curb and regional exchanges, and the exclusion of bonds and foreign shares.

Our dataset advances the existing knowledge of market capitalization along two main dimensions. First, the estimates go beyond benchmark years which allow us to discern general trends, making sure they are not skewed by year-specific outliers, to look at both short-, medium- and long-run changes in capitalization within a unified framework, and, together with the data on stock prices and other financial variables, decompose the changes in capitalization into prices and quantities, and conduct a more detailed analysis of what the underlying drivers of stock market size are. None of the analysis in Sections 3–6 would have been possible to conduct without annual data. Second, our estimates are based on updated and generally higher-quality source data compared to previous work, covering an extended time period from 19th to 21st century, all based on a consistent definition of market cap. The next four sections present several novel facts and findings that emerge from these new data.

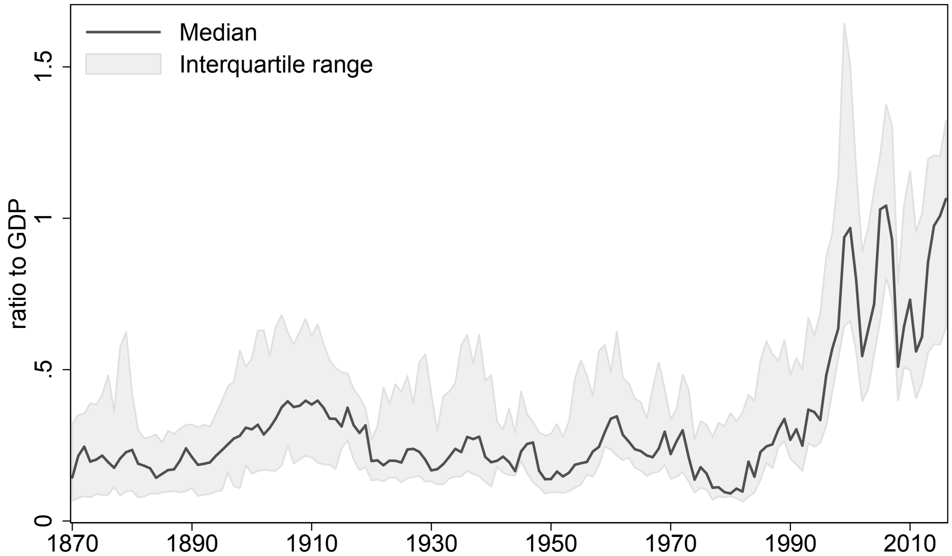
3. The Big Bang

Figure 1 shows the ratio of stock market capitalization to GDP across the 17 economies in our sample between 1870 to today. The solid black line is the sample median, and the shaded area is the interquartile range of country-level data.

From the end of the industrial revolution and up to the late 1980s, the size of the stock market had been relatively stable, at around one-third of a country's output. This was true both across time, with the median stock market cap to GDP ratio always below 0.5 during this period, and across countries, with the interquartile range oscillating between 10% and 60% of GDP. Market capitalization has experienced several pronounced swings during that time: the boom of the early 1900s during which capitalization roughly doubled, and the subsequent collapse during World War 1 when it halved again; the modest decline after World War 2, and the downturn during the stagflation of the 1970s. But each time, market capitalization eventually returned to its historical average level, around one-third of GDP.

Over the last several decades however, the stock market has undergone a historically unprecedented expansion. The median market cap to GDP ratio increased from 0.2 in 1980 to 1 in 2000, with some countries' stock markets growing to more than three times the size of their gross output. Moreover, this surge in stock market cap seems to have been persistent – despite sharp equity price

Figure 1: *Stock market capitalization in advanced economies*



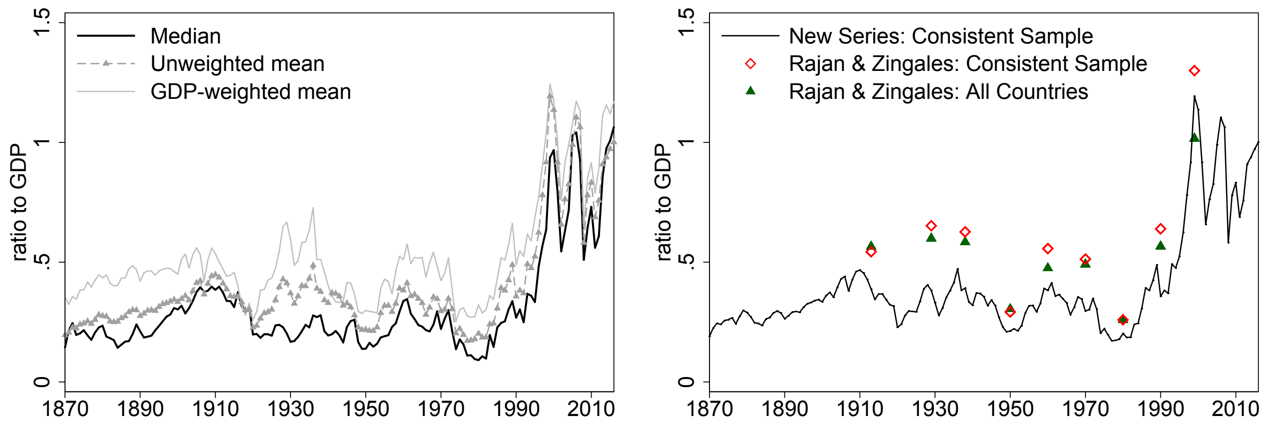
Notes: Stock market capitalization to GDP ratio, 17 countries. The solid line and the shaded area are, respectively, the median and interquartile range of the individual country capitalization ratios in each year.

corrections in the early 2000s and the Global Financial Crisis of 2008–09, market cap to GDP ratios today remain around three times larger than the historical norm. We loosely term this sudden and rapid growth of the stock market in the 1980s and 1990s as "the big bang".

Figure 2a shows that this hockey stick pattern holds regardless of how we aggregate the individual country data: the time trend of the unweighted and GDP-weighted stock market cap series is very similar to that of the median shown in Figure 1, and shows the sharp and persistent increase starting in the 1980s. Figure 3 further plots the trends for each individual country in our sample. The big bang is very much a cross-country phenomenon. The sharp equity market expansion in the 1980s and 1990s is evident in every single country in our dataset. In the vast majority of countries, the longer term time series pattern follows a hockey stick similar to that in Figure 1, with the peaks reached during the big bang period unsurpassed and unprecedented over the remainder of the sample. For a few countries in our dataset, the big bang can be seen as a return to some previously high level of market capitalization that was in place before a structural decline, financial or economic shocks – such as the two world wars or, in the case of Portugal, the Carnation revolution – reduced the size of the respective stock markets, only for them to experience a renaissance over the recent decades.

In comparison to existing literature, the big bang hockey stick differs from the U-shape "great reversals" pattern documented by Rajan and Zingales (2003) (henceforth RZ). RZ compiled data on market capitalization and other financial development indicators at benchmark years between 1913 and 1999, and argued that markets were well developed during the early 20th century, subdued during the mid-20th century, and bounced back over the more recent period. Figure 2b compares our market capitalization estimates to those of RZ. To improve comparability, we have excluded

Figure 2: *Alternative market capitalization estimates*



(a) *Alternative aggregators* **(b)** *Comparison to Rajan and Zingales (2003)*

Notes: Stock market capitalization to GDP ratio. Left-hand panel: Median, unweighted and GDP-weighted averages of 17 countries. Right-hand panel: Estimates in our data compared to those of Rajan and Zingales (2003), unweighted averages. The consistent sample includes all countries in our dataset apart from Finland, Portugal and Spain.

Finland, Portugal and Spain, which are present in our sample but not that of RZ, from our series (solid black line). The figure also presents the original RZ estimates for 22 countries (green triangles), and their estimates for the 14 countries in our reduced consistent sample (red diamonds).

We can see that the differences between our estimates and those of RZ is not driven by sample composition. Even though their sample includes some countries that are absent in ours, this makes little difference: countries with high market capitalization to GDP ratios in the 1913 RZ data – such as Cuba and Egypt – are counterbalanced by others with relatively low ratios, such as Russia and India. Some of the differences can be attributed to the improved quality of our data. Earlier estimates of stock market capitalization sometimes lacked accuracy because they included securities other than the ordinary shares of domestic companies – for example, bonds – or did not include data from smaller stock exchanges. But as with the sample composition, these differences balance out to a certain extent: excluding bonds or foreign shares reduces some of the market cap estimates, while including other stock exchanges increases them. Altogether, our aggregate stock market capitalization estimates are somewhat below those of RZ, especially for the mid-20th century period, but the figures are broadly comparable. The extensive Data Appendix presents a detailed comparison of our data with alternative estimates for each country, including those of RZ. The averages in Figure 2b do obscure some sizeable differences for individual countries, as can be seen in the comparisons for Australia, Canada, Japan and Norway in Appendix Figures D.1, D.3, D.9 and D.11.

The main reason that, up to this point, the big bang has been somewhat hidden from view, is the lack of annual data on stock market capitalization. Because equity prices are volatile, stock market capitalization varies substantially from year to year. The annual standard deviation in the

Figure 3: *Stock market capitalization to GDP ratio in individual countries*

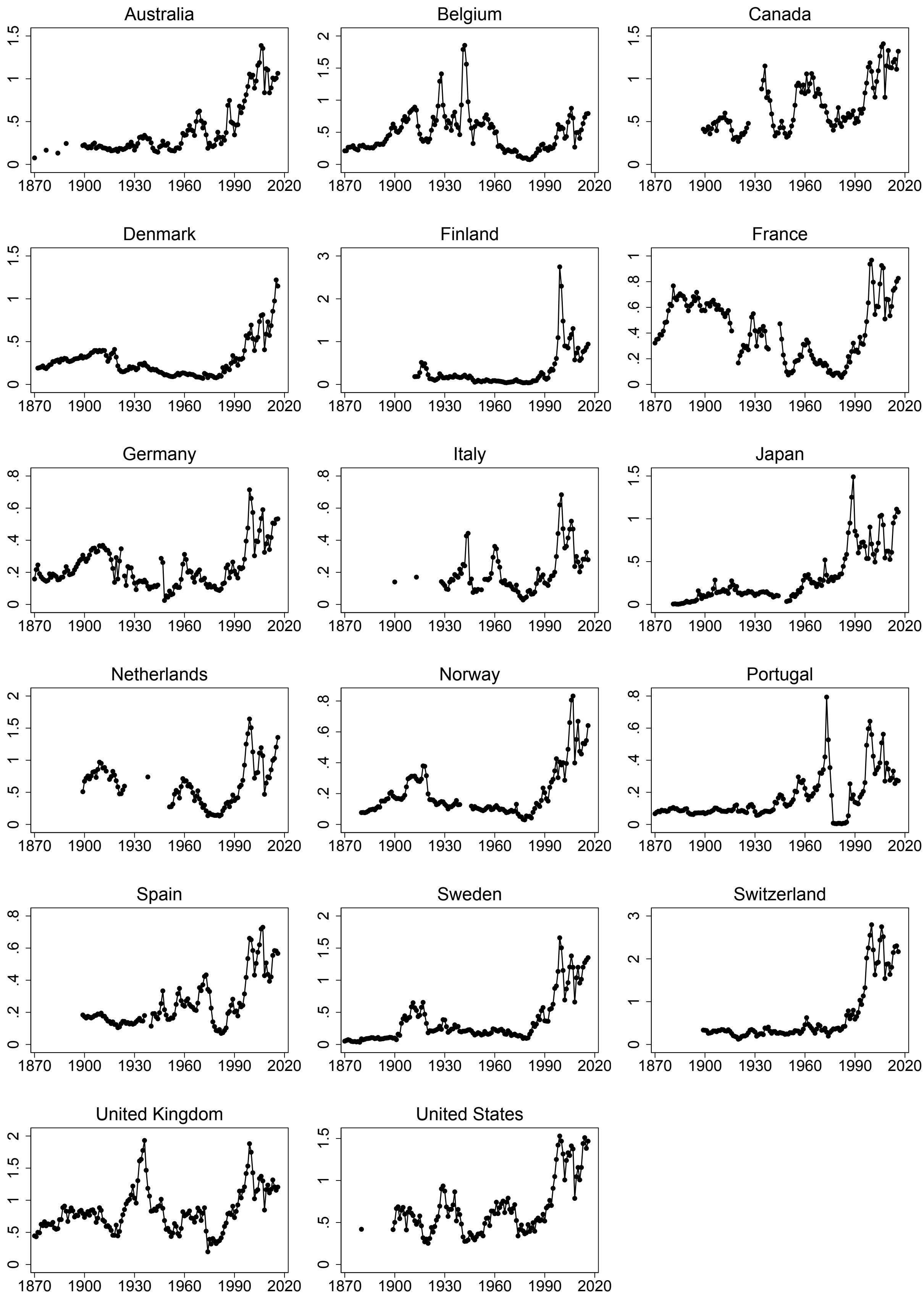
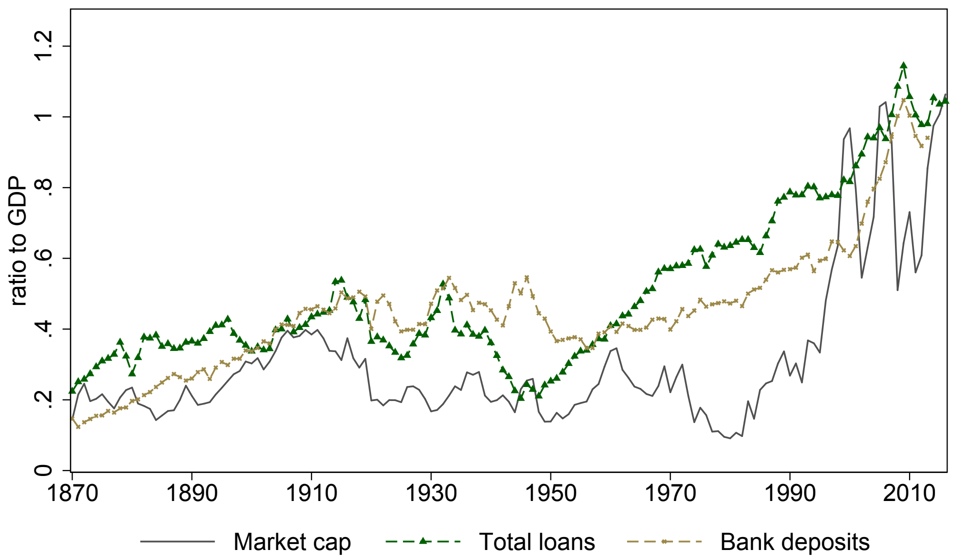


Figure 4: *Stock market capitalization and other measures of financial development*



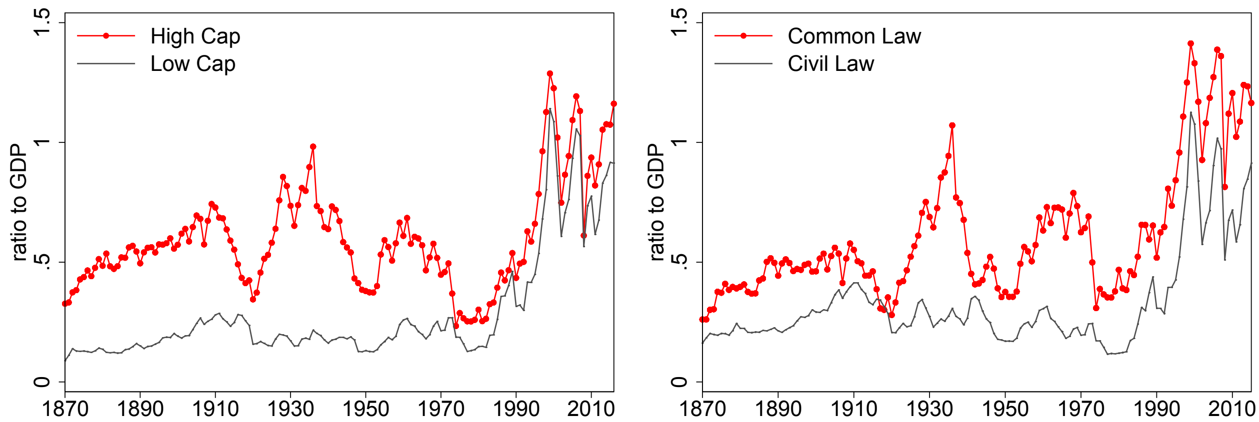
Notes: Median ratio of stock market capitalization, total loans and bank deposits to GDP, 17 countries.

market cap to GDP ratio is close to 0.4, around the same size as the mean of the series. The choice of the benchmark year thus has a significant influence on long-run market cap comparisons, and can obscure the underlying trends in the data. For their comparison, RZ mostly relied on years 1913, 1980 and 1999. But Figure 2b shows that 1980 was a trough of the equity price cycle, while 1913 and 1999 were peaks. Focussing only on these individual years makes the long-run market cap pattern more similar to a U shape. Adding the 18 years of data beyond 1999 further helps establish that the increase in market capitalization in the 1980s and 1990s was a persistent structural shift, rather than a short-lived equity boom.

Does this mean that financial markets in the early 20th century, and as recently as 1980, were far less developed than they are today? We postpone the detailed discussion of this question until the next section, but some of the broad patterns in the data indicate that this may not be the case. First, the evolution of other measures of financial development points to a far more gradual and slow-moving improvement over the last 150 years. Figure 4 shows the evolution of total credit to the non-financial sector (green triangles), and total bank deposits (brown crosses) alongside market cap, all expressed as a ratio to GDP. The credit data come from Jordà, Schularick, and Taylor (2016), and deposit data – from Jordà, Richter, Schularick, and Taylor (2017). Both of these measures show a steady growth in the late 19th century, followed by a plateau and a fall around World War 2, before a steady rise starting in the 1950s and continuing until today. The time pattern of the changes is quite different to stock market cap: the 20th century trough occurs around the time of World War 2 rather than World War 1, and the recovery starts much earlier, and continues for a longer time and at a slower pace than the big bang.

Much of the literature on financial development has also emphasised the importance of persis-

Figure 5: *Market capitalization across different groups of countries*



(a) *High vs low initial market cap* **(b)** *Legal origin*

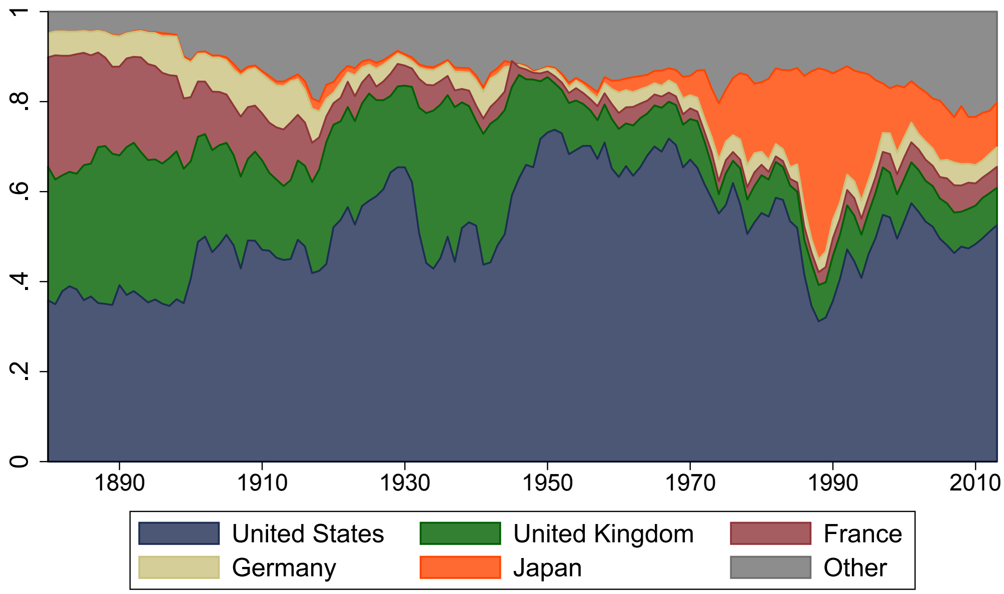
Notes: Stock market capitalization to GDP ratio by country group, unweighted averages. Left-hand panel: High cap countries are Belgium, Canada, France, Netherlands, the UK and the US. Low cap countries are all other countries in our dataset. Right hand panel: Common law countries are Australia, Canada, the UK and the US. Civil law countries are all other countries in our dataset.

tence, or initial conditions in shaping future financial growth (King and Levine, 1993). This pattern of historical persistence is, to an extent, also echoed in our market capitalization measure. Figure 5a splits our countries into two groups: those which had large stock markets in 1910 (red diamonds), and those that did not (solid black line). Countries with large stock exchanges during that time consist of the financial centres in the UK, US and France, and smaller but highly developed and internationally integrated markets of the Netherlands and Belgium, as well as Canada, whose high capitalization was largely driven by the large caps of Canadian railway and financial stocks (Michie, 1988). This group of countries already had much larger stock exchanges as early as in 1870, and their advantage persisted throughout the 20th century. The big bang, however, marks a point of convergence between these two groups of countries: from 1990 onwards, average stock market capitalization in countries with initially small stock markets was similar to those with initially large markets. To some extent, this process of convergence already started before the big bang, as the high-cap group of countries was more heavily hit by the shocks of World War 2 and the 1970s stagflation.

A similar convergence pattern emerges when we group the countries according to their legal norms, shown in Figure 5b. La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997) hypothesised that stock markets in common law countries tend to be more developed because of the more market-friendly legal norms. This pattern is largely borne out by the evidence in Figure 5b: common law countries (red circled line) – which, in our dataset, consist of Britain, Canada, US and Australia – have generally had larger market capitalization than civil law countries (solid black line), in particular during the mid-20th century.[3] But the differences had not always been large, and the

[3] Also consistent with the legal origin thesis, civil law countries tend to have more bank-based, rather

Figure 6: *World market capitalization shares*



Notes: Shares of individual countries' capitalization in world total. Capitalization shares are computed by transforming domestic stock market capitalization into US dollars using historical exchange rates and dividing it by the sum of capitalizations of all 17 countries. Shares of the United States, the United Kingdom, France, Germany and Japan are shown separately. All other countries are combined together into one joint item.

two groups of countries have converged somewhat during the big bang. Furthermore, market capitalization in both the "high-cap" group of countries in Figure 5a, and the common law countries in Figure 5b tends to be more volatile, or cyclical, with large peaks in the 1930s and 60s, and troughs around the two world wars and in the 1970s.

The new dataset also allows us to investigate the relative importance of individual domestic equity markets. Figure 6 shows the share of each country's stock market in the world market capitalization (i.e. the total of our 17 countries). It reports separate shares for the US, UK, France, Germany and Japan and lumps all other countries together. In 1880 world capital markets were roughly divided between three major players: the United States, France and Great Britain. This distribution, however, changed markedly during the subsequent 50 years. While the US was able to quickly increase its market share between 1880 and 1930, the French stock market's global importance more or less vanished. UK's market share also dwindled, albeit at a slower pace than France's. After the Second World War global equity markets became almost entirely dominated by the United States, with US equities accounting for roughly 70% of the global market cap in 1950. Even though the US has lost importance over recent decades, the size of its stock market today is still

than market-based financial systems. But interestingly, this is not only because their market-based financial intermediation is relatively less developed (as shown in Figure 5b). Banking systems in civil law countries also tend to be more developed – relative to GDP – than those in common law countries. Appendix Figure A.2 shows that civil law countries tend to have higher deposit-to-GDP and, especially, loan-to-GDP ratios, both throughout history and in present day.

comparable to that of the other 16 economies grouped together. New equity markets have gained importance, with other countries slowly catching up, and Japan's market share expanding during the high growth era after World War 2. Even though Japan still has an important equity market today, it is the Japanese stock market bubble of the 1990s that stands out in the data. Capitalization of Japanese listed companies grew from 5% of the global market in 1970 to 40% in 1989 – comparable in size to the US – and collapsed thereafter.

Our long-run data show that stock market size had been relatively stable before a relatively recent upsurge in the 1980s and 1990s. This upsurge occurred across countries and has no historical precedent. It constitutes a structural break in the evolution of market cap, rather than a reversal to some previously high stock market cap level. At country level, market capitalization tends to be persistent, and shows some relation to legal norms – but the big bang also resulted in a convergence of stock market size across different economies. At the global level, total stock capitalization has been dominated by US equities until recent decades.

Can we interpret these patterns as changes in financial development? Was there no financial development for 100 years between 1870 and 1980, and are countries far more financially developed today than they were 30–40 years ago, and at any point from 1870 to today? To answer these questions, we need to understand what drives changes in stock market cap over these long periods of time, and across countries. Section 4 decomposes the market capitalization changes into quantities and prices, and Section 5 looks into the deeper underlying drivers of these structural trends.

4. Decomposing the Big Bang

We first seek to understand whether stock market cap growth is driven by quantities or prices – i.e. stock market issuance, by both new and existing firms, or the valuation of issued stocks. To do this, we decompose the market cap to GDP growth into issuances, valuations and GDP growth using a similar technique to the Piketty and Zucman (2014) decomposition of growth in wealth-to-income ratios.[4] To derive the decomposition, we first note that total market capitalization $MCAP$ is simply the the sum of the capitalizations – or quantity Q times prices P – of each individual share listed on the exchange:

$$MCAP_t = \sum_{i=1}^{N} P_{i,t} Q_{i,t}, \tag{1}$$

[4] Piketty and Zucman (2014) decompose the growth in the ratio of wealth to income into capital gains on wealth, income growth and saving rates – equivalent to, respectively, capital gains on equity, GDP growth and net issuance in our decomposition.

where N is the total number of listed shares. Rewriting equation (1) in difference terms, the change in market cap either comes about from higher quantities Q – i.e. issuance, or higher prices P:

$$MCAP_t = MCAP_{t-1} + Issuances_t + Capital\ Gains_t \tag{2}$$

$$Issuances_t = (Gross\ issues_t - Redemptions_t)/MCAP_{t-1} \tag{3}$$

$$Capital\ Gains_t = MCAP_{t-1} * P_t/P_{t-1} \tag{4}$$

Here $Issuances_t$ is total net equity issuance in proportion to previous year's market cap, $Capital\ Gains_t$ is the capital appreciation of the previous year's capitalization, and P_t is the value-weighted stock price index. Dividing through by GDP, rearranging and taking logs, we can write down the following linear approximation of the growth in the market cap to GDP ratio:

$$g_t^{MCAP/GDP} \approx iss_t + r_t^{eq} - g_t \tag{5}$$

Equation (5) breaks market cap to GDP growth down into three components: issuances (i.e. quantities), capital gains (i.e. changes in P), and real GDP growth. Here, $g^{MCAP/GDP}$ is the geometric growth in the market cap to GDP ratio, $g^{MCAP/GDP} = log(MCAP_t/GDP_t) - log(MCAP_{t-1}/GDP_{t-1})$. iss_t is the yearly net stock issuance relative to previous year's market cap, again expressed in terms of geometric growth: $iss_t = log(1 + Issuances_t/MCAP_{t-1})$. r_t^{eq} is the real equity capital gain, $r_t^{eq} = log(P_t/P_{t-1}) - log(1 + \pi_t)$, where π_t is the CPI inflation rate. g_t is real GDP growth, $g_t = log(GDP_t/GDP_{t-1}) - log(1 + \pi_t)$.

Table 1 shows this decomposition in our data, for the full sample and three different subperiods, which roughly correspond to the trend in market capitalization shown in Figure 1.[5] The subperiods cover the initial pre-WW1 market cap growth (column 2), the mid-20th century stagnation (column 3), and the big bang (column 4).[6] Starting with the full sample results in column 1, the average geometric growth in the stock market cap to GDP ratio of 1.6% is modest, but over 150 years it adds up to the market cap increase of close to 80% GDP, from 20% of GDP in 1870 to 100% of GDP in 2015.[7] Hardly any of this long-run growth is attributable to real capital gains, which average just 0.4% per year, far below the real GDP growth of 2.8%. Had there been no capital market issuance throughout the period, the market cap to GDP ratio would have been falling. The shortfall is made up by positive net issuance, which, on average, amounts to around 4% of market cap, or a little over 1% of GDP.

High net issuances were the driving factor propping up market capitalization over the long

[5]Table 1 also includes a small approximation error, which arises because of the log approximation, and because real GDP and real equity price growth use different deflators.

[6]We choose 1985 as a benchmark for two reasons. First, 1985 marks the point of recovery in stock market returns from the trough in 1980 to close to their historical average, and allows us to look through the equity market cycle. Second, it roughly coincides with the famous "big bang" financial sector liberalisation in the UK under Thatcher, which soon after took hold in many other countries in our sample.

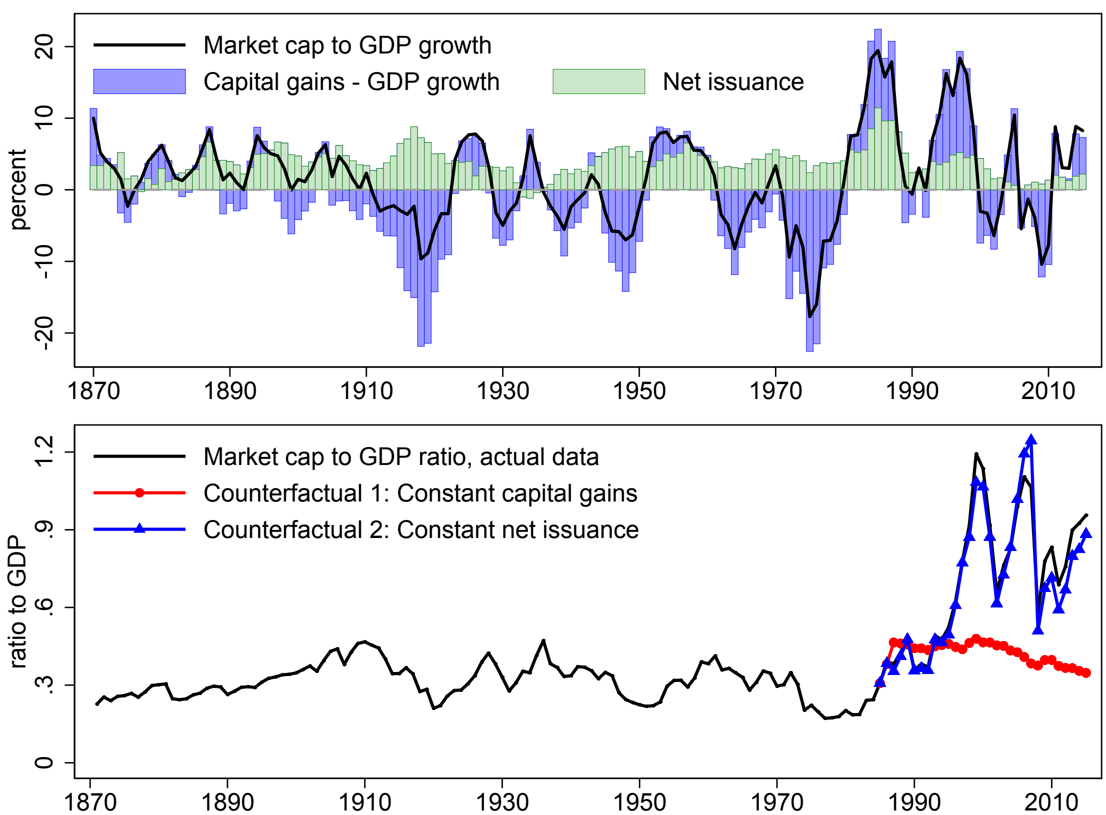
[7]The 1.6% growth rate applied to the average market cap to GDP ratio of 0.4 means an average annual increase in market cap of around 0.6% of GDP (1.6% $\times$ 0.4), adding up to 80% of GDP over 145 years.

Table 1: *Market capitalization growth decomposition*

	(1) Full sample	(2) Pre 1914	(3) 1914–1985	(4) Post 1985
Market capitalization growth	1.54	2.47	-0.13	4.42
Decomposition of market capitalization growth into:				
Implied issuance to market cap	3.86	3.76	4.09	3.43
+ Real capital gain on equity	0.41	0.96	-1.17	3.41
− Real GDP growth	2.84	2.41	3.26	2.28
+ Approximation residual	0.11	0.16	0.21	-0.14
Observations	2068	448	1116	504

Notes: Decomposition of market cap to GDP ratio growth into issuances, capital gains and GDP growth based on equation (5). Market cap growth is the change in the log of market cap to GDP ratio. Implied issuance is the change in market cap not explained by equity prices or GDP growth. The sum of implied issuance and real capital gains, minus real GDP growth is equal to total market cap growth, subject to a small approximation residual from using log growth rates. Average of pooled cross-country observations.

Figure 7: *Decomposition trends and counterfactual*



Notes: Top panel: Decomposition of annual stock market cap to GDP growth into issuances, and capital gains less GDP growth, using equation (5). Centered five-year moving averages. For variable descriptions, see notes to Table 1 and main text. Bottom panel: Counterfactual market cap to GDP ratio evolution during the big bang. Constant capital gains counterfactual forces the real capital gains during 1985–2015 to equal the pre-1985 average. Constant net issuance counterfactual forces net issuance relative to market cap during 1985–2015 to equal the pre-1985 average. All data are unweighted averages of 17 countries.

run. Long-run averages aside, however, most of the time variation in the market cap to GDP ratio can be attributed to changes in real capital gains. This can be most easily seen in Figure 7, which decomposes five-year moving average annual market capitalization growth (black line) into issuances (blue bars) and capital gains minus GDP growth (green bars).[8] Net issuances are very stable from year to year, and show little secular or cyclical patterns. Most of the variation in the stock market cap to GDP ratio is driven by short and medium run swings in real capital gains. Furthermore, these capital gain movements tend to drive market capitalization changes at horizons far longer than the typical business or financial cycle frequency. This can be most easily seen by going through the decomposition trends across the different historical subperiods, presented in Table 1 columns 2–4. The differences in market capitalization growth across these time periods, which generally last between 40 and 70 years, are largely driven by capital gains.

Table 1 column 2 presents the growth decomposition for the initial increase in market cap, from 0.2 of GDP in 1870 to 0.4 of GDP in 1913. Looking at this period in isolation, one could conclude that the main driver behind this increase was net stock issuance, and ultimately financial development, since issuance growth makes up the largest contribution to the growth in market cap. But in the bigger picture, this issuance growth of 3.9% is roughly equal to the full-sample average. The underlying drivers of this initial market cap increase are slightly above-trend real equity price growth (1% p.a vs long-run average of 0.4% p.a.) combined with slightly below-trend real GDP growth (2.4% p.a vs long-run average of 2.8% p.a.). The initial market cap increase can, therefore, be attributed to the near-absence of large shocks to equity valuations at the same time as the general macroeconomic performance was relatively weak (see also Figure 7).

Moving on to the market cap stagnation during 1914–1985, Table 1 column 2 shows that, indeed, the average market cap to GDP growth during this time period was approximately zero. The relatively robust net issuance (on average, 4.1% of market cap) was held back by negative real capital gains (-1.2% p.a.), and higher than average real GDP growth (3.3% p.a.). Figure 7 shows that these negative capital gains were a result of several large shocks that hit the equity market during this period. The largest aggregate shocks occurred during World War 1 and the 1970s stagflation. World War 2 and the Great Depression also had a negative, but smaller, effect on the stock market. These aggregate trends mask further shocks that hit individual countries, with the largest of these occurring during the Portuguese Carnation Revolution of 1974. In its aftermath, the Portuguese stock market lost roughly 98% of its value (see Appendix Figure D.12). The impact of other political shocks, such as the Spanish Civil war and the Nazi occupation was sometimes negative, but generally small (see Le Bris, 2012, for the case study of occupied France).

Column 4 of Table 1 captures the period of the big bang, or explosive and persistent growth in market capitalization in the 1980s and 1990s. On average, market cap to GDP ratios grew by around 4.4% per year, or 3.2% of GDP (4.4% times the average market cap to GDP ratio of 0.7). This growth

[8] Capital gains and GDP growth are combined to reduce complexity, but Appendix Figure B.1 presents all three series separately.

was not driven by net issuances: these were on average slightly lower than over the full sample.[9] Lower real GDP growth made a positive, but relatively small contribution (2.3% p.a. vs 2.8% p.a. full-sample average). Instead, the big bang is largely driven by higher real capital gains. Stock prices grew at a rate of 3.4% per year in real terms, eight times the full-sample average. Figure 7 shows that these increases largely occurred in the 1980s and 1990s, and were only partially tempered by the burst of the dot-com bubble and the Global Financial Crisis of the 2000s.

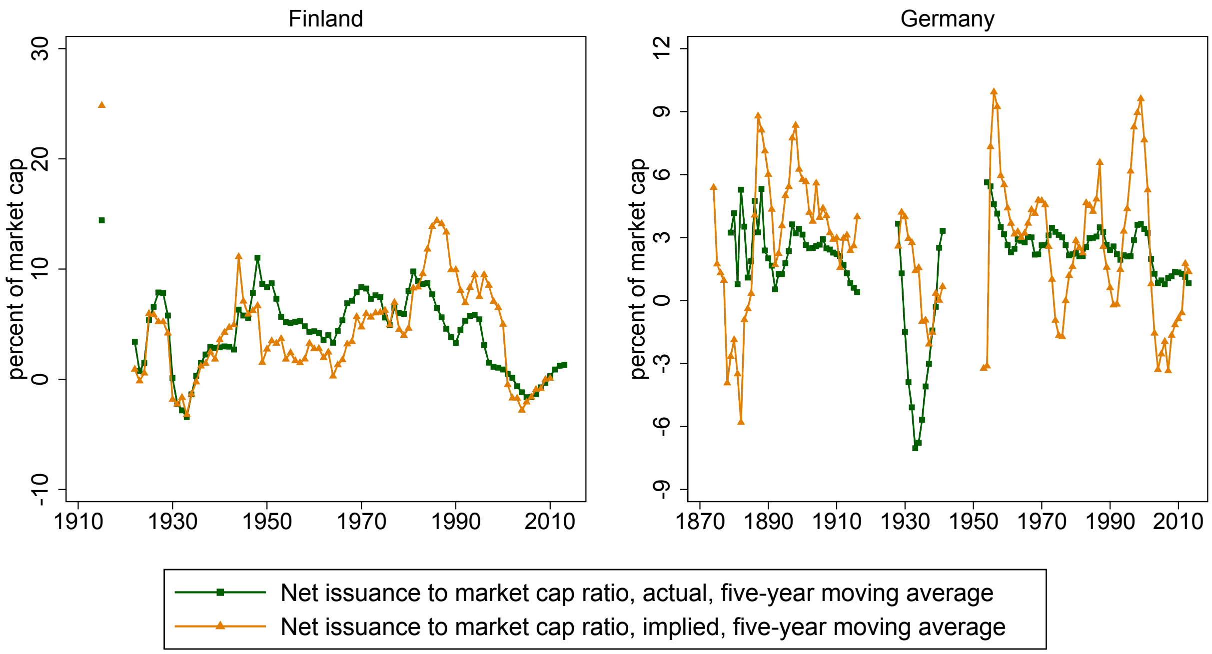
The bottom panel of Figure 7 further illustrates this result. It displays two counterfactual market cap evolutions together with the actual data (solid black line). The first counterfactual, marked by red diamonds, shows what the market cap evolution after 1985 would have been if we fixed the capital gains to their pre-1985 average. Under this scenario, all changes in the stock market cap from 1985 onwards are attributable to net issuance and real GDP growth. Without abnormally high capital gains in the 1980s and 1990s, market capitalization stays relatively constant, and even shows a mild decline over the last 20 years. The second counterfactual (blue triangles) instead fixes issuances to their pre-1985 mean, and attributes all the growth in stock market cap after 1985 to real capital gains. In line with the discussion above, this counterfactual closely follows the actual data. In essence, the big bang is simply a marked and persistent increase in stock market valuations.

How robust are the findings in Table 1? The first thing to note is that our net issuance data are simply a proxy, or residual: the change in market capitalization that is not accounted for by capital gains. It is, therefore, subject to measurement error. This measurement error would arise if there is an inconsistency between the equity price index and the stock market capitalization measure. Such inconsistencies are typically driven by either timing or coverage differences. In terms of timing, we seek to measure both market capitalization and equity prices at the end of each calendar year. But this is not always possible, especially when it comes to historical data. If, for example, market capitalization is measured at end of the year, equity prices at mid-year, and the stock price increases during the second half of the year, this increase would be interpreted as higher net issuance. In terms of coverage, market capitalization, by definition, covers all listed firms. The stock price index, however, may be based on a subsample of firms, or an unweighted average of all firms, which means that the price gain in the index may not be reflected of the all-firm market cap weighted average. For the vast majority of the sample, we use best-practice all-firm value weighted equity price indices, as detailed in Jordà et al. (2019a). But for some countries and years, we rely on a subsample of firms, or weights other than market capitalization, which may create a discrepancy.

To check the extent of this measurement error, we need to compare our implied issuance data with actual net equity issuance. To be consistent with the decomposition in (5), net equity issuance should capture all changes in listed capital by listed firms, and any new listings, measured at market value. Such a measure is difficult to obtain for the historical sample, which is precisely why we rely on the decomposition proxied by equation (5) in the first place. But for a few countries, we were

[9] Because stock market cap to GDP grew over this period, net issuance relative to GDP (rather than market cap, as shown in Table 1) was actually slightly higher than in the previous subperiods, but the differences are small (average net issuance is 1.2% of GDP over the full sample, and 1.5% of GDP after 1985.

Figure 8: *Implied and actual net equity issuance*



Notes: Actual and implied net equity issuance in year t as a proportion of stock market capitalization at the end of year $t-1$. Centered five-year moving averages. Actual issuance is either the change in book value of listed firms, or the market value of gross equity issues less gross redemptions. Implied issuance is calculated as the change in stock market capitalization that is not explained by capital gains divided by last years market capitalization.

able to obtain high quality issuance data that allow for such a historical comparison.

Figure 8 compares the actual and implied equity issuance series for two countries with the best historical data coverage – Germany and Finland. The light-orange line is the implied net equity issuance computed using equation (5). The dark-green line is the actual net issuance data. For most years, this is measured as the change in total book value of capital of listed firms. For the more recent period (post-1950 for Germany and post-1990 for Finland), it measures the market value of net issuance by listed firms. Both series use five-year moving averages to get a better overview of the trends. For both countries, the implied and actual net equity issuance have similar magnitudes and move closely together. The implied issuance series tends to be more volatile because of the measurement error discussed above. This analysis suggests that, if anything, the actual net issuance is more stable across time than the implied issuance data. This supports the finding in Table 1 that net issuance, despite a large contribution to the overall growth of market cap over the long run, makes little difference to the time variation in that growth, including the rapid increase in market capitalization during the big bang.

We also check whether aggregate trends in Table 1 mask cross-country heterogeneity. In particular, as discussed in Section 3, the US stock market is by far the largest globally, so the big bang on a global scale would largely be influenced by developments in the US, rather than the

Table 2: *Decomposition of market cap to GDP growth by country and period*

Country	(1)	(2)	(3)	(4)	(5)	(6)
	Pre 1985			Post 1985		
	$g_t^{MCAP/GDP}$	iss_t	$r_t^{eq} - g_t$	$g_t^{MCAP/GDP}$	iss_t	$r_t^{eq} - g_t$
Australia	.61	2.28	-1.72	3.33	4.47	-.99
Belgium	-.15	2.85	-3.36	4.93	2.91	2.74
Canada	-.42	2.54	-3.42	2.38	1.39	.71
Germany	1.09	2.64	-1.66	2.82	1.86	1.13
Denmark	.1	2.64	-2.98	5.81	1.08	4.87
Finland	-.76	5.17	-5.16	7.02	4.86	3.43
France	-.46	5.55	-6.34	5.89	4.1	2.05
Italy	1.11	6.91	-5.22	3.06	4.88	-1.65
Japan	5.88	10.21	-4.46	2.15	2.02	-.29
Netherlands	1.65	3.7	-1.97	4.35	3.37	1.54
Norway	.67	5.64	-4.69	4.59	3.61	.73
Portugal	-1.32	4.81	-5.05	9.79	15.27	-2.87
Spain	-.15	4.55	-5.18	5.78	4.79	1.05
Sweden	1.57	3.87	-2.31	4.32	.24	3.96
Switzerland	.82	2.58	-1.71	4.06	.9	2.86
UK	.32	1.35	-1.23	1.94	2.08	.07
USA	.28	1.97	-2.16	3.2	.3	2.89

Notes: Decomposition of log market cap to GDP growth into issuances, capital gains less GDP growth using equation (5). $g_t^{MCAP/GDP}$ is the growth in stock market capitalization, iss_t is net issuance relative to last period's market cap, and $r_t^{eq} - g_t$ is the difference between capital gains on equity and the GDP growth rate. Using log growth rates creates a small approximation residual. Period coverage differs across countries.

cross-country averages in Table 1. Table 2 presents the decomposition results for each country, for the periods before (columns 1 - 3) and after the big bang (columns 4–6), with aggregate market cap growth (columns 1 and 4) made up by net equity issuance (columns 2 and 5) and the $r_t^{eq} - g_t$ gap (columns 3 and 6).

Before 1985, market capitalization growth in most countries was low or slightly negative. Only Japan, which started with very low market capitalization and underwent a rapid stock market boom in the 1970s and early 1980s, experienced a robustly positive capitalization growth during this time period, driven by high net equity issuances. For every other country in the sample, positive net equity issuance is roughly offset by the negative gap between equity returns and GDP growth, both around 2–4 per cent. The decline in the global importance of the Paris and London stock exchanges (Figure 6), and the devastating impact of the Portuguese Carnation Revolution are evidenced by the below-average market cap to GDP growth in the corresponding countries. The low growth rates in France and Portugal are largely attributed to low equity returns, and the stagnation of the UK market – to low issuance.

Turning to the period of the big bang, market capitalization in all countries apart from Japan – which stagnated after the burst of its stock market bubble – grew at high rates, typically close to 5% p.a. This growth was driven by sharp increases in the $r_t^{eq} - g_t$ gap, which, in contrast to the pre-1985 period, is positive or close to zero in the majority of countries. Net issuance is positive in every country, but close to full sample average everywhere apart from Portugal – a special case reflecting the re-emergence of the stock market following the revolution.

Figure 9 graphically illustrates the cross-country correlation of market capitalization growth (y axis) with changes in net issuance (x axis, Figure 9a), and capital gains less GDP growth (x axis, Figure 9b), again, for the pre and post big bang periods. We exclude Japan and Portugal from the sample, so that the analysis is not overshadowed by the effects of the Japanese stock market bubble and the Portuguese revolution. Both before and after the big bang, the cross-country differences in the market cap to GDP ratio are largely explained by capital gains, not issuances. Net equity issuance shows no correlation with cross-country market cap growth before 1985, and only a small positive correlation after 1985 (Figure 9a). By contrast, capital gains show a large positive correlation (Figure 9b). After 1985, market capitalization grows almost one for one with the $r_t^{eq} - g_t$ gap, as shown by the near-45 degree slope of the line in the right-hand panel of Figure 9b.

The decomposition of stock market cap growth into issuance, capital gains and GDP growth suggests that even at long horizons, the time trends and cross-country differences in market capitalization are largely a result of changing prices, not quantities. This is particularly true for the period that saw the rapid expansion of the stock market over the recent decades – the big bang, but is also the case for earlier historical periods. The next section studies the long-run evolution of the possible underlying drivers of these changing stock valuations.

5. Structural drivers of stock valuations

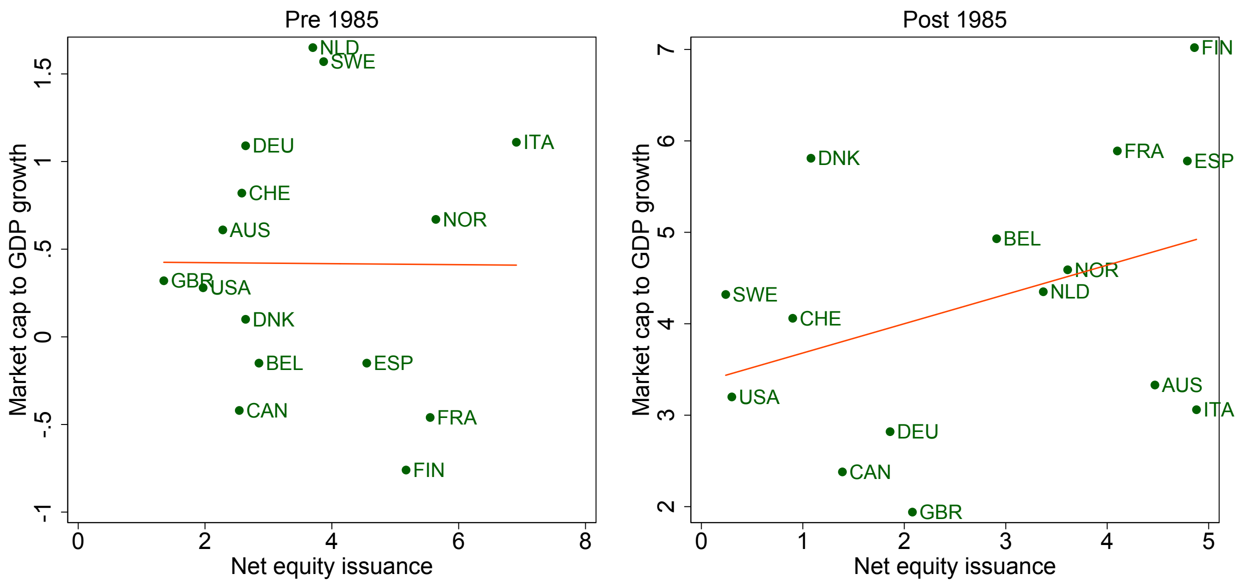
The 1980s and 1990s saw a structural increase in stock market valuations. To shed light on the possible drivers of this increase, it helps to go back to equation (1), and express the stock price as the sum of expected future cashflows $CF_{i,t+j}$, net of tax τ_{t+j}, discounted at rate r_t:

$$MCAP_t = \sum_{i=1}^{N} P_{i,t} Q_{i,t} = \sum_{i=1}^{N} Q_{i,t} \sum_{j=1}^{\infty} \frac{CF_{i,t+j}(1-\tau_{t+j})}{(1+r_t)^j} \tag{6}$$

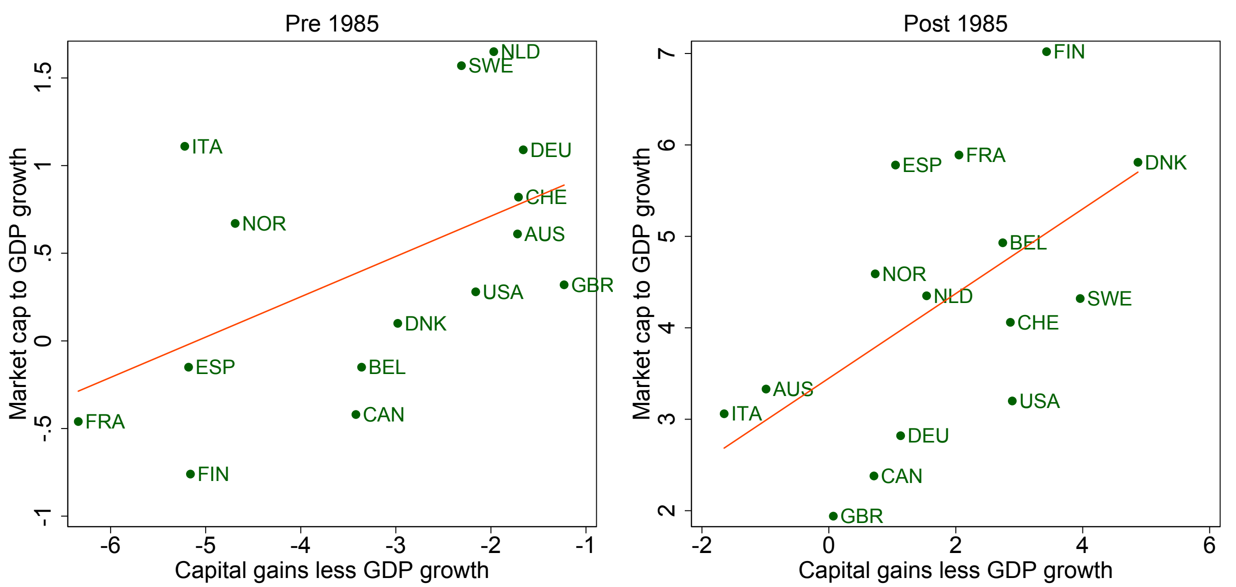
After ruling out quantity based explanations in section 4, an increase in stock valuations can occur for the three following reasons: higher expected cashflows $CF_{i,t+j}$, lower taxes τ_{t+j}, or lower discount rates r_t. We start by examining the long-run evolution of the fundamentals underlying stock valuations – pre-tax cashflows CF and taxes τ – before discussing the historical trend in the rate at which these future fundamentals are discounted, r.

Figure 9: *Cross-country correlations between market cap, issuances and capital gains*

(a) *Market cap growth and equity issuance*

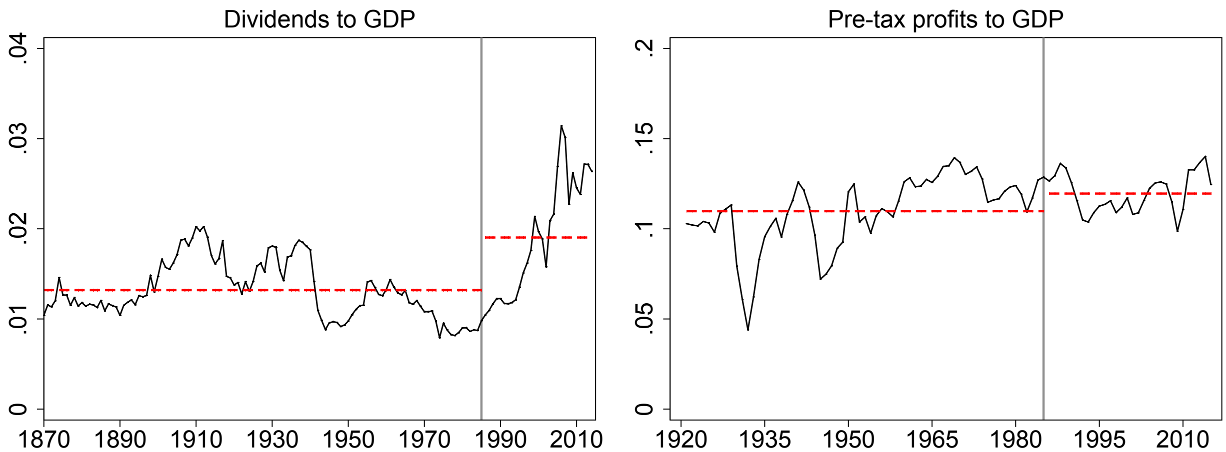


(b) *Market cap growth and capital gains*



Note: Full sample and post-1980 averages of (log) growth in stock market cap to GDP ratio, issuances relative to market cap, and capital gains less GDP growth rate. Japan and Portugal outliers excluded (Japan's rise from very low market cap in the 19th century to the stock bubble in the 1980s, and Portugal's Carnation revolution otherwise skew the overall results).

Figure 10: *Gross equity cashflows and the big bang*



Note: Unweighted averages, 17 countries (left-hand panel) and four countries (right-hand panel). Solid black line indicates the start of the big bang in 1985. Dashed horizontal lines show the average of the series before and after the big bang.

5.1. Pre-tax cashflows

Over the long run, equity cashflows CF_t should correspond to total dividends paid. The left-hand panel of Figure 10 shows the evolution of dividend payments of listed companies relative to GDP.[10] The big bang coincided with a structural and persistent increase in dividends, which rose by a factor of 2.5 between 1985 and 2015, from 1% to 2.5% of GDP. This substantial increase in dividends to GDP occurred virtually universally across countries, with the notable exception of the US. The dividend-to-GDP ratio also shows positive co-movement with market cap over the earlier historical period.

Realised dividend payments are, however, an imperfect proxy for the present value of expected future cashflows in equation (6). Year-on-year dividend changes can be driven by variation in payout policies of firms, or intertemporal substitution between current and future payouts. Tracking the overall profitability of the corporate sector may be a better way to gauge the underlying trend in expected future cashflows. The right-hand panel of Figure 10 displays the total pre-tax profits of private corporations, again relative to gross output.[11] Unlike dividends, the trend in the level of total profits is far less clear, with only a slight increase occurring since the 1980s.[12] Appendix Figure B.2 shows that after-tax profits have also changed little since 1980. This evidence is consistent with Gutierrez (2017), who shows that in cross-country data, profit shares over the recent decades have

[10] The dividend-to-GDP ratio for each country is calculated as the dividend yield D_t/P_t, or dividends paid throughout the year D_t divided by the end-of-year share price P_t, multiplied by the market cap to GDP ratio at the end of the year, $MCAP_t/GDP_t$.

[11] The dividend-to-GDP data cover the full sample, whereas profits to GDP cover four countries – Canada, France, Japan and the US – and start in 1920.

[12] The increase becomes slightly larger if we limit the sample to the US, and goes away if we exclude the large, mostly unanticipated, profitability shocks of the Great Depression, World War 2 and the Global Financial Crisis.

been surprisingly stable.

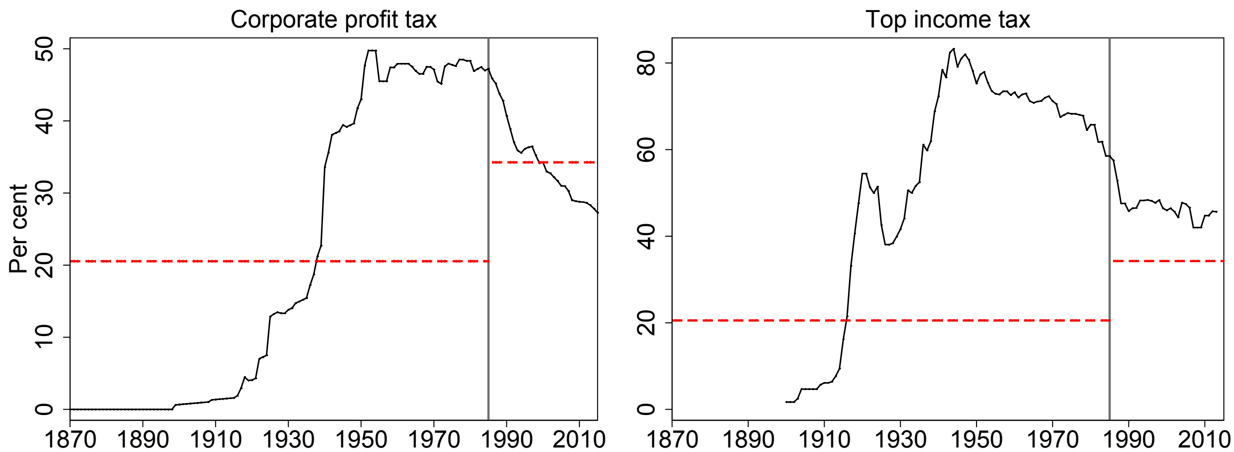
Several potential explanations can help reconcile the differential trends in dividend payments and corporate profitability. First, the profit measure in Figure 10 may understate the growth in economic profits because it does not account for changes in "factorless income" – a part of GDP factor income that is not assigned to any specific production factor. Eggertsson, Robbins, and Wold (2018) show that in the US, the total of corporate profits and factorless income has increased substantially over recent decades. But Karabarbounis and Neiman (2018) argue that a large part of this increase in factorless income is driven by lower risk premiums, which is precisely what we want to exclude from our cashflow measures; hence we do not include this type of income in our baseline calculation in Figure 10. Second, the dividends in Figure 10 are for listed firms only, whereas the profit data cover both listed and unlisted firms. Some of the increase in dividends can, therefore, be attributed to a compositional shift, whereby profits of listed firms grow at the expense of unlisted firms, for example if large listed companies accumulate market power (De Loecker and Eeckhout, 2017, provide evidence of increasing market power in the US). Appendix Figure B.3 shows that indeed, US listed firms' profits have grown faster than those of unlisted firms over recent decades. Third, firms in advanced economies have been declaring an increasingly large share of their profits off-shore to minimise corporate tax payments (Zucman, 2014). These off-shore profits would be absent from the advanced economy profit data. Finally, higher dividend payments may be a result of changes in payout policy, and have little to do with expected future profits or cashflows.

5.2. Taxes

A reduction in taxes τ_t increases the cashflows received by investors, and should drive up valuations P_t even if the pre-tax cashflows CF_t remain unchanged. For example, McGrattan and Prescott (2005) argue that a large part of the recent increase in equity valuations in the US can be attributed to changes in the corporate tax code. Corporate cashflows are generally taxed on two levels: first a corporate tax is applied to total profits, and then any distributions or realised capital gains are taxed as income. Sometimes allowances for double-taxation are made, so that, for example, dividends are only taxed once. Regardless, we consider both types of taxes in isolation, and it turns out that they follow a similar historical trend.

Figure 11 plots the long-run evolution of taxes on corporate profits (left-hand panel) and top personal incomes (right-hand panel) across countries, thus capturing the two levels of taxation discussed above. The corporate income tax measures the deductions from cashflows before distribution. The top income tax only serves as a rough proxy for dividends and capital gains taxation, but given that stocks are typically owned by households in the top percentiles of the income and wealth distribution, and dividends are typically taxed as income, it remains informative of the likely marginal tax rate on distributed profits. The income tax data are an average of seven countries: Canada, France, Germany, Italy, Japan, UK and the US and come from from Roine and Waldenström (2012) and Piketty (2014). The corporate tax data are based on a somewhat smaller subset of four

Figure 11: *Taxation and the big bang*



Note: Unweighted averages, 4 countries (right-hand panel) and 7 countries (right-hand panel). Solid black line indicates the start of the big bang in 1985. Dashed horizontal lines show the average of the series before and after the big bang.

countries with long-run data – Australia, Germany, Japan and the US – but cover the remaining countries later on. All countries within the sample do, however, follow a similar time pattern.

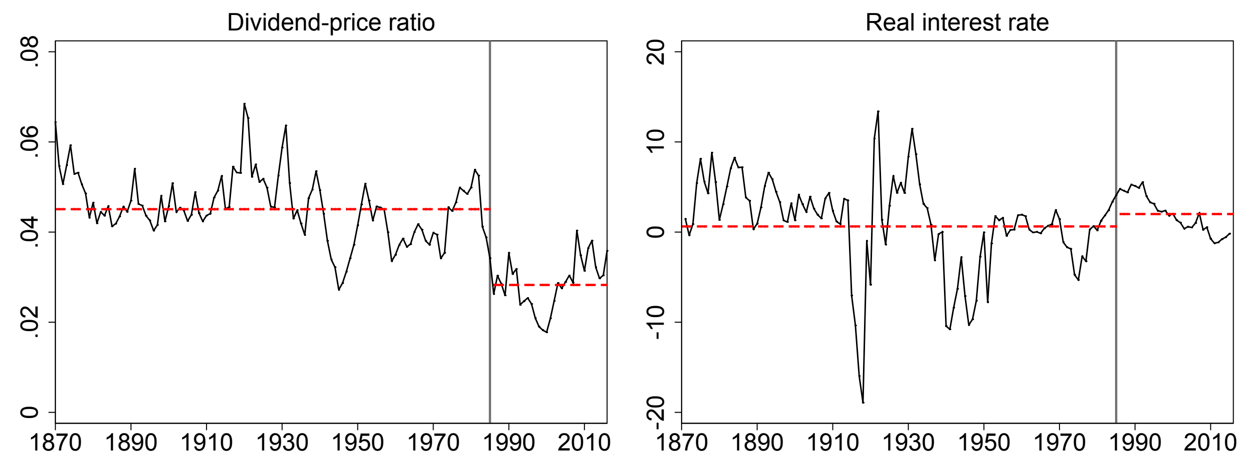
Both corporate and top income taxes were close to zero in the late 19th and early 20th century, before rapidly shooting up to reach levels of close to 50% and 80% respectively shortly after World War 2. During the 1980s, governments began cutting taxes, with rates eventually falling to around 30% for corporates and 40% for top incomes. On the surface, the timing of these tax cuts roughly coincides with the big bang (Figure 11 vertical black line in 1985). But looking at the longer run historical picture, the relationship becomes much weaker. Both corporate and income taxes were near zero up to 1910s or 1920s, and below current levels up until World War 2. The sample averages before 1985 are well below the post 1985 levels. And yet, stock market capitalization and stock valuations are much higher today than in the early 20th century (Figure 1).

5.3. Discount rates

Ex ante discount rates on equities are not directly observable. But Campbell and Shiller (1988) show that the discount rate can be proxied by the dividend-price ratio, as long as this ratio helps forecast future stock returns. Kuvshinov (2019) shows that high stock valuations – or low dividend-price ratios – do forecast low future stock returns at short and medium term horizons in our historical sample. This means that the dividend-price can be used to proxy the equity discount rate ($1 + r_t$ in equation (6)).

The left-hand panel of Figure 12 plots the long-run evolution of the average dividend-price ratio across the 17 countries in our sample. The vertical line marks the start of the big bang in 1985, and the two dashed lines plot the pre- and post- big bang sample averages of the series. Discount rates

Figure 12: *Discount rates and the big bang*



Note: Unweighted averages, 17 countries. Solid black line indicates the start of the big bang in 1985. Dashed horizontal lines show the average of the series before and after the big bang. Real interest rate is the short-term government bill rate minus inflation.

were stable until the 1980s at around 4–5% p.a. Around the start of the big bang, discount rates fell sharply and reached the all-time historical trough of 2% at the height of the dot-com bubble in 2000. Since then, discount rates recovered somewhat and increased in the Global Financial Crisis, but remain substantially below their pre-1985 mean.[13] The trend is apparent not only in price-dividend, but also price-earnings ratios, which are relatively unaffected by changes in payout policy, and the fact that distributions to shareholders in recent decades have often taken the form of stock buybacks, rather than dividends. Appendix Figure B.4 shows that the US buyback-adjusted earnings-price ratio shows a similar downward trend after 1985. These facts suggest that at least part of the increase in stock valuations, and hence market cap, since the 1980s can be attributed to lower discount rates.

The fall in the discount rate since the 1980s could correspond to either lower risk premiums, or a lower risk-free rate. It is difficult to discern these two factors because data on ex ante risk free rates are not available for our long-run sample. The right-hand panel of Figure 12 looks at ex post realised risk-free rates instead, and plots the average real short-term government bill rate across the 17 countries in our sample, as well as the pre and post big bang averages. Even though real rates have fallen since the 1980s, this fall does not appear particularly large from a historical perspective, with the current safe rate level close to the long-run average. It could, however, be the case that the inflation shocks in our data hide a somewhat more subtle decline in the ex ante real rate (Del Negro, Giannone, Giannoni, and Tambalotti, 2019, provide evidence supportive of this claim). But as Appendix Figure B.5 shows, using inflation forecasts instead of realised inflation to construct a better proxy of the ex ante real rate, results in roughly the same long-run trends. And even the

[13]Consistent with this, structural break analysis suggests that most countries in the sample experienced a structural break in the dividend-price ratios in late 1980s or 1990s. Results available from authors upon request.

1950s and 1960s – two time periods without substantial positive inflation surprises during which we would expect to see a close correspondence between ex ante and ex post realised rates – saw similar levels of the real rate to today, but much lower market capitalization.[14]

Finally, the upturn in the discount rate since its trough in 2000 (Figure 12) is consistent with recent evidence presented in Farhi and Gourio (2018), who argue that the risk premium in the US has risen over the period 2001–2016. This recent uptick in the risk premium – albeit, taken relative to the all-time high of the dot-com boom – has moderated the post-1980 upsurge in market cap, with the long-run time trend stabilising at levels close to 100% of GDP.

5.4. Quantifying the contribution of different drivers

The long-run evidence in Figures 10, 11 and 12 suggests that the big bang is driven by a combination of more favourable stock market fundamentals, and lower ex ante compensation for risk demanded by equity investors. To quantify the relative contribution of potential drivers, we turn to cross-country explanatory regressions. Table 3 regresses the stock market cap to GDP ratio on dividends to GDP, dividend-price ratio, real interest rates and corporate taxes. In order to capture structural trends, we analyse the relationship in levels and changes happening over a medium (5-year) and long (10-year) horizon.[15]

Consistent with the long-run trends in Figures 10 and 12, stock market cap is strongly correlated with changes in discount rates and cashflows. On the contrary, market cap shows no correlation with current or future corporate taxes, and real interest rates. Contemporaneously, a one percentage point increase in the dividend to GDP ratio predicts around 20–25 percentage points higher market cap to GDP, consistent with the average price-dividend ratio of around 30 in our sample. But market cap shows little co-movement with future dividend payments. One percentage point lower dividend-price ratios predict 7–10 percentage point higher market cap.

The lack of correlation with taxes is relatively robust: for example, it also holds for income taxes, effective corporate tax rates – i.e. total taxes paid as a share of corporate profits – and under a variety of alternative regression specifications. Appendix Table B.1 shows that if we limit the sample to the post-1985 period, thereby excluding the early-20th century period of low taxes and low market cap, we observe a small negative correlation between taxes and capitalization in some specifications, but the effects remain relatively weak. Appendix Table B.2 shows that using inflation forecasts instead of realised inflation to obtain a better proxy for the ex ante safe rate results in a somewhat stronger correlation between the safe rate and market cap, but the regression coefficients of the dividend-price ratio remain in the same ballpark as in Table 3.[16]

[14]These time periods also show a similar trend level of the world interest rate to today in the estimates of Del Negro et al. (2019).

[15]The levels specification takes the level of each variable at time t, but the results are unchanged if we smooth the data by applying a 10-year moving average filter to look through short-term trends. Results are available from authors upon request.

[16]Inflation forecasts are based on past GDP growth and past inflation and estimated for each monetary

Table 3: *Quantifying the relative contribution of stock market cap determinants*

	Levels		5-Year Changes		10-Year Changes	
	(1)	(2)	(3)	(4)	(5)	(6)
D_t/GDP_t	25.27***	26.21***	23.75***	30.39***	25.08***	26.40***
	(2.4)	(2.8)	(2.8)	(6.1)	(2.3)	(4.3)
D_{t+1}/GDP_{t+1}	1.36	0.89	0.45	2.35	3.31*	-1.45
	(1.9)	(1.9)	(1.1)	(2.5)	(1.8)	(2.6)
D_t/P_t	-8.89***	-9.89***	-6.77***	-8.44***	-5.88***	-6.73***
	(1.2)	(1.8)	(1.2)	(1.8)	(1.1)	(1.9)
r_t	0.03	-0.19	-0.05	-0.32	-0.16	-0.42
	(0.1)	(0.2)	(0.1)	(0.3)	(0.1)	(0.3)
τ_t^{corp}		-0.09		0.16		0.11
		(0.2)		(0.1)		(0.2)
τ_{t+1}^{corp}		0.00		0.05		-0.33*
		(0.2)		(0.1)		(0.2)
R^2	0.743	0.718	0.476	0.486	0.608	0.509
Observations	1879	849	1652	681	1475	520

Note: Regressions with country fixed effects and robust standard errors. Standard errors in parentheses. Columns (1) and (2) show regression coefficients of dividends to GDP, the dividend to price ratio and corporate tax rates on the market capitalization level. Column (3)–(5) report the regression coefficients of the analysis in five year and 10 year changes. For the five-year and ten-year change regressions, the one-year ahead variables such as D_{t+1}/GDP_{t+1} become five-year ahead variables, i.e. $D_{t+5}/GDP_{t+5} - D_t/GDP_t$. *, **, ***: Significant at 10%, 5% and 1% levels respectively.

Turning to pre-tax cashflows and risk premiums, since the early 1980s, dividend payments have increased by 2 percent of GDP (Figure 10), and the dividend-price ratio has fallen by around 1.5–2 percentage points (Figure 12). Using the above regression coefficient estimates, higher dividend cashflows have contributed to a roughly 50 percentage points increase in stock market cap to GDP (2×25), and lower discount rates added a further 16 percentage points (2×8). These two effects have also reinforced each other, with higher cashflows discounted at lower rates. Together they explain almost all of the increase in stock market cap during the big bang (80% of GDP), with little room left for additional factors such as taxes and equity issuance.

What are the potential mechanisms that could explain these observed patterns? The explanations that assign a dominant role to cashflows center around rising mark-ups of large firms. De Loecker and Eeckhout (2017) show that over recent decades, market power in the United States has increased substantially, and Diez, Leigh, and Tambunlertchai (2018) find a similar pattern in other advanced economies. De Loecker and Eeckhout (2017) argue that market power can explain increasing stock valuations in the US. Relatedly, Greenwald, Lettau, and Ludvigson (2014) show that the US labour

regime individually. See footnote of Figure B.5 for more information.

share has substantial explanatory power for stock returns.

Turning to discount rate based explanations, the fact that the big bang has taken place in multiple countries, and has coincided with increases in valuations of other risky assets such as housing (Knoll, Schularick, and Steger, 2017) points towards the importance of global macroeconomic factors. These could include lower levels of macroeconomic risk – for example through falling consumption volatility, one of the explanations for the recent decline in the equity premium in the US (Lettau, Ludvigson, and Wachter, 2008). But as Appendix Figure B.6 shows, consumption volatility has been steadily declining since the late 19th century, while the global equity premium decline and the big bang are much more recent phenomena. Bianchi, Lettau, and Ludvigson (2016), instead, link the structural fall in the equity risk premium to the emergence of inflation targeting as the dominant monetary regime. Aside from lower risk, the fall in the equity premium could be driven by structurally higher demand for risky assets, both domestic – through increases in market access and participation rates – and foreign, through higher precautionary savings by the emerging economies (Bernanke, 2005). Consistent with the domestic demand channel, data from the Survey of Consumer Finances in Appendix Figure B.7 show that stock market participation in the US has increased substantially since the 1980s.

The evidence presented in the last two sections suggests that structurally lower equity risk premia have played an important role in driving the recent increases in stock market capitalization, and the big bang. This means that rather than measuring changes in stock issuance and financial development, market capitalization can serve as an informative indicator of time variation in the risk premium on stocks. We examine this claim more systematically in the next section.

6. Stock market capitalization and the equity risk premium

If stock market capitalization is, to an extent, driven by movements in the equity risk premium, it may, in of itself, contain information on investor valuations of stock market fundamentals, and in turn future equity return and risk. In this section, we draw on the vast literature that examines the cyclical patterns of returns and risk premia in financial markets to evaluate the impact of shifts in stock market capitalization on future stock market performance. We start by running return predictability regressions to test whether cyclical movements in market cap, on average, help forecast future returns for the equity investors. We then proceed by focussing on the tails of the market cap and return distributions, and test whether sharp run-ups in stock market cap display a range of characteristics typically associated with stock market bubbles.

6.1. Market capitalization as a predictor of stock returns

Stock market capitalization is correlated with equity risk premium measures such as the dividend-price ratio (Figure 12 and Table 3). This correlation, however, does not fully capture the link between market cap and risk premia. On the one hand, dividend-price ratios can change in response

to expected cashflows as well as expected returns or risk premia (Campbell and Shiller, 1988). Stock market capitalization may, then, also reflect expected cashflow rather than expected return movements. On the other hand, it may be that stock market cap itself is a better measure of the equity risk premiums than the dividend-price ratio. In this case, the correlations in Figure 12 and Table 3 would understate the importance of time varying risk premia in determining the size of the equity market. These propositions can be easily tested within the framework of return predictability regressions (see Cochrane, 2011, for a summary). If market cap is driven by future cashflows, high market cap should forecast high future dividend growth. If it is driven by discount rates or risk premia, high market cap should forecast low future equity returns. We test these two hypotheses by running the following predictive regressions:

$$r_{t+1} = \beta_0 + \beta_1 log(MCAP_t/GDP_t) + \beta_2 log(P_t/D_t) + u_t \tag{7}$$

$$dg_{t+1} = \gamma_0 + \gamma_1 log(MCAP_t/GDP_t) + \gamma_2 log(P_t/D_t) + e_t \tag{8}$$

Here r_{t+1} is the log of real, or excess equity return (real measured net of inflation, and excess – relative to the short-term risk-free rate), dg_t is log of real dividend growth, $MCAP_t/GDP_t$ is the market capitalization to GDP ratio, and P_t/D_t is the price-dividend ratio – the variable that is commonly used in such predictive regressions. We use price-dividend ratios instead of dividend-price ratios to allow for an easier joint interpretation of the coefficients. If $\beta_1 < 0$, high market capitalization predicts low future returns, and signals low discount rates. If $\gamma_1 > 0$, high market cap signals high future cashflows. We run the regressions in logs to be consistent with the formulation in equation (6), but the results are unchanged if we run them in levels.

Table 4 presents the results of the return predictability regressions. The numbers show the predictive coefficients β and γ, when used to predict real returns (columns 1 and 2), excess returns (columns 3 and 4), and dividend growth (columns 5 and 6). The top panel shows predictability at an one-year ahead horizon and the bottom panel at a five-year ahead horizon. Several results stand out.

First, high stock market capitalization forecasts low equity returns. The estimated coefficient β_1 is negative for both real and excess returns, and at a one-year as well as five-year horizon. Using the richer specifications in column 2, a 10 percentage point increase in the stock market cap to GDP ratio (25% in relative terms) forecasts a 0.8 percentage points lower return 1 year ahead ($0.25 \times (-0.03) \times 1.048$), and a 5.2 percentage points lower cumulative return 5 years ahead ($0.25 \times (-0.04) \times 1.048 \times 5$). Columns 3 and 4 show that stock market cap predicts excess equity returns with a similar statistical significance, sign and magnitude of the coefficient. Consistent with the long-run evidence in Section 6 and Figure 12, this suggests that time variation in stock market cap is, to a larger reflect, capturing the changes in the discount rate and – given the strong predictive performance for excess returns – in particular the risk premium for equities.

Second, market cap is a better predictor of equity returns than the more commonly used price-dividend ratio. Once included in the same specification (columns 2 and 4), the coefficient on the

Table 4: *Stock market capitalization as a predictor of equity returns and dividends*

	Real returns		Excess returns		Real dividend growth	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel 1: *One-year ahead returns and dividend growth*						
$log(MCAP_t/GDP_t)$	-0.037***	-0.029**	-0.033***	-0.028***	-0.008	-0.053***
	(0.007)	(0.010)	(0.006)	(0.008)	(0.009)	(0.015)
$log(P_t/D_t)$		-0.030		-0.018		0.161***
		(0.017)		(0.017)		(0.035)
R^2	0.015	0.019	0.011	0.012	0.000	0.066
Observations	1986	1986	1986	1986	1986	1986
Panel 2: *Five-year ahead average returns and dividend growth*						
$log(MCAP_t/GDP_t)$	-0.039***	-0.035***	-0.033***	-0.030***	-0.004	-0.033***
	(0.006)	(0.007)	(0.005)	(0.004)	(0.006)	(0.009)
$log(P_t/D_t)$		-0.014		-0.012		0.102***
		(0.012)		(0.010)		(0.016)
R^2	0.084	0.088	0.064	0.068	0.001	0.182
Observations	1883	1883	1883	1883	1883	1883

Note: Returns and dividend growth are measured in logs. *, **, ***: Significant at 10%, 5% and 1% levels respectively. Regressions with country fixed effects. Country-clustered standard errors in parentheses.

price-dividend ratio becomes insignificant, and the R^2 stays roughly the same as with market cap alone. This is especially true for longer horizon regressions, and those for excess equity returns.

Third, high stock market capitalization is not a sign of high future cashflows. The coefficient γ_1 on real dividend growth in column 5 is statistically insignificant. Once the price-dividend ratio is added to the regression (column 6), the coefficient even turns significantly negative. 10 percentage point higher stock market cap forecasts 1.3 ppts lower real dividend growth one year ahead ($0.25 \times (-0.053) \times 1.003$), and 4.2 ppts lower dividend growth five years ahead ($0.25 \times (-0.033) \times 1.003 \times 5$). High price-dividend ratios are, on the contrary, a sign of high future cashflows.

Appendix Table C.1 presents the predictability regression estimates for the longer 10-year horizon, and for the post-1985 period. These are particularly important for our understanding of the long-run trends and structural breaks that underly the big bang. If anything, the patterns in the data discussed above become stronger. A 10 percentage point increase in stock market cap to GDP forecasts 17 ppts lower cumulative real equity returns, and 13 ppts lower real dividend growth 10 years ahead. After 1985, a 10 ppt increase in stock market cap to GDP forecasts 3.2 ppts lower returns one year ahead.

Warren Buffett famously called stock market capitalization the "the best single measure of where valuations stand at any given moment" (Buffett and Loomis, 2001). Our findings largely confirm his priors. But why does market capitalization do so well as an equity return predictor? The natural explanation is that it contains information on fundamentals, and issuance or quantities, that is not

Table 5: *The price-GDP ratio as a predictor of equity returns and dividends*

	Real returns		Excess returns		Real dividend growth	
Panel 1: *One-year ahead returns and dividend growth*						
	(1)	(2)	(3)	(4)	(5)	(6)
$log(P_t/Y_t)$	-0.059***	-0.052***	-0.038***	-0.034***	-0.031**	-0.062***
	(0.006)	(0.007)	(0.007)	(0.007)	(0.012)	(0.009)
$log(P_t/D_t)$		-0.032**		-0.021*		0.145***
		(0.013)		(0.012)		(0.030)
R^2	0.033	0.038	0.013	0.015	0.006	0.063
Observations	2245	2194	2144	2093	2190	2190
Panel 2: *Five-year ahead average returns and dividend growth*						
$log(P_t/Y_t)$	-0.062***	-0.060***	-0.036***	-0.034***	-0.029***	-0.049***
	(0.005)	(0.006)	(0.005)	(0.006)	(0.007)	(0.007)
$log(P_t/D_t)$		-0.010		-0.013		0.099***
		(0.013)		(0.010)		(0.016)
R^2	0.029	0.029	0.067	0.071	0.032	0.206
Observations	2162	2111	2048	1997	2095	2095

Note: Returns and dividend growth are measured in logs. P/Y is the detrended log of a cumulative stock price index divided by nominal GDP. *, **, ***: Significant at 10%, 5% and 1% levels respectively. Regressions with country fixed effects. Country-clustered standard errors in parentheses.

captured by other commonly used valuation measures. The superior performance of the market cap to GDP ratio when compared to the dividend-price ratio could be because GDP is a better measure of fundamentals than dividends. Dividends are often criticised for not incorporating all future cashflows to the shareholder and for being excessively smooth relative to firm profitability. Indeed, the price to GDP ratio and the output gap are reliable predictors of equity returns in the United States (Cooper and Priestley, 2008; Rangvid, 2006). Market cap to GDP might also outperform the dividend to price ratio due to the additional informational content from equity quantities. Even though quantity changes play a relatively small role in long-run structural trends (Section 4), cyclical swings in net equity issuance may still tell us something about future returns. Existing evidence for the US suggests that high equity issuance tends to precede periods of substandard market returns (Baker and Wurgler, 2000; Nelson, 1999). With our new data, we can test whether such patterns hold in our richer cross-country setting.

We first study whether GDP includes information about firm fundamentals that is not included in dividends. Table 5 replaces market cap to GDP with a price-GDP ratio. The format follows that of Table 4: we regress log real and excess returns, and real dividend growth, one and five years ahead, on the price-GDP ratio, alone and alongside the price-dividend ratio. Following Rangvid (2006) we construct the price-GDP ratio by dividing the nominal stock market index by nominal GDP. Unlike

Table 6: *Net equity issuance as a predictor of equity returns and dividends*

Panel 1: *One-year ahead returns and dividend growth*						
	Real returns		Excess returns		Real dividend growth	
	(1)	(2)	(3)	(4)	(5)	(6)
Issuance/GDP	-0.844*	-0.780*	-0.619**	-0.559*	-0.251	-0.421
	(0.400)	(0.383)	(0.290)	(0.283)	(0.335)	(0.380)
$log(P_t/D_t)$		-0.046***		-0.043***		0.121***
		(0.010)		(0.012)		(0.029)
R^2	0.011	0.021	0.006	0.015	0.001	0.049
Observations	1903	1903	1903	1903	1903	1903
Panel 2: *Five-year ahead average returns and dividend growth*						
Issuance/GDP	-0.350**	-0.307*	-0.390***	-0.348**	-0.081	-0.172
	(0.159)	(0.149)	(0.126)	(0.126)	(0.104)	(0.104)
$log(P_t/D_t)$		-0.035***		-0.034***		0.074***
		(0.008)		(0.009)		(0.013)
R^2	0.010	0.040	0.013	0.042	0.000	0.120
Observations	1806	1806	1806	1806	1806	1806

Note: Returns and dividend growth are measured in logs. *Issuance/GDP* is implied net issuance relative to GDP smoothed by averaging over three years, from $t-3$ to t. *, **, ***: Significant at 10%, 5% and 1% levels respectively. Regressions with country fixed effects. Country-clustered standard errors in parentheses.

Rangvid (2006), we deduct a time trend from $log(P_t/Y_t)$ to obtain a stationary series.[17]

Table 5 shows that the price-GDP ratio is a reliable predictor of equity returns and excess returns at short and medium term horizons. Furthermore, the price-GDP ratio incorporates information that is not included in the price-dividend ratio. Once included in the same specification, both variables predict returns one year ahead, and the price-GDP ratio dominates the horse race between the two predictors over longer horizons. These results suggests that GDP contains information about fundamentals that is not included in dividends. We investigate this question more explicitly by studying the predictive power of the dividend-GDP ratio in Appendix Table C.2. High dividends relative to GDP predict low future dividend growth, which suggests that dividends show a tendency to converge towards a stable share of output, with the short-run deviations from this stable ratio potentially reflecting deviations of dividends from fundamentals due to, for example, changes to corporate payout policy.

Table 6 tests whether the additional information on quantities helps improve the predictive performance of the stock market cap to GDP ratio. Here we run the predictive regression of one and five year ahead stock returns and dividend growth on the current level of net equity issuance. To

[17]Equity capital gains were relatively minor during the first 100 years of our sample. GDP therefore grew at a faster pace than the stock market index creating a downward sloping trajectory of the price to GDP series. This differs from the 1929–2003 US series used in Rangvid (2006), which was largely stationary due to the relatively high capital gains in the corresponding sample.

reduce the potential measurement error in the net issuance series, which is estimated as a residual (see Section 4), we use the three-year backward-looking moving average of net issuance instead of the annual data. Returns and dividend growth are expressed in logs, but as before, the results in levels are very similar.

Table 6 shows that high net equity issuance robustly predicts low future real and excess returns, one and five years ahead, but it does not predict high future cashflows. A 1% of GDP increase in net equity issuance signals 1 percentage point lower returns one year ahead, and 2 percentage points lower returns five years ahead.[18] The return coefficients on the issuance to GDP ratio remain significant once the price-dividend ratio is added to the regression, but unlike the market cap regression in Table 4, the dividend-price ratio retains its predictive power. This confirms our prior that these variables measure two different things, quantities and prices, both of which help predict future returns. The strength of the market cap to GDP ratio is that it combines these two metrics.

Why could GDP be a better measure of fundamentals than dividends, and capitalization – inclusive of issuance – a better measure of valuations than prices? Unlike dividends, GDP is relatively unaffected by time variation in payout policy such as dividend smoothing and the use of stock buybacks as implicit dividend payouts. Chen, Da, and Priestley (2012) and Chen (2009) show that, respectively, dividend smoothing and unstable corporate policy can adversely affect the empirical performance of return predictability regressions. Turning to quantities, time variation in net equity issuance should better capture changes in investor sentiment than information on prices alone. Baker and Wurgler (2000) show that if firms time the market to issue equity when investor sentiment is elevated, periods of high equity valuations and low risk premia should be accompanied by high issuance activity. Baker and Wurgler (2000) also show that the equity share in total issues is a powerful predictor of returns in US data. Greenwood and Hanson (2013) argue that times of elevated sentiment also open the market up to poorer quality issuers. Deteriorating issuer quality can help explain why, conditional on price valuations, high market capitalization forecasts low, rather than high dividend growth.

We have shown that on average, high market capitalization is followed by low subsequent returns. Next we turn our attention to the more extreme tails of the return and market cap distribution, and examine whether sharp run-ups in market cap are followed by equally sharp corrections, and whether they share other characteristics with stock market bubbles.

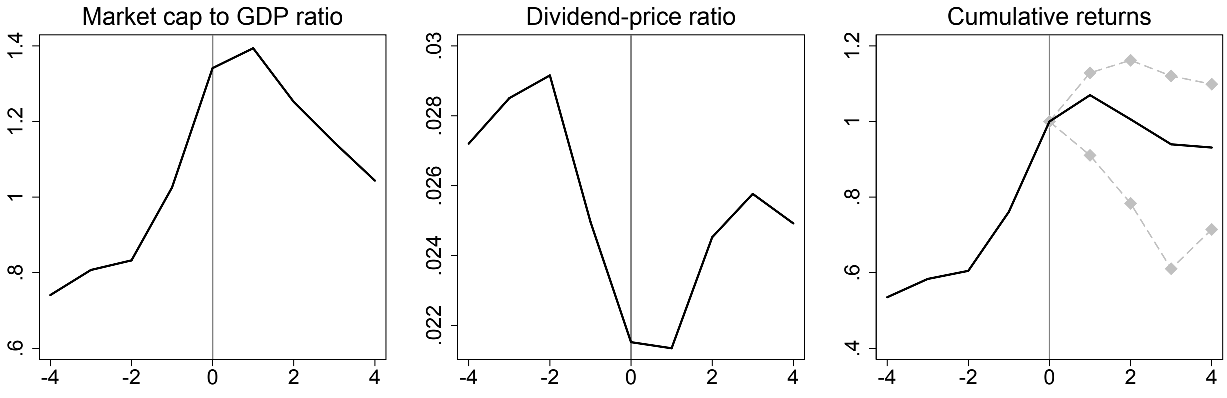
6.2. Equity bubbles and crashes

To test whether changes in market capitalization can inform us about stock market bubbles and crashes, we investigate how the equity market behaves during and after sharp increases in stock market cap. To define a "sharp" increase, we follow existing literature, and in particular the Greenwood, Shleifer, and You (2018) definition of sector-specific equity market bubbles. Greenwood et al. (2018) define equity market run-ups as sharp increases in real equity returns over two years,

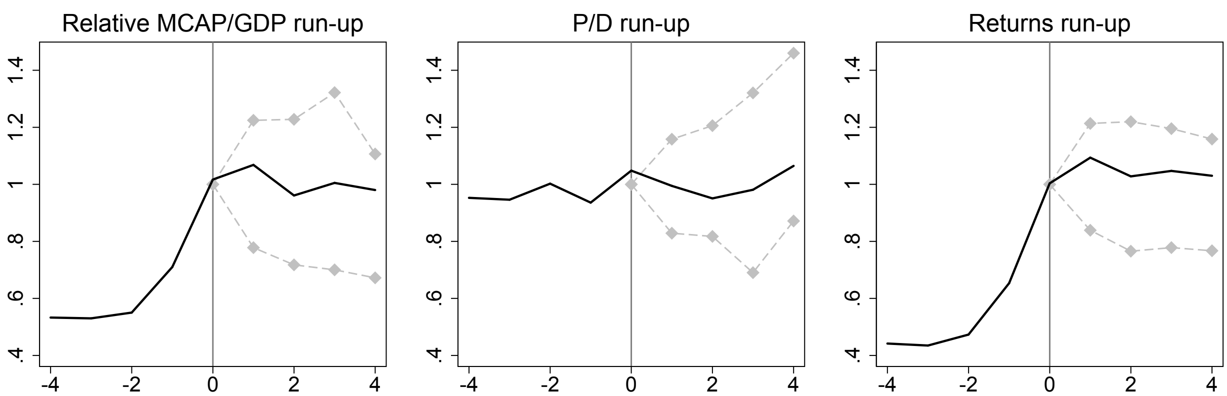
[18] For one year, Table 6 suggests a 1*0.78 = 0.8% relative increase in gross real return, from 1.04 to 1.05 p.a.

Figure 13: *Market capitalization and stock market bubbles*

(a) *Stock valuations and returns around sharp increases in market cap*



(b) *Stock returns around run-ups in alternative valuation measures*



Note: Average market cap to GDP, dividend-price ratio and cumulative real return during and after stock market run-ups. Panel (a): run-up defined as a 35% GDP or higher increase in market cap over 2 years ($t = -2$ to $t = 0$), and 17.5% GDP or higher increase over 5 years ($t = -5$ to $t = 0$). Panel (b), left-hand graph: run-up defined as a doubling of market cap to GDP over 2 years, and 50% relative increase over 5 years. Panel (b), middle graph: run-up defined as a log price-dividend increase of 0.7 or more over 2 years, and 0.35 or more over 5 years. Panel (b), right-hand graph: run-up defined as a cumulative real total return of 100% or more over 2 years, and 50% or more over 5 years. Returns and relative market cap indexed to 1 at $t = 0$.

that follow persistently high returns over a longer time period. In a similar vein, we define a market cap run-up as a 35% GDP or more increase in market cap over 2 years, that follows a cumulative increase of at least 17.5% GDP over 5 years. Adding the 5-year growth assumption allows us to focus on run-ups and exclude recoveries from temporarily low market cap levels. This definition gives us roughly the same number of run-ups as the Greenwood et al. (2018) definition that is based on growth in the total return index.[19]

[19] Greenwood et al. (2018) define a stock market run-up as 100% growth in the sector specific stock return index over two years, and at least 50% growth over 5 years. Applied to our aggregate data, this gives us around 30 run-up observations, a number that we target with the thresholds for increases in market cap. Because we apply the Greenwood et al. (2018) definition to the aggregate index, rather than sector-specific returns, this, given the cross-sector diversification gains, makes our definition somewhat more conservative.

Figure 13a shows the trends in stock capitalization, dividend-price ratios and stock returns during and after such run-ups in market cap. The typical market cap increase during the run-up is around 60% of GDP (Figure 13a left-hand panel). The middle panel of Figure 13a shows that a run-up in market cap is accompanied by increases in more conventional measures of stock valuations: the dividend-price ratio, on average, falls by almost a percentage point (one-quarter of its long-run mean) during these episodes. Stock returns (right-hand panel) are also high. The boom, however, quickly runs out of steam and is typically followed by a sharp correction in market cap. After the sharp increase, stock market cap falls on average by 40% of GDP, dividend-price ratios increase, and real returns are on average negative over the subsequent four years. The average geometric equity return in the sample is around 4.5% p.a., so a 10% cumulative fall in the four-year return represents an almost 30 percentage point drop relative to the counterfactual of mean return growth ($4.5 \times 4 + 10$). The low average real returns also come with a higher risk of equity market crashes. The grey lines in Figure 13a show the 75th and 25th percentile of cumulative equity returns after the run-up in stock market cap. Within the one-quarter of the worst outcomes, returns fall by as much as 40% in cumulative terms over 4 years.

Figure 13b shows the evolution of equity returns under alternative definitions of stock market run-ups. The left-hand panel looks at *relative* increases in stock market cap – i.e. a doubling of the market cap to GDP ratio over two years, and at least a 50% increase over five years. This places less emphasis on the events where market cap was already high before the run-up – such as the dot-com boom – and a greater emphasis on increases from low values of stock market cap. The returns follow a similar pattern to Figure 13a, even though the average fall is not quite as pronounced. The middle panel shows returns after steep increases in the log price-dividend ratio (a doubling of the price-dividend ratio over two years and at least a 50% increase over five years). The real returns are flat, but do not generally come with overly high tail risk. The comparison of market cap and price-dividend ratio run-ups echoes the findings of Section 6.1: in general, market cap seems to be a better measure of discount rates, and stock market over- or under-valuation than the dividend-price ratio. Finally, Figure 13b right-hand panel focuses on run-ups in real returns, with the definition from Greenwood et al. (2018): a 100% increase in real returns over 2 years, and at least a 50% increase over 5 years. The results are similar to market cap run-ups, although again, the bubble aftermath is slightly less severe, with on average flat rather than declining returns, and slightly lower losses in the "market crash" tail.

Table 7 formally tests whether high levels, or growth in market cap signals a higher probability of a market crash. We define an equity market crash as a return realisation in the bottom 5th percentile of the return distribution, for one and 2 year ahead returns, which gives us a threshold of -25%.[20] To assess the link between market capitalization and equity crash risk, we estimate the

[20]We set the crash dummy $C_{i,t}$ equal to 1 if there is a -25% equity return in year t, or a -25% cumulative equity return in years t and $t+1$. Appendix Table 7 evaluates the results under a number of alternative crash definitions, and finds them more or less unchanged.

Table 7: *Predicting equity market crashes*

	(1)	(2)	(3)	(4)
$log(MCAP_{t-1}/GDP_{t-1})$	0.45***		0.71***	0.50***
	(0.14)		(0.13)	(0.16)
$\Delta_3\ log(MCAP_{t-1}/GDP_{t-1})$		1.06***	0.73**	0.57
		(0.32)	(0.29)	(0.35)
$log(D_{t-1}/P_{t-1})$				-0.78***
				(0.17)
Country fixed effects			✓	✓
ROC	0.62	0.64	0.71	0.71
Number of Crashes	125	123	123	123
Observations	1939	1862	1862	1807

Note: Dependent variable is the equity market crash dummy at time t. All episodes with real equity returns falling by more than 25% in one year or within a two year window, and with no crashes in the two previous years are dated as crashes. Logit coefficient estimates with country clustered standard errors in parentheses. *, **, ***: Significant at 10%, 5% and 1% levels respectively.

following logit model:

$$Prob(C_{i,t} = 1) = \Lambda\left(MCAP_{i,t-1}/GDP_{i,t-1}, X_{i,t-1}, \beta\right), \tag{9}$$

where C is the equity crash dummy, X are other predictors, β is the estimated coefficient vector, Λ is the logistic distribution function, and i and t are country and time indices. Table 7 reports the estimated β coefficients and standard errors. Consistent with the stylised facts in Figure 13, high market cap to GDP ratios (column 1), or high growth in market cap (column 2) predict a heightened probability of a crash. These results hold when controlling for country fixed effects (column 3), and the dividend-price ratio (column 4). The ROC of 0.65–0.7 compares the predictive performance of our regression with a random sorting into crash and non-crash observations, and shows that our model does substantially better than the naive prediction (ROC of 0.5).[21] Appendix Table C.3 shows that high, or growing, stock market cap predicts crash risk across different time periods, when controlling for credit growth, and for a range of alternative crash definitions.

Sharp increases in market capitalization are signs of brewing trouble in the equity market. Run-ups in the market cap to GDP ratio are, on average, followed by sharp reversals in risk premiums and valuations, and a higher risk of an equity market crash. These risks are also borne out in our aggregate market capitalization trends in Figure 1. The long-run structural increase in capitalization during the big bang has been accompanied by several boom-bust cycles, including the dot-com boom of the 1990s and the Global Financial Crisis, with rapid run-ups in market cap followed up by market crashes and reversals to the structurally higher long-run mean. Just like the big bang, these booms and busts have typically occurred in most of the countries in our sample, suggesting

[21] For further details on the application of ROC curves to the financial extreme event analysis, see Schularick and Taylor (2012).

an increasingly important role for time variation in the global equity premium during the recent decades (Jordà, Schularick, Taylor, and Ward, 2019b).

7. Conclusion

This paper has presented a new dataset of annual stock market capitalization in 17 advanced economies from 1870 to today. Exploring the trends in the data, and their co-movement with various financial and economic variables has revealed several surprising facts. First, the historical evolution of stock market cap resembles a hockey stick: the market cap to GDP ratio was roughly flat up until the 1980s, at which point it expanded sharply, and remains high today. We term this sudden and unprecedented expansion in stock market size the "big bang".

At the same time, the forces that underly this structural shift in stock market size pose challenges for equating stock market growth with financial development. For the most part, changes in market capitalization are driven by shifting stock valuations, with much of these valuation shifts in turn driven by changing equity risk premia. In one sense, this explanation is somewhat unsatisfactory: it attributes even long-run changes in stock market size to a "dark matter" in stock valuations that is unrelated not only to market access and financial development, but also to future stock market fundamentals. In another sense, it is revealing because it tells us that changes in listed equity wealth, including the big bang, have little to do with changes in capital market entry, stock market efficiency, or physical accumulation of corporate stocks. Consistent with this "risk premium view" of stock market wealth, we find evidence that high levels of market capitalization predict low subsequent equity returns, and a heightened risk of stock market crashes.

References

Alvaredo, Facundo, Anthony B. Atkinson, and Salvatore Morelli. 2018. Top Wealth Shares in the UK over more than a Century. *Journal of Public Economics* 162: 26–47.

Atje, Raymond, and Boyan Jovanovic. 1993. Stock Markets and Development. *European Economic Review* 37(2): 632–640.

Bach, Laurent, Laurent E. Calvet, and Paolo Sodini. 2016. Rich Pickings? Risk, Return, and Skill in the Portfolios of the Wealthy. CEPR Discussion Paper 11734.

Baker, Malcolm, and Jeffrey Wurgler. 2000. The Equity Share in New Issues and Aggregate Stock Returns. *Journal of Finance* 55(5): 2219–2257.

Bernanke, Ben S. 2005. The Global Saving Glut and the US Current Account Deficit. Remarks by Governor Ben S. Bernanke at the Homer Jones Lecture, St. Louis, Missouri, The Federal Reserve Board of Governors.

Bianchi, Francesco, Martin Lettau, and Sydney C. Ludvigson. 2016. Monetary Policy and Asset Valuation. NBER Working Paper 22572.

Buffett, Warren, and Carol Loomis. 2001. Warren Buffet on the Stock Market. Fortune Magazine, December 10th 2001.

Burdett, Henry C. 1882. *Burdetts Official Intelligence for 1882*. London: Spottiswoode.

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

Chen, Long. 2009. On the Reversal of Return and Dividend Growth Predictability: A Tale of Two Periods. *Journal of Financial Economics* 92(1): 128–151.

Chen, Long, Zhi Da, and Richard Priestley. 2012. Dividend Smoothing and Predictability. *Management Science* 58(10): 1834–1853.

Cochrane, John H. 2008. The Dog That Did Not Bark: A Defense of Return Predictability. *Review of Financial Studies* 21(4): 1533–1575.

Cochrane, John H. 2011. Presidential Address: Discount Rates. *Journal of Finance* 66(4): 1047–1108.

Cooper, Ilan, and Richard Priestley. 2008. Time-varying Risk Premiums and the Output Gap. *Review of Financial Studies* 22(7): 2801–2833.

De Loecker, Jan, and Jan Eeckhout. 2017. The Rise of Market Power and the Macroeconomic Implications. NBER Working Paper 23687.

Del Negro, Marco, Domenico Giannone, Marc P. Giannoni, and Andrea Tambalotti. 2019. Global Trends in Interest Rates. *Journal of International Economics* forthcoming.

Diez, Federico, Daniel Leigh, and Suchanan Tambunlertchai. 2018. Global Market Power and its Macroeconomic Implications. IMF Working Paper 18137.

Eggertsson, Gauti B., Jacob A. Robbins, and Ella Getz Wold. 2018. Kaldor and Pikettys Facts: The Rise of Monopoly Power in the United States. NBER Working Paper 24287.

Farhi, Emmanuel, and François Gourio. 2018. Accounting for Macro-Finance Trends: Market Power, Intangibles, and Risk Premia. NBER Working Paper 25282.

Goldsmith, Raymond W. 1985. *Comparative National Balance Sheets: A Study of Twenty Countries, 1688–1978*. Chicago, Ill.: University of Chicago Press.

Green, Theodor. 1887. Fondsbørsen. Nationaløkonomisk Tidsskrift 5.

Greenwald, Daniel L., Martin Lettau, and Sydney C. Ludvigson. 2014. Origins of Stock Market Fluctuations. NBER Working Paper 19818.

Greenwood, Robin, and Samuel G. Hanson. 2013. Issuer Quality and Corporate Bond Returns. *Review of Financial Studies* 26(6): 1483–1525.

Greenwood, Robin, Andrei Shleifer, and Yang You. 2018. Bubbles for Fama. *Journal of Financial Economics* forthcoming.

Gutierrez, German. 2017. Investigating Global Labor and Profit Shares. Working paper.

Hannah, Leslie. 2018. The London Stock Exchange, 1869-1929: New Statistics for Old? *Economic History Review* 71(4): 1349–1356.

Hoffmann, Walther G. 1965. *Das Wachstum der Deutschen Wirtschaft seit der Mitte des 19. Jahrhunderts*. Berlin: Springer.

Holston, Kathryn, Thomas Laubach, and John C. Williams. 2017. Measuring the Natural Rate of Interest: International Trends and Determinants. *Journal of International Economics* 108(S1): 59–75.

Jordà, Òscar, Katharina Knoll, Dmitry Kuvshinov, Moritz Schularick, and Alan M. Taylor. 2019a. The Rate of Return on Everything, 1870–2015. *Quarterly Journal of Economics* forthcoming.

Jordà, Òscar, Björn Richter, Moritz Schularick, and Alan M. Taylor. 2017. Bank Capital Redux: Solvency, Liquidity, and Crisis. NBER Working Paper 23287.

Jordà, Òscar, Moritz Schularick, and Alan M. Taylor. 2016. Macrofinancial History and the New Business Cycle Facts. In *NBER Macroeconomics Annual 2016, Volume 31*, edited by Martin Eichenbaum, Jonathan A. Parker, pp. 213–263. Chicago, Ill.: University of Chicago Press.

Jordà, Òscar, Moritz Schularick, Alan M. Taylor, and Felix Ward. 2019b. Global Financial Cycles and Risk Premiums. Technical Report 1.

Karabarbounis, Loukas, and Brent Neiman. 2018. Accounting for Factorless Income. NBER Working Paper 24404.

King, Robert G., and Ross Levine. 1993. Finance and Growth: Schumpeter Might Be Right. *Quarterly Journal of Economics* 108(3): 717–737.

Knoll, Katharina, Moritz Schularick, and Thomas M. Steger. 2017. No Price like Home: Global House Prices, 1870–2012. *American Economic Review* 107(2): 331–352.

Kuhn, Moritz, Moritz Schularick, and Ulrike I. Steins. 2017. Income and Wealth Inequality in America , 1949–2013. CEPR Discussion Paper 20547.

Kuvshinov, Dmitry. 2019. The Time Varying Risk Puzzle. Working paper.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert W. Vishny. 1997. Legal Determinants of External Finance. *Journal of Finance* 1131–1150.

Le Bris, David. 2012. Wars, Inflation and Stock Market Returns in France, 1870–1945. *Financial History Review* 19(3): 337–361.

Lettau, Martin, and Sydney Ludvigson. 2002. Consumption, Aggregate Wealth, and Expected Stock Returns. *Journal of Finance* 56(3): 815–849.

Lettau, Martin, Sydney C. Ludvigson, and Jessica A. Wachter. 2008. The Declining Equity Premium: What Role Does Macroeconomic Risk Play? *Review of Financial Studies* 21(4): 1653–1687.

Levine, Ross, and Sara Zervos. 1996. Stock Market Development and Long-run Growth. *World Bank Economic Review* 10(2): 323–339.

McGrattan, Ellen R., and Edward C. Prescott. 2005. Taxes, Regulations, and the Value of U.S. and U.K. Corporations. *Review of Economic Studies* 72(3): 767–796.

Michie, Ranald C. 1988. The Canadian Securities Market, 1850–1914. *Business History Review* 62(1): 35–73.

Musacchio, Aldo. 2010. Law and Finance c. 1900. NBER Working Paper 16216.

Nelson, William. 1999. The Aggregate Change in Shares and the Level of Stock Prices. Federal Reserve Board Finance and Economics Discussion Series 1999-08.

Piketty, Thomas. 2014. *Capital in the Twenty-First Century*. Cambridge, Mass.: Harvard University Press.

Piketty, Thomas, and Gabriel Zucman. 2014. Capital is Back: Wealth-Income Ratios in Rich Countries 1700–2010. *Quarterly Journal of Economics* 129(3): 1255–1310.

Rajan, Raghuram G., and Luigi Zingales. 2003. The Great Reversals: the Politics of Financial Development in the Twentieth Century. *Journal of Financial Economics* 69(1): 5–50.

Rangvid, Jesper. 2006. Output and Expected Returns. *Journal of Financial Economics* 81(3): 595–624.

Roe, Alan. 1971. *The Financial Interdependence of the Economy, 1957-1966*. London: Chapman and Hall.

Roine, Jesper, and Daniel Waldenström. 2012. On the Role of Capital Gains in Swedish Income Inequality. *Review of Income and Wealth* 58(3): 569–587.

Saez, Emmanuel, and Gabriel Zucman. 2016. Wealth Inequality in the United States since 1913: Evidence from Capitalized Income Tax Data. *Quarterly Journal of Economics* 131(2): 519–578.

Schularick, Moritz, and Alan M. Taylor. 2012. Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870–2008. *American Economic Review* 102(2): 1029.

Sylla, Richard. 2006. Schumpeter Redux: a Review of Raghuram G. Rajan and Luigi Zingales's Saving Capitalism from the Capitalists. *Journal of Economic Literature* 44(2): 391–404.

Waldenström, Daniel. 2014. Swedish Stock and Bond Returns, 1856–2012. In *Historical Monetary and Financial Statistics for Sweden, Volume 2: House Prices, Stock Returns, National Accounts and the Riksbank Balance Sheet, 1860-2012*, edited by Rodney Edvinsson, Tor Jacobson, and Daniel Waldenström, pp. 223–293. Stockholm: Sveriges Riksbank and Ekerlids förlag.

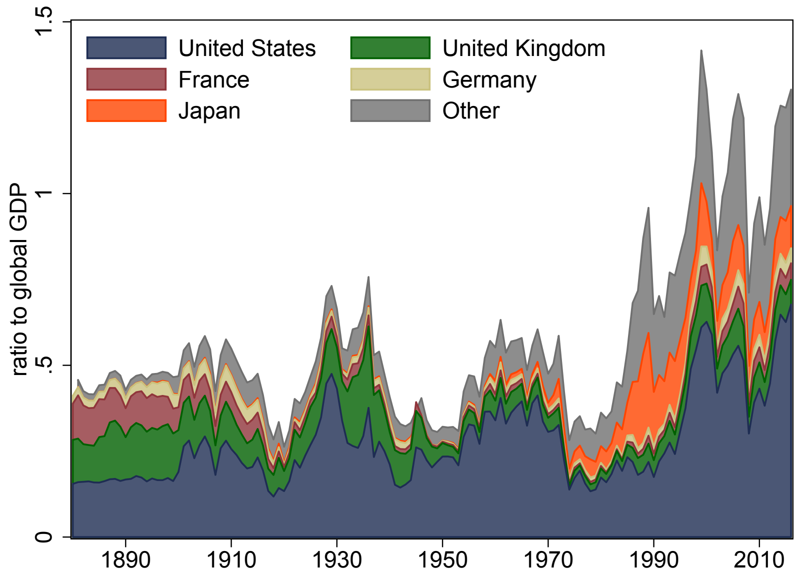
Zucman, Gabriel. 2014. Taxing Across Borders: Tracking Personal Wealth and Corporate Profits. *Journal of Economic Perspectives* 28(4): 121–48.

Online Appendix

The Big Bang: Stock Market Capitalization in the Long Run

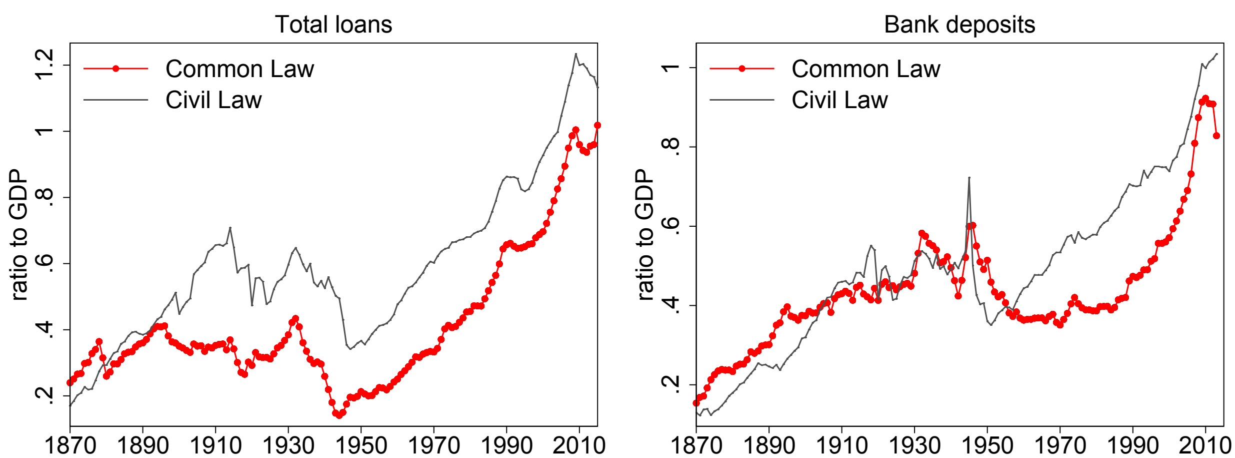
A. Trends in market capitalization

Figure A.1: *World market capitalization*



Notes: The ratio of global market capitalization to global GDP. Global variables are the sum of the 17 countries in our sample, converted to US dollars. Missing values are interpolated to maintain sample consistency. Country shares correspond to the US dollar value of the specific country's stock market relative to global GDP.

Figure A.2: *Loans, deposits and legal norms*

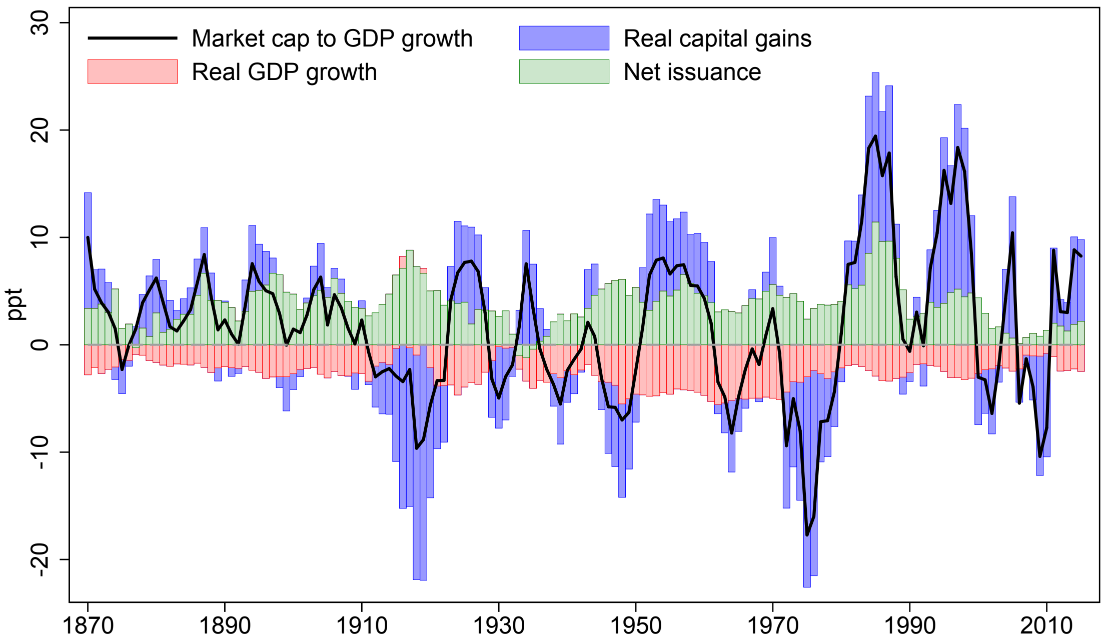


Notes: The ratio of total loans and bank deposits to GDP by country group, unweighted averages. Common law countries are Australia, Canada, the UK and the US. Civil law countries are all other countries in our dataset.

B. Drivers of stock valuations

B.1 Decomposition into capital gains, net issuance and GDP growth

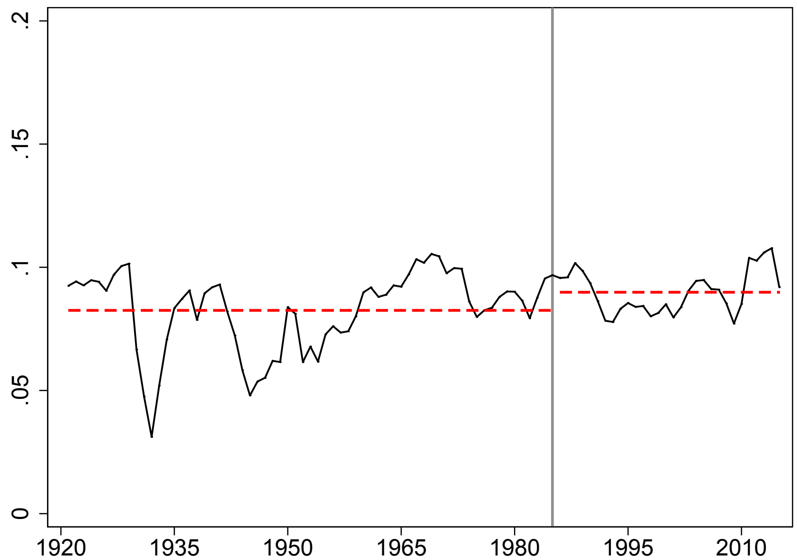
Figure B.1: *Decomposition Trends with 3 Components*



Notes: Decomposition of annual stock market cap to GDP growth into issuances, real capital gains and real GDP growth, using equation (5). Five-year moving averages. Market cap growth is the change in the log of market cap to GDP ratio. Implied issuance is the change in market cap not explained by equity prices or GDP growth. Using log growth rates creates a small approximation residual.

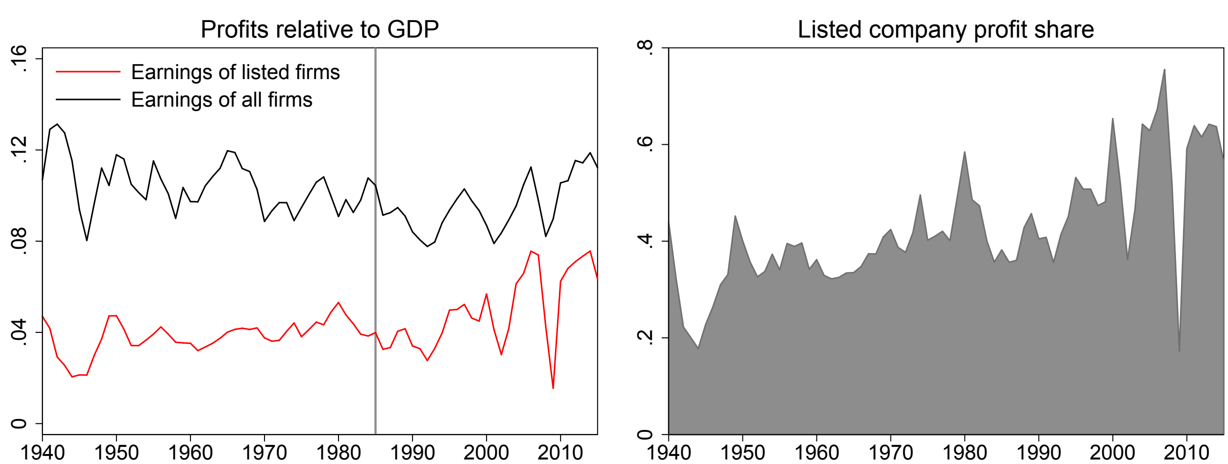
B.2 Long-run trends in equity cashflows

Figure B.2: *Post-tax profits relative to GDP*



Note: Unweighted average of four countries. Black vertical line indicates the start of the big bang in 1985. Dashed horizontal lines show the average of the series before and after the big bang.

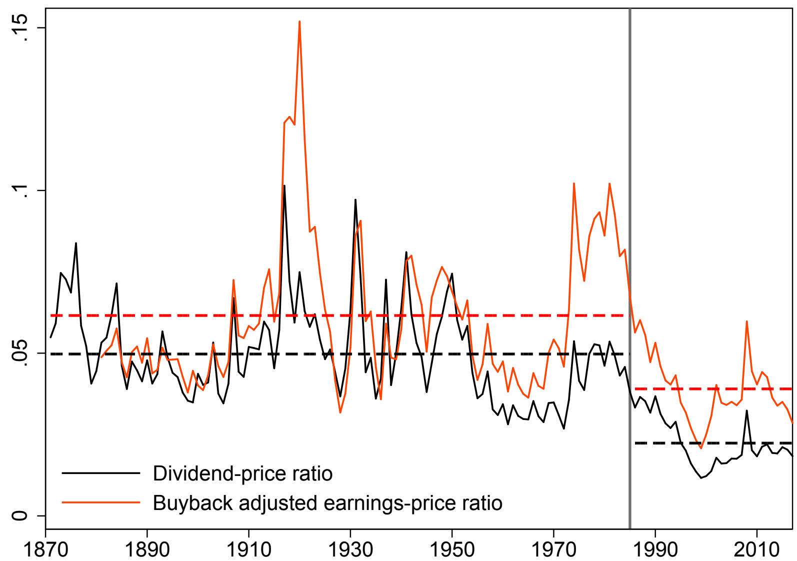
Figure B.3: *Earnings share of listed companies in the United States*



Note: Earnings of listed companies compared to earnings of all companies from national accounts. Earnings of listed companies relative to GDP is calculated by combining the average of monthly earnings figures and end of year price data from Shiller (2015) with our end of year market cap to GDP estimate.

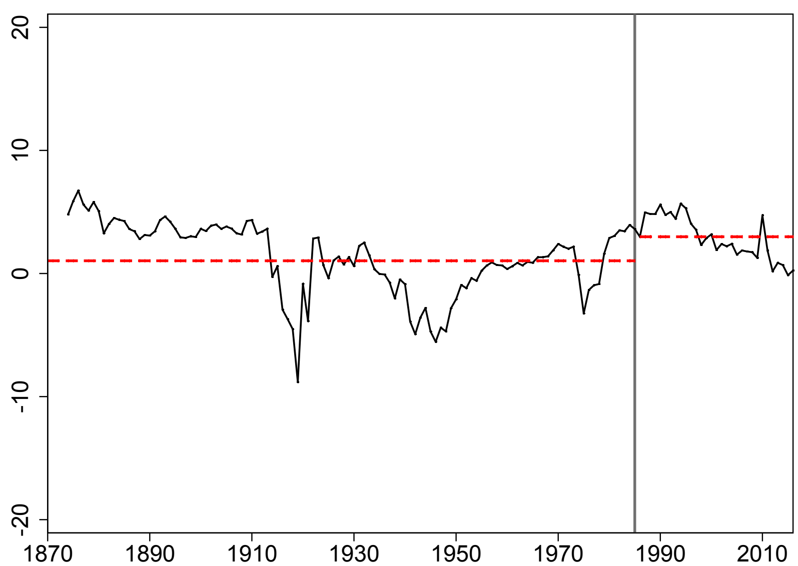
B.3 Long-run trends in equity discount rates

Figure B.4: *Dividend-price and buyback adjusted earnings-price ratio in the United States*



Note: Dividend-price ratio and cyclically adjusted total return earnings-price ratio (inverse of P/E10 CAPE) from Shiller (2015). December values. Black vertical line in 1985 signifies the big bang. Dashed horizontal lines show the averages of the series before and after the big bang.

Figure B.5: *A proxy for the ex ante real interest rate*



Note: Real interest rate calculated by substracting predicted inflation from a long-term government bond yield. Inflation is predicted using last years inflation, two lags of GDP growth and changes in inflation in a cross-country fixed effects regression. To account for monetary regimes, we split the sample into four periods 1870-1913, 1913-1945, 1946-1973, 1974-2015 and estimate the inflation expectation for each period separately. Black vertical line in 1985 signifies the big bang. Dashed horizontal lines show the averages of the series before and after the big bang.

B.4 Quantifying the contribution of different drivers

Table B.1: *Quantifying the relative contribution of stock market cap determinants, post-1985 sample*

	Levels		5-Year Changes		10-Year Changes	
	(1)	(2)	(3)	(4)	(5)	(6)
D_t/GDP_t	32.94***	32.45***	37.63***	37.38***	34.86***	36.00***
	(3.0)	(3.0)	(6.3)	(6.5)	(9.5)	(7.7)
D_{t+1}/GDP_{t+1}	-0.03	-0.52	3.73	3.58	-0.52	-0.96
	(1.9)	(1.8)	(3.1)	(3.3)	(3.4)	(2.4)
D_t/P_t	-18.55***	-18.73***	-11.31***	-11.71***	-6.78**	-9.38***
	(3.1)	(3.1)	(2.8)	(3.2)	(2.6)	(2.9)
r_t	-0.14	0.24	-0.89*	-0.90*	-1.11*	-1.59**
	(0.4)	(0.3)	(0.4)	(0.5)	(0.6)	(0.7)
τ_t^{corp}		-0.47**		0.14		0.69
		(0.2)		(0.2)		(0.4)
τ_{t+1}^{corp}		0.13		0.17		-1.10**
		(0.3)		(0.4)		(0.5)
R^2	0.743	0.746	0.513	0.518	0.463	0.493
Observations	474	472	410	396	328	263

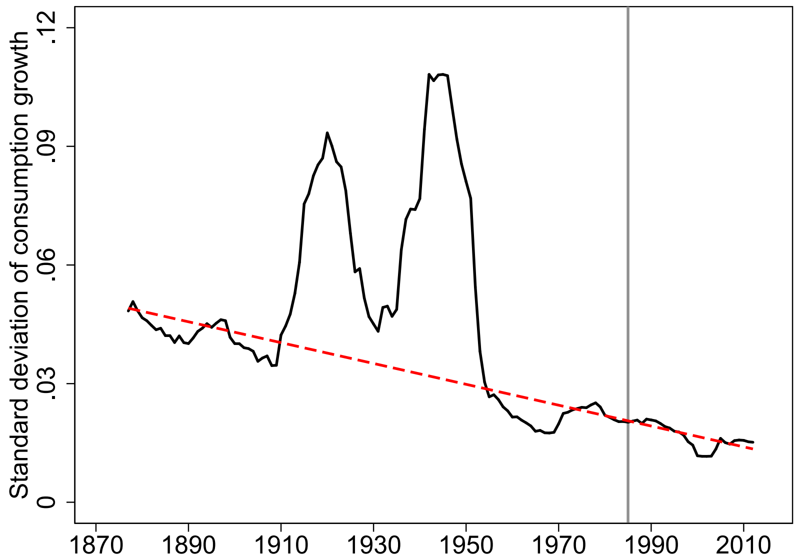
Note: Regressions with country fixed effects and robust standard errors. Standard errors in parentheses. Columns (1) and (2) show regression coefficients of dividends to GDP, the dividend to price ratio and corporate tax rates on the market capitalization level. Column (3)–(5) report the regression coefficients of the analysis in five year and 10 year changes. For the five-year and ten-year change regressions, the one-year ahead variables such as D_{t+1}/GDP_{t+1} become five-year ahead variables, i.e. $D_{t+5}/GDP_{t+5} - D_t/GDP_t$. Sample limited to post-1985 only. *, **, ***: Significant at 10%, 5% and 1% levels respectively.

Table B.2: *Quantifying the relative contribution of stock market cap determinants, ex ante real rate proxy*

	Levels		5-Year Changes		10-Year Changes	
	(1)	(2)	(3)	(4)	(5)	(6)
D_t/GDP_t	24.84***	25.27***	22.69***	28.03***	23.47***	23.63***
	(2.3)	(2.8)	(2.4)	(5.6)	(1.9)	(3.9)
D_{t+1}/GDP_{t+1}	1.57	0.83	0.01	1.53	2.73	-1.18
	(1.8)	(1.7)	(1.1)	(2.4)	(1.6)	(2.3)
D_t/P_t	-9.09***	-9.81***	-6.46***	-7.90***	-5.35***	-5.84***
	(1.3)	(1.9)	(1.2)	(1.7)	(1.0)	(1.4)
r_t^{pred}	-0.00	-0.68*	-1.07***	-1.75**	-1.37***	-3.04***
	(0.3)	(0.3)	(0.3)	(0.7)	(0.3)	(1.0)
τ_t^{corp}		-0.03		0.18*		0.17
		(0.2)		(0.1)		(0.2)
τ_{t+1}^{corp}		-0.03		0.11		-0.38**
		(0.2)		(0.1)		(0.2)
R^2	0.740	0.718	0.495	0.494	0.636	0.563
Observations	1986	906	1748	732	1557	561

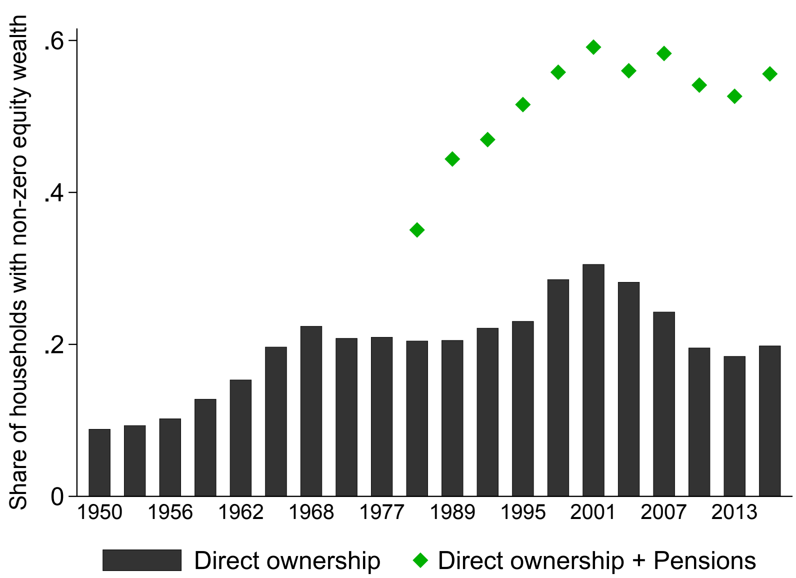
Note: Regressions with country fixed effects and robust standard errors. Standard errors in parentheses. Columns (1) and (2) show regression coefficients of dividends to GDP, the dividend to price ratio and corporate tax rates on the market capitalization level. Column (3)–(5) report the regression coefficients of the analysis in five year and 10 year changes. For the five-year and ten-year change regressions, the one-year ahead variables such as D_{t+1}/GDP_{t+1} become five-year ahead variables, i.e. $D_{t+5}/GDP_{t+5} - D_t/GDP_t$. r_t^{pred} is the real interest rate calculated by substracting predicted inflation from a long-term government bond yield. See footnote of Figure B.5 for more detail. *, **, ***: Significant at 10%, 5% and 1% levels respectively.

Figure B.6: *Consumption volatility over the long run*



Note: Annual standard deviation of real consumption growth over rolling decadal windows (1875 figure is the decade 1870–1880). Unweighted average of 17 countries. Black vertical line in 1985 signifies the big bang. Dashed horizontal line is the peacetime trend in the time series.

Figure B.7: *Positive wealth in direct and indirect stock ownership*



Note: Share of households owning stocks in the United States. Data are sourced from the Survey of Consumer Finances, kindly shared with us by Kuhn, Schularick, and Steins (2017). Direct ownership includes all households with positive stock or mutual fund wealth. The estimate of direct ownership + pensions includes all households with positive pension assets, stock or mutual fund wealth.

C. Predicting equity returns and market crashes

C.1 Predicting returns and dividend growth

Table C.1: *Return predictability at long horizons and during the big bang*

	Real returns		Excess returns		Real dividend growth	
Panel 1: *Ten-year ahead average returns and dividend growth*						
	(1)	(2)	(3)	(4)	(5)	(6)
$log(MCAP_t/GDP_t)$	-0.063***	-0.065***	-0.044***	-0.045***	-0.003	-0.050***
	(0.010)	(0.012)	(0.007)	(0.007)	(0.011)	(0.012)
$log(P_t/D_t)$		0.008		0.003		0.158***
		(0.015)		(0.013)		(0.019)
R^2	0.126	0.127	0.073	0.073	0.000	0.275
Observations	1753	1753	1753	1753	1753	1753
Panel 2: *One-year ahead returns and dividend growth after 1985*						
$log(MCAP_t/GDP_t)$	-0.129***	-0.121***	-0.103***	-0.094***	-0.029	-0.056**
	(0.014)	(0.014)	(0.015)	(0.016)	(0.022)	(0.025)
$log(P_t/D_t)$		-0.073***		-0.090***		0.254***
		(0.017)		(0.019)		(0.054)
R^2	0.063	0.075	0.036	0.052	0.002	0.109
Observations	487	487	487	487	487	487

Note: Returns and dividend growth are measured in logs. *, **, ***: Significant at 10%, 5% and 1% levels respectively. Regressions with country fixed effects. Country-clustered standard errors in parentheses.

Table C.2: *Dividend-to-GDP as a predictor of equity returns and dividends*

	Real returns		Excess returns		Real dividend growth	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel 1: *One-year ahead returns and dividend growth*						
$log(D_t/Y_t)$	-0.016	-0.028**	-0.019**	-0.028***	-0.075***	-0.054***
	(0.010)	(0.010)	(0.008)	(0.008)	(0.018)	(0.015)
$log(P_t/D_t)$		-0.063***		-0.048***		0.106***
		(0.012)		(0.011)		(0.029)
R^2	0.002	0.020	0.004	0.015	0.036	0.069
Observations	2032	2032	1986	1986	2029	2029
Panel 2: *Five-year ahead average returns and dividend growth*						
$log(P_t/Y_t)$	-0.062***	-0.060***	-0.036***	-0.034***	-0.029***	-0.049***
	(0.005)	(0.006)	(0.005)	(0.006)	(0.007)	(0.007)
$log(P_t/D_t)$		-0.010		-0.013		0.099***
		(0.013)		(0.010)		(0.016)
R^2	0.029	0.029	0.067	0.071	0.032	0.206
Observations	2162	2111	2048	1997	2095	2095

Note: Returns and dividend growth are measured in logs. *, **, ***: Significant at 10%, 5% and 1% levels respectively. Regressions with country fixed effects. Country-clustered standard errors in parentheses.

C.2 Predicting equity market crashes

Table C.3: *Predicting equity market crashes: alternative specifications*

	(1) Pre 1945	(2) Post 1945	(3) Post 1985	(4) War Obs.	(5) Credit Growth
$log(MCAP_{t-1}/GDP_{t-1})$	3.12***	0.64***	1.47***	0.70***	0.75***
	(0.92)	(0.14)	(0.34)	(0.12)	(0.10)
$\Delta_3\ log(MCAP_{t-1}/GDP_{t-1})$	1.46**	0.52**	1.26***	0.67***	0.64***
	(0.60)	(0.25)	(0.33)	(0.25)	(0.24)
Country fixed effects	✓	✓	✓	✓	✓
ROC	0.79	0.69	0.78	0.69	0.74
Number of Crashes	25	98	53	143	118
Observations	571	1178	544	2048	1895
	(1) Decade	(2) Large Crashes	(3) 1-year Crashes	(4) 3-year Crashes	(5) MCAP Crashes
$log(MCAP_{t-1}/GDP_{t-1})$	0.61***	1.00***	0.70***	0.86***	0.50***
	(0.22)	(0.22)	(0.13)	(0.11)	(0.10)
$\Delta_3\ log(MCAP_{t-1}/GDP_{t-1})$	0.87***	1.26**	-0.08	1.23***	0.95***
	(0.29)	(0.56)	(0.18)	(0.40)	(0.26)
Country fixed effects	✓	✓	✓	✓	✓
ROC	0.78	0.79	0.68	0.75	0.69
Number of Crashes	123	28	92	104	149
Observations	2008	1643	1862	1862	1862

Note: Dependent variable is the equity market crash dummy at time t. In Panel 1 and Panel 2 column 1, a crash is defined as real equity returns falling by more than 25% in one year or within a two year window, and with no crashes in the two previous years. *, **, ***: Significant at 10%, 5% and 1% levels respectively. Standard errors in parentheses. All estimates are based on logit estimations with country fixed effects and country clustered standard errors. Panel 1: Column (1) restricts the panel to observations before 1945. Column (2) and (3) only include observations after 1945 and 1985 respectively. Column (4) adds observations from the world wars and Column (5) includes five lags of real private per capita credit growth as additional controls. Panel 2: Column (1) reports estimates with decade fixed effects and Column (2) to (5) are based on alternative crash definitions. Large crashes are all crashes with a 50% fall in real equity returns either in the first year or within a two year window. 1-year crashes are all episodes with a 25% fall of equity prices in one year and 3-year crashes are based on a three year window. MCAP Crashes uses market capitalization to GDP instead of real equity returns to date crashes.

Data appendix

This section details the sources of our market capitalization estimates for each country, and compares them to alternative estimates. The alternative estimates are generally country specific, but we always compare our data to those of Goldsmith (1985) (sourced from La Porta et al., 2008) and Rajan and Zingales (2003) when available. All the annual estimates reflect end-of-year values, unless otherwise stated.

Australia

Table D.1: *Data sources: Australia*

Year	Data source
1870–1889	Total capitalization of the Melbourne Stock Exchange, from Hall (1968)
1899–1924	Total capitalization of the Sydney Stock Exchange, from Moore (2010b). Converted to AUD using the exchange rates in Jordà et al. (2016).
1925–1978	Total capitalization of the Sydney Stock Exchange, from Black, Kirkwood, Williams, and Rai (2013).
1979–2013	Total capitalization of all Australian listed firms, shares listed on Australian exchanges. Source: World Bank *WDI database*. Almost identical to the Sydney cap in the 1970s; spliced with Black et al. (2013) data in 1979.
2014–2016	Total capitalization of all Australian listed firms, shares on Australian exchanges. Source: World Federation of Exchanges (WFE) *Statistical Reports*, various years.

Figure D.1: *Australia: alternative stock market cap estimates*

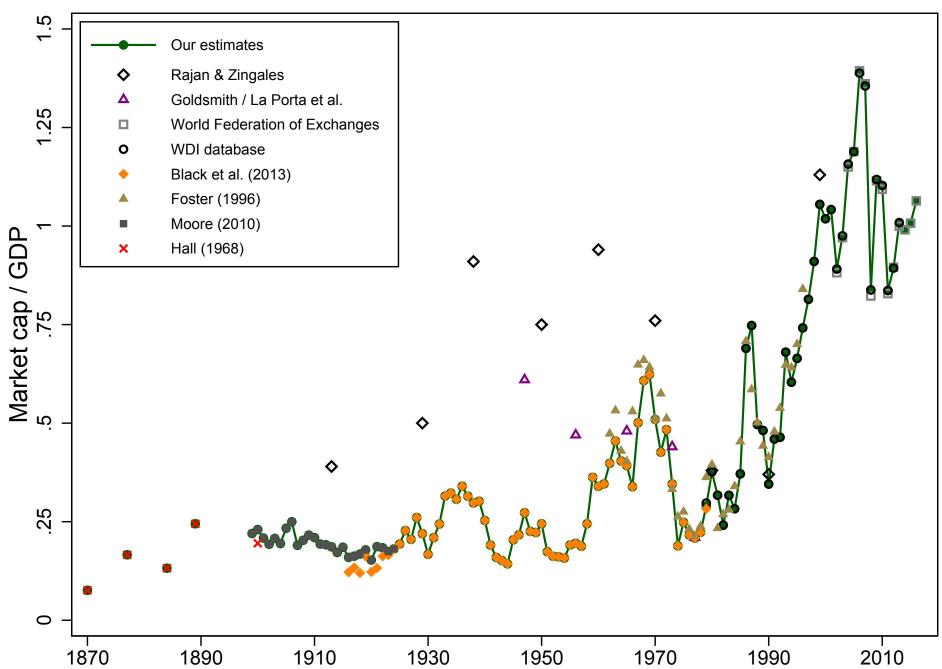


Table D.1 documents the sources of our stock market capitalization data for Australia, and Figure D.1 plots the resulting series alongside alternative existing estimates. The Australian securities market has generally been dominated by two major stock exchanges, located in Sydney and Melbourne. Hall (1968) argued that the Melbourne stock exchange was dominant in the late 19th century, largely because of large capitalizations of stocks of mining companies, and the data in Black et al. (2013) and Lamberton (1958) suggest that the Sydney stock exchange became dominant in the early 20th century. Based on this, we use the Hall (1968) estimates of the Melbourne stock market capitalization for the 19th century data, and switch to the Sydney exchange in the 20th century, using estimates of Moore (2010b) and Black et al. (2013), which are also consistent with the RBA Historical Statistics data in Foster (1996). From the 1970s onwards we switch to the total Australian firm capitalization estimates provided by the *World Federation of Exchanges* reports and the World Bank *WDI database*.

The main potential bias in the data for Australia comes from two sources: the fact that until the 1970s, we only have data for either the Sydney or the Melbourne exchange, not both; and the fact that these data include both foreign and domestic companies (again, up to the 1970s). These two biases do, however, largely seem to balance each other out: the total Australian exchange capitalization in the 1970s is very similar to that of the Sydney stock exchange, and Lamberton (1958) indicates that the Sydney stock exchange became the most important center for financial activity much earlier. Therefore we do not make any further adjustments to the early Australian data, which focus mostly on the Sydeny exchange, including both domestic and foreign companies.[22]

Our approach of focussing on the Melbourne cap in the late 19th century, and the Sydney cap in the 20th century is in line with that of Rajan and Zingales (2003). As Figure D.1 shows, however, our estimates of market capitalization are somewhat below those of both Rajan and Zingales (2003) and Goldsmith (1985), largely due to better available up-to-date statistics, for example from Black et al. (2013) and Moore (2010b).

We are grateful to the Reserve Bank of Australia and Anna Nietschke for sharing the data from Black, Kirkwood, Williams, and Rai (2013) with us, and providing other helpful references.

[22] As a side note, adding up the Hall (1968) and Moore (2010b) estimates for 1899 would grossly overestimate the total cap of Australian firms because it does not adjust for cross-listings.

Belgium

Table D.2: *Data sources: Belgium*

Year	Data source
1870–2015	Total capitalization of all Belgian companies on the Brussels Stock exchange, SCOB Database. Data shared by Frans Buelens. See Annaert, Buelens, and De Ceuster (2012) for details.
2016–2017	Extrapolated forward using the cap of all Belgian companies listed in Belgium, from the *ECB Statistical Data Warehouse*, Security issues statistics. The ECB and SCOB data are in general very similar, but we use the SCOB data as the benchmark for greater overall consistency.

Figure D.2: *Belgium: alternative stock market cap estimates*

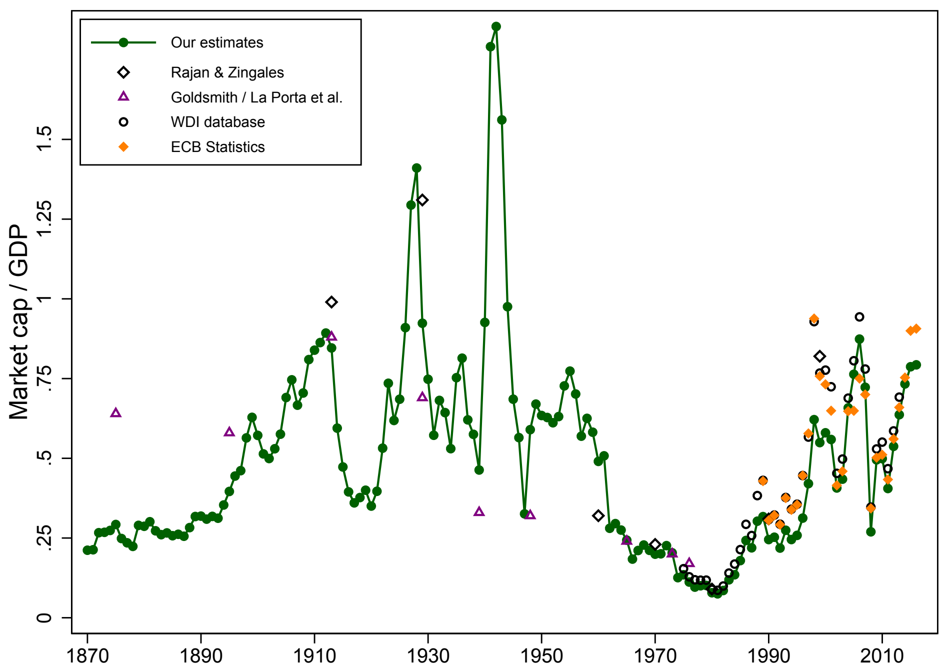


Table D.2 documents the sources of our stock market capitalization data for Belgium, and Figure D.2 plots the resulting series alongside alternative existing estimates. The data cover the Brussels stock exchange, which was the dominant stock exchange throughout the data coverage period in our paper, and are sourced from the security-level SCOB database (see Annaert et al., 2012, for the description). The data cover all companies with main economic activities in Belgium, that are listed on the Brussels stock exchange. Unlike other existing estimates, the capitalization is aggregated up from security-level data for each year, and does not rely on estimation or extrapolation. For the modern period, the SCOB estimates are similar to other commonly used sources such as the *WDI* database and the *ECB Statistical Data Warehouse* data.

We are grateful to Frans Buelens for sharing the SCOB market capitalization data with us.

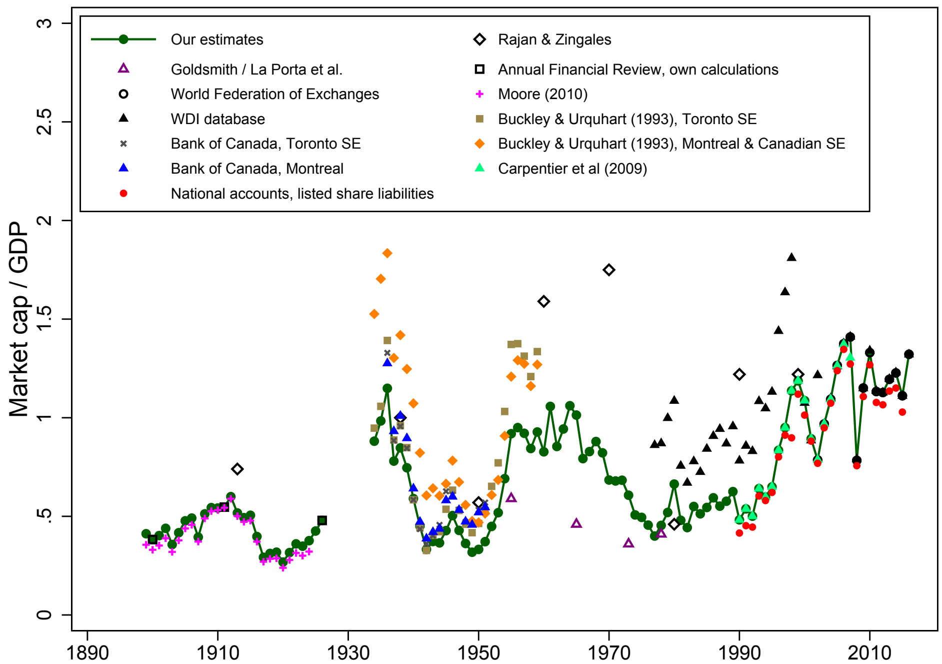
Canada

Table D.3: *Data sources: Canada*

Year	Data source
1899–1926	Capitalization of all Canadian firms listed on foreign exchanges. Baseline data from Moore (2010b), scaled up using own calculations from microdata in the *Annual Financial Review* in years 1900, 1911 and 1926. The scaling accounts for firms missing from the listings in Moore (2010b) data, and exclusion of foreign firms. Market cap growth for 1924–1926 estimated using the change in the share price index and assumed net issuance of 1.2% of market cap (the average of observed issuance for 1937–2016, using data from the Bank of Canada *Statistical Summaries* (*Financial Supplement*, years 1964–1969) and *Banking and Financial Statistics* database.
1934–1958	Combined capitalization of the Toronto, Montreal and Canadian Stock Exchanges from Buckley and Urquhart (1993), scaled down to exclude cross-listings, foreign shares and preference shares, in order to match the market capitalization estimate for 1959. The scaling ratio between unadjusted and adjusted capitalization (3:1) is similar to the one obtained by Carpentier, L'Her, and Suret (2009) for year 1990.
1959–1969	1970 capitalization extrapolated back using growth in share prices and net issuance of ordinary shares. Share price data from Kuvshinov (2019), issuance data from Bank of Canada *Statistical Summaries*.
1970–1974	1975 capitalization extrapolated back using the growth in market value of equity liabilities of Canadian firms, from the Bank of Canada *CANSIM* database, national balance sheet data.
1975–1989	1990 capitalization extrapolated back using growth in share prices and net issuance of ordinary shares. Share price data from Kuvshinov (2019), issuance data from the Bank of Canada *Banking and Financial Statistics*.
1990–2001	Total capitalization of all Canadian firms listed in Canada, adjusted for cross-listings, from Carpentier, L'Her, and Suret (2009).
2002–2016	Total capitalization of all Canadian listed firms, shares listed on all Canadian exchanges, adjusted for cross-listings, from the World Federation of Exchanges (WFE) *Statistical Reports*, various years

Table D.3 documents the sources of our stock market capitalization data for Canada, and Figure D.3 plots the resulting series alongside alternative existing estimates. Constructing historical market capitalization estimates is especially challenging in the case of Canada, for several reasons. First, throughout the whole of our sample period, Canada has operated at least two large and active stock exchanges, in Toronto and Montreal. The capitalizations of these two exchanges have tended to quite similar, with Montreal slightly larger in the early historical period, and Toronto – in the latter. Many available statistics provide the gross total value of securities listed on each exchange. But most large companies were listed on both of these stock exchanges, which makes adjusting gross estimates for cross-listings especially important. Even in the modern data, including the estimates of Rajan and Zingales (2003) and the World Federation of Exchanges, the total Canadian capitalization was not adjusted for cross listings until year 2002, such that the totals often double-counted the shares of large cross-listed firms (Carpentier, L'Her, and Suret, 2009). Second, the Canadian industry and financial markets were internationally integrated with the US and UK due to geographical proximity

Figure D.3: *Canada: alternative stock market cap estimates*



and colonial-era ties. This makes the exclusion of foreign listings from calculations important. Further, a few Canadian firms were only listed on US exchanges or in London, meaning that they should be excluded from our data. Third, many statistics group together all "stocks" issued by Canadian firms, which include both ordinary and preference shares, whereas we want to capture ordinary shares only.

The severity of these various measurement issues can be seen in the existing estimates of Rajan and Zingales (2003) (RZ) and Goldsmith (1985) (GS) in Figure D.3. RZ generally use a mix of unadjusted Toronto cap, unadjusted Montreal cap, the sum of the two, or an adjusted total, depending on the particular year. This results in changes in the series which seem to be mostly attributable to this variation in measurement: for example, between 1970 and 1980, RZ estimate that the market cap to GDP ratio fell by roughly four times, or 150% of GDP. At the same time, stock prices more than doubled. GS documents a small increase in the market cap to GDP ratio between 1973 and 1978. Finally, the RZ market capitalization estimates in the 1960s and 1970s are roughly three times those of GS, despite the fact that in principle, the RZ data should cover listed firms only, while GS covers both listed and unlisted firms. These biases are not easily remedied by other official statistics. Buckley and Urquhart (1993) and the Bank of Canada *Statistical Summaries* provide estimates of the capitalization of the Toronto and Montreal stock exchanges for the period 1934–1959, shown in Figure D.3. These estimates, however, are gross of cross-listed securities, foreign firms and preference shares. If we add up the Buckley and Urquhart (1993) estimates of the Toronto and Montreal capitalization in the 1930s, we get a market cap to GDP ratio of almost 400% right in the aftermath of the Great Depression, which seems implausibly high.

We seek to deal with the difficulties discussed above when constructing our own market capitalization estimates. For both the early 20th century, and the recent decades, we are able to calculate the total capitalization of Canadian listed firms, with all the necessary adjustments, with a high degree of accuracy. The baseline data for the early series come from Moore (2010b), who

uses stock listings data to compute the total cross-listings-adjusted capitalization of the Toronto and Montreal stock exchanges. Nonetheless, these data include foreign firms, and might not include securities of smaller companies or those listed on unofficial or curb exchanges. Given that the Moore (2010b) estimates for the 1920s are so far below those of Buckley and Urquhart (1993) and Bank of Canada *Statistical Summaries* in the 1930s, and the fact that stock price aprpeciation between late 1920s and early 1930s in Canada was very small due to the Great Depression, we construct our own estimates for the early period which enable us to benchmark the Moore (2010b) data.

Our benchmark-year estimates for the early period are constructed from the microdata on individual companies in the *Annual Financial Review* publication for years 1901, 1912 and 1927.[23] Because the *Annual Financial Review* only has each company enter once, this effectively adjusts for any cross listings. In addition, these data contain information on company headquarters and operations, as well as which exchanges the firm is listed on, allowing us to control for factors such as foreign ownership. For the purpose of this calculation, we include firms incorporated and governed from Canada, but with operations overseas, such as the various Mexican tramway companies which appear in the 1911 listing, but this has little bearing on our results. It turns out that the benchmark estimates are close to the data from Moore (2010b) (see Figure D.3): around 15–20% higher for 1900 and 1926, and similar in size for 1911, due to a high number of foreign companies on the market during that year, which we adjust out but Moore (2010b) does not. Based on this, we scale up the Moore (2010b) data slightly to match the adjusted total, and bridge the 1924–1926 gap by using share price appreciation for those years, and an assumed net issuance that equals the long-run average in Canadian data.

For the recent period, the World Federation of Exchanges provide statistics which measure the adjusted total capitalization of all Canadian firms listed in Canada for years 2002–2016. Previous years' estimates from this source include some double-counting, hence for the period 1990–2001 we rely on data from Carpentier et al. (2009), who calculate an adjusted total market cap accounting for cross-listings and excluding foreign firms and non-equity securities. For 1990, Carpentier et al. (2009) estimate total capitalization which is roughly one-third of the unadjusted sum. These data match up nicely with the national balance sheet estimates for the market value of listed equity liabilities of Canadian firms (Figure D.3, red diamonds), available from the national accounts data in the *CANSIM* database of the Bank of Canada.

We have several sources available to us for the period from 1934 to 1989: the estimates from the World Bank's *WDI Database* for the period 1975–2016, historical statistics data for 1934–1959 from Buckley and Urquhart (1993), the estimates by the Bank of Canada in their *Statistical Summaries*, which are the underlying source of the Buckley and Urquhart (1993) data, as well as the computations of Rajan and Zingales (2003) and Goldsmith (1985). We also have data on net equity issuance which cover the period 1937–2016, with a gap in 1970–1974, with historical data sourced from the Bank of Canada *Statistical Summaries Financial Supplement*, and modern data from the Bank of Canada's *Banking and Financial Statistics*, as well as share price appreciation data from Kuvshinov (2019), and national balance sheet estimates of the total equity value of listed and unlisted Canadian firms. Some of these sources are, however, likely to contain a lot of measurement error. The *WDI Database* estimates before 2002 are highly noisy and, according to Carpentier et al. (2009), their underlying source – the WFE database – double- or triple-counts cross-listed securities for this period. The estimates of Rajan and Zingales (2003) switch definitions in terms of exchange coverage and are also often gross of cross-listings, as discussed earlier, while the underlying definitions of the Goldsmith (1985) data are uncertain. As seen from Figure D.3, the data for all three of these sources are also rather noisy. Based on this, we decide not to use any of these sources, and restrict ourselves to the

[23] Capitalization data refer to the end of each respective previous calendar year, i.e. end-1900, end-1911 and end-1926.

estimates of Buckley and Urquhart (1993), Bank of Canada, and the share price and net issuance data.

For the period 1960–1989, we largely rely on the data on share prices and net issuance. We extrapolate back the 1990 estimate using share price growth, and subtracting each year's net issuance, inflated at half the year's share price appreciation. The trend is similar to that obtainable from the WDI data during the 1970s and 1980s, when the growth trend in the WDI data seems reasonably accurate, and definition of the series – consistent from year to year. This gives us confidence that our data track the underlying evolution of adjusted Canadian stock market cap during this time period. For years 1970–1974, we do not have net issuance data, and use the year-on-year changes in the market value of Canadian firms' equity liabilities instead, which implicitly assumes a constant proportion of listed firms, and similar price changes between listed and unlisted equities. Given the short time period under consideration, and the fact that unlisted firm equity price changes tend to be estimated from those of listed firms, the error resulting from this extrapolation should be small.

For the period 1934–1959, we have two choices of how to use the Buckley and Urquhart (1993) (BU) and *Statistical Summaries* data. First, we can adjust the raw series to account for the extent of cross-listing, exclude foreign firms and preference shares. We can estimate each of these adjustments using the *Annual Financial Review* microdata, and data on issuance of different types of securities in the Bank of Canada *Statistical Summaries*. In total, this would adjust the BU series down by roughly a factor of 2. However, the resulting capitalization in both 1934 and 1959 would then appear too high: in 1934, too high relative to 1926 data, and in 1959, too high relative to our estimate described above.[24] In light of this, we take a different approach: we scale down the BU series to match our total market capitalization estimate for 1959, constructed by extrapolating 1990 cap back using share price and net issuance data. This results in a downward adjustment by a factor close to 3 – the ratio similar to that in the Carpentier et al. (2009) adjustment for 1990, which gives us some confidence about the measurement. The resulting adjusted series are shown as the green solid line in Figure D.3.

Taken together, our estimates for Canada should go some way towards resolving the considerable uncertainty resulting from the wide range of existing estimates in Figure D.3. That being said, the severity of the potential measurement issues for Canada mean that, especially for the period 1934–1970, the series are likely to contain some measurement error.

[24]Note that the stock price growth between 1934 and 1926 was close to zero due to the Great Depression, and though nominal GDP declined, the implied net issuance for 1926–1934 using this estimate would be rather large.

Denmark

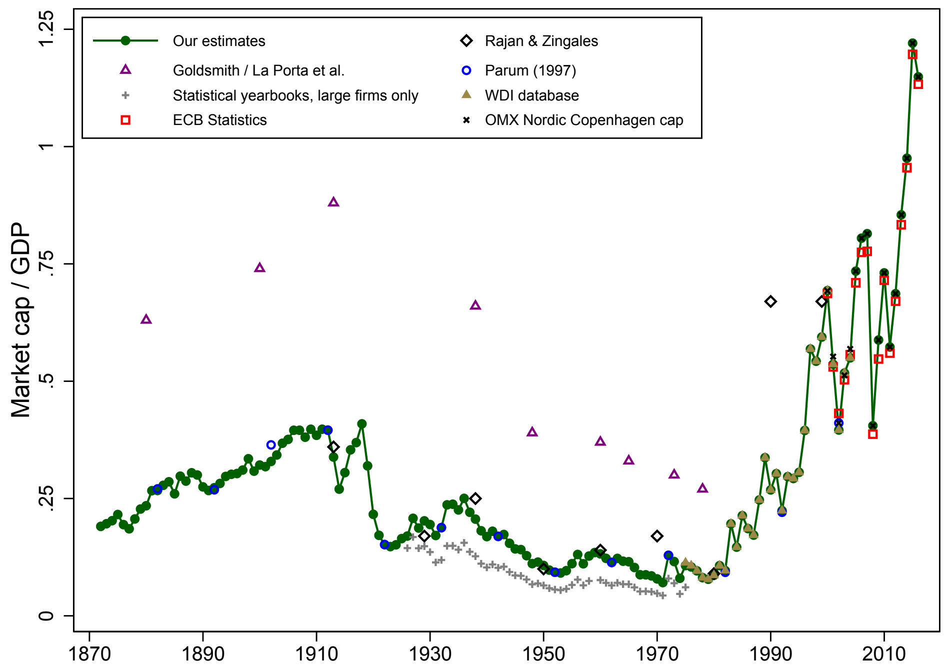
Table D.4: *Data sources: Denmark*

Year	Data source
1872–1899	Total market cap of all Danish firms listed in Denmark, aggregated up from individual firms' capitalization in the Green's *Dankse Fonds of Aktier* yearbooks, various years. Ordinary shares only.
1900–1925	Total market cap of all Danish firms listed in Denmark, computed as previous years' market cap * the total book cap of listed firms * market-to-book ratio of listed firms, benchmarked to Parum (1997)'s decennial market cap estimates. Book cap of listed firms estimated as book cap of all firms from Hansen and Svendsen (1968) and *Statistical yearbooks* (various years), times share of listed firms estimates from own data in 1899 and Erichsen (1902). Parum's decennial estimates sourced from Abildgren (2006).
1926–1975	Market capitalization of large listed Danish firms, scaled up to match capitalization of all firms at decennial benchmarks. Data for all firms from Parum (1997). Data for large firms are from the listings in the *Statistical yearbooks*, various years, and contain 50–60 firms for each year.
1975–2004	Total capitalization of all Danish listed firms, shares listed on Danish exchanges, from World Bank's *WDI database*. Spliced with the scaled-up capitalization of largest firms over the years 1975–1977 (the two series are very similar).
2005–2016	Total capitalization of ordinary shares on the Copenhagen stock exchange, sourced from the OMX Nordic *Yearly Nordic Statistics*.

Table D.4 documents the sources of our stock market capitalization data for Denmark, and Figure D.4 plots the resulting series alongside alternative existing estimates. Long-run estimates of the total capitalization of Danish firms for the period 1882–2002 are available from Parum (1997) and Abildgren (2006). However, these data are computed at decennial frequency only. To fill the gaps, we construct our own estimates of the total stock market capitalization of ordinary shared of listed Danish firms for each year between 1872 and 1899 using statistics on individual firms' share prices and book capital in Green's *Dankse Fonds of Aktier*. Green's yearbooks contain data on all Danish listed firms at annual frequency.

For years 1900–1925, we combine benchmark year estimates from our own microdata and Parum (1997) with statistics on share prices and book capital of listed firms. We estimate listed firms' book capital using data on total capital of all firms, available in Hansen and Svendsen (1968) up to 1914 and yearly editions of the *Statistical Yearbooks* thereafter, and estimates of the proportion of firms listed in Erichsen (1902), as well as those computed by comparing the total book capital estimates with data on share prices and market cap at benchmark years. We compute the annual change in market capitalization as the change in total book capital of all firms, times the change in the share of firms listed, times the capital appreciation in the share price index (for 1900–1914, we also compute the actual market-to-book of listed firms, and use that instead, but the estimation gives us similar numbers to using the share index). We then adjust the growth rates of capitalization in each year to match the data at benchmark dates. The main adjustment concerns the period 1915–1922, during which the book capital of all firms nearly doubled while the book capital of listed firms remained flat, presumably following sharp delistings during the banking crisis of the early 1920s. The trend

Figure D.4: *Denmark: alternative stock market cap estimates*



in the book capital of all firms gives us the boom-bust dynamics of high capital issuance during the book of the late 1910s, and delisting during the early 1920s, which we then rescale to match the implied larger delistings by listed firms. For years 1923–1925, very little adjustment to growth rates is necessary.

From 1926 onwards, each yearly edition of the *Statistical yearbook* publishes a summary stock listings, which includes data on capital and market-to-book of all major listed firms in Denmark. We use these data to estimate total market capitalization by scaling it up to match the total cap in Parum (1997) at decennial benchmark periods, and scaling the growth rates in-between if necessary. It turns out that the large firms in the *Statistical yaerbook* listings, which number around 50–60 in total, consistently represent around half of the total Danish market cap, and track the aggregate data very well, so very little adjustment to growth rates is necessary to match the capitalization estimates for all firms at the benchmark years.

For the recent period, market capitalization estimates for all of Denmark, or the Copenhagen stock exchange are available from the World Bank's *World Development Indicators*, ECB *Statistical Data Warehouse* and the OMX Noric *Yearly Nordic Statistics*. We use a compbination of the *WDI* and *OMX Nordic* data for our estimates, but the data are similar to the estimates of the ECB. Even though the *OMX Nordic* data in principle only cover Copenhagen, and cover foreign as well as domestic firms, in practice these numbers follow total Danish capitalization estimates almost one-for-one, and we use these data rather than the ECB statistics to avoid potential measurement error when converting the ECB data from euros to kronas.

Our estimates are substantially below those of Goldsmith (1985), with the most likely reason for the upward bias in Goldsmith (1985)'s estimates being the inclusion of unlisted equities and debt securities. Our estimates are close to those of Rajan and Zingales (2003) for the respective benchmark years.

We would like to thank Kim Abildgren for helping us locate and interpret the historical data sources for Denmark.

Finland

Table D.5: *Data sources: Finland*

Year	Data source
1870–1991	Total capitalization of all Finnish companies on the Helsinki Stock exchange, form Nyberg and Vaihekoski (2014a), kindly shared by Mika Vaihekoski.
1992–2017	Total capitalization of all Finnish firms, shares listed in Finland. Source: *ECB Statistical Data Warehouse*, Security issues statistics.

Figure D.5: *Finland: alternative stock market cap estimates*

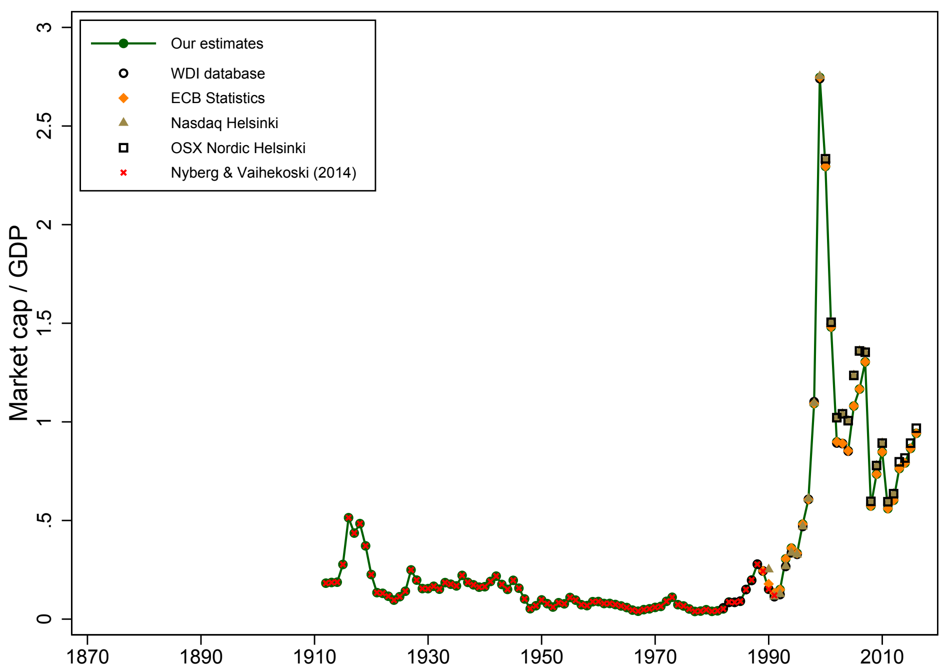


Table D.5 documents the sources of our stock market capitalization data for Finland, and Figure D.5 plots the resulting series alongside alternative existing estimates. The long-run data come from Nyberg and Vaihekoski (2014a), who have compiled a database of returns and capitalization on all stocks listed on the Helsinki exchange between its foundation in 1912 and 1991, when modern capitalization indices are available (see Nyberg and Vaihekoski, 2011, 2014b, for further details on the data). The Nyberg and Vaihekoski (2014a) series are aggregated up from individual share-level data, obtained from a range of historical sources, and fit the modern day series well for the overlapping period, as shown in Figure D.5. The modern data from the ECB series are very close to Helsinki stock exchange capitalization estimates from Nasdaq and OMX Nordic (Figure D.5).

We are grateful to Mika Vaihekoski for sharing data and providing help and support in locating the sources for Finland.

France

Table D.6: *Data sources: France*

Year	Data source
1870–1899	Stock market capitalization of the Paris stock exchange from Arbulu (1998) and Le Bris and Hautcoeur (2010), at roughly 5-year benchmarks, scaled up to proxy France total using data from Bozio (2002) (using the 1904 ratio between the Le Bris and Hautcoeur (2010) Paris series and Bozio (2002) France series as the benchmark), and year-to-year movements between the benchmark years estimated using changes in the capitalization of all French securities from Saint-Marc (1983).
1900–1988	Market capitalization of all shares of French companies listed on French stock exchanges, from Bozio (2002).
1989–2017	Total capitalization of all French firms, shares listed in France, from the *ECB Statistical Data Warehouse*, Security issues statistics.

Figure D.6: *France: alternative stock market cap estimates*

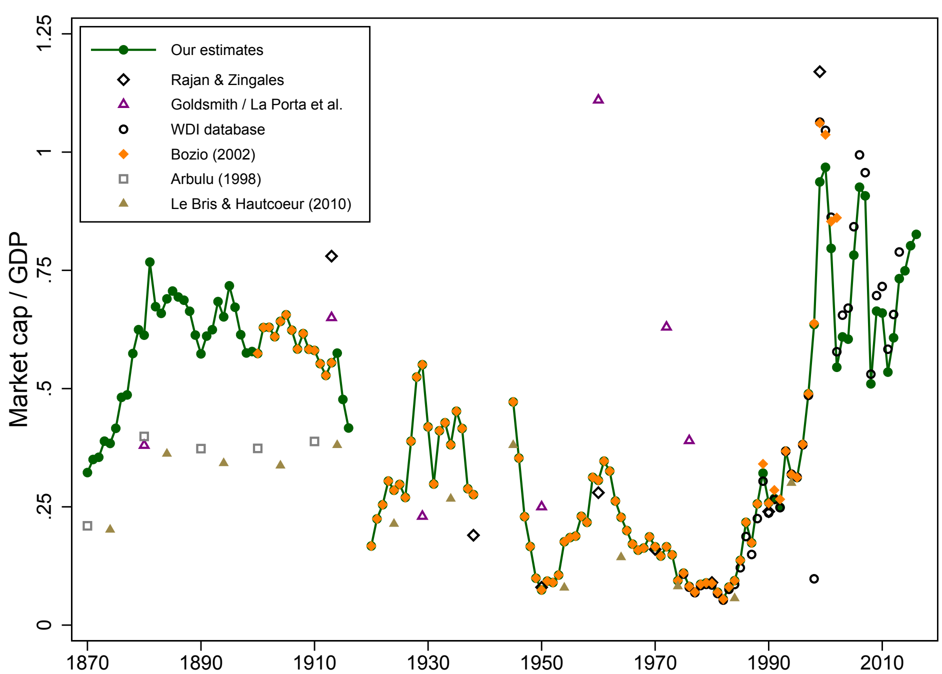


Table D.6 documents the sources of our stock market capitalization data for France, and Figure D.6 plots the resulting series alongside alternative existing estimates. Most of the data are drawn from the comprehensive study of Bozio (2002), which estimated the total capitalization of French shares listed on all French exchanges between 1900 and 2002. Between 1900 and 1963, Bozio (2002) relied on yearly capitalization of the *Cote Officielle* for the Parisian bourse, scaled up to match the total for France using data for all French stock exchanges at benchmark periods. After 1964, the Bozio

(2002) data are a direct estimate of the total capitalization of all French stock exchanges. For the recent period, these data match up well with the series from the World Bank's *WDI Database*, and ECB *Statistical Data Warehouse*. We rely on the ECB data for the recent period.

For the 19th century, we make use of benchmark year estimates for the total capitalization of the Parisian bourse, from the studies of Le Bris and Hautcoeur (2010) and Arbulu (1998). We scale up these data to proxy the capitalization of all French exchanges, using the ratio of Parisian to total French market cap in year 1904. This extrapolation, therefore, implicitly assumes that the market share of regional exchanges did not change too much during the late 19th century. It is possible that the regional exchanges were somewhat more important during this early period, in which case our data would somewhat understate the total French market cap.[25] In-between the benchmark years, we use the changes in Saint-Marc (1983)'s estimates of the total capitalization of French securities, computed by scaling up capital income data, to proxy the year-to-year movements in market cap during the late 19th century.

Figure D.6 also highlights the uncertainty around earlier market capitalization estimates, especially those of Goldsmith (1985), and also to some extent the Rajan and Zingales (2003) data: on average they tend to overstate the French stock market capitalization, perhaps by including securities which are not common stocks, which can often be the case with national balance sheet estimates such as those of Goldsmith (1985), or foreign securities. In the early 1960s, the Goldsmith (1985) market capitalization estimate is almost 5 times the size of the Rajan and Zingales (2003) estimate, with our estimate, derived from Bozio (2002) data in-between these two, but closer to those of Rajan and Zingales (2003).

We are grateful to Antoine Bozio for providing help in understanding the various sources for the French market capitalization data.

[25] Bozio (2002)'s estimates suggest that the relative importance of the Parisian stock exchange increased slightly between 1900 and 1913, remained roughly unchanged between 1913 and 1938, and spiked again after World War 2.

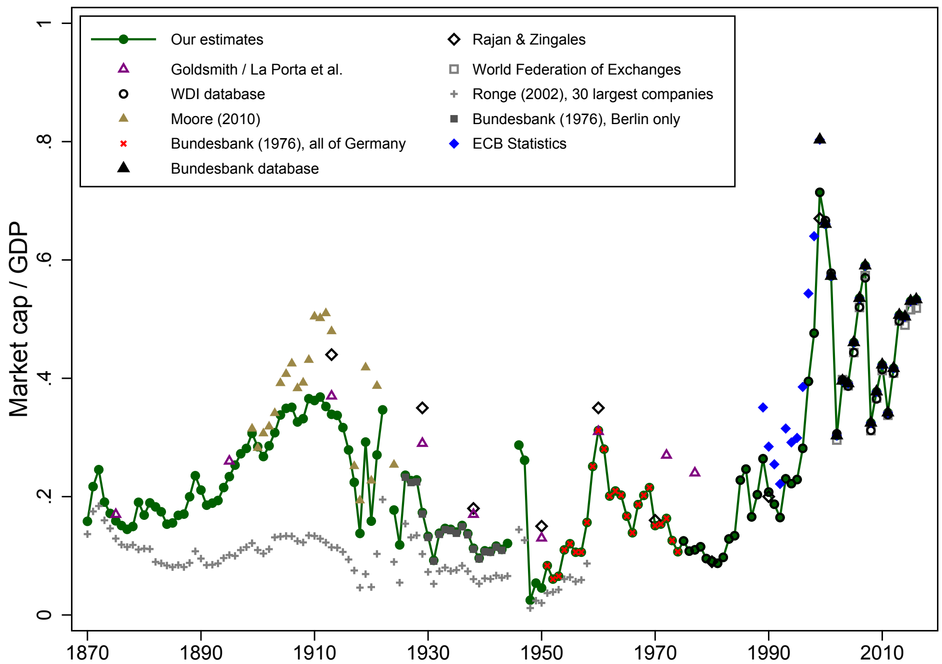
Germany

Table D.7: *Data sources: Germany*

Year	Data source
1870–1871	1872 total German market cap extrapolated back using the growth in the capitalization of 30 largest German listed companies from Ronge (2002).
1872–1913	Market capitalization of all German firms listed on all major German exchanges (Berlin, Frankfurt, Hamburg, Cologne, Leipzig and Munich), adjusted for cross-listings, computed by authors from microdata helpfully shared by Christian Hirsch at the Frankfurt Center for Financial Studies. The underlying data are sourced from the regional financial newspapers and stock listings, namely: the *Berliner Börsen-Zeitung*, *Berliner Börsencourier* and *Neumann's Cours-Tabellen*; Frankfurt, Munich and Leipzig *Börsen-Kursblatt*; *Frankfurter Zeitung*, *Hamburgischer Correspondent*, *Kölnische Zeitung* and *Kölner Tageblatt*.
1914–1918	Capitalization of 30 largest German listed companies from Ronge (2002) scaled up to match all German listed companies (1913 used as benchmark year for scaling).
1919–1924	Total market capitalization of shares listed on the Berlin stock exchange from Moore (2010b), scaled up to match all of Germany and down to exclude foreign firms, using data for overlapping years between the Moore (2010b) and our all-Germany series in the early 20th century.
1925	Capitalization of 30 largest German listed companies from Ronge (2002) scaled up to match all German listed companies (1913 used as benchmark year for scaling).
1926–1943	Total capitalization of shares listed on the Berlin stock exchange from Deutsche Bundesbank (1976), scaled up to match all of Germany and down to exclude foreign firms, using data for overlapping years between Moore (2010b)'s Berlin series and our all-Germany series in the early 20th century.
1944–1950	Capitalization of 30 largest German listed companies from Ronge (2002) scaled up to match all German listed companies (1943 and 1950 used as benchmark years).
1951–1974	Total market cap of all German listed firms, shares listed on German exchanges, from Deutsche Bundesbank (1976). Spliced with the scaled-up Berlin series over years 1944–1950.
1975–1998	Total market cap of all German listed firms, shares listed on German exchanges, from World Bank's *WDI Database*.
1999–2017	Total market cap of all German listed firms, shares listed on German exchanges, from the Bundesbank database (series BBK01.WU0178).

Table D.7 documents the sources of our stock market capitalization data for Germany, and Figure D.7 plots the resulting series alongside alternative existing estimates. For years 1873–1914, we construct our own best-practice estimate of the German stock market capitalization, using data on individual securities listed on all major German exchanges (Berlin, Frankfurt, Hamburg, Cologne, Leipzig and Munich), adjusted for cross-listings, and computed from microdata helpfully shared by Christian Hirsch at the Frankfurt Center for Financial Studies. Outside of these data, we rely on a number of proxies to construct the capitalization of all German companies listed in Germany from a

Figure D.7: *Germany: alternative stock market cap estimates*



variety of other sources. These proxies consist of the Ronge (2002) estimates of the capitalization of the largest 30 listed German companies, helpfully shared with us by Ulrich Ronge, and covering the period 1870–1958; and the total capitalization of the Berlin stock exchange computed by Moore (2010b) for years 1899–1924, and by Deutsche Bundesbank (1976) for years 1926–1943. We scale down the Berlin capitalization data to mimic the exclusion of foreign companies, and scale it up to mimic the inclusion of regional exchanges, by comparing the Berlin capitalization estimates to those for the whole of Germany for various benchmark years. Finally, we use the Ronge (2002) series to fill in the remaining gaps.

The different early-period series match up with each other rather well: for example, in the 1870s most of the total market cap can be accounted for by the 30 largest companies (the Ronge, 2002, estimates), and the top-30 share gradually decreases as new listed firms enter the market in the late 19th and early 20th centuries, before the market becoming more concentrated again during the interwar period and the 1930s. In the early 20th century, the total Berlin capitalization is actually somewhat larger than that of the German companies listed on all German exchanges, due to a large presence of foreign stocks, and the two measures (Berlin total vs all-Germany German companies) become very similar in the 1920s and 1930s as the share of foreign stocks drops after World War 1.

The post-1950 data cover all German company ordinary shares listed on German exchanges, and are sourced from the various Bundesbank publications, namely Deutsche Bundesbank (1976) and the online statistical database of the Bundesbank. These match up rather well with alternative estimates from the ECB database, the World Bank's *WDI database*, and data from the *World Federation of Exchanges*. Concerning the earlier estimates, both Rajan and Zingales (2003) and Goldsmith (1985) have tended to overestimate the size of the German stock market relative to GDP somewhat.

We are grateful to Christian Hirsch for sharing data, to Ulrich Ronge for sharing data and offering advice on the historical German seris, and to Carsten Burhop for helping us locate the historical data sources.

Italy

Table D.8: *Data sources: Italy*

Year	Data source
1900, 1913	Total stock market capitalization of Italian firms, estimates from Musacchio (2010).
1928–1949	Total stock market capitalization of Italian firms, shares listed in Italy, aggregated from individual stock capitalizations published in Mediobanca (Various years).
1950–1988	Total stock market capitalization of Italian firms, shares listed in Italy, using aggregate estimates published in Mediobanca (Various years). No data for 1951.
1989–2017	Total capitalization of Italian firms, shares listed in Italy, from the *ECB Statistical Data Warehouse*, Security issues statistics.

Figure D.8: *Italy: alternative stock market cap estimates*

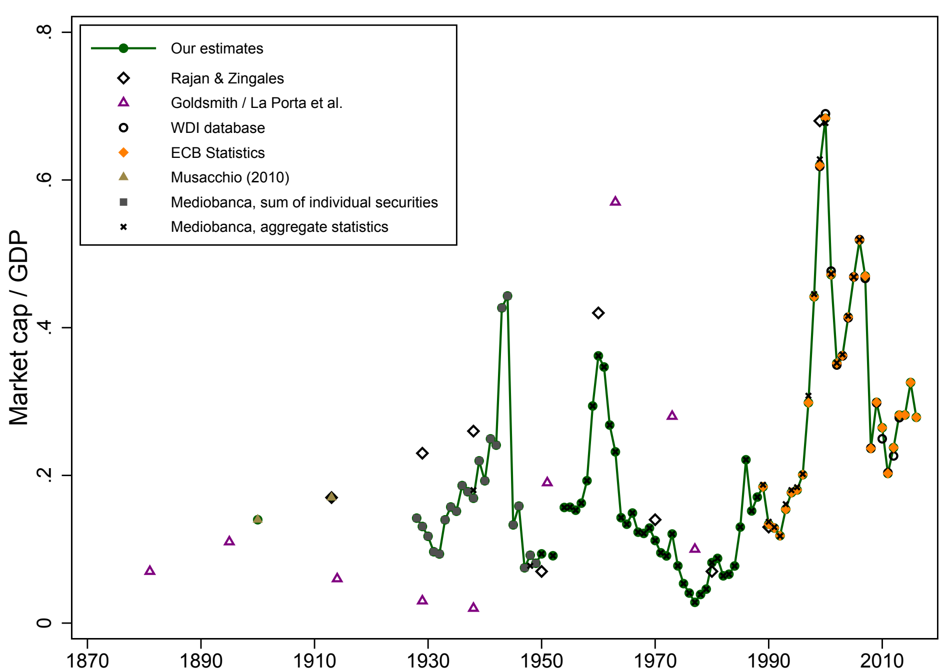


Table D.8 documents the sources of our stock market capitalization data for Italy, and Figure D.8 plots the resulting series alongside alternative existing estimates. Most of the data are sourced from the *Indici e Dati* publication, Mediobanca (Various years), which presents various aggregate and security-level statistics on Italian stocks and bonds, as well as further accounting data for the major Italian companies. For years 1928–1949, this publication publishes the market capitalization of individual Italian listed companies, and we compute our market cap measure as an aggregate of these security-level data. From 1950 onwards, *Indici e Dati* publishes aggregate market capitalization statistics relating to shares of all Italian firms listed on Italian exchanges, which becomes the main source of our data. Even though the individual security listings from the earlier years could miss

out on some smaller firms, comparison of the two Mediobanca series (dark squares and x crosses in Figure D.8) suggests that these differences are, in practice, negligible. The later-years Mediobanca aggregate series match up well with alternative estimates from the World Bank's *WDI Database* and the ECB *Statistical Data Warehouse*. We use the ECB series for our estimates from 1989 onwards.

For the early years, we use Musacchio (2010) estimates of the Italian market capitalization in 1900 and 1913, with the 1913 estimate being the same as those of Rajan and Zingales (2003). We do not use the earlier Goldsmith (1985) estimates, because in years 1910, 1930 and 1940 these seem to vastly underestimate the size of the Italian stock market. The Rajan and Zingales (2003) estimates are, on average, somewhat higher than those in our paper.

We are grateful to Stefano Battilossi for providing helpful advice in locating the historical data sources for Italy.

Japan

Table D.9: *Data sources: Japan*

Year	Data source
1881–1899	The 1900 market capitalization extrapolated back using changes in the book capital of business corporations from Bank of Japan (1966), and stock price growth from Jordà et al. (2019).
1900–1924	Total capitalization of the Tokyo stock exchange from Moore (2010b).
1925–1945	The 1924 market capitalization extrapolated back using changes in the book capital of business corporations from Bank of Japan (1966), and stock price growth from Jordà et al. (2019).
1948–2004	Total capitalization of the Tokyo stock exchange first and second sections, from the *Statistics Bureau of Japan* historical statistics, Tables 14-25a and 14-25b.
2005–2013	Total capitalization of Japanese firms' shares listed on Japanese exchanges, from World Bank's *WDI Database*.
2014–2016	Total capitalization of Japanese firms listed on the Tokyo stock exchange, from the *World Federation of Exchanges* statistical reports.

Figure D.9: *Japan: alternative stock market cap estimates*

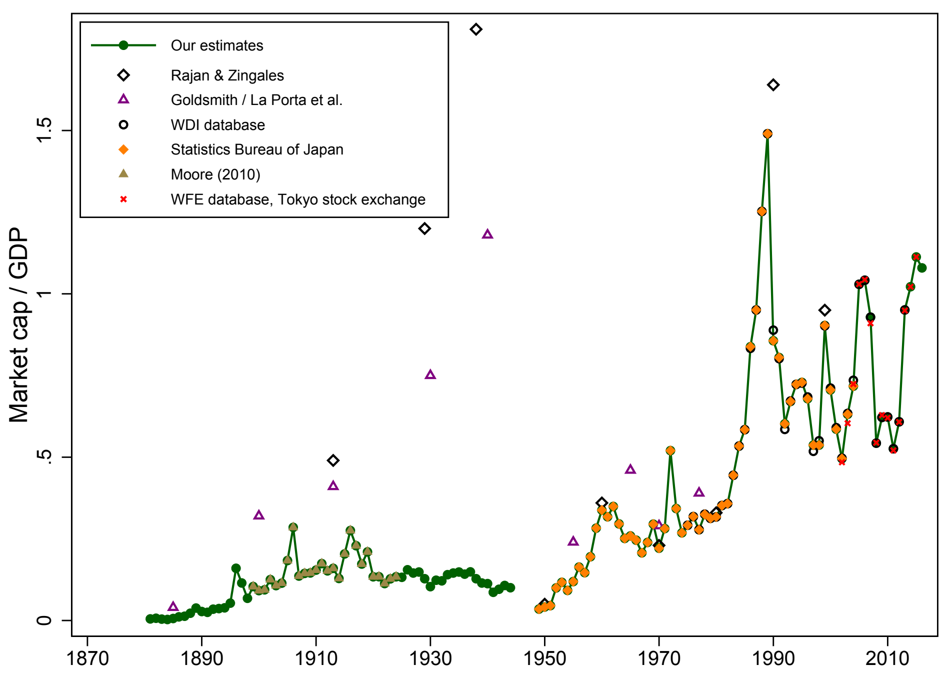


Table D.9 documents the sources of our stock market capitalization data for Japan, and Figure D.9 plots the resulting series alongside alternative existing estimates. For the early historical period, our

main source are the Moore (2010b) estimates of the total capitalization of the Tokyo stock exchange. While these may somewhat understate the total capitalization of Japanese firms because they exclude regional exchanges, they may also overstate it via including foreign shares, with these two biases, to some extent, balancing against each other. The Moore (2010b) data cover the period 1899–1924. For the adjacent historical periods, we rely on a mixture of book capital data that covers both listed and unlisted businesses, from Bank of Japan (1966), and stock price data from Jordà et al. (2019). For each year in the period 1881–1898 and 1925–1945, we estimate the change in market cap as the stock price change multiplied by the change in the book capital of listed firms. This implicitly assumes that the share of the book capital of listed firms relative to that of all firms remains relatively stable. For the late 19th century period our data may, therefore, somewhat understate the growth in market cap – but the book capital statistics already capture the rapid growth in business equity in Japan during this period, with both book and market cap growing rapidly between 1881 and 1900. The ratio of market cap to GDP, and the relative importance of listed and unlisted firms seem to somewhat stabilise from 1910 onwards, even during the period for which we have the non-extrapolated market capitalization data.

Alternative estimates for the early period do exist, but they appear somewhat more noisy and less reliable than even our extrapolated data. The estimates of Rajan and Zingales (2003) and Goldsmith (1985) are not too far away from ours in the 1880s, but report much higher capitalization especially for the period of the 1930s and World War 2. These very high capitalization ratios are, however, may be somewhat difficult to justify in light of other available data. The implied stock market expansion in the 1930s goes far beyond both the book capital growth and the increase in the share price index, implying new listings that far exceed the data reported for other periods and countries in our sample. The post World War 2 data, where our estimates, based on the Statistics Bureau of Japan historical statistics, are more consistent with those of Rajan and Zingales (2003) and Goldsmith (1985), again suggest a drop in market size that far exceeds that suggested by the stock price data. Even though the Tokyo stock exchange was closed during years 1946–1947, the market capitalization ratios reported by Rajan and Zingales (2003) and Goldsmith (1985) in the 1940s are in the region of 1.2–1.8 of GDP, whereas those reported in the late 1940s and 1950s by both Statistics Bureau of Japan and Rajan and Zingales (2003) are closer to 0.035–0.05 of GDP. Even without taking the falls in GDP during this period into account, this implies a 30–50 fold drop company valuations during this short period of time, which seems unlikely. In light of these, we do not benchmark our series to the Rajan and Zingales (2003) and Goldsmith (1985) estimates, but without a doubt, there is likely to be some noise in this early period data, especially in the 1930s and 1940s.

For the recent period, we use the Statistics Bureau of Japan estimates of the Tokyo stock exchange capitalization (both the 1st and 2nd sections) during the period 1949–2004, which match up rather well with the total capitalization of all Japanese listed firms reported in the World Bank's *WDI Database*. For the latest period, we use the *World Federation of Exchanges* capitalization of Japanese firms listed on the Tokyo exchange, which is similar to the *WDI Database* estimates. Even though *WFE* also provide estimates for the Osaka exchange capitalization, a comparison with *WDI* data suggests a high degree of cross-listings among the two exchanges, therefore we use the Tokyo only series for the most recent years.

Netherlands

Table D.10: *Data sources: Netherlands*

Year	Data source
1899–1924	Total capitalization of the Amsterdam stock exchange from Moore (2010b), scaled down to proxy domestic firms only (using the proportion of domestic to foreign shares listed on the exchange in Moore, 2010b).
1938	Netherlands stock market cap estimate from Rajan and Zingales (2003).
1951–1974	Total capitalization of Dutch firms listed on the Amsterdam stock exchange from Central Bureau of Statistics (2010).
1975–1988	Total capitalization of Dutch firms' shares listed on Dutch exchanges, from World Bank's *WDI Database*.
1989–2017	Total capitalization of Dutch firms, shares listed in the Netherlands, from the *ECB Statistical Data Warehouse*, Security issues statistics. Spliced with WDI data for year 1989.

Figure D.10: *Netherlands: alternative stock market cap estimates*

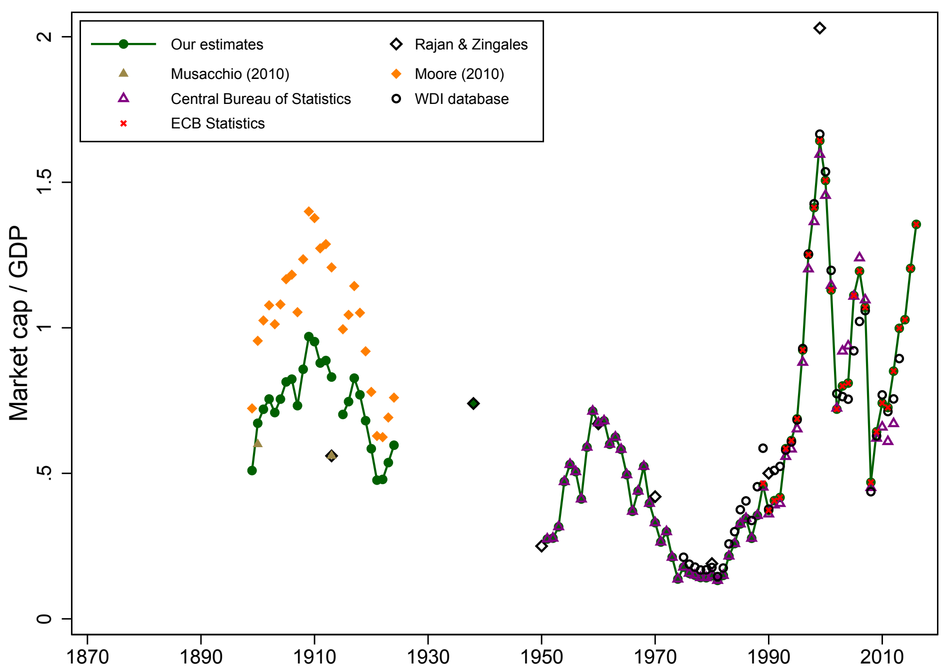


Table D.10 documents the sources of our stock market capitalization data for the Netherlands, and Figure D.10 plots the resulting series alongside alternative existing estimates. In the early period, our main source are the Moore (2010b) estimates of the total capitalization of the Amsterdam stock exchange. One issue, however, is that the Amsterdam exchange played an important role in the

international financial system during this time period, and was used to trade many foreign as well as domestic stocks, as is clear from examining the stock exchange listings and the summary statistics on foreign and domestic listings in Moore (2010b). The total Amsterdam capitalization estimates in Moore (2010b) are, therefore, likely to substantially overstate the capitalization of Dutch firms. This also helps explain why the Moore (2010b) market cap estimates are higher than those of Rajan and Zingales (2003) and Musacchio (2010) for the early period, whereas our estimates for the later periods are broadly in line with those of Rajan and Zingales (2003). To adjust for this bias, we scale down the total capitalization of the Amsterdam exchange using the statistics on domestic and foreign shares listed in years 1899, 1909 and 1924 in Moore (2010b), calculating capitalization for this early period as total Amsterdam cap * number of Dutch shared listed / total number of shares listed. Depending on the relative size of the average capitalization of domestic and foreign shares, and the accuracy of estimates in-between the benchmark periods, these estimates could either somewhat over- or understate the total capitalization of Dutch firms.

For the post-1950 data, we rely on estimates of capitalization of Dutch firms listed on Dutch exchanges from three sources: the 111 year statistics Central Bureau of Statistics (2010), and the data from World Bank's *WDI database* and ECB's *Statistical Data Warehouse*. These estimates tend to be similar to each other, and to those of Rajan and Zingales (2003). In light of this data consistency among the different sources, we also make use of the Rajan and Zingales (2003) estimate of the 1938 Dutch stock market cap.

Norway

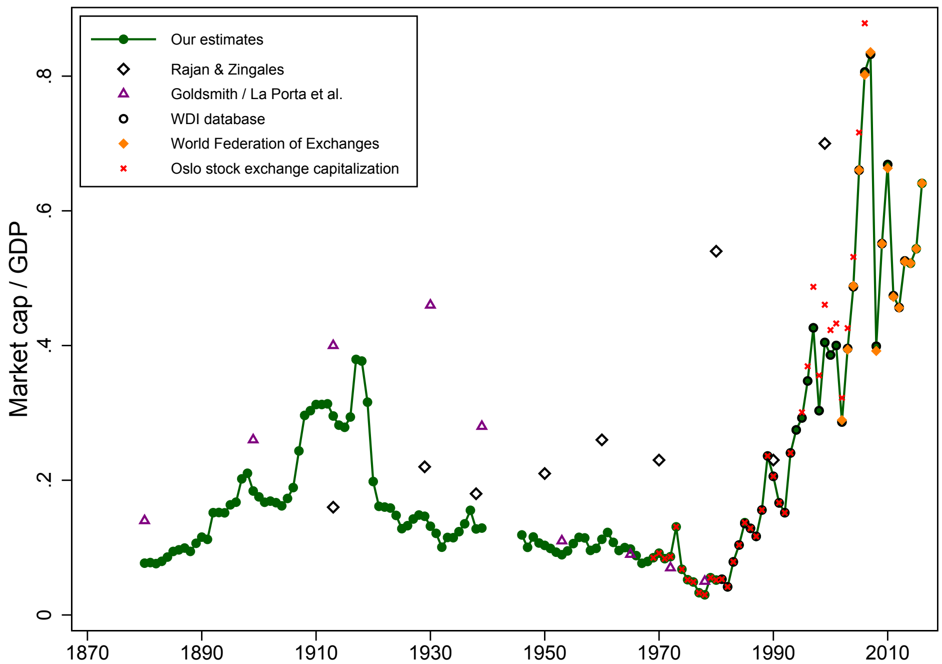
Table D.11: *Data sources: Norway*

Year	Data source
1880–1899	Total market capitalization of all Norwegian listed firms' ordinary shares, own estimates using individual stock data in the *Kierulf handbook* and Oslo stock exchange listings.
1900–1918	Market to book of listed firms times an estimate of listed book capital. Changes in listed book capital proxied using changes in total book capital for years 1900–1911 and 1911–1917. The data for 1912 and 1918 are direct measures of the total market capitalization of Norwegian firms, computed in the same way as for the period 1880–1899. Microdata sourced from *Kierulf handbook* and Oslo *Kurslisten*; aggregate book capital data sourced from the statistical yearbooks, various years.
1919–1968	Estimate of the total capitalization of Norwegian firms, computed as share capital of all Norwegian firms * proxy for share of listed firms * market-to-book of listed firms. The share of listed firms calculated as listed book capital relative to book capital of all firms in 1918, and as market capitalization of Oslo stock exchange relative to market value of all firm equity in 1969, and interpolated in-between (the 1918 and 1969 listed firm shares are very similar). Sources: *Kierulf handbook*, Oslo *Kurslisten*, statistical yearbooks, various years.
1969–1993	Total capitalization of the Oslo stock exchange, data kindly shared by Daniel Waldenström.
1994–2013	Total capitalization of Norwegian firms' shares listed in Norway, from World Bank's *WDI Database*.
2014–2016	Total capitalization of Norwegian firms' shares listed in Norway, from *World Federation of Exchanges* (WFE) reports, various years.

Table D.11 documents the sources of our stock market capitalization data for Norway, and Figure D.11 plots the resulting series alongside alternative existing estimates. For the early historical period, we construct our own estimates of stock market capitalization using data on individual stock prices and quantities, sourced from various issues of the *Kierulf handbook*, and the Oslo stock exchange listings. For the late 19th century, we compute market capitalization in this manner for each individual year, and for the early 20th century we compute capitalization at benchmark years and use changes in book capital of all companies and the market-to-book value of listed companies to calculate the year-on-year movements in market capitalization. Since the share of listed company capital relative to book capital of all companies varies little across the different benchmark years, this calculation ought to be fairly accurate. The data show a substantial stock market boom in the late 1910s, and the subsequent stock market crash of the early 1920s during which market capitalization more than halved.

For the modern period (1969 onwards), we start off by using the total capitalization of the Oslo stock exchange. Given the negligible presence of non-Norwegian companies on the exchange during this time period (which can be seen, for example, by comparing the *WDI* estimates for Norwegian firms with the Oslo exchange cap for overlapping years in Figure D.11), this acts as a good proxy for the total capitalization of Norwegian listed firms. In the 1990s and 2000s, we switch to using the

Figure D.11: *Norway: alternative stock market cap estimates*



WDI and *WFE* data, which focus on Norwegian firms only.

To link the 1969 and 1918 measures of stock market cap, we estimate market cap movements using changes in the book capital of all firms, the market-to-book value of listed firms, and a proxy for the proportion of the firms that are listed. The time between the 1920s bust and the 1980s marks a relatively stable period for the Norwegian stock market with, for example, the listed firm share growing by only 4 percentage points, from 30% in 1918 to 34% in 1969, which suggests that our estimates should have a relatively high degree of accuracy.

Taken together, our market capitalization estimates are substantially below those of Rajan and Zingales (2003). Somewhat surprisingly, the benchmark year Rajan and Zingales (2003) estimates for the early 20th century do not contain any evidence of the large boom-bust cycle that took place around 1920 and is evident both in the share price and our market capitalization data. The estimates of Goldsmith (1985) are above ours for the early to mid 20th century period, but similar to ours after 1950.

We would like to thank Jan Tore Klovland for helping us locate and interpret the historical sources for the Norwegian stock price data, and the staff at the Oslo Nasjonalbiblioteket in Oslo for their help in locating the sources.

Portugal

Table D.12: *Data sources: Portugal*

Year	Data source
1870–1987	Total market capitalization of all Portuguese firms listed in Lisbon, own estimates using individual stock data and company published accounts. Sourced from *Diario do Governo*, *Boletim da Bolsa* and individual company accounts, various years. For years 1900–1925, we use changes in book capital for a subset of listed firms to estimate the changes in book capital of all listed firms. Market capitalization during the Carnation revolution related stock market closure in 1975–1976 is interpolated linearly using the data for 1974 and 1977.
1988	Splice own estimates constructed from microdata in the *Boletim da Bolsa* and the ECB series, using the average of 1987 cap * price growth, and 1989 cap / price growth.
1989–2017	Total capitalization of Portuguese firms, shares listed in Portugal, from the *ECB Statistical Data Warehouse*, Security issues statistics.

Figure D.12: *Portugal: alternative stock market cap estimates*

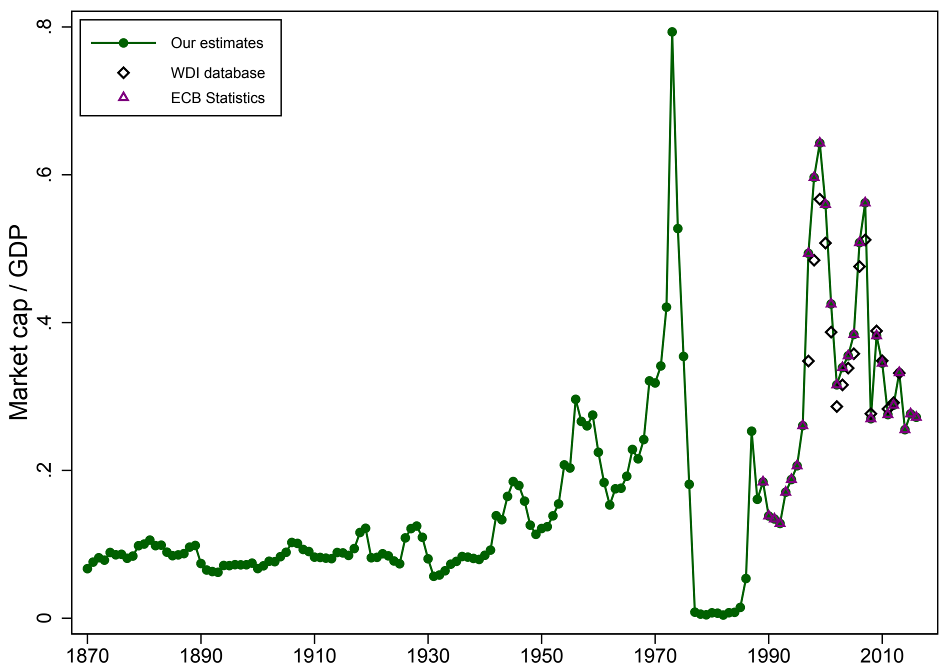


Table D.12 documents the sources of our stock market capitalization data for Portugal, and Figure D.12 plots the resulting series alongside alternative existing estimates. Very few estimates of the Portuguese market capitalization exist, particularly for the period before 1990. Therefore we construct our own data using the prices and quantities of each stock listed on the Lisbon stock exchange during this period, and aggregating the individual shares' market capitalization.

Throughout, we exclude preference shares, foreign and colonial companies to arrive at a measure of domestic market capitalization. Even though a smaller stock exchange operated in Porto, data from the stock listings suggest that its size was very small relative to the Lisbon exchange; therefore our estimates provide a good measure of the total market capitalization of Portuguese listed firms.

Most of the early period data are sourced from the official stock exchange listing *Boletim da Bolsa*, available for years 1874 to 1987. This listing contains information on both stock prices and quantities. These data are complemented by stock listings and company balance sheets published in the government newspaper *Diario do Governo*, and balance sheet data in the published accounts of limited companies. These additional sources are particularly important for the period 1900–1925, during which the official *Boletim* stopped publishing share quantity data. For these years, we use a subset of listed companies, for which we have published accounts data, to estimate the changes in share quantities for the entire market. Another approximation is undertaken during years 1975–1976, when the stock exchange was closed in the aftermath of the Carnation revolution. Stock market capitalization dropped almost twenty-fold between 1974 and 1977, and we interpolate this drop across the years during which the stock exchange was closed, so that it this negative shock is not absent from our data. After the shock of the Carnation revolution, the market stagnated during the 1970s before recovering apidly in the late 1980s. Portugal is the only country in our sample that saw very high net issuance during this "big bang" period as new companies entered the market – this, however, is rather specific to the recovery of the market from the turmoil associated with the 1970s revolution.

The modern data are sourced from the World Bank *World Development Indicators* and ECB's *Statistical Data Warehouse*, and match up with our own estimated series, as well as each other, rather well.

We are grateful to Jose Rodrigues da Costa and Maria Eugenia Mata for help and advice in finding and interpreting the data sources for the historical Portuguese data. We are also grateful to staff at the Banco do Portugal archive for helpful advice and sharing data.

Spain

Table D.13: *Data sources: Spain*

Year	Data source
1900–1924	Total market capitalization of all Spanish firms listed in Madrid, own estimates using microdata helpfully shared by Lyndon Moore. See Moore (2010b) and Moore (2010a) for the original source. We scale up the series to match our own estimates using microdata from the Madrid stock exchange listings in 1925.
1925–1936; 1940	Total market capitalization of all Spanish firms listed in Madrid, own estimates using microdata from the Madrid stock exchange listings, *Boletin de Cotization Oficial*, various years.
1941–1988	Total capitalization of the major Spanish stock exchanges from López, Carreras, and Tafunell (2005). Between 1941 and 1971, data are provided at 5-year benchmarks, with the in-between changes in market cap estimated using the changes in the stock price index from Jordà et al. (2019), and changes in the total book capital of Spanish firms from López et al. (2005).
1989–2017	Total capitalization of Spanish firms, shares listed in Spain, from the *ECB Statistical Data Warehouse*, Security issues statistics.

Figure D.13: *Spain: alternative stock market cap estimates*

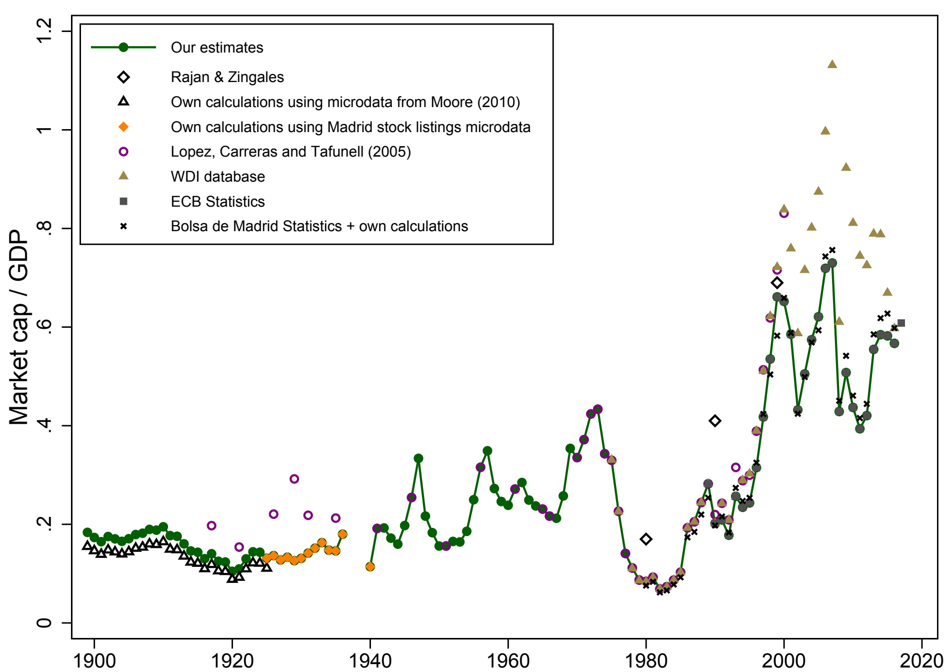


Table D.13 documents the sources of our stock market capitalization data for Spain, and Figure D.13 plots the resulting series alongside alternative existing estimates. For the early historical period, we

construct estimates of total capitalization of ordinary shares of Spanish firms listed on the Madrid stock exchange by aggregating up the capitalizations of individual shares in the official Madrid stock list. The data on share prices and quantities for 1925–1941 were source directly from the official stock list, *Boletin de Cotization Oficial*. Microdata for the 1899–1924 period were helpfully shared with us by Lyndon Moore, and are a slightly updated version of the series in Moore (2010b), sourced from Moore (2010a). The 1899–1924 are missing some of the smaller securities listed on the exchange, and we scale up these series slightly using benchmark ratios from overlapping data in 1925. The data do not include the Barcelona stock exchange, as the listings in, for example, the *La Vanguardia* newspaper do not contain information on quantities. But the early 20th century Barcelona listings suggest that trading on that exchange mainly comprised of government and corporate bonds, with few shares listed on the Barcelona exchange. The bias from excluding this exchange is, therefore, likely to be small. During the Spanish civil war, the stock exchange was closed, hence the data for years 1937–1939 are missing. Given that the stock capitalization did not change dramatically over this period, and that the missing period covers several years, we choose not to interpolate the data for the civil war period.

From 1941 onwards, we use estimates for the total capitalization of the major Spanish exchanges – starting with Madrid, and later also including Barcelona, Bilbao and Valencia – provided by López, Carreras, and Tafunell (2005). Before 1970, these are only available at 5-year benchmark periods. To estimate the market cap movements between benchmark years, we estimate the year-to-year changes in capitalization as the stock price growth times the change in the capital of all Spanish firms, using data from Jordà et al. (2019) and López et al. (2005) respectively, with the growth rates scaled up or down to match the capitalization at benchmark years. Accurate interpolation relies on the proportion of listed firms not fluctuating too much from year to year within the five-year benchmark periods. Given that book capital of listed firms does not vary dramatically from year to year in other time periods in the Spanish data, or in the data for other countries, the measurement error from this interpolation is unlikely to be large. From 1970 onwards, López et al. (2005) provide annual estimates of Spanish listed firms' market capitalization. The *WDI Database*, Bolsa de Madrid and the ECB *Statistical Data Warehouse* provide alternative estimates for the modern period. The WDI estimates for Spain, unfortunately, seem to suffer from considerable measurement error (after liaison with the WDI database staff some of these were fixed, but some seem to remain in place given the difference between the WDI series and all other estimates in Figure D.13). The *Bolsa de Madrid Statistics* estimates are accurate, but the share of foreign firms had to be proxied by us before year 2001. In light of this, we use the ECB's series for the modern period, which are close to estimates provided by López et al. (2005) and Bolsa de Madrid.

We would like to thank Lyndon Moore for sharing the microdata from the Madrid stock exchange for the early historical period as well as offering helpful advice, and Stefano Battilossi in helping locate the historical data sources.

Sweden

Table D.14: *Data sources: Sweden*

Year	Data source
1870–2012	Total market capitalization of Swedish firms from Waldenström (2014).
2013–2017	Total capitalization of Swedish firms, shares listed in Sweden, from the *ECB Statistical Data Warehouse*, Security issues statistics.

Figure D.14: *Sweden: alternative stock market cap estimates*

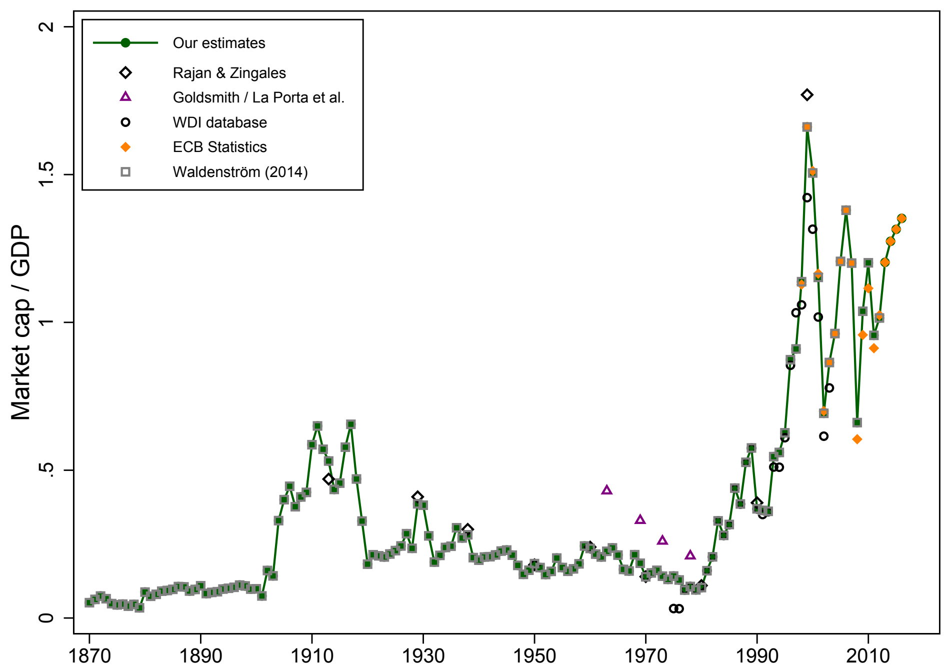


Table D.14 documents the sources of our stock market capitalization data for Sweden, and Figure D.14 plots the resulting series alongside alternative existing estimates. The main source for our series are the data compiled by Waldenström (2014), who put together a long-run series of Swedish stock market capitalization as part of a broader effort to document the evolution of returns and capitalization of the Swedish stock market, and the evolution of wealth in Sweden. For the modern period, the Waldenström (2014) series are very similar to the estimates in the World bank's *WDI Database* and the ECB's *Statistical Data Warehouse*. Because the WDI series contains what looks like typos in years 1975–1976, we use the ECB series to complement the Waldenström (2014) data for the modern period. Our data are close to the estimates of Rajan and Zingales (2003) for the selected benchmark years, and somewhat below the earlier Goldsmith (1985) series.

We are grateful to Daniel Waldenström for providing helpful advice in interpreting the historical Swedish data and sources.

Switzerland

Table D.15: *Data sources: Switzerland*

Year	Data source
1900–1925	Total market capitalization of all Swiss firms listed in Zurich, own estimates using microdata helpfully shared by Lyndon Moore. See Moore (2010b) and Moore (2010a) for the original source.
1926–1974	1925 stock market cap extrapolated forward using net issuance data from the Swiss National Bank *Capital Market statistics*, and stock returns, with growth rates adjusted down on average 0.15% per year to match the 1975 market cap value from the *WDI Database*. Net issuance before 1941 is estimated as fixed proportion of gross issuance.
1975–1979	Total capitalization of all Swiss listed firms, shares listed on Swiss exchanges. Source: World Bank *WDI database*.
1980–2017	Total capitalization of the Swiss and Liechtenstein firms listed on the SIX (Swiss stock exchange), from the SNB *Capital Market Statistics*.

Figure D.15: *Switzerland: alternative stock market cap estimates*

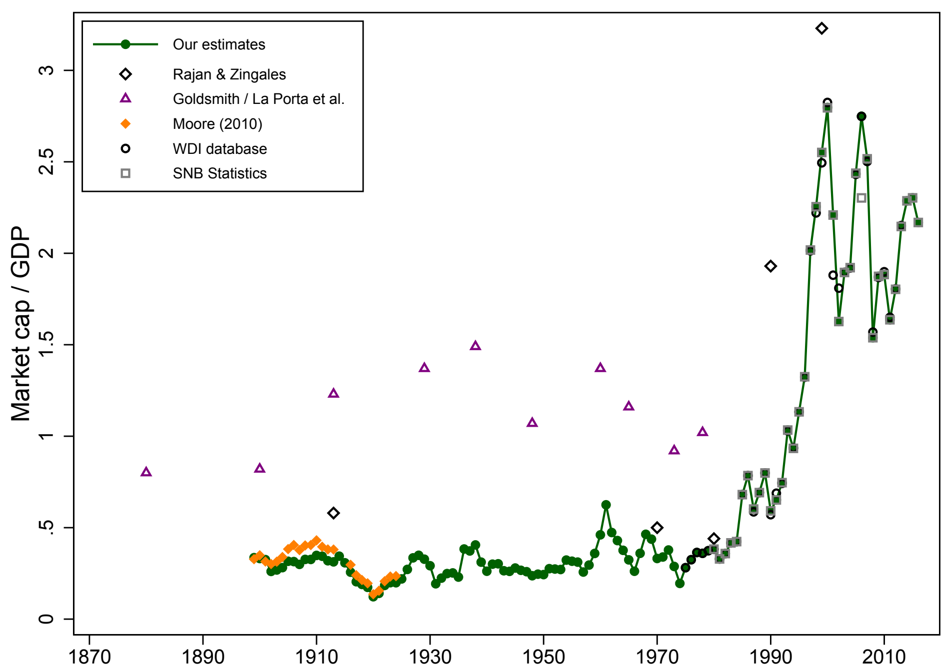


Table D.15 documents the sources of our stock market capitalization data for Switzerland, and Figure D.15 plots the resulting series alongside alternative existing estimates. The early estimates of the Swiss stock market capitalization are based on the Moore (2010b) data for the capitalization of the Zurich stock exchange. We use microdata helpfully shared with us by Lyndon Moore to construct our own estimate of the capitalization of Swiss firms listed in Zurich, with the data sourced from

Moore (2010a), a sligthly updated version of Moore (2010b). The estimates are close to the Zurich total in Moore (2010b), but slightly below it due to the exclusion of foreign firms.

The modern data are based on the statistics in the World Bank's *WDI Database*, and the *Capital Market Statistics* of the Swiss National Bank, both of which aim to capture all Swiss firms listed in Switzerland. The two series are close to each other, and we use the WDI series for the early years, switching to the SNB data when these become available.

To link the capitalization estimates in 1925 and 1975, we use data on net issuance, provided by the SNB, and stock price data from Jordà et al. (2019). The net issuance data cover all publicly floated issues, and thus closely mirror the issuance of listed firms. Before 1944, we proxy net issuance as a fixed proportion of the gross issuance series. We calculate the capitalization in each year as the previous year's capitalization, times the stock capital gain, plus the net issuance times half the capital gain for the year (thus assuming that the issuance, on average, occurred in the middle of the year). Altogether, this proxy captures the two drivers of the movements in market capitalization, and hence should have a high degree of accuracy. Consistent with this, our estimate of the market capitalization in 1975, constructed by extrapolation using net issuance and capital gains over the period 1926–1975, is within 10% of the WDI stock market cap value in 1975, implying an average estimation error of less than 0.2% of market cap (or 0.06% of GDP) per year. We adjust the overall growth rate between 1926–1975 down slightly to match the 1975 benchmark.

Compared to other commonly used estimates, ours are substantially smaller than the early proxies from Goldsmith (1985), and are similar but slightly below the estimates of Rajan and Zingales (2003) at the corresponding benchmark years.

We would like to thank Lyndon Moore for sharing the microdata from the Zurich stock exchange and offering helpful advice, and to Carmen Hofmann and Rebekka Schefer for helping locate the historical sources.

United Kingdom

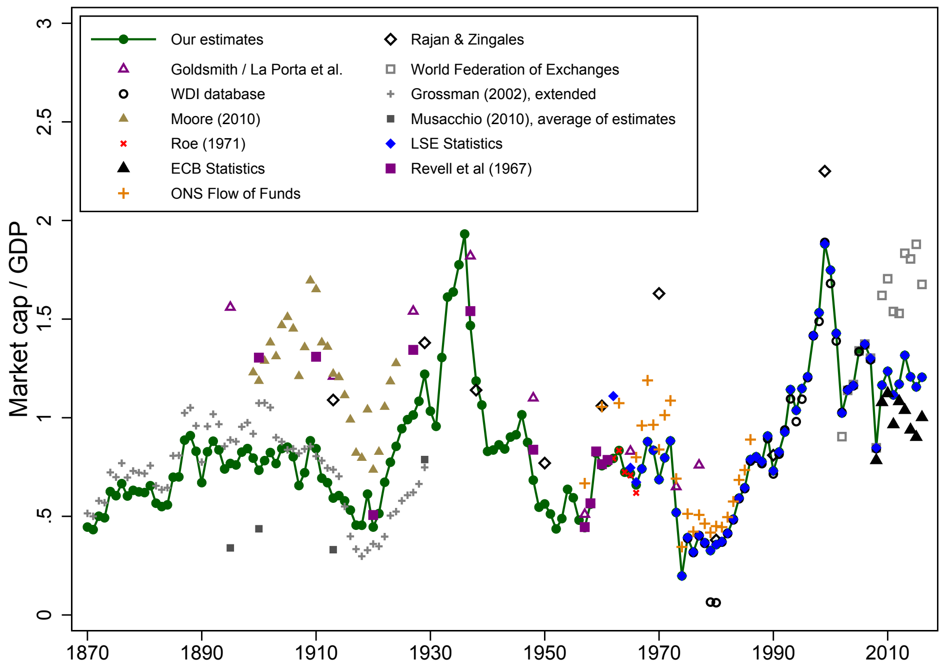
Table D.16: *Data sources: United Kingdom*

Year	Data source
1870–1898	The 1899 capitalization extrapolated back using annual changes in the market capitalization of all UK firms shared with us by Richard Grossman (see Grossman, 2002, for a description of the data).
1899–1924	Estimate of total market capitalization of all UK firms from the total capitalization of the London Stock Exchange computed by Moore (2010b). We scale down the Moore (2010b) estimates to proxy UK-only firms using data on the share of domestic firms in the listings from Musacchio (2010), and scale it up to proxy non-London exchanges by using data on the share of regional exchanges from Campbell, Rogers, and Turner (2016).
1925–1929	The 1924 capitalization extrapolated forward using annual changes in the market capitalization of all UK firms shared with us by Richard Grossman (see Grossman, 2002, for a description of the data).
1930–1956	Market value of equity of all UK firms (listed and unlisted) from Solomou and Weale (1997), scaled down to proxy listed firms only, using overlapping data with our estimates in the 1920s, and the market value of quoted shares estimated by Roe (1971) in the 1950s.
1957–1964	Total value of quoted UK ordinary shares, from Roe (1971).
1965–1994	Marked value of all UK and Irish companies listed on the London Stock Exchange, from *LSE Historical Statistics*. Spliced with the Roe (1971) data over the period 1965–1967.
1995–2004	Marked value of all UK companies listed on the London Stock Exchange, from *LSE Historical Statistics*.
2005–2006	Total capitalization of the UK firms listed at the London Stock Exchange, from the *World Federation of Exchanges* (WFE) reports, various years.
2007–2017	Marked capitalization of all UK listed firms, from the London Stock Exchange *Main Market Factsheets*, various years.

Table D.16 documents the sources of our stock market capitalization data for the United Kingdom, and Figure D.16 plots the resulting series alongside alternative existing estimates. The main difficulty in estimating the UK's stock market capitalization comes about from two sources. First, since London has been an active financial center throughout the historical period considered, with an especially active role in the 19th and early 20th centuries, many stocks listed in London are those of foreign companies and need to be excluded from the total. Second, especially in the 19th century, the UK had a number of active regional exchanges (Campbell et al., 2016), whose capitalization needs to be added to the total.

For the early years in our sample, Grossman (2002) provides an estimate of UK market capitalization that fits our desired definition: the total cap of UK ordinary shares listed in London and other UK exchanges, using data from the *Investor Monthly Manual*, that covers UK and foreign stock listed on all UK exchanges. We would like to thank Richard Grossman for sharing his market capitalization estimates with us, in an extended version of the Grossman (2002) dataset that covers

Figure D.16: *United Kingdom: alternative stock market cap estimates*



years 1869–1929. The accuracy of these data is, however, subject to recent debate, with Hannah (2018) pointing out a number of potential irregularities in the series when compared to other sources. While current debate remains active around the quality of these early data, we use the estimates of Moore (2010b), instead, as our main source. The Moore (2010b) capitalization data, however, are for all London shares, and need to be adjusted to exclude foreign shares, and include shares listed on other exchanges. We do this in two steps. First, we scale the series down to exclude foreign stocks, using Musacchio (2010) estimates of domestic and foreign capitalization on the LSE. Musacchio (2010) provides a range of estimates covering benchmark years 1895, 1900, 1913 and 1929, and we use the average of his estimates interpolated between these benchmark years to proxy the domestic share (which remains close to 60% throughout this period). Second, we scale the domestic series up using estimates in Campbell, Rogers, and Turner (2016) of the London capitalization compared to other UK and Irish exchanges, using the share of London relative to UK and Ireland minus Dublin at 10-year benchmarks. The Campbell et al. (2016) data include preference shares and debt as well as ordinary shares, so we cannot use their estimates directly, and instead use them to scale the Moore (2010b) data, which cover ordinary shares only.

The resulting early-period series, green line in Figure D.16, are below the Moore (2010b) estimates of total London market cap, because the foreign share is much larger than the contribution of provincial and regional exchanges to the total. The series is reasonably close to the estimates of Grossman (2002), and we use the changes in the Grossman (2002) series to extrapolate movements in stock market cap beyond the years 1899–1924 that are covered by the adjusted Moore (2010b) data. Our estimates are substantially below those of Goldsmith (1985) and Rajan and Zingales (2003), whose proxies are much closer to the London total, unadjusted to exclude foreign shares, and above the average of estimates in Musacchio (2010).[26]

[26] Musacchio (2010) recognises the difficulty of estimating the UK stock market capitalization precisely, and offers a range of estimates.

For the mid-20th century, we rely on estimates of the national wealth of the UK, published in a variety of sources, and in particular the part of wealth that is attributed to quoted UK shares. The early data are sourced from Solomou and Weale (1997), who publish a combined figure that includes the market value of both listed and unlisted UK firms. We scale this down to proxy the capitalization of listed firms only, using overlapping data with listed-only series in the 1920s (our estimates based on Grossman, 2002; Moore, 2010b) and 1950s (the data from Roe, 1971). In the 1950s, we switch to Roe (1971)'s estimated of the value of all quoted UK shares. What stands out in these data is the UK stock market boom in the 1930s which saw market capitalization rise to as high as 2 times GDP – a value similar to that observed at the height of the dot-com boom in the late 1990s. The growth in market capitalization in the 1930s was almost entirely driven by rising stock prices – consistent with evidence reported in Section 4 of this paper – and dissipated close to the onset of World War 2. The only reason why this boom was not apparent in earlier estimates of Goldsmith (1985) and Rajan and Zingales (2003) is presumably the benchmark-year nature of their data – for example, the boom is apparent in the total listed and unlisted equity wealth estimates provided by Solomou and Weale (1997) (not shown in Figure D.16, but available from authors upon request).

For the second half of the 20th century and 21st century, we rely on official estimates of the capitalization of UK, or UK and Irish firms, provided by the London Stock Exchange. We use the UK and Irish capitalization provided in the *LSE Historical Statistics* between the 1960s and 1994. For the early 1960s, we stick to the Roe (1971) data, given that the LSE statistics estimate for 1962 seems to be an outlier, making us doubt its correctness (see Figure D.16). For 1995 onwards, we use data for UK firms only, with data before 2005 taken from the *LSE Historical Statistics*, and data after 2007 – from the LSE *Main Market Factsheets*, with the 2005–2006 gap plugged using the UK firms' London capitalization estimates provided by the *World Federation of Exchanges* (WFE) in their monthly statistical reports. A number of alternative estimates for this later period are shown in Figure D.16. These include national wealth estimates from the *Office for National Statistics*, World Bank's *WDI Database*, WFE reports and ECB's *Statistical Data Warehouse* data. These are generally close to our data and the estimates from the LSE, but overall seem somewhat less accurate, with outliers such as the WDI data for 1975–1976 making us prefer the LSE data overall. Our estimates of the capitalization for the 1980s are similar to those of Rajan and Zingales (2003), while those at the height of the dot-com boom in 1999 are somewhat below theirs.

The diversity of the UK market, its large size, and the need to account for foreign shares and regional exchanges, make estimating the UK's market capitalization a tricky task, illustrated by the large variety of alternative estimates in Figure D.16. The ability to draw on all this previous work, however, means that we are able to select those estimates that best fit a consistent definition of UK firms' listed market cap, and provide a historical series that maps the evolution of the size of the UK equity market with a reasonable degree of accuracy. We are grateful to Richard Grossman for providing helpful advice and sharing data, and to Leslie Hannah and John Turner for offering helpful feedback on the data and historical sources.

United States

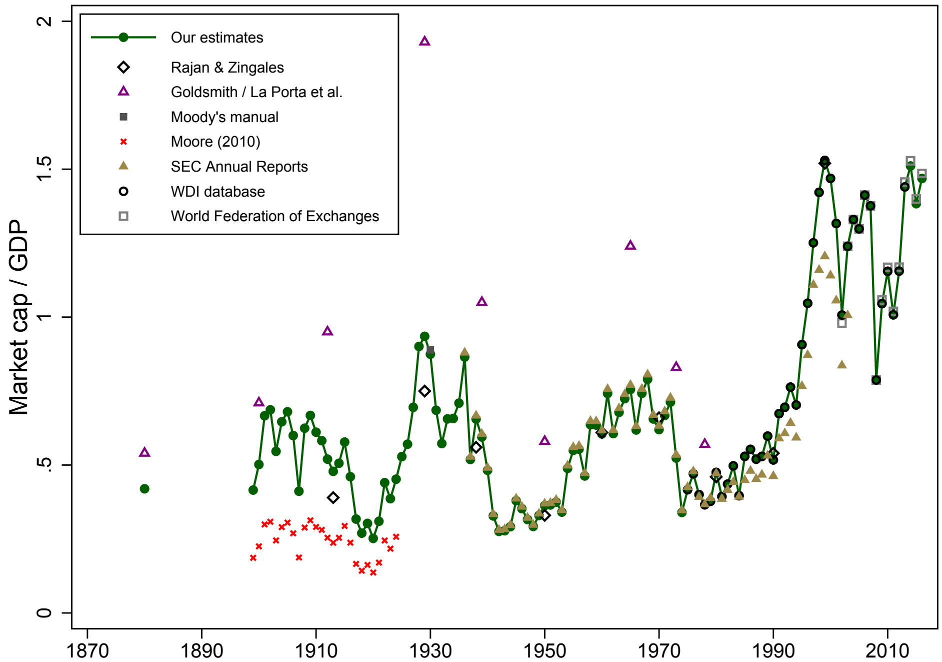
Table D.17: *Data sources: United States*

Year	Data source
1880	Goldsmith (1985) estimate of total equity wealth, scaled down to proxy the market capitalization of US listed firms, using the ratio of overlapping data for 1900 as the scaling factor.
1899–1924	Total NYSE market capitalization scaled up to reflect all exchanges, and scaled down to exclude foreign stocks. NYSE data from Moore (2010b). Scaling done using the data on relative importance of the NYSE and other exchanges helpfully shared by Leslie Hannah, and the ratio of NYSE to total cap in the Moody's manual. Share of foreign firms calculated using *NYX* historical data.
1925–1935	Total equity wealth of US firms scaled down to capture listed shares only. Equity wealth data from Piketty, Saez, and Zucman (2018). Scaling done by benchmarking to our pre-1925 estimates, to Moody's total US capitalization in 1930, and to SEC's data on capitalization of all US exchanges in 1936.
1936–1974	Total market capitalization of all US exchanges, from the SEC's *Annual Reports*, scaled down slightly to exclude foreign firms. Share of foreign firms calculated using *NYSE Historical Statistics*, and by comparing the SEC and WDI data for the 1970s.
1975–2013	Total capitalization of all US listed firms, shares listed on US stock exchanges, from the World Bank's *WDI database*.
2014–2016	Total capitalization of all US listed firms, shares listed on US stock exchanges, from *World Federation of Exchanges* (WFE) reports, various years.

Table D.17 documents the sources of our stock market capitalization data for the United States, and Figure D.17 plots the resulting series alongside alternative existing estimates. Most of the widely available estimates of US stock market capitalization refer to the New York stock exchange only, so the main challenge here reflects obtaining capitalization estimates that cover not only NYSE, but also other stock exchanges, and also adjusting estimates to exclude any foreign listings. Inclusion of non-NYSE stock exchanges is especially important for the early US data, with much of the trading taking place on the curb exchange and regional markets, as suggested in Sylla (2006)'s critique of Rajan and Zingales (2003) data.

Our early data use the Moore (2010b) estimates of the NYSE cap, scale these up to also account for other stock exchanges, and scale down to exclude foreign listings. We rely on a number of benchmark year estimates to approximate the relative importance of the NYSE. The 1906 NYSE share was helpfully shared with us by Leslie Hannah, and amounts to just over 40% in terms of book cap. Put differently, the New York Stock exchange accounted for less than half of total US capitalization in the early 20th century. By 1930, comparison of the total capitalization of US firms in Moody's manua to the NYSE capitalization estimates indicates that the NYSE share reached more than 60%, and by late 1930s that share was larger than 80%, as suggested by data in the *SEC Annual Reports*. These broad trends are also consistent with turnover statistics of the different stock exchanges reported in O'Sullivan (2007). We interpolate the NYSE share in-between these benchmark years to obtain an annual proxy. As for the foreign share, based on the data from *NYX Historical Statistics*, this amounted to little over 2% in the mid 1920s. A similarly small foreign share

Figure D.17: *United States: alternative stock market cap estimates*



is obtained by comparing the *SEC Annual Reports* and *WDI Database* estimates for the 1970s. Based on this, we adjust the Moore (2010b) NYSE-only estimates up substantially to approximate the inclusion of other exchanges, and account for the gradually increasing importance of the NYSE, and adjust them down slightly to proxy the exclusion of foreign ordinary shares. As a result, our market capitalization estimates in Figure D.17 are substantially above the NYSE capitalization in Moore (2010b), and are also higher than the Rajan and Zingales (2003) estimates which include regional exchanges but do not include the curb exchange, which was the largest non-NYSE market during this early period. We also use a market capitalization proxy for 1880, obtained from scaling down the Goldsmith (1985) data, which contain both listed and unlisted shares.

From mid-1930s onwards, estimates of total US market capitalization are available from the *SEC Annual Reports*. These include NYSE, Amex and regional exchanges. We adjust the estimates down very slightly to proxy the exclusion of foreign firms, and link the SEC series to the *WDI* data in the mid 1970s. For the modern period, we rely on a mixture of the *WDI* and *WFE* (World Federation of Exchanges) data, whose definition more precisely fits what we are after – namely, including all US company shares listed on US stock exchanges. To fill a small gap in the 1920s and 1930s, we use annual growth in the capitalization of all US firms (listed and unlisted), provided by Piketty, Saez, and Zucman (2018), to estimate market capitalization growth in-between benchmark years.

Taken together, our US market capitalization estimates are much smaller than the early data from Goldsmith (1985), which includes a mixture of listed and unlisted shares. They are above the estimates of Rajan and Zingales (2003) for the early period, thanks to our inclusion of the curb exchange, and similar to the Rajan and Zingales (2003) estimates for the more recent period.

We would like to thank Leslie Hannah for sharing data and helping us locate and interpret the various historical sources.

References

Abildgren, Kim. 2006. Monetary Trends and Business Cycles in Denmark 1875–2005: New Evidence Using the Framework of Financial Accounts for Organising Historical Financial Statistics. Danmarks Nationalbank Working Paper 43.

Annaert, Jan, Frans Buelens, and Marc De Ceuster. 2012. New Belgian Stock Market Returns: 1832–1914. *Explorations in Economic History* 49(2): 189–204.

Arbulu, Pedro. 1998. *Le marché Parisien des Actions au XIXe Siècle: Performance et Efficience d'un Marché Émergent*. Ph.D. thesis, Orléans.

Bank of Japan. 1966. *Hundred-Year Statistics of the Japanese Economy*.

Black, Susan, Joshua Kirkwood, Thomas Williams, and Alan Rai. 2013. A History of Australian Corporate Bonds. *Australian Economic History Review* 53(3): 292–317.

Bozio, Antoine. 2002. *La Capitalisation Boursière en France au XXe Siècle*. Master's thesis, Ecole Normale Supérieure.

Buckley, Kenneth Arthur Haig, and Malcolm Charles Urquhart. 1993. *Historical Statistics of Canada*. Statistics Canada.

Campbell, Gareth, Meeghan Rogers, and John D. Turner. 2016. The Rise and Decline of the UK's Provincial Stock Markets, 1869-1929. QUCEH Working Paper 2016-03.

Carpentier, Cécile, Jean-François L'Her, and Jean-Marc Suret. 2009. On the Competitiveness of the Canadian Stock Market. *Banking and Finance Law Review* 24(2): 287.

Central Bureau of Statistics. 2010. *111 Jaar Statistiek in Tijdreeksen, 1899–2010*. Den Haag: Statistics Netherlands.

Deutsche Bundesbank. 1976. *Deutsches Geld-Und Bankwesen in Zahlen, 1876-1975*. Knapp.

Erichsen, Christian. 1902. Green's Danske Fonds og Aktier 1902. Udgivet og Redigeret af Holmer Green og Hendrik Stein. Nationaløkonomisk Tidsskrift 3.

Foster, Rob A. 1996. Australian Economic Statistics 1949–50 to 1994–95. Reserve Bank of Australia Occasional Paper 8.

Goldsmith, Raymond W. 1985. *Comparative National Balance Sheets: A Study of Twenty Countries, 1688–1978*. Chicago, Ill.: University of Chicago Press.

Grossman, Richard S. 2002. New Indices of British Equity Prices, 1870–1913. *Journal of Economic History* 62(1): 121–146.

Hall, Alan Ross. 1968. *The Stock Exchange of Melbourne and the Victorian Economy 1852–1900*. Canberra, ACT: Australian National University Press.

Hannah, Leslie. 2018. The London Stock Exchange, 1869-1929: New Statistics for Old? *Economic History Review* 71(4): 1349–1356.

Hansen, Svend Aage, and Knud Erik Svendsen. 1968. *Dansk pengehistorie. 1: 1700–1914*. København: Danmarks Nationalbank.

Jordà, Òscar, Katharina Knoll, Dmitry Kuvshinov, Moritz Schularick, and Alan M. Taylor. 2019. The Rate of Return on Everything, 1870–2015. *Quarterly Journal of Economics* forthcoming.

Jordà, Òscar, Moritz Schularick, and Alan M. Taylor. 2016. Macrofinancial History and the New Business Cycle Facts. In *NBER Macroeconomics Annual 2016, Volume 31*, edited by Martin Eichenbaum, Jonathan A. Parker, pp. 213–263. Chicago, Ill.: University of Chicago Press.

Kuhn, Moritz, Moritz Schularick, and Ulrike I. Steins. 2017. Income and Wealth Inequality in America , 1949–2013. CEPR Discussion Paper 20547.

Kuvshinov, Dmitry. 2019. The Time Varying Risk Puzzle. Working paper.

La Porta, Rafael, Florencio Lopez-de Silanes, and Andrei Shleifer. 2008. The Economic Consequences of Legal Origins. *Journal of Economic Literature* 46(2): 285–332.

Lamberton, Donald McLean. 1958. *Share Price Indices in Australia: An Examination of the Measurement and Significance of Changes in Share Prices, Together with New Indices for the Period July, 1936-December, 1957*. Law Book Company of Australia.

Le Bris, David, and Pierre-Cyrille Hautcoeur. 2010. A Challenge to Triumphant Optimists? A Blue Chips Index for the Paris Stock Exchange, 1854–2007. *Financial History Review* 17(2): 141–183.

López, Carlos Barciela, Albert Carreras, and Xavier Tafunell. 2005. *Estadísticas Históricas De España: Siglos XIX–XX*. Madrid: Fundacion BBVA.

Mediobanca. Various years. Indici e Dati Relativi ad Investimenti in Titoli Quotati.

Moore, Lyndon. 2010a. Financial Market Liquidity, Returns and Market Growth: Evidence from Bolsa and Börse, 1902-1925. *Financial History Review* 17(1): 7398.

Moore, Lyndon. 2010b. World Financial Markets 1900–25. Working paper.

Musacchio, Aldo. 2010. Law and Finance c. 1900. NBER Working Paper 16216.

Nyberg, Peter M., and Mika Vaihekoski. 2011. Descriptive Analysis of Finnish Equity, Bond and Money Market Returns. Bank of Finland Discussion Paper Series 14/2011.

Nyberg, Peter M., and Mika Vaihekoski. 2014a. Descriptive Analysis of the Finnish Stock market: Part II. Bank of Finland Discussion Paper Series 10/2014.

Nyberg, Peter M., and Mika Vaihekoski. 2014b. Equity Premium in Finland and Long-Term Performance of the Finnish Equity and Money Markets. *Cliometrica* 8(2): 241–269.

O'Sullivan, Mary. 2007. The Expansion of the U.S. Stock Market, 1885–1930: Historical Facts and Theoretical Fashions. *Enterprise and Society* 8(3): 489–542.

Parum, Claus. 1997. Det Danske Organiserede Aktiemarked i Historisk Belysning. Copenhagen Business School Department of Finance Working Paper 97-6.

Piketty, Thomas, Emmanuel Saez, and Gabriel Zucman. 2018. Distributional National Accounts: Methods and Estimates for the United States. *Quarterly Journal of Economics* 133(2): 553–609.

Rajan, Raghuram G., and Luigi Zingales. 2003. The Great Reversals: the Politics of Financial Development in the Twentieth Century. *Journal of Financial Economics* 69(1): 5–50.

Roe, Alan. 1971. *The Financial Interdependence of the Economy, 1957-1966*. London: Chapman and Hall.

Ronge, Ulrich. 2002. *Die Langfristige Rendite Deutscher Standardaktien: Konstruktion eines Historischen Aktienindex ab Ultimo 1870 bis Ultimo 1959*. Frankfurt am Main: Lang.

Saint-Marc, Michèle. 1983. *Histoire Monétaire de la France (1800–1980)*. Paris: Presses Universitaires de France.

Shiller, Robert J. 2015. *Irrational Exuberance*. Princeton, N.J.: Princeton University Press.

Solomou, Solomos, and Martin Weale. 1997. Personal Sector Wealth in the United Kingdom, 1920–1956. *Review of Income and Wealth* 43(3): 297–318.

Sylla, Richard. 2006. Schumpeter Redux: a Review of Raghuram G. Rajan and Luigi Zingales's Saving Capitalism from the Capitalists. *Journal of Economic Literature* 44(2): 391–404.

Waldenström, Daniel. 2014. Swedish Stock and Bond Returns, 1856–2012. In *Historical Monetary and Financial Statistics for Sweden, Volume 2: House Prices, Stock Returns, National Accounts and the Riksbank Balance Sheet, 1860-2012*, edited by Rodney Edvinsson, Tor Jacobson, and Daniel Waldenström, pp. 223–293. Stockholm: Sveriges Riksbank and Ekerlids förlag.