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THE BIG BANG: STOCK MARKET CAPITALIZATION IN THE LONG RUN

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Abstract

This paper studies long-run trends in stock market capitalization and their drivers. New annual data for 17 advanced economies reveal a striking time series pattern: the ratio of stock market capitalization to GDP was roughly constant between 1870 and 1980, tripled with a historically unprecedented “big bang” in the 1980s and 1990s, and remains high to this day. We use data on equity returns, yields and cashflows to explore the underlying forces behind this structural shift. We show that the big bang is driven by two factors: a secular decline in the equity discount rate from 1980 onwards, and an upward shift in cashflows paid by listed firms. Equity issuance and new listings make next to no contribution to the structural increase in market cap. We also show that high market capitalization forecasts low equity returns, low dividend growth and a high risk of a stock market crash. This suggests that the currently high valuations and capitalization are a sign of high, rather than low risk in equity markets.

JEL Classification: E44, G10, N20, O16

Keywords: stock market capitalization, wealth-to-income ratios, return predictability, equity valuations, risk premiums

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1. Introduction

Which forces drive the evolution of stock market size over the long run? Standard theory – going back to the famous "Kaldor facts" – suggests that stock market capitalization should grow in line with real activity. But this need not be so. Rajan and Zingales (2003) argue that stock markets grew rapidly in the early and late 20th century, outpacing GDP growth, but stagnated in-between. These growth differentials are typically linked to changes in the institutional set-up of the market, financial development and entry barriers for newly listed firms (La Porta, Lopez-de-Silanes, Shleifer, and Vishny, 1997).

This paper proposes an alternative view of the secular trend in stock market wealth and its determinants. We introduce new annual long-run data on stock market capitalization in 17 advanced economies and show that indeed, the ratio of stock market cap to GDP has not been constant. After a century of relative stability, stock markets underwent a rapid expansion, tripling in size during the 1980s and 1990s and remaining at these high levels thereafter. We show that this expansion is driven in its entirety by higher equity prices, in turn attributable to two factors: a lower discount rate, and one-off increases in cashflow payments by listed firms. This structural trend, then, has relatively little to do with either economic growth or changes in the organisation of the equity market. Instead, we show that the market cap to GDP ratio serves as a rather good proxy for equity valuations, and is a powerful predictor of stock returns. Our findings suggest that the recent increase in total and stock market wealth (Piketty and Zucman, 2014) is intrinsically linked to broader macro-financial trends in safe interest rates, the price of risk, and the profitability of large firms (Holston, Laubach, and Williams, 2017; Lettau, Ludvigson, and Wachter, 2008; Barkai, 2019). They also suggest that similarly to the consumption-wealth ratio of Lettau and Ludvigson (2002), we can use observable changes in stock market wealth to track the time variation in the equity premium.

The bedrock for our analysis is a novel comprehensive dataset on stock market capitalization in advanced economies. The data cover 17 countries at annual frequency 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. The series go far beyond currently available data which only cover selected time periods in individual countries, or benchmark years in a cross-country sample. Together with the extensive documentation in the Data Appendix, these data provide a new resource for researchers to study the development of the stock market, equity finance, and capital structure throughout the last 146 years.

The first 100 years of our data conform to the "Kaldor view" of stock market growth, with the ratio of market capitalization to GDP roughly constant at around 0.3. But starting in the 1980s, market capitalization skyrockets, reaching 100% of GDP by the early 2000s and remaining at these historically unprecedented levels to this day. This "big bang" pattern is a robust feature of the data: the stock market expansion 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. Cross-country differences in stock market cap do show some correspondence to legal norms, but

these differences become smaller during the big bang. 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 stock market accounting for close to 70% of the total 17-country capitalization.

We next ask the following question: is the secular variation in market cap driven by changing equity prices or quantities? To do this, we combine our market capitalization estimates with data on equity returns, yields and cashflows from Jordà, Knoll, Kuvshinov, Schularick, and Taylor (2019) to decompose the year-on-year growth in market cap into equity capital gains and net equity issuance by new and existing firms. It turns out that capital gains, not issuance are the key driver of changes in market cap growth over the long run. Net issuance is sizeable at roughly 4% of market cap but stays remarkably constant over time. Real capital gains average less than 1% over the entirety of our sample, but show much more cyclical and secular variation. Thus, the stagnation in market capitalization between World War 1 and 1980 can be attributed to the equity price shocks coming from the two world wars, the Great Depression, and the 1970s stagflation. Most crucially for our analysis, the big bang coincided with a sharp and persistent increase in equity prices, with real stock price growth after 1985 averaging 3.5% per year, around 5 times the historical norm. A counterfactual exercise shows that this higher price growth is sufficient to explain the entirety of the market cap increase during the big bang, while changes in equity issuance make no contribution to the post-1985 structural increase in market cap.

The higher post big bang equity prices are driven by higher future cashflows or a lower discount rate – but which one is key? We tease out the relative contribution of these factors in two steps. First, we run predictive regressions and show that high stock market cap to GDP ratios forecast low future equity returns, but do not forecast high future dividend growth. These predictive relationships hold robustly over a variety of data definitions, subsamples and regression specifications. They also become stronger during the big bang: after 1985, a given increase in market capitalization forecasts a larger decline in the expected return on equity. This suggests that, if anything, the big bang should be driven by a lower equity discount rate. But we also show that despite having no predictive power for future cashflow growth, market cap to GDP is strongly correlated with current dividend levels. This poses a second potential driver of the big bang – a level shift in the profits of listed companies that is not accompanied by higher future growth rates.

To evaluate the relative contribution of these two factors, we construct proxies of the equity discount rate and cashflows paid by listed firms relative to GDP. The discount rate is proxied as either the dividend-price ratio, or the expected return on equity constructed by Kuvshinov and Zimmermann (2020) as the sum of the dividend-price ratio and the expected future cashflow growth rate obtained from a predictive regression. The ratio of dividends to GDP is calculated as market cap to GDP times the dividend-price ratio. The trends in these two variables confirm our priors. First, we show that the equity discount rate underwent a protracted fall in the 1980s and 1990s, and remained low thereafter. We further decompose this fall into changes in the risk premium and the

safe rate, using trend real safe rate estimates based on the methodology of Del Negro, Giannone, Giannoni, and Tambalotti (2019). The entirety of the initial decline in the discount rate during the 1980s and 1990s is driven by a lower equity premium. But the reason why market capitalization did not mean revert at least partially after 2000 is the recent decline in safe interest rates, which kept the equity discount rate low even as the risk premium went up. Turning to cashflows, we find that dividends paid by listed firms relative to GDP more than doubled between 1985 and 2015. Given that dividends are an imperfect measure of total shareholder compensation, we also show that these two trends hold for earnings-based proxies of discount rates and cashflows for the US.

Finally, we run a counterfactual exercise and show that these two trends alone – a drop in the discount rate and a level increase in dividend payments – explain almost all of the increase in market capitalization during the big bang. Calculating counterfactual market cap as $(D/GDP)/(r-g)$, we show that the increase in dividend payments in the data – D/GDP going up from 1.3% in 1870–1985 to 2% in 1985–2015 – and the fall in r from 6.5% to 5.5% can together explain 85% of the observed increase in the market cap to GDP ratio.

What are the ultimate causes of falling discount rates and rising cashflow payments? Recent evidence suggests that a higher desire for saving – for example, due to demographic changes – and a lower price of risk have played a key role in the discount rate decline in the US (Baldwin and Teulings, 2014; Lettau et al., 2008). In a related paper (Kuvshinov and Zimmermann, 2020), we analyse the trends and determinants of discount rates on equity and housing in cross-country long-run data. We argue that a lower price of risk, potentially linked to lower macro-financial volatility, is the key reason why discount rates have declined. The fact that listed firm dividends have increased while aggregate advanced economy productivity growth has been slowing (Fernald, 2015) suggests that this increase represents a shift in profits or factor rewards away from other sectors of the economy towards listed companies. Again, recent evidence for the US suggests that this shift may have occurred because of greater market power (De Loecker et al., 2020), rising capital shares (Greenwald, Lettau, and Ludvigson, 2019) or changes in corporate taxation (McGrattan and Prescott, 2005).

Discount rates are an important driver of secular trends in stock market wealth. But what about cyclical variation? Warren Buffet famously said that the stock market cap to GDP ratio is "the best single measure of where valuations stand at any given moment" (Buffett and Loomis, 2001). We show that Buffet's intuition is supported by the data. Stock market capitalization not only predicts equity returns unconditionally, but also outperforms the price-dividend ratio as a predictor. Unlike the price-dividend ratio which positively predicts dividend growth in our long-run cross-country sample, high market capitalization levels also conditionally predict negative rather than positive dividend growth. Further to this, sharp run-ups in market capitalization share many characteristics with stock market bubbles, being accompanied by high returns and rising valuations but followed by low equity returns and a higher risk of an equity market crash.

The reasons why stock market capitalization is a good proxy for equity valuations are twofold. First, GDP may be a better measure of the underlying corporate fundamentals than dividends –

being, for example, relatively unaffected by changes in dividend policy. Second, capitalization may be a better valuation metric than prices because it also includes information on quantities which helps capture swings in investor sentiment through, for example, firms timing the market to issue equity when valuations are high. We provide empirical evidence to support both of these claims. We show that the ratio of equity prices to GDP and net equity issuance both predict future stock returns even conditional on the current level of the price-dividend ratio, but neither of these measures predicts dividend growth in the right direction.

Our work is related to three strands of existing literature. The first strand seeks to quantitatively document the long-run evolution of wealth in general and stock market wealth in particular. Rajan and Zingales (2003) provide cross-country estimates of stock market capitalization at selected benchmark years, and Piketty and Zucman (2014) produce annual estimates of aggregate wealth for 8 countries, 4 of these going back to the 1800s. But efforts to understand the evolution of different types of wealth substantially predate these recent studies. Already in the 19th century, rich financiers commissioned occasional surveys of stock market activity which yielded piecewise estimates of capitalization (Burdett, 1882; Green, 1887). From mid 20th century onwards, economic historians put together more consistent estimates of market cap for individual countries (Hoffmann, 1965; Roe, 1971; Waldenström, 2014), while Goldsmith (1985) marked the first comprehensive effort to chart the evolution of total wealth in a cross-section of economies. 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 of the literature seeks to understand what drives the changes in total and equity market wealth. La Porta et al. (1997, 2008) provide evidence that market capitalization is correlated with the quality of the country's institutions and legal norms. Piketty and Zucman (2014), in turn, argue that long-run changes in aggregate wealth are driven by saving rates rather than capital gains. A number of papers focussing on recent US data, however, point to the importance of equity capital gains and their underlying drivers in determining the market cap. McGrattan and Prescott (2005) attribute the recent increase in equity wealth of US corporations to changes in the corporate tax code, and De Loecker et al. (2020) show that market capitalization of individual firms is strongly correlated with their market power. In a recent paper, Greenwald et al. (2019) argue that the post-1950 increase in market capitalization in the US is largely attributable to a fall in the capital share. Our paper is able to reconcile the long-run studies of market capitalization with evidence on the importance of equity prices that has thus far been confined to the recent US experience. We show that capital gains matter not only in the short but also in the long run, and the reason that they matter primarily comes down to time varying discount rates and shifts in the profit distribution rather than aggregate long-run profitability growth.

In highlighting the link between time varying discount rates and market capitalization, we contribute to a third literature which studies the cyclical drivers of stock price volatility and the associated empirical predictability relationships. Existing literature has shown that the dividend-

price ratio predicts equity returns in long-run data for the US (Cochrane, 2008; Golez and Koudijs, 2018) and globally (Engsted and Pedersen, 2010; Kuvshinov, 2019). Lettau and Ludvigson (2002), however, show that wealth-based valuation metrics – in their case the consumption-wealth ratio – may outperform the dividend-price ratio, particularly at long horizons. Rangvid (2006) and Cooper and Priestley (2008) further show that fundamental measures of real economic activity, such as the price-GDP ratio and the output gap, have predictive power for stock returns, while Baker and Wurgler (2000) show that not only prices but also quantities of listed equity matter. Our paper shows that an easily observable measure of wealth – the stock market cap to GDP ratio – is able to outperform the price-dividend ratio in predictive regressions, and that this outperformance comes about from the aforementioned advantages of GDP and total capitalization as proxies for market fundamentals and valuations.

Stock markets today are larger than at any point in recent history. This does not necessarily mean that financial markets are substantially more developed. Rather than being a sign of low risk or high future corporate profitability, these high market cap levels signal low future returns, low dividend growth and a higher chance of equity market crashes – and hence suggest that the level of risk in the equity markets is high rather than low.

2. New long-run data on 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, 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 E.1–E.17 and Figures E.1–E.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 (2019) and Kuvshinov (2019).

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 constructing our own benchmark year estimates where necessary, 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 E.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 largely reflects the inclusion of curb and regional exchanges in the US data, and exclusions of bonds and foreign shares for the UK (see Sylla, 2006, for a further discussion of these issues).

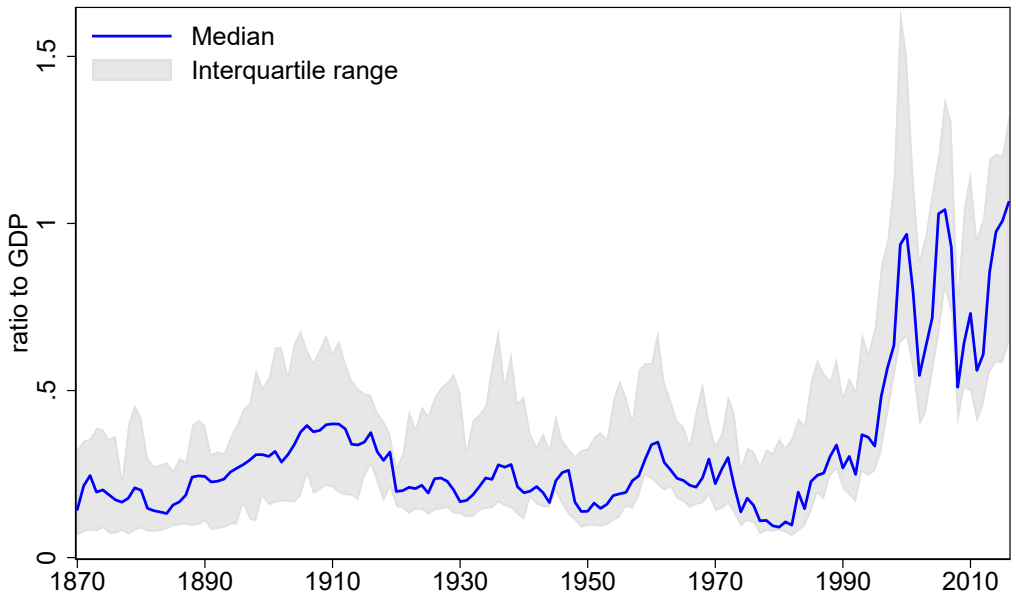
Our dataset advances the existing knowledge of market capitalization along two main dimensions. First, the estimates go beyond benchmark years and record the evolution of stock market capitalization at annual frequency. This not only allows us to discern general trends and make sure they are not skewed by year-specific outliers, but together with the data on stock prices and cashflows, allows us to decompose changes in capitalization into prices and quantities, and conduct a more detailed analysis of the underlying drivers of stock market size. 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 blue line is the sample median, and the shaded area is the interquartile range of country-level data.

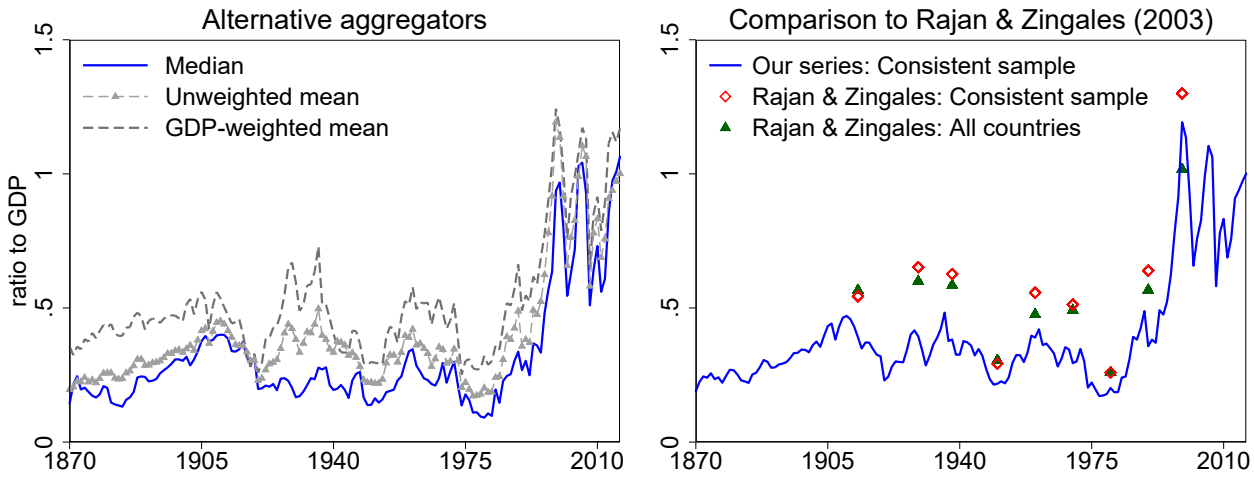
From the end of the industrial revolution and up until the late 1980s, the size of the stock market was relatively stable at around one-third of output. This was true both across time with the median market cap to GDP ratio always below 0.5 during this period, and across countries,

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.

Figure 2: *Comparison to alternative estimates*



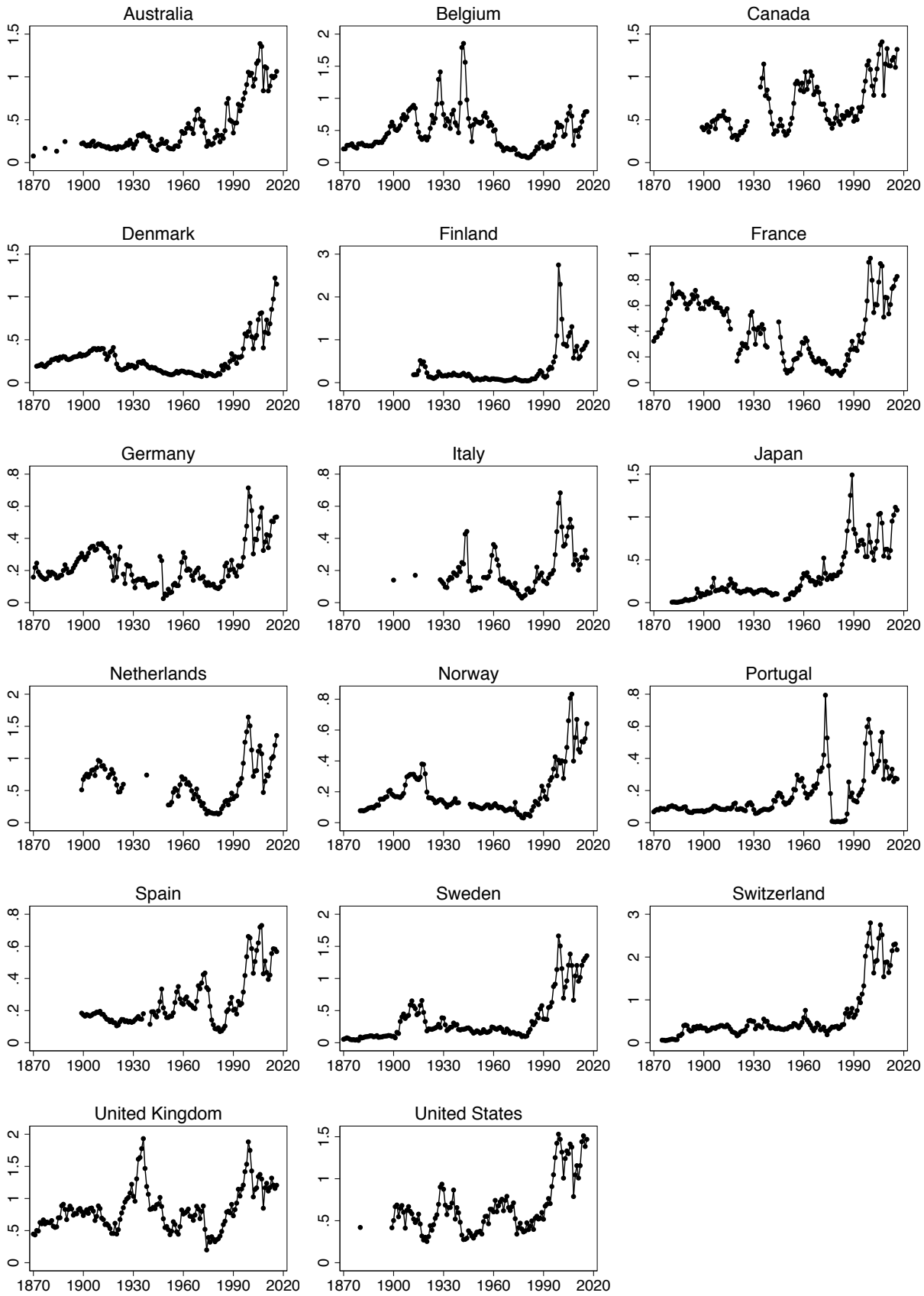
Notes: Stock market capitalization to GDP ratio. Left-hand panel: Median, unweighted and GDP-weighted averages of 17 countries. Right-hand panel: Estimates in our data compared to those of Rajan and Zingales (2003), unweighted averages. The consistent sample includes all countries in our dataset apart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

with the interquartile range oscillating between 10% and 60% of GDP. During these 100 years, market capitalization experienced several pronounced swings: the boom of the early 1900s during which capitalization roughly doubled, 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 of 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 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".

The left-hand panel of Figure 2 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

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



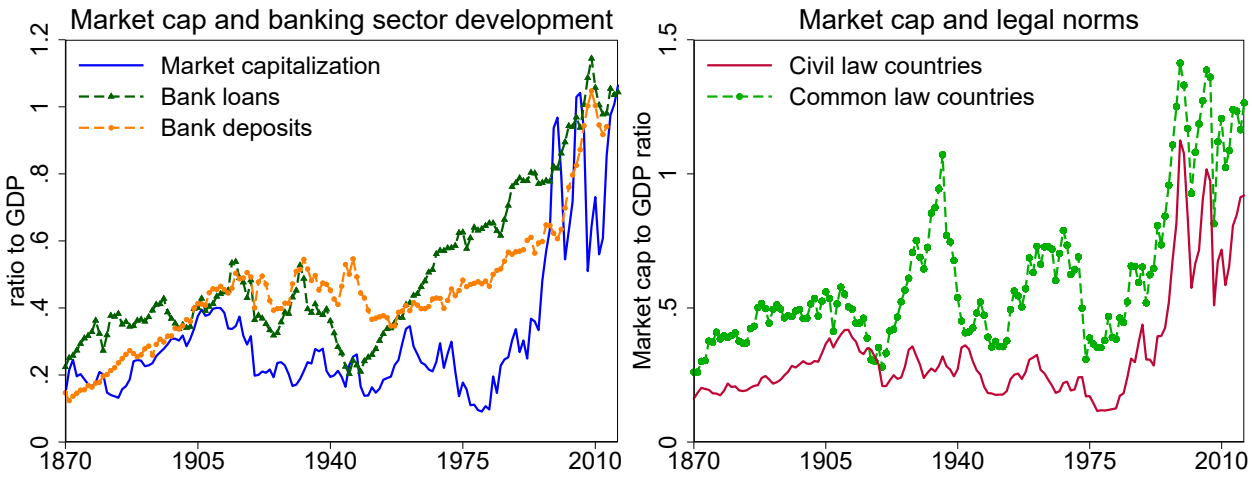
return to some previously high level of market capitalization that was in place before a structural decline, financial or economic shocks – such as the two world wars or, in the case of Portugal, the Carnation revolution – reduced the size of the respective stock markets, only for them to experience a renaissance over the recent decades.

In comparison to existing literature, this hockey stick time series pattern differs somewhat from the U-shaped "great reversals" trend documented by Rajan and Zingales (2003) (henceforth RZ). RZ compiled data on cross-country 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. The right-hand panel of Figure 2 compares our market capitalization estimates to those of RZ. To improve comparability, we have excluded Finland, Portugal and Spain, which are present in our sample but not that of RZ, from our series (solid blue 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 matters little for the aggregate trends: 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, and shows that the averages shown in Figure 2 do obscure some more sizeable differences at individual country level.

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 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. RZ mostly relied on years 1913, 1980 and 1999 for their benchmark comparisons. But Figure 2 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.

Figure 4: *Stock market capitalization, financial development and legal norms*

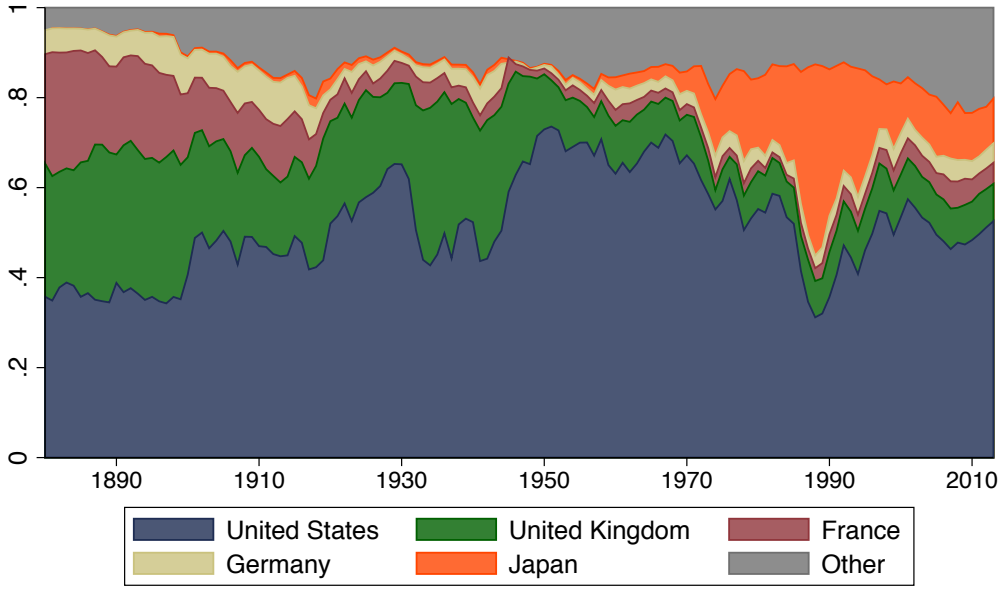


Notes: Left-hand panel: median ratio of stock market capitalization, total loans and bank deposits to GDP, 17 countries. Right-hand panel: median market cap to GDP ratios for two groups of countries. Common law countries are Australia, Canada, the UK and the US. Civil law countries are all other countries in our dataset.

Existing literature often takes market capitalization to be a proxy for financial development, measuring the availability equity finance, in turn determined by deep structural factors such as the country's legal norms and institutional characteristics (Rajan and Zingales, 2003; La Porta et al., 1997). We next investigate whether the structural increase in market capitalization can be linked to other measures of financial development or countries' legal characteristics. The left-hand panel of Figure 4 shows the evolution of market capitalization alongside that of two measures for banking sector development: the total credit to the non-financial sector (green triangles, sourced from Jordà, Schularick, and Taylor, 2016) and total bank deposits (brown crosses, sourced from Jordà, Richter, Schularick, and Taylor, 2017). While all three indicators display an upward trend in the second half of the 20th century, the timing of this increase differs markedly between the stock market and bank-based forms of intermediation. The bank-based intermediation measures start increasing much earlier than stock market cap, and show the sharpest increase during the early 2000s – a time when the stock market cap to GDP ratio was stagnating.

The right-hand panel of Figure 4 displays the evolution of stock market capitalization across two groups of countries: those with common law legal systems (Britain, Canada, US and Australia) and those operating under civil law (the rest of our sample). La Porta et al. (1997) hypothesised that stock markets in common law countries tend to be more developed because of the more market-friendly legal norms. Consistent with this hypothesis, this group of countries tends to have a persistently higher market cap to GDP ratio. Nevertheless, the post-1980 increase in stock market cap "takes off" at a similar time and is similar in magnitude across both of these country groups. During the 1980s and 1990s, the levels of market capitalization in civil law countries did seem to catch up somewhat, but level differences have re-emerged in the decade following the global financial crisis, with civil law countries experiencing bigger equity market declines during 2007–09 and a slower recovery.

Figure 5: *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.

The new dataset also allows us to investigate the relative importance of individual domestic equity markets. Figure 5 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 equally 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. The 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 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 has 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, and shows little correspondence with other measures of financial development or country-specific legal norms. Which factors are driving this increase in market capitalization in the data? To answer this question, we first decompose the variation in market capitalization into changes in quantities and prices, and then assess the deeper structural drivers behind the secular increase in equity wealth.

4. Decomposing long-run growth in market capitalization

What are the underlying drivers of the big bang? Even though there are many potential candidates, they can be broadly split in two categories: changes in equity prices and changes in quantities. To fix ideas, note that total market capitalization at any time t is the sum of market values of individual shares:

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

Above, $MCAP$ is aggregate market capitalization, P is price and Q is quantity of issued shares for each share i, and there are N shares in total. An increase in market capitalization can then come about from share issuance by listed companies – an increase in Q; new companies entering the listing – an increase in N; or higher prices of existing listings – an increase in P. Any year-on-year change in market cap should therefore be attributable to either new issuance – through both IPOs and SPOs – or capital gains on the previous period's market cap:

$$MCAP_t = (1 + Capital\ gain_t) * MCAP_{t-1} + Net\ issuance_t \tag{2}$$

Dividing both sides by $MCAP_{t-1}$, the growth rate of market cap is then simply the sum of the capital gain and net equity issuance relative to the previous year's market cap:

$$g_t^{MCAP} = cg_t + iss_t \tag{3}$$

Here $g_t^{MCAP} = \Delta MCAP_t / MCAP_{t-1} - \pi_t$ is the real growth rate of market cap, cg_t is the real capital gain on listed equities, and $iss_t = Net\ issuance_t / MCAP_{t-1}$. Note that for the purposes of equation (3), the market cap growth rate g and capital gain cg can be either nominal or real, but for ease of interpretation across periods we perform the decomposition with real growth rates.

The decomposition in equation (3) is a pure accounting exercise and does not rely on any assumptions about the underlying sources of stock market wealth. The different components can be estimated directly from the data: we observe market cap growth g and capital gains cg, and calculate net issuance as the residual. This decomposition mirrors the technique used by Piketty and Zucman (2014), among others, to decompose changes in wealth-to-income ratios into savings and capital gains. The main difference to us is that Piketty and Zucman (2014) observe savings and

impute capital gains, whereas we observe capital gains and impute net issuance. The evolution of the market cap to GDP ratio depends on how growth in market capitalization compares to the growth of GDP. When market cap grows faster than GDP, the market cap to GDP ratio will be growing, and when it grows by less than GDP it will be shrinking.

Table 1 summarises the growth in market capitalization and its components in our data. The top row shows the average change in market cap to GDP for the full sample and three selected time periods: the initial pre-WW1 market cap growth (column 2), the mid-20th century stagnation (column 3), and the big bang (column 4). Before 1985, market cap was either growing slowly – at around 0.6% of GDP per year before 1914 – or stagnating, with near-zero growth in market cap relative to GDP between 1914 and 1985. After 1985, the market cap to GDP ratio grew, on average, by more than 2 percentage points per year – roughly 5–6 times the historical norm. To see if this growth was driven by prices or quantities, the middle three rows of Table 1 decompose real market cap growth g into capital gains cg and net issuance iss according to equation (3). The top panel of Figure 6 shows how market cap growth and its two components have evolved over time at a more granular frequency using centered five-year moving averages of cross-country annual data.

Column 1 of Table 1 shows that issuance is important in propping up equity market wealth over the long run: since stock prices grow only slightly faster than inflation, an average net issuance of close to 4% is necessary to keep stock market cap growing at rates similar to GDP. But this sizeable net issuance stays more or less constant over time. Figure 6 (top panel) shows that net equity issuance remained close to 4% of market cap throughout the entirety of our sample. In fact, net issuance was actually slightly lower after 1985 – at around 3.5% of market cap – than during the earlier historical period (Table 1). Real capital gains, on the contrary, vary markedly from period to period – from losses of close to 20% p.a. during the decades around World War I and the 1970s stagflation, to sustained gains of 10–20% p.a. during the 1950s and 1980s/1990s. Moreover, these capital gain changes do not necessarily mean-revert, and hence can create structural shifts in the capitalization of the stock market. This can most easily be seen from Table 1. The sharp stock price increases of the 1980s and 1990s were not followed by comparatively sharp corrections, meaning that the average capital gain after 1985 was roughly 5 times its historical norm.

To ascertain the importance of capital gains and equity issuance in driving the big bang, the bottom panel of Figure 6 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 capital gains to their pre-1985 average. Under this scenario, all changes in the market cap to GDP ratio from 1985 onwards are attributable to net issuance and real GDP growth. 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. We benchmark the estimates so that the combined growth under the two counterfactual scenarios equals the actual growth in market cap over 1985–2015.[1]

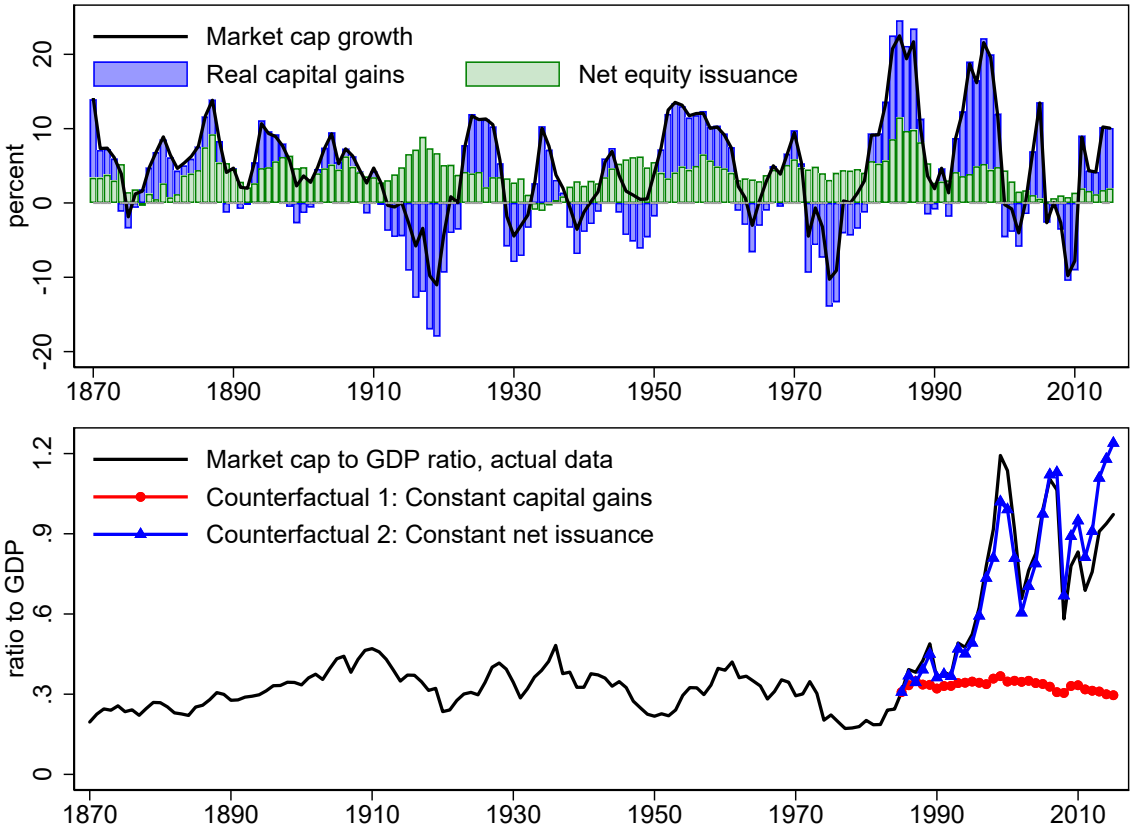
[1]The benchmarking ensures that the different timing of the shocks to issuance and capital gains, and the correlation between the two, do not bias our findings. For example, after the burst of the Japanese bubble

Table 1: *Market capitalization growth decomposition*

	(1) Full sample	(2) Pre 1914	(3) 1914–1985	(4) Post 1985
Average change in $MCAP/GDP$	0.63	0.61	-0.05	2.13
Market cap growth decomposition:				
Real market cap growth ≈	4.61	5.30	3.41	6.61
Real capital gain on equity	0.70	1.23	-0.75	3.43
+ Implied issuance to market cap	3.96	3.96	4.17	3.48
Real GDP growth	2.83	2.42	3.26	2.28
Observations	2092	472	1116	504

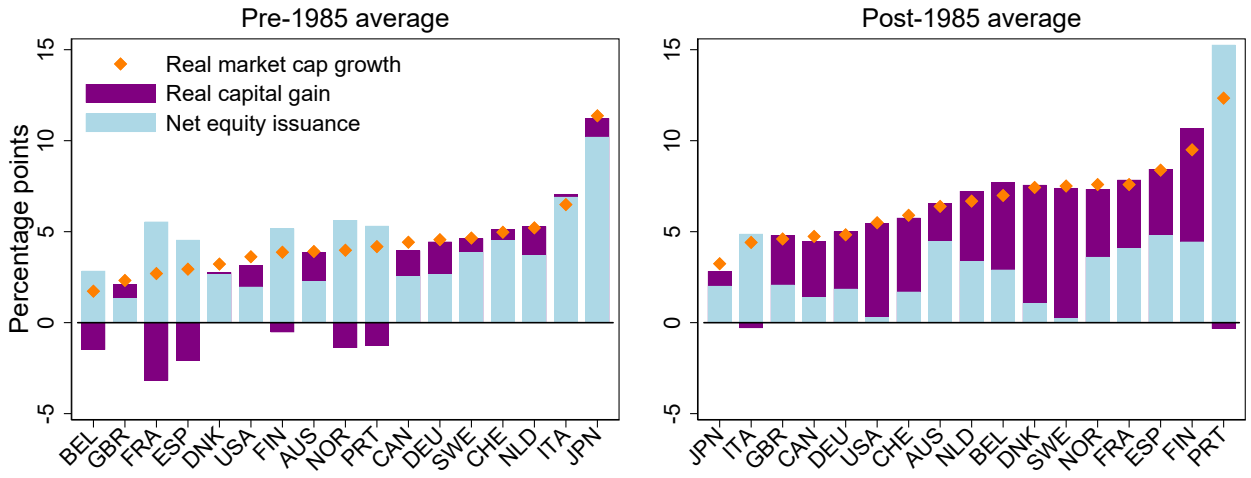
Notes: Top row: average change in the market cap to GDP ratio, percent of GDP. Middle rows: decomposition of real market cap growth – the year-on-year growth in nominal market cap less inflation – into real equity capital gains and net equity issuance. Bottom row: year-on-year growth in real GDP. All data are pooled sample averages of log growth rates.

Figure 6: *Decomposition trends and counterfactual*



Notes: Top panel: decomposition of real market cap growth into capital gains and net issuance. Centered 5-year moving averages. 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. Data are benchmarked so that the combined growth of the two counterfactuals between 1985 and 2015 equals the actual growth in observed market cap data. All data are unweighted averages of 17 countries.

Figure 7: *Decomposition of market cap growth by country*



Notes: Real market cap growth decomposed into real capital gains and net issuance relative to market cap. Averages of log growth rates for each country before and after 1985. The sum of the bars can deviate from the orange diamond because of the correlation between issuance and capital gains.

Counterfactual 1 shows that ignoring the post-1985 capital gains eliminates the big bang entirely from our data, with market cap staying relatively constant and even declining slightly over the past 20 years due to lower net issuance. Counterfactual 2 closely follows actual data, which means that higher post-1985 capital gains can explain the entirety of the big bang. If anything without the slight slowdown in net issuance after 1985 shown in Table 1 column 4, the growth in market cap over recent decades would have been even stronger.

Figure 7 shows that these aggregate trends are reflected in coutry-level data. The left-hand panel shows the average growth rate of market cap before the big bang decomposed into capital gains and issuance, and the right-hand panel shows the average growth rate during the big bang. As with cross-country averages shown in Table 1 and Figure 6, almost all of the stock market cap growth before 1985 is attributable to net issuances (light-blue bars) rather than capital gains (purple bars). After 1985, the situation changes. For around half the countries, capital gains make a larger contribution than issuances, and out of the remaining half only Portugal shows strong market cap growth backed by high issuance. This country, however, presents a rather special case: it stock market almost disappeared after the 1977 Carnation revolution, and the high issuance relative to market cap simply reflects the re-establishment of this market from a very low base during the 1970s and 1980s. Appendix Figure B.2 additionally shows the counterfactual evolutions of market cap for each country, first fixing capital gains and then net issuance to their pre-1985 levels. In every country bar two (Australia and Portugal), the fixed-issuance counterfactual closely follows actual

both issuance and capital gains were sharply negative, meaning that any subsequent growth took place from a very low base. Ignoring the correlation between these two shocks would overstate the counterfactual market cap growth under both scenarios. That being said, data for non-benchmarked counterfactuals show even higher market cap growth under counterfactual 2 of fixed issuance which further confirms our findings; results available from authors upon request.

data whereas the fixed-capital-gain counterfactual results in little or no market cap growth, again showing that higher post-1985 capital gains are key.

How robust are these findings? Because we estimate net issuance as a residual from equation (3), they could potentially be driven by measurement error in the net issuance series. To guard against this, we calculate the decomposition using data on actual net issuance of listed equities, available over the long run for four countries: Finland, Germany, Switzerland and the USA. Appendix Figure B.1 shows the year-by-year decomposition of market cap growth into capital gains, actual net issuance and a residual (top panel); as well as the counterfactual evolution of market cap during the big bang. The results suggest that if anything, our baseline estimates understate the stability of net issuance and hence the importance of capital gains in driving both the cyclical and the structural variation in stock market cap. The top panel of Appendix Figure B.1 shows that actual issuance is even more stable than implied issuance over the long run, with part of the variation in implied issuance in Figure 6 and Table 1 driven by measurement error. Actual net issuance also shows a stronger decline in the 2000s, meaning that the counterfactual evolution of market cap during the big bang is even more dependent on higher capital gains.

In sum, the sharp post-1980 increases in capitalization are not generated by existing firms issuing new equity or new firms listing on the market. The big bang in stock market cap is driven by higher equity prices. What are then, the deeper underlying reasons for the sharp and persistent equity price increase, and hence the big bang itself? We address this question in the following section.

5. Structural drivers of the big bang

The big bang in stock market capitalization is driven by higher equity prices. Stock prices should equal the discounted value of future cashflows. The big bang should therefore be attributable to either higher cashflows and profitability of listed firms, or a lower rate at which these cashflows are discounted. To fix ideas, consider as in equation (1) that market capitalization is the product of quantities Q and stock prices P, and that stock prices equal the sum of future dividends D discounted at rate r:

$$MCAP_t = \sum_{i=1}^{N_t} Q_{i,t} * P_{i,t} = \sum_{i=1}^{N_t} Q_{i,t} * \mathbb{E}\left(\sum_{s=1}^{\infty} \frac{D_{i,t+s}}{(1+r_t)^s}\right) \tag{4}$$

Defining total economy-wide dividends as $D_t = \sum_{i=1}^{N} Q_{i,t} D_{i,t}$ and normalising by GDP yields the following expression:

$$\frac{MCAP_t}{GDP_t} \approx \frac{D_t}{GDP_t} * \mathbb{E}\left(\sum_{s=1}^{\infty} \frac{(1+g_{t+s})^s}{(1+r_t)^s}\right) \tag{5}$$

If future dividend growth is constant $g_{t+s} = g_{t+1} \; \forall \; s$, this simplifies to

$$\frac{MCAP_t}{GDP_t} \approx \frac{D_t}{GDP_t} * \mathbb{E}\left(\frac{1}{r_{t+1} - g_{t+1}}\right) \tag{6}$$

Equations (5) and (6) are the equivalent of the Gordon dividend discount model for the entire stock market. They show that market capitalization can be high if dividends are high (high D and g), or the discount rate r is low. In the rest of this section, we test the importance of these two forces in driving the structural increase in market capitalization during the big bang. First, we run predictive regressions to test whether market capitalization in general responds to news about future cashflows $\mathbb{E}(g)$ or discount rates $\mathbb{E}(r)$. Second, we document trends in D, g and r to see if these have, in fact, shown structural increases (for cashflows) or declines (for discount rates) around the time of the big bang. If either cashflows or discount rates are a structural driver of the big bang, they should not only be predictable by market cap, but also show a structural shift in the right direction during the post-1980 time period. To quantify the contribution of different structural drivers, we run a counterfactual exercise which evaluates the evolution of stock market cap during the big bang under alternative assumptions about trends in r, D and g.

5.1. Predictive regressions

If stock market cap responds to expected future returns and dividends as in equation (5), today's capitalization should predict future realised returns and dividend growth. We test whether this is the case by running predictive regressions of the following form:

$$r_{j,t+1} = \alpha_j^r + \beta^r mcap_{j,t} + \gamma^r mcap_{j,t} * Post1985 + u_{j,t}^r \tag{7}$$

$$dg_{j,t+1} = \alpha_j^{dg} + \beta^{dg} mcap_{j,t} + \gamma^{dg} mcap_{j,t} * Post1985 + u_{j,t}^{dg} \tag{8}$$

Above, r is log real total return, dg is log real dividend growth, $mcap$ is the log market cap to GDP ratio and $Post1985$ is a dummy that equals 1 from 1985 onwards. We run the regressions using a panel of 17 countries $j = \{1, 17\}$ over years $t = \{1870, 2015\}$ clustering standard errors by country and year and allowing for serial autocorrelation in residuals as in Driscoll and Kraay (1998).[2] If $\beta^r < 0$, this means that market cap responds to changes in discount rates or expected returns, and if $\beta^{dg} > 0$ it responds to news about future dividends. $\gamma^r \neq 0$ or $\gamma^{dg} \neq 0$ mean that these relationships have become either stronger or weaker during the big bang period.

Table 2 presents the results of these predictability regressions. The numbers show the predictive coefficients β and the big bang interaction dummy γ when used to predict real returns (columns 1 and 2), excess returns (columns 3 and 4), and real dividend growth (columns 5 and 6). The top panel shows predictability at the one-year horizon and the bottom panel at the five-year horizon. Market capitalization forecasts future returns, which suggests that it responds to changes in the discount rate r. The coefficients in columns 1 and 2 are negative and significant, indicating that a 10 percentage point increase in the stock market cap to GDP ratio forecasts a 1 percentage point

[2] All of these adjustments are important since market cap follows a common trend across countries, especially after the big bang, and is a persistent variable that is serially correlated. The maximum lag for error autocorrelation is determined as the average of optimal Newey-West bandwidths for individual countries, which is 17.

Table 2: *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*						
$log(MCAP_t/GDP_t)$	-0.038***	-0.041***	-0.046***	-0.047***	-0.009	-0.010
	(0.011)	(0.010)	(0.013)	(0.013)	(0.017)	(0.016)
$log(MCAP_t/GDP_t) * Post1985$		-0.068***		-0.022		-0.026
		(0.019)		(0.022)		(0.021)
R^2	0.017	0.037	0.022	0.024	0.001	0.003
Observations	2060	2060	2060	2060	2060	2060
Panel 2: *Five-year ahead average returns and dividend growth*						
$log(MCAP_t/GDP_t)$	-0.038***	-0.040***	-0.048***	-0.048***	-0.003	-0.005
	(0.009)	(0.008)	(0.009)	(0.009)	(0.012)	(0.012)
$log(MCAP_t/GDP_t) * Post1985$		-0.040**		0.001		-0.035***
		(0.016)		(0.018)		(0.013)
R^2	0.087	0.122	0.132	0.132	0.001	0.025
Observations	1953	1953	1953	1953	1953	1953

Note: Returns and dividend growth are measured in logs. Regressions with country fixed effects. Standard errors clustered by country and year and adjusted for autocorrelation are in parentheses. *, **, ***: Significant at 10%, 5% and 1% levels respectively.

lower real equity return 1 year ahead.[3] Moreover, the predictive power of market cap becomes much stronger after 1985, with a 10 percentage point increase in the cap to GDP ratio now associated with 3 percentage point lower year-ahead returns.

Columns 3 and 4 show that much of this predictive power comes from excess returns – the difference between total return on equity and long-term government bonds – indicating that market capitalization responds to changes in the equity risk premium. The increase in predictive power after 1985, however, is not nearly as strong for excess returns as for total returns. The higher post-1985 predictive power comes about from safe rates rather then risk premia. Confirming this, Appendix Table D.2 shows that market cap has no predictive power for real government bond returns before 1985 but substantial predictive power afterwards with magnitudes similar to equity return prediction. Remarkably, higher market capitalization does not predict higher future dividend growth, with coefficients in Table 2 columns 5 and 6 generally insignificant or negative.

Panel 2 of Table 2 shows that this predictive power tends to cumulate at longer horizons. A 10 percentage point higher market cap to GDP ratio forecasts 5 percentage points lower cumulative real total returns, and 6 percentage points lower excess returns 5 years ahead. As with the 1-year horizon regressions, predictability for real returns becomes stronger after 1985, and dividend growth is either not forecastable or has the wrong sign. Appendix Table D.1 shows that these predictive relationships

[3] A 10 percentage point increase is roughly 25% in relative terms, meaning a $0.25 \times 0.038 \times 1.048 \approx 0.01$ fall in real total return.

also hold for 10-year-ahead returns, using year fixed effects and when limiting the sample to the post-1985 period. Detrending the market cap to GDP ratio to focus on cyclical variation in expected returns and cashflows makes the predictive relationships stronger (panel 3 of the Appendix Table D.1). Our findings are consistent with existing literature on predicting equity returns and dividends, which generally find that time varying discount rates are the most important driver of changes in equity valuations (Cochrane, 2008). Similarly to the consumption-wealth ratio of Lettau and Ludvigson (2002), we find that a ratio of stock market wealth to GDP is a powerful predictor of stock returns, especially at long horizons, but unlike the ratio of total wealth to consumption, high market cap to GDP ratios do not forecast high future dividend growth. Further analysis in Section 6 shows that stock market cap is more responsive to discount rate changes and less responsive to cashflow changes than the valuation metric most commonly used in the literature, the price-dividend ratio.

Altogether, this suggests that changes in market capitalization are primarily driven by time varying discount rates rather than cashflows. Before 1985, this time variation seems to primarily come about through changes in the equity risk premium, since excess equity returns are predictable and safe returns are not, and after 1985, both changes in the risk premium and the safe discount rate matter. But discount rate variation can only be a driver of the big bang if discount rates actually fell after 1985.

5.2. Trends in discount rates and cashflows

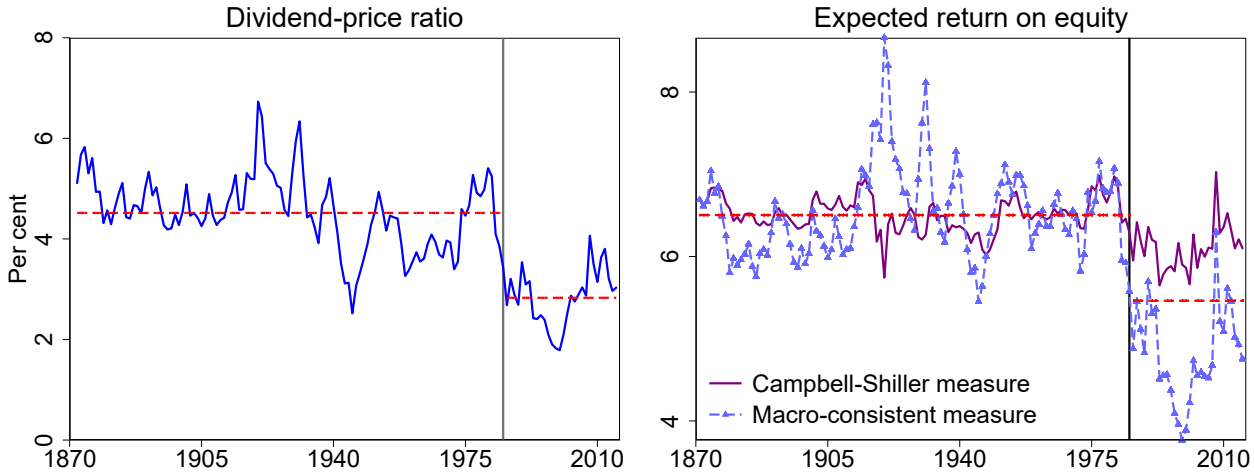
Based on the Gordon dividend discount model, we can express the equity discount rate as the sum of the dividend-price ratio and expected future dividend growth $\tilde{g}$:[4]

$$\mathbb{E}\left(R_{t+1}\right) \approx \mathbb{E}\left(D_{t+1}/P_t\right) + \mathbb{E}\left(\tilde{g}_{i,t+2}\right) \tag{9}$$

A simple proxy for the equity discount rate is the dividend yield D/P – the first component of equation (9). As long as cashflow growth changes little, a lower dividend yield will mean lower long-run returns on equity investments. The left-hand panel of Figure 8 shows the evolution of the cross-country average dividend yield in our sample over time. The vertical line represents the big bang, and dashed horizontal lines are pre and post big bang averages. Echoing the importance of time varying discount rates in the predictability regressions of Section 5.1, the dividend-price ratio underwent a sharp and persistent decline around the time of the big bang, falling from 5.5% in 1980 to 2% in 2000. After 2000, the burst of the dot-com bubble has meant that equity valuations declined somewhat and dividend-price ratios increased, but they remain substantially below their historical levels. These trends are apparent not only in dividend-price, but also in earnings-price

[4]This expression can be derived by linearising the dynamic dividend-discount equation $P_t = \mathbb{E}\left(\sum_{s=1}^{\infty}(1+g_{t+s})^s/(1+r_t)^s\right)$, see for example Blanchard (1993). $\tilde{g}_{i,t+2}$ is the annuity value of future dividend growth, which is a weighted average of expected future dividend growth rates calculated as $\tilde{g}_{t+2} = w_1\mathbb{E}g_{t+2} + w_2\mathbb{E}g_{t+3} + ... + w_\tau\mathbb{E}g_{t+\tau+1}$. Here $g_t = D_t/D_{t-1} - 1$ is the year-on-year cashflow growth, and the weights are $w_t = (1+g)^{\tau-1}(r-g)/(1+r)^\tau$, where g and r are the average dividend growth and return rates.

Figure 8: *Trends in equity discount rates*



Note: Unweighted averages of 17 countries. Cambell-Shiller expected returns are calculated as the sum of the predictability VAR forecasts for the dividend-price ratio and cashflow news. Macro-consistent expected returns are calculated as the sum of the VAR forecast of the dividend-price ratio and a forecast of long-run real GDP growth. Vertical black lines indicate the start of the big bang in 1985. Dashed horizontal lines show the average of the series before and after the big bang (in the right-hand panel, this applies to the average of the two expected return measures).

ratios shown for the US in Appendix Figure C.1, which suggests that the decline in dividend-price ratios in Figure 8 represents more than just a switch from dividend payments to share repurchases.[5]

The decline in dividend-price ratios could, however, simply be attributable to higher cashflow growth expectations. In this case, a higher $\tilde{g}$ in equation (9) would offset the decline in D/P such that expected returns hardly move. To see if this is the case, we estimate expected cashflow growth $\mathbb{E}(\tilde{g})$ and the expected return in equation (9). For details of this estimation, the reader is referred to Kuvshinov and Zimmermann (2020) which studies how expected returns and risk premia on housing and equity have evolved over the long run.

In brief, we use two alternative ways to estimate $\mathbb{E}(g)$ and $\mathbb{E}(R)$ in equation (9), with both of these estimates plotted in the right-hand panel of Figure 8. The first method relies on the Campbell and Shiller (1988) decomposition of the dividend-price ratio into cashflow and discount rate news. To implement this, we use the dividend-price ratio to forecast future returns and dividend growth rates using a flexible time-varying VAR specification. We find that the dividend-price ratio forecasts both future returns and cashflows with roughly equal strength, which suggests that roughly half of the decline in the dividend yield in the left-hand panel of Figure 8 is attributable to lower discount rates and the other half – to higher cashflow growth. The resulting expected return estimate is then a somewhat flatter version of the dividend-price ratio time trend, plotted as the solid purple line in the right-hand panel of Figure 8.

[5]Data in Megginson and Von Eije (2008) suggest that share repurchases are a less common form of shareholder compensation in European countries compared to the US, especially during the 1980s and 1990s.

But the Campbell-Shiller estimates of g have one particular shortcoming: they suggest that long-run dividend growth and corporate profitability have increased sharply after the 1980s, at the same time when trend productivity and real GDP growth have been slowing down (Fernald, 2015). As long as the share of capital income in GDP remains bounded in the future, persistent increases in long-run dividend growth rates should eventually be accompanied by higher growth in GDP and productivity. To impose this macroeconomic consistency directly, we produce a second estimate of expected returns which follows Farhi and Gourio (2018) and uses expected long-run GDP growth as a proxy for $\tilde{g}$ in equation (9). We forecast the annuity value of real GDP growth using today's GDP growth rate, term premium and the dividend-price ratio, and then calculate the expected returns as the sum of the dividend-price ratio and this forecast, which gives us the dashed blue line in the right-hand panel of Figure 8. This "macro" measure of expected returns shows a more pronounced decline than the Campbell-Shiller measure, of roughly 3 percentage points at peak and 2.5 percentage points in total. Sections 2 and 3 of Kuvshinov and Zimmermann (2020) provide further details behind these expected return calculations.

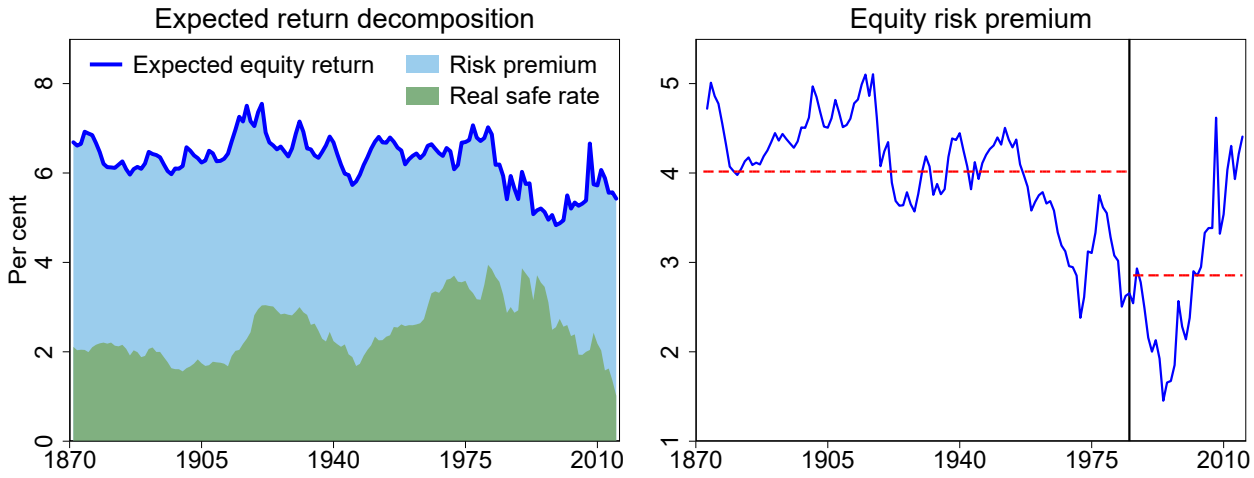
In the end, regardless of which estimate we use – be it the dividend-price ratio, the Campbell-Shiller measure or the macro-consistent measure – we find a substantial decline in expected equity returns during 1980s and 1990s and relative stability afterwards, exactly mirroring the trend in aggregate stock market cap in Figure 1. Combined with the predictability evidence of Section 5.1, this suggests both that the discount rate on equity has declined, and that this decline has manifested itself in higher stock market capitalization.

Finally, we decompose the decline in discount rates around the big bang into safe rates and equity risk premia. We find that even though the well-documented safe rate decline plays a role in the big bang, it tells far from the whole story. To do this, we first estimate the trend real safe rate for our sample using the methodology of Del Negro, Giannone, Giannoni, and Tambalotti (2019), and then calculate the risk premium as the difference between the expected return – the average of the Campbell-Shiller and macro measures in Figure 8 – and the safe rate.[6]

The left-hand panel of Figure 9 shows the decomposition of the trend in expected returns (solid blue line) into real safe rates (shaded green area) and risk premia (shaded light-blue area), while the right-hand panel plots the risk premium separately. During the first 80 years of our sample, the equity premium was relatively stable at around 4.5%. The risk premium started falling in the 1960s, but up until 1980 this decline was masked by an increase in the safe rate, which reached a historical high during the high inflation period of the 1970s. High safe rate levels persisted into the 1980s, meaning that all of the decline in the discount rate during the initial phase of the big bang – the 1980s and 1990 – was driven by a drop in the equity premium. Safe rates declined sharply from around 2000 onwards meaning that the equity discount rate remained stable and low by historical standards despite the recent increase in the equity premium shown in the right-hand panel of Figure

[6] Kuvshinov and Zimmermann (2020) provide more detail on this estimation. In brief, we estimate a Bayesian VAR with common and country-specific trends in short-term safe rates, long-term safe rates and inflation, and use the country-specific long-term real government bond rate trend as the safe rate estimate.

Figure 9: *Expected equity returns, safe rates and risk premia*



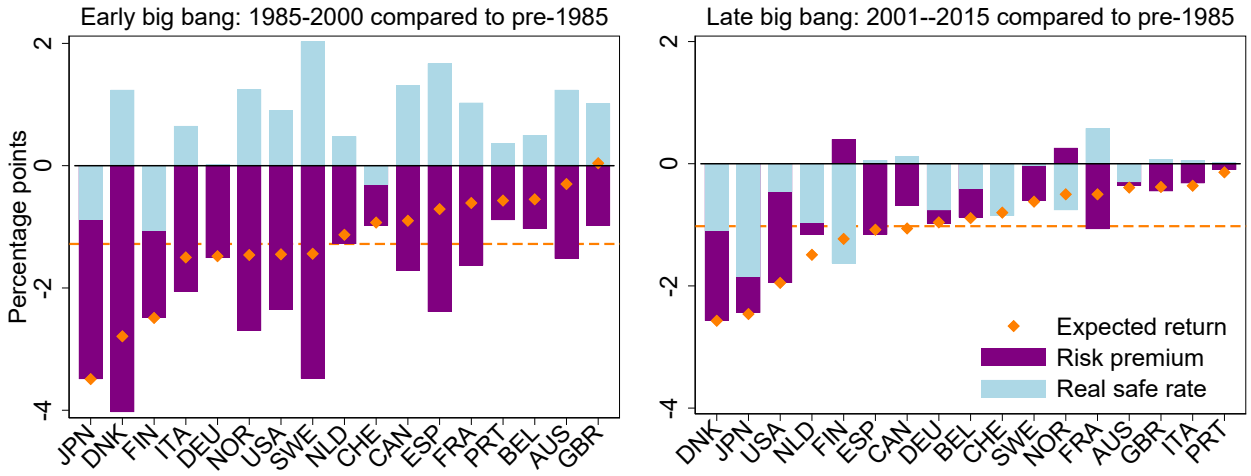
Notes: Unweighted averages of 17 countries. The expected return is the sum of the dividend-price ratio and the average of two cashflow growth expectations: the first implied by the Campbell-Shiller decomposition, and the second implied by the long-run GDP growth forecast (the average of the two measures in Figure 8). The risk premium is the difference between the expected return and ex ante safe rate. Ex ante real safe rate is the long-term rate estimated using a Bayesian VAR with slow-moving trends as in Del Negro et al. (2019). In the right-hand panel, the vertical line is the start of the big bang in 1985 and dashed horizontal lines are pre- and post-1985 averages of the series.

9. These cross-country trends in the safe rate and risk premium mirror those found in existing literature for the US. Blanchard (1993), Fama and French (2002) and Jagannathan, McGrattan, and Scherbina (2000) find that the US ex ante equity premium fell between 1970 and 2000, and Farhi and Gourio (2018) show that the equity premium increased during recent decades, all using methods similar to our paper. Option-based proxies of the equity premium covering the recent time period such as Martin (2016) also confirm the post-2000 increase seen in our data.

Figure 10 shows that these time series trends are also evident at the country level. The left-hand panel of Figure 10 compares the level of risk premia and safe rates in the early phase of the big bang – years 1985–2000 – to the pre-1985 period. While safe rates were high by historical standards, risk premiums were unusually low. The right-hand panel of Figure 10 compares safe rate and risk premium levels during the late stage of the big bang – years 2000–2015 – to historical averages. Unlike the early big bang period, safe rates in a number of countries are materially below the historical average, while the differences in risk premiums compared to historical averages are less pronounced than during the initial stage of the big bang. These results are consistent with the findings of the predictability regressions in Section 5.1: while lower risk premiums contribute to rising market cap throughout the entirety of our sample, lower safe rates only become important during the last few decades.

The regressions in Section 5.1 have shown that time variation in future dividend growth rates is not an important determinant of market cap. But unanticipated level shifts in dividend payments – the D/GDP in equation (6) – can still drive up equity wealth even if expected dividend growth

Figure 10: *Drivers of falling expected returns during early and late big bang*

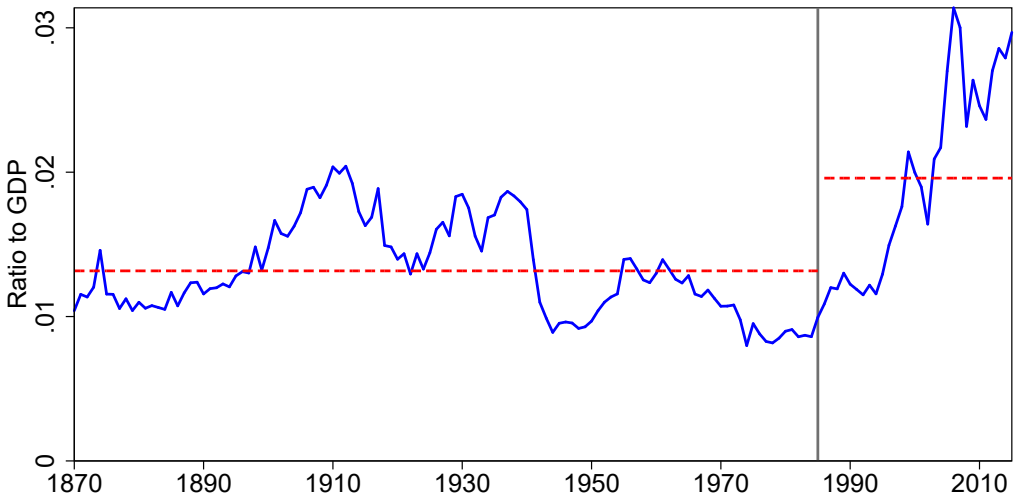


Notes: Left hand panel: the difference between the average level of expected return, risk premium and safe rate during 1985–2000, and 1870–1984, for each country. Right-hand panel shows the differences between average levels in 2001–2015 and 1870–1984.

rates remain unchanged. To see whether this is the case, Figure 11 plots the time evolution of total dividends paid by listed firms relative to GDP. The big bang coincided with a structural and persistent increase in dividend payouts, which more than doubled between 1985 and 2015. The fact that market cap is so much higher now than before 1985 means that even though dividend-price ratios have declined, dividends relative to GDP have on average, in fact, increased substantially. Appendix Figure C.1 shows that the United States are a notable exception to this pattern, with the dividend-GDP ratio registering only a small increase after 1980. The US trend could, however, be influenced by the increased use of stock buybacks as means of shareholder compensation in the United States (Grullon and Michaely, 2002). Indeed, Figure C.1 shows that the ratio of US listed company earnings to GDP – which looks through the substitution between buybacks and dividends – has been increasing over recent decades.

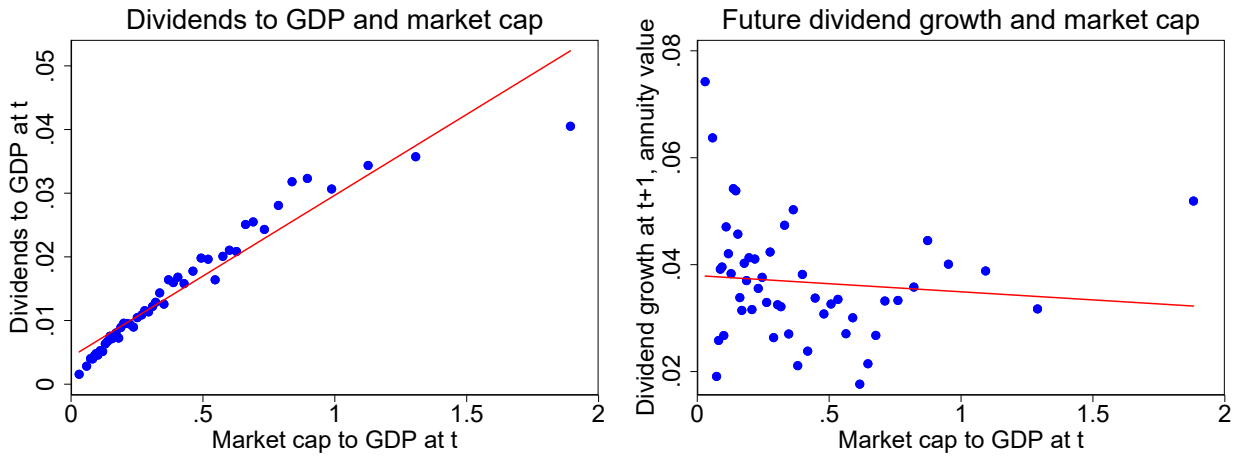
Figure 12 helps reconcile this increase in dividends relative to GDP with the lack of dividend growth predictability in Section 5.1. The left-hand panel shows the contemporaneous correlation between market cap to GDP and dividends to GDP at time t, and the right-hand panel shows the correlation between market cap and year-ahead dividend growth. Consistent with the findings of Section 5.1, market cap has no predictive power for future dividend growth. But it shows a strong positive correlation with the contemporaneous level of dividend payments. Market capitalization tends to be high when current dividend payments are high. These high dividends may, however, mean revert in the future, helping explain the sometimes negative correlation between market cap and future dividend growth rates (Tables 2 and D.1). In terms of equation (6), variation in the current level of D_t/GDP_t and the discount rate $\mathbb{E}(r_{t+1})$ is strongly related to market cap, but variation in future dividend growth $\mathbb{E}(g_{t+1})$ is not. This suggests that the big bang itself is driven by an unexpected increase in the level of dividend payments by listed firms, rather than any increase in

Figure 11: *Dividends paid by listed firms relative to GDP*



Note: Unweighted averages of 17 countries. Vertical 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. 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, $MCAP_t/GDP_t$.

Figure 12: *Correlation between market cap, dividends to GDP, and future dividend growth*



Notes: Binned scatter plots of pooled cross-country data (17 countries, 1870–2015), 50 bins.

expected long-run dividend or profit growth rates. This finding mirrors the evidence in Greenwald et al. (2019) who show that the increase in US equity wealth over the recent decades can be in large part attributable to good luck - a string of favourable individual shocks that reallocated rents to shareholders.

5.3. Can trends in discount rates and dividends explain the big bang?

Taken together, our explanation of the big bang boils down to just two factors: a lower discount rate on equities, and an upward level shift in dividend payments by listed firms that is not expected to mean revert. To determine the relative contribution of these two factors, we run the following back-of-the envelope counterfactual exercise. We use the simplified economy-wide Gordon model equation (6) to estimate the stock market cap to GDP ratio under different counterfactual scenarios and compare these to realized values. The market cap at any time t should roughly equal today's dividends relative to GDP discounted at the equity discount rate $\mathbb{E}(r_{t+1})$ minus expected cashflow growth $\mathbb{E}(g_{t+1})$. Since expected dividend growth is not an important determinant of changes in market cap to GDP, we fix its counterfactual value to the full-sample mean of 2.6% p.a. and focus on the other two factors.[7]

Table 3 shows the actual market cap to GDP ratio before and after big bang in the top row, the counterfactual market cap level under various scenarios in the bottom row, and the different inputs into the counterfactual in the middle rows. Starting with column 1, the average level of market cap before the big bang was around one-third of GDP. During this period, dividends were around 1.3% of GDP and expected equity returns were on average 6.5%. Plugging these into equation (6), this gives us an implied market cap to GDP ratio of $1.3/(6.5-2.6) = 0.35$, close to the ratio of 0.32 in the data.

The average market cap to GDP ratio during the big bang was 0.72, more than double the pre-big-bang ratio. During this time, dividends paid by listed firms increased from 1.3% to 2% of GDP. Holding the other two components of equation (6) fixed, this alone accounts for a $(2-1.3)/(6.5-2.6) = 0.16$ (16% of GDP) increase in the market cap to GDP ratio – around 40% of the total in the data (0.16/0.4). Discount rates have, on average, fallen by 1 percentage point, generating a $1.3/(5.5-2.6) - 1.3/(6.5-2.6) = 0.12$ increase in the market cap to GDP ratio – around 30% of the total. Together, these two forces amplify each other as higher dividends to GDP are discounted at a lower rate, generating an implied market cap to GDP ratio of $2/(5.5-2.6) = 0.69$ for the 1985–2015 period, and a total increase of 0.35 – roughly 85% of the increase observed in

[7] To calculate the full-sample mean, we first calculate the annuity value of real dividend growth $\tilde{g}_{t+2}$ in equation (9) as the discounted sum of all future dividend growth rates from $t+1$ onwards, setting the growth rate after 2015 to the sample mean. We then winsorize the data at the 1% level to reduce the influence of outliers, e.g. high growth rates from a very low base. The average of these winsorized annuity-value growth rates is 2.6%. Using non-winsorized or non-annuity based averages results in a higher g and hence makes us able to explain an even higher proportion of the big bang with the observed dividend-GDP and equity discount rate trends.

Table 3: *Contribution of discount rates and dividends to the big bang*

Variable	1870–1985 average	1985–2015 average	Predicted change in MCAP/GDP	Share of increase in the data
Actual MCAP/GDP	0.32	0.72		
Market cap determinants:				
D_t/GDP_t	1.3 %	2.0%	0.16	40%
$\mathbb{E}(r_{t+1})$	6.5%	5.5%	0.12	30%
Constant $\mathbb{E}(g_{t+1})$	2.6%	2.6%		
Implied MCAP/GDP	0.35	0.69	0.35	85%

Notes: Pooled averages, annual data for 17 countries. D/GDP are dividends paid by all listed firms relative to GDP. $\mathbb{E}(r)$ is the expected return on equities, average of the Campbell-Shiller and macro-consistent measures. g is annuity-value real dividend growth, winsorized at 1% level to reduce influence of outliers. Implied market cap is calculated as $\frac{D}{GDP} * \frac{1}{\mathbb{E}(r)-\mathbb{E}(g)}$. The predicted change is implied market cap during 1985–2015 minus the implied market cap during 1870–1985. Share of increase in the data is the predicted change divided by the actual change in market cap between these two time periods.

the data. This counterfactual exercise suggests that the changes in discount rates and dividend payments after 1985 suffice to explain almost the entirety of the big bang. The remaining 15% of the market cap increase could be attributable to several factors – for example, the decline in the discount rate could have been more than we have assumed, or cashflow growth expectations may have become more elevated.

What are the deeper underlying reasons for the decline in the discount rate and the increase in dividend payments? The discount rate fall is partly driven by a lower safe rate, attributed by existing literature to a range of factors from demographics and population ageing to a cheaper price for investment goods and a lower supply of safe assets (Summers and Rachel, 2019; Sajedi and Thwaites, 2016; Caballero and Farhi, 2014). But lower safe rates tell far from the whole story – as seen above, a secular fall in the risk premium played the key part especially during the earlier phase of the big bang, which oversaw the entirety of the increase in market cap. Kuvshinov and Zimmermann (2020) find that this risk premium decline took place not only for equities, but also in the real estate market. They document long-run declines in consumption volatility and the frequency of macro-financial disasters which help rationalise higher investor risk appetite and hence a lower price of risk, echoing the findings of Lettau, Ludvigson, and Wachter (2008) for the US. Increases in stock market participation – shown in the Appendix Figure C.2 for the US – are likely to have further increased risky asset demand and put downward pressure on the risk premium.

The increase in dividend payments by listed firms has two peculiar features. First, it is largely a level shift which is not accompanied by higher expected future dividend growth rates. Second, it occurred at the time of slowing productivity in the US and globally (Fernald, 2015). This suggests that these higher dividend payments reflect a redistribution of factor rewards within the economy rather than a higher overall growth rate, consistent with recent developments documented for the US. Greenwald et al. (2019) use a model to show that the rise in the capital share can explain the

majority of the recent increase in US stock market capitalization. Barkai (2019) shows that US listed firm profits have increased at the expense of both lower capital and labour shares. The profit redistribution towards listed companies may also reflect the increasing market power of these firms. De Loecker, Eeckhout, and Unger (2020), Philippon (2019), De Loecker and Eeckhout (2018) and Diez, Leigh, and Tambunlertchai (2018) show that market power has increased dramatically over recent decades, both in the US and other advanced economies. De Loecker et al. (2020) further show that market power of individual firms is highly correlated with their stock market capitalization. A reduction in corporate taxes may also have boosted both after tax earnings and equity values (McGrattan and Prescott, 2005).

Structural shifts in discount rates and cashflows are clearly an important part of the story behind the big bang. But above and beyond these structural movements, the fact that stock market cap predicts equity returns suggests that capitalization tracks the variation in the equity premium at cyclical frequency. Put differently, market capitalization may be a useful metric of where equity valuations stand, and could help investors detect impending market booms or crashes. We investigate whether this is the case in the next section.

6. The Buffet indicator

Warren Buffett famously called stock market capitalization the "the best single measure of where valuations stand at any given moment" (Buffett and Loomis, 2001). The evidence presented so far seems to confirm this view. When market capitalization is high, investors can expect low future equity returns and, if anything, low rather than high dividend growth. But how does market cap perform relative to other commonly used valuation metrics, and does it do as well at detecting large swings in the equity premium, for example occurring during stock market crashes?

6.1. Further return predictability evidence

The market cap to GDP ratio measures equity values relative to fundamentals and predicts equity returns, but not dividends (see Table 2 and Section 5.1). The most commonly used valuation measure is the price-dividend ratio, which has also been shown to be a reliable equity return predictor for the US (Cochrane, 2011) and globally (Engsted and Pedersen, 2010; Kuvshinov, 2019). Appendix Table D.3 confirms that high price-dividend ratios predict low future returns and high future dividend growth in our long-run data sample. The question is, then – does market capitalization contain additional information relative to the price-dividend ratio, and if so, why? To test for this, we run predictive regressions of the following form:

$$r_{j,t+1} = \alpha_j^r + \beta^{mcap} mcap_{j,t} + \beta^{pd} pd_{j,t} + u_{j,t}^r \tag{10}$$

$$dg_{j,t+1} = \alpha_j^{dg} + \zeta^{mcap} mcap_{j,t} + \zeta^{pd} pd_{j,t} + u_{j,t}^{dg} \tag{11}$$

Table 4: *Horse race between market cap and the price-dividend ratio*

	Real returns		Excess returns		Real dividend growth	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel 1: *One-year ahead returns and dividend growth*						
$log(MCAP_t/GDP_t)$	-0.038***	-0.028**	-0.046***	-0.041***	-0.009	-0.053***
	(0.011)	(0.013)	(0.013)	(0.015)	(0.017)	(0.018)
$log(P_t/D_t)$		-0.034		-0.019		0.159***
		(0.022)		(0.018)		(0.028)
R^2	0.017	0.022	0.022	0.023	0.001	0.078
Observations	2060	2060	2060	2060	2060	2060
Panel 2: *Five-year ahead average returns and dividend growth*						
$log(MCAP_t/GDP_t)$	-0.038***	-0.033***	-0.048***	-0.044***	-0.003	-0.031***
	(0.009)	(0.010)	(0.009)	(0.011)	(0.012)	(0.011)
$log(P_t/D_t)$		-0.018		-0.014		0.097***
		(0.018)		(0.014)		(0.016)
R^2	0.087	0.094	0.132	0.136	0.001	0.196
Observations	1953	1953	1953	1953	1953	1953

Note: Returns and dividend growth are measured in logs. Regressions with country fixed effects. Standard errors clustered by country and year and adjusted for autocorrelation are in parentheses. *, **, ***: Significant at 10%, 5% and 1% levels respectively.

As in the baseline specification in Section 5.1 equations (7) and (8), we regress log real returns r and real dividend growth dg on $mcap$, the log market cap to GDP ratio, but this time we also condition on the log price-dividend ratio pd. As before, we run the regression using country fixed effects and Driscoll and Kraay (1998) two-way clustered autocorrelation-adjusted standard errors. The results are shown in Table 4.

Columns 1, 3 and 5 of Table 4 reproduce the baseline predictive regressions from Table 2. Columns 2, 4 and 6 show the predictive power of market cap for real total returns, excess returns and real dividend growth conditional on the price-dividend ratio. Several results stand out. First, market cap continues to predict returns when the price-dividend ratio is added to the regression. The coefficients on market cap in columns 2 and 4 are similar to baseline. Second, market cap tends to outperform the price-dividend ratio as a return predictor. For one-year-ahead real returns (panel 1 column 2), the coefficients on both variables are similar but the price-dividend ratio coefficient is insignificant. For excess returns and five-year ahead returns, the coefficient on the price-dividend ratio is not only insignificant but also close to zero, while the coefficient on market cap is similar to the standalone specifications in columns 1 and 3. Moreover, the R^2 of the predictive regressions including both the price-dividend ratio and market cap is similar to that of the regressions including market cap alone.

Third, while the price-dividend ratio forecasts dividend growth in the right direction, the market

cap to GDP ratio forecasts it in the wrong direction. Column 6 shows that a one-quarter higher price-dividend ratio predicts roughly 4 percentage points higher real dividend growth 1 year ahead, and 12 percentage points higher cumulative real dividend growth five years ahead. A one-quarter higher market cap to GDP ratio, on the contrary, predicts 1 percentage points lower real dividend growth 1 year ahead and 3 percentage points lower cumulative real dividend growth 5 years ahead.[8]

Appendix Table D.4 shows that the high predictive power of market capitalization holds under a wide variety of alternative regression specifications. Market cap outperforms price-dividend ratios even more when considering ten-year ahead returns (Table D.4 panel 1), detrended market cap (panel 3) or restricting the sample to the post-1985 period (panel 4). Adding year fixed effects to the regression (Table D.4 panel 2) somewhat strengthens the predictive power of the price-dividend ratio and weakens that of market cap. This suggests that some of the predictive power of market capitalization comes about from capturing common cross-country movements in the equity premium.

The evidence presented so far seems to confirm the Buffet view on stock market capitalization. But why does market cap perform so well as an equity return predictor? There are two potential reasons for this. Compared to the price-dividend ratio, the capitalization metric uses both a different numerator – cap rather than prices – and denominator – GDP rather than dividends. As both ratios seek to measure values relative to fundamentals, the question then becomes: does capitalization offer a better metric of valuations than prices alone, and does GDP offer a better metric of fundamentals than dividends? Existing literature provides supportive evidence for both of these views. Dividends are often criticised for not incorporating all future cashflows to the shareholder and for being excessively smooth relative to firm profitability (Chen, Da, and Priestley, 2012). GDP may, therefore, provide an independent fundamentals metric that cannot be manipulated by firms and better measures movements in underlying profitability. Consistent with this, the stock price to GDP ratio and the output gap have been shown to be reliable predictors of equity returns in the United States (Rangvid, 2006; Cooper and Priestley, 2008).

Capitalization – unlike prices – contains information on the quantity of issued equity. Baker and Wurgler (2000) show that equity issuance predicts equity returns, and argue that issuance acts as a proxy for investor sentiment because firms time the market to issue equity during times when stock prices are relatively high. Greenwood and Hanson (2013) argue that times of elevated sentiment also open the market up to poorer quality issuers, which may help explain why, conditional on prices, high market capitalization forecasts low rather than high dividend growth.

To test these propositions in the data, we check whether stock prices relative to GDP and issuance relative to GDP help predict returns either alone or conditional on the price-dividend ratio. To construct the price to GDP ratio, we follow Rangvid (2006) and divide the nominal stock market

[8] A one-quarter increase in pd is equivalent to going from a sample average price-dividend ratio of 25 to 33, forecasting $0.25 \times 0.159 \times 1.003 \approx 0.04$ or 4 percentage points higher year-ahead real dividend growth. A one-quarter increase in market cap to GDP is 10 percentage points, forecasting $0.25 \times 0.053 \times 1.003 \approx 0.013$ lower year-ahead real dividend growth.

Table 5: *The price-GDP ratio 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*						
$log(P_t/GDP_t)$	-0.055***	-0.048***	-0.040***	-0.035***	-0.029**	-0.059***
	(0.005)	(0.006)	(0.008)	(0.008)	(0.012)	(0.010)
$log(P_t/D_t)$		-0.033**		-0.026**		0.144***
		(0.014)		(0.012)		(0.032)
R^2	0.033	0.038	0.015	0.018	0.006	0.076
Observations	2189	2189	2189	2189	2189	2189
Panel 2: *Five-year ahead average returns and dividend growth*						
$log(P_t/GDP_t)$	-0.057***	-0.052***	-0.040***	-0.035***	-0.023***	-0.042***
	(0.004)	(0.004)	(0.007)	(0.008)	(0.007)	(0.006)
$log(P_t/D_t)$		-0.021*		-0.024***		0.091***
		(0.010)		(0.008)		(0.015)
R^2	0.168	0.178	0.085	0.099	0.025	0.210
Observations	2081	2081	2081	2081	2081	2081

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

index by nominal GDP. We additionally subtract a linear trend to account for the fact that stock prices tend to grow at a slower pace than GDP for the majority of our sample.[9]

Table 5 checks whether the price to GDP ratio helps predict future equity returns, standalone (columns 1, 3 and 5) or conditional on the price-dividend ratio (columns 2, 4 and 6). It turns out that the price to GDP ratio is a powerful equity return predictor. The standard deviation of the detrended log price-GDP ratio is 0.65, which means that a 1 standard deviation increase in P/GDP predicts 3.7 percentage point lower real equity returns one year ahead and 19.4 percentage points lower cumulative real equity returns 5 years ahead.[10] The price-GDP ratio remains a powerful predictor when considering excess returns and when controlling for the price-dividend ratio. Like stock market cap, the price-GDP ratio does not predict dividend growth in the right direction (columns 5 and 6). Interestingly, the price-dividend ratio remains significant in all regressions, suggesting that rather than making this traditional predictor redundant, prices relative to GDP offer additional information on the equity discount rate.

[9]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.

[10]Using the specification in column 1, we get a $0.65 \times 0.055 \times 1.048 \approx 0.037$ lower predicted return 1 year ahead and $0.65 \times 0.057 \times 1.048 \times 5 \approx 0.194$ lower cumulative predicted return 5 years ahead.

Table 6: *Net equity issuance 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*						
Implied issuance / GDP	-0.670**	-0.597*	-0.580**	-0.503	-0.034	-0.196
	(0.277)	(0.314)	(0.283)	(0.325)	(0.355)	(0.318)
$log(P_t/D_t)$		-0.051***		-0.054***		0.115***
		(0.019)		(0.017)		(0.022)
R^2	0.007	0.021	0.005	0.018	0.000	0.048
Observations	1974	1974	1974	1974	1974	1974
Panel 2: *Five-year ahead average returns and dividend growth*						
Implied issuance / GDP	-0.321**	-0.276*	-0.471***	-0.414**	-0.080	-0.169
	(0.139)	(0.154)	(0.173)	(0.199)	(0.213)	(0.168)
$log(P_t/D_t)$		-0.036**		-0.045***		0.071***
		(0.014)		(0.009)		(0.011)
R^2	0.009	0.044	0.018	0.070	0.001	0.130
Observations	1872	1872	1872	1872	1872	1872

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. Regressions with country fixed effects. Standard errors clustered by country and year and adjusted for autocorrelation are in parentheses. *, **, ***: Significant at 10%, 5% and 1% levels respectively.

Turning to net equity issuance, we use the implied issuance estimates from Section 4 scaled by GDP as the main proxy. Because these are calculated as a residual from market cap and capital gains movements, these estimates can be rather noisy at an annual frequency and we smooth the data over 3 years to reduce measurement error. As with the price-GDP ratio, net issuance predicts both total and excess equity returns, but contains no information on dividend growth. A net issuance increase of 1% GDP predicts 0.7 percentage points lower equity returns one year ahead and 2 percentage point lower cumulative real equity returns 5 years ahead.[11] Net issuance continues to predict future returns even when the price-dividend ratio is added to the regression, but as with the price-GDP ratio, the price-dividend ratio remains significant in all specifications suggesting that information on quantities supplements rather than supplants information on prices.

Appendix Table D.5 shows that these results are robust to alternative definitions of the price-GDP ratio and net issuance. Panel 1 of Table D.5 uses an alternative detrending procedure for the price-GDP ratio which allows for separate linear trends before and after 1985. This alternative detrending further strengthens the predictive power of the price-GDP ratio. Panel 2 of Table D.5 uses actual issuance data instead of implied issuance. Even though the sample is substantially smaller, high actual equity issuance predicts low future equity returns, with the magnitude of the effect

[11] A 1% of GDP higher net equity issuance predicts a $0.01 \times 0.67 \times 1.048 \approx 0.007$ or 0.7 percentage points lower real equity return 1 year ahead.

larger than that for implied issuance. This suggests that the coefficients in Table 6 may understate the predictive power of equity issuance because of measurement error.

Taken together, the market cap to GDP ratio is a reliable and robust predictor of future equity returns, generally outperforming the more commonly used price-dividend ratio. The reason it does so well is that market cap includes information on equity quantities and uses GDP rather than dividends as a proxy for market fundamentals. Moreover, market cap to GDP is in some sense a "pure" risk premium measure because it does not predict dividend growth in the right direction. These results confirm Warren Buffet's intuition that market capitalization is a good proxy for whether the stock market is over- or under-valued. But from the perspective of a risk-averse investor, this over- or under-valuation may be particularly relevant when it comes to large swings in equity prices. We next investigate the role of market capitalization in helping detect stock market bubbles and crashes.

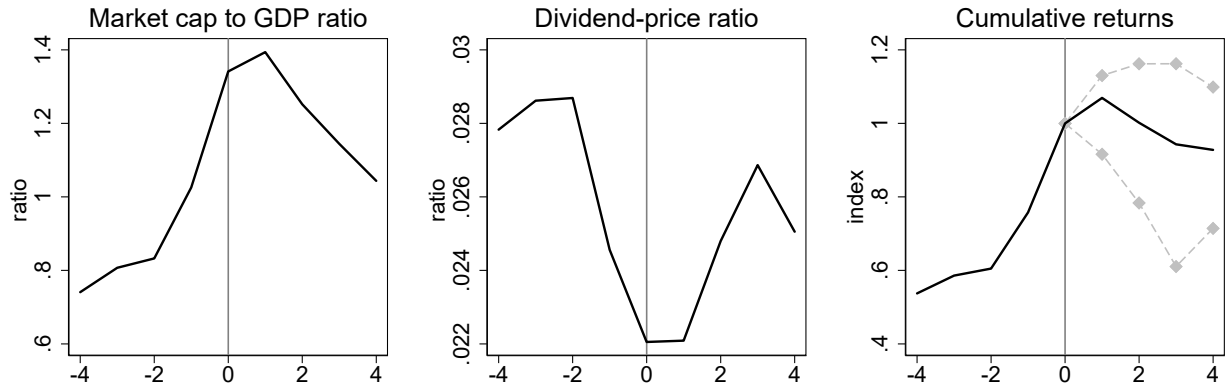
6.2. Market capitalization, equity bubbles and crashes

Can changes in market capitalization inform us about potential stock market bubbles and heightened crash risk? We approach this question by examining the equity market during and after sharp increases in stock market cap. To define what constitutes a "sharp" increase, we follow existing literature and use the Greenwood, Shleifer, and You (2019) definition of sector-specific equity market bubbles. Greenwood et al. (2019) define equity market run-ups as sharp increases in real equity returns over two years that follow a period of persistently high returns. 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 requirement allows us to focus on run-ups and exclude recoveries from temporarily low market cap levels. Figure 13a shows the average levels of stock capitalization and the dividend-price ratio, and the cumulative real stock return around the run-up in market cap. The stock return is indexed to equal 1 at the end of the run-up.

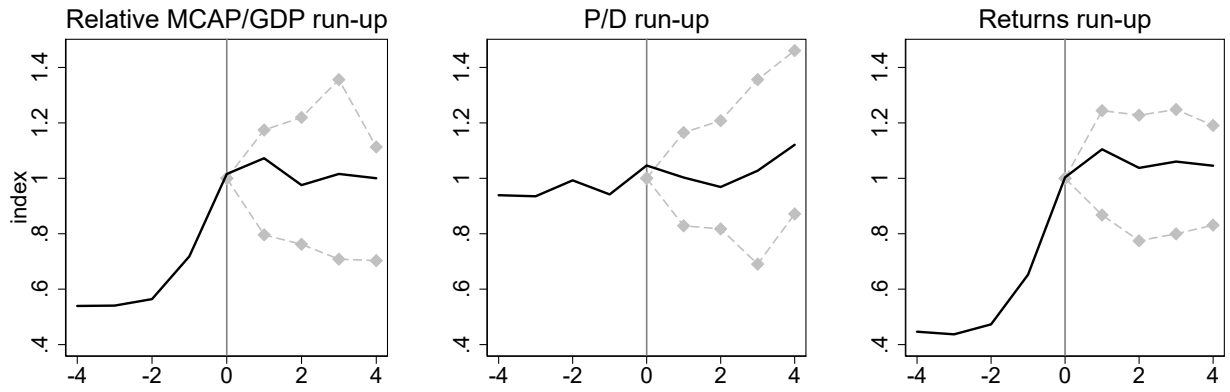
The typical market cap increase during the run-up is around 60% of GDP (Figure 13a left-hand panel). The middle panel of Figure 13a shows that a run-up in market cap is accompanied by increases in more conventional measures of stock valuations: the dividend-price ratio, on average, falls by almost a percentage point (one-quarter of its long-run mean) during these episodes. Stock returns (right-hand panel) are also high – around 20% per year in real terms during the last two years of the run-up. These sharp increases in returns and valuations are, however, typically followed by a sharp correction. In the four years after the run-up, stock market cap falls on average by 40% of GDP, dividend-price ratios increase, and real returns are negative. The average geometric equity return in the sample is around 4.5% p.a., so a 10% cumulative fall in the four-year return after the run-up 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 downside risk. The grey lines in Figure 13a show the 75th and 25th percentile of cumulative equity returns after the

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 $t = 0$.

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 cumulative 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

Table 7: *Predicting equity market crashes*

	(1)	(2)	(3)	(4)
$log(MCAP_{t-1}/GDP_{t-1})$	0.46^{***}		0.73^{***}	0.51^{***}
	(0.15)		(0.14)	(0.15)
$\Delta_3\ log(MCAP_{t-1}/GDP_{t-1})$		1.10^{***}	0.78^{**}	0.60^{*}
		(0.33)	(0.31)	(0.36)
$log(P_{t-1}/D_{t-1})$				0.79^{***}
				(0.16)
Country fixed effects			✓	✓
ROC	0.62	0.64	0.71	0.71
Number of Crashes	124	122	122	122
Observations	1964	1887	1887	1874

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.

years). Real returns show little change around the run-up, echoing the predictability findings of Section 6.1 – that in general, market cap seems to be a better proxy of equity valuations than the price-dividend ratio. Finally, the right-hand panel of Figure 13b focuses on run-ups in real returns, with the definition from Greenwood et al. (2019) – 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 the post run-up decline in returns and the downside risk in the tail of the return distribution are both smaller.

We next formally test whether a high level 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%. 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 $t+1$. To assess the link between market capitalization and equity crash risk, we estimate the following logit model:

$$Prob(C_{j,t} = 1) = \Lambda\left(mcap_{j,t-1}, X_{j,t-1}, \beta\right), \tag{12}$$

where C is the market crash dummy, $mcap$ is the log market cap to GDP ratio, X are other predictors, β is the estimated parameter vector, Λ is the logistic distribution function, and j and t are country and time indices.

Table 7 reports the estimated β coefficients and standard errors for the market crash prediction. 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 price-dividend ratio (column 4). The ROC statistic in Table 7 compares our predictive model to a random sorting of observations into

crash and non-crash episodes.[12] Appendix Table D.6 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.

High levels of stock market capitalization are generally bad news for equity investors: they signal low future returns, low dividend growth and a higher probability of a market crash. While this section has focussed on cyclical variation, these risks are also borne out in the structural trends shown in Figure 1. The upward shift in market capitalization during the big bang has coincided with several pronounced boom-bust episodes including the dot-com boom and the global financial crisis of 2007–09. Together with the empirical evidence presented in this section, this suggests that even though stock valuations and equity wealth are near all-time historical peaks, the level of risk in the stock market is actually also high by historical standards.

7. Conclusion

This paper has presented a new dataset of stock market capitalization in 17 advanced economies covering years 1870 to 2016. A deeper exploration of the data has revealed several surprising facts. First, the historical evolution of stock market cap resembles a hockey stick: the cross-country market cap to GDP ratio was roughly flat for 100 years up until the 1980s, at which point it expanded sharply, and remains high today. Second, this stock market expansion is not driven by deep fundamental forces relating to firm market entry or broader growth in productivity. Rather, it is a result of two structural shifts occurring during the 1980s and 1990s: a persistent decline in the discount rate on equities, and an upward shift in dividends paid by listed firms relative to GDP. The underlying causes of these two trends likely have little to do with the development of the stock market itself. Rather, they are connected to a range of broader macroeconomic phenomena including an increased desire for saving, lower macroeconomic volatility and a redistribution of factor returns away from labour and unlisted firms towards large listed companies. That being said, stock market capitalization is still a valuable barometer of the state of the equity market. But rather than signalling high growth and benign market prospects, high levels of capitalization are a sign of brewing trouble, predicting low returns, low dividends, and a high probability of a market crash.

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

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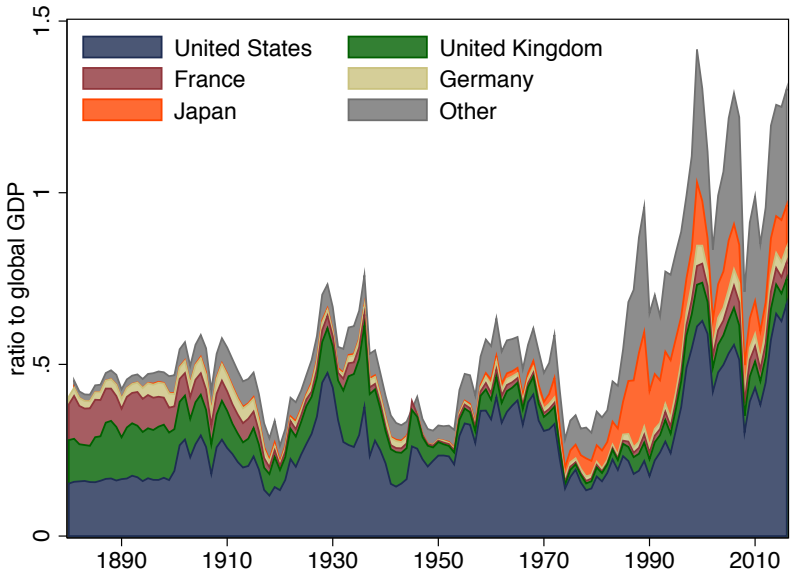
Online Appendix

The Big Bang: Stock Market Capitalization in the Long Run

A. Trends in market capitalization

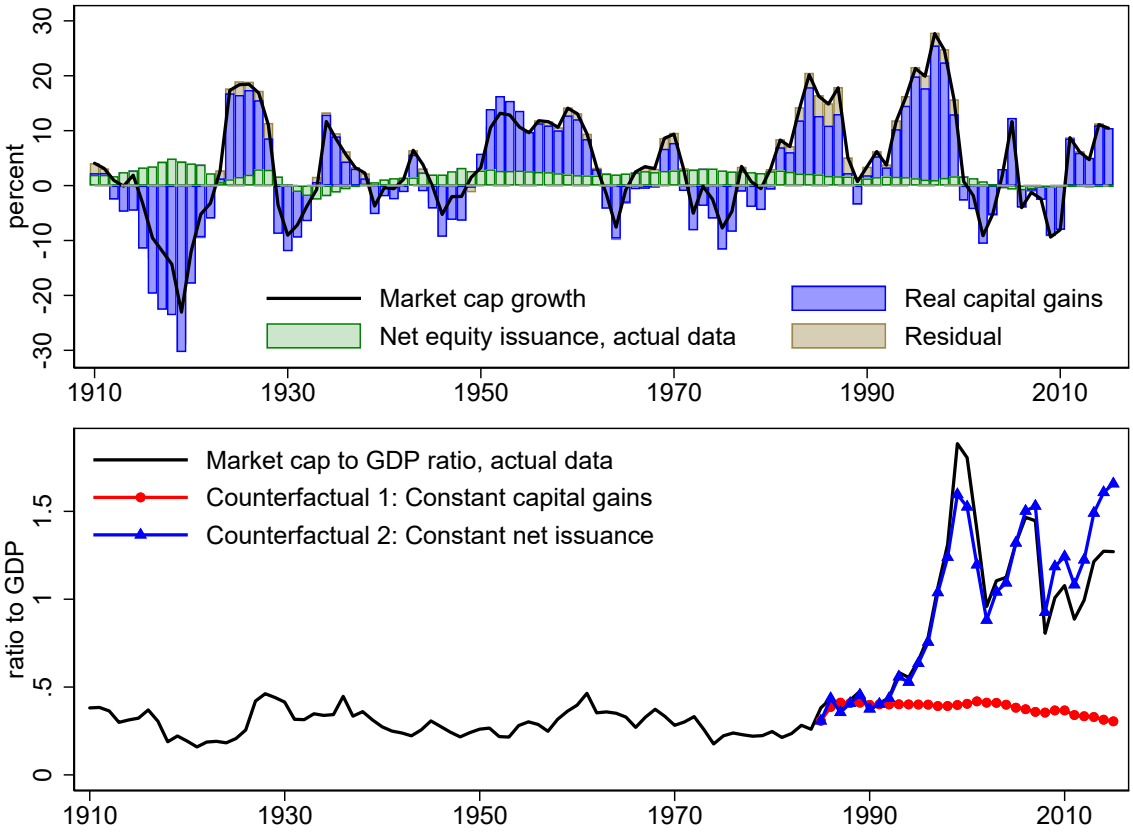
Figure A.1: *World market capitalization*



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.

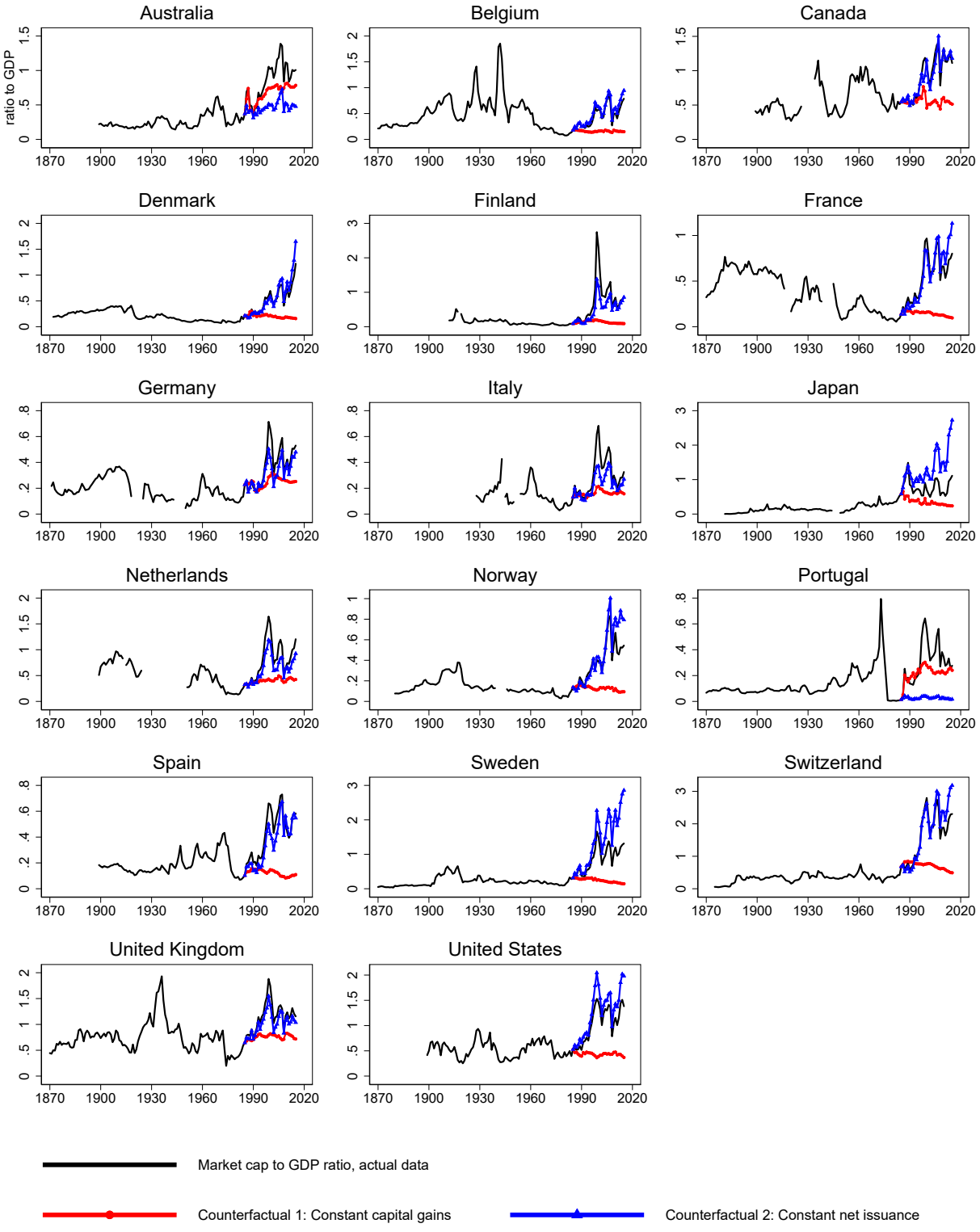
B. Decomposing the Big Bang: additional material

Figure B.1: *Decomposition trends and counterfactual: actual net issuance data*



Notes: Unweighted averages of 4 countries: Finland, Germany, Switzerland and USA. Top panel: decomposition of real market cap growth into capital gains, net issuance and a residual; using actual net issuance and capital gains data. Centered 5-year moving averages. 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. Data are benchmarked so that the combined growth of the two counterfactuals between 1985 and 2015 equals the actual growth in observed market cap data.

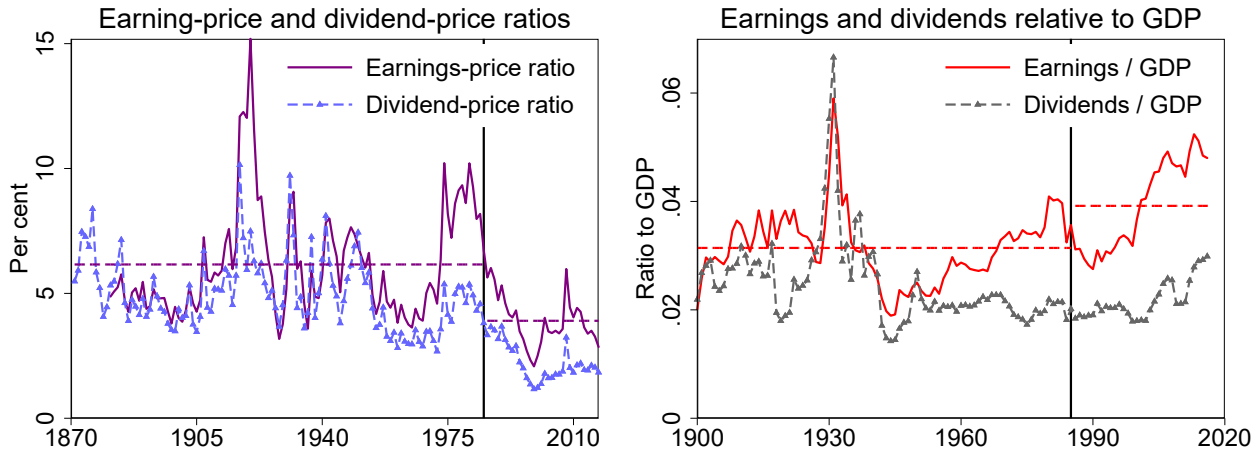
Figure B.2: *Counterfactual evolution of market cap in individual countries*



Notes: 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 for the specific country. Constant net issuance counterfactual forces net issuance relative to market cap during 1985–2015 to equal the pre-1985 average. Data are benchmarked so that the combined growth of the two counterfactuals between 1985 and 2015 equals the actual growth in observed market cap data.

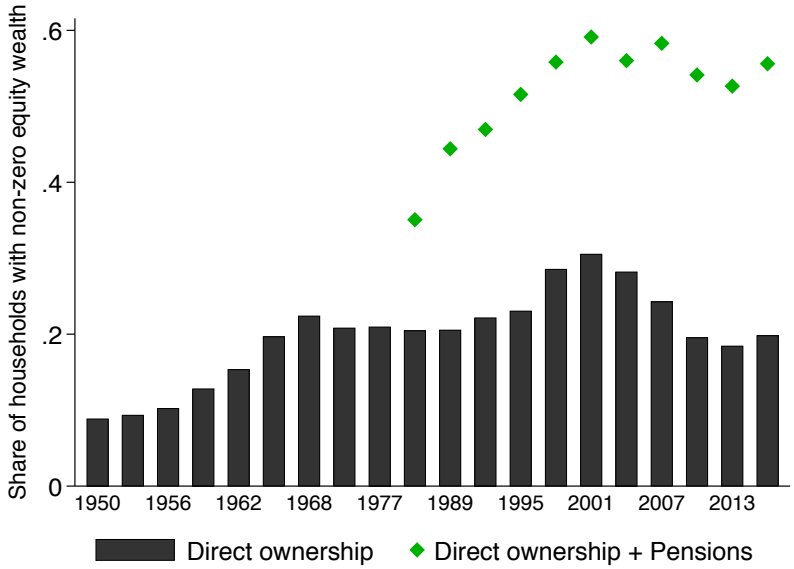
C. Trends in discount rates and cashflows: additional material

Figure C.1: *Earnings and dividends of listed firms in the US*



Note: Left-hand panel: dividend-price ratio and the cyclically adjusted total return earnings-price ratio (inverse of P/E10 CAPE) from Shiller (2015), December values. Right-hand panel: earnings to GDP calculated as market cap to GDP times the earnings-price ratio. Black vertical line in 1985 signifies the big bang. Dashed horizontal lines show the averages of the earning-price ratio series (left-hand panel) and earnings-GDP series (right-hand panel) before and after the big bang.

Figure C.2: *Positive wealth in direct and indirect stock ownership in the US*



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.

D. Predictive regressions: additional material

Table D.1: *Predicting equity returns and dividends with market cap: additional results*

	Real returns		Excess returns		Real dividend growth	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel 1: *Ten-year ahead returns and dividend growth*						
$log(MCAP_t/GDP_t)$	-0.030***	-0.033***	-0.033***	-0.033***	-0.001	-0.003
	(0.007)	(0.006)	(0.006)	(0.006)	(0.012)	(0.011)
$log(MCAP_t/GDP_t) * Post1985$		-0.038***		0.003		-0.042***
		(0.007)		(0.007)		(0.009)
R^2	0.127	0.206	0.158	0.158	0.000	0.086
Observations	1823	1823	1823	1823	1823	1823
Panel 2: *Year fixed effects*						
$log(MCAP_t/GDP_t)$	-0.039***	-0.036***	-0.024**	-0.023**	-0.031*	-0.033*
	(0.011)	(0.012)	(0.011)	(0.011)	(0.017)	(0.017)
$log(MCAP_t/GDP_t) * Post1985$		-0.024		-0.011		0.027
		(0.018)		(0.023)		(0.025)
R^2	0.489	0.490	0.479	0.480	0.173	0.173
Observations	2060	2060	2060	2060	2060	2060
Panel 3: *Detrended market cap*						
$log(MCAP_t/GDP_t)$	-0.095***	-0.074***	-0.063***	-0.041**	-0.064***	-0.071***
	(0.023)	(0.020)	(0.023)	(0.016)	(0.022)	(0.022)
$log(MCAP_t/GDP_t) * Post1985$		-0.148***		-0.154**		0.051
		(0.052)		(0.065)		(0.045)
R^2	0.045	0.059	0.017	0.030	0.014	0.015
Observations	2060	2060	2060	2060	2060	2060
Panel 4: *Post-1985 sample*						
$log(MCAP_t/GDP_t)$	-0.140***		-0.125**		0.000	
	(0.044)		(0.049)		(0.045)	
R^2	0.085		0.047		0.000	
Observations	504		504		504	

Note: Returns and dividend growth are measured in logs. In panel 3, market cap is detrended using separate linear trends for the 1870–1985 and 1985–2015 periods. Regressions with country fixed effects. Standard errors clustered by country and year and adjusted for autocorrelation are in parentheses. *, **, ***: Significant at 10%, 5% and 1% levels respectively.

Table D.2: *Predictability of real government bond returns*

	1-year returns		5-year returns		10-year returns	
	(1)	(2)	(3)	(4)	(5)	(6)
$log(MCAP_t/GDP_t)$	-0.002	-0.005	-0.000	-0.002	-0.006	-0.009
	(0.010)	(0.011)	(0.009)	(0.009)	(0.010)	(0.010)
$log(MCAP_t/GDP_t) * Post1985$		-0.060***		-0.048***		-0.047***
		(0.012)		(0.010)		(0.008)
R^2	0.000	0.029	0.000	0.055	0.003	0.087
Observations	2060	2060	1953	1953	1823	1823

Note: 1-year ahead, 5-year ahead average and 10-year ahead average log total real return on long-maturity governent bonds. Regressions with country fixed effects. Standard errors clustered by country and year and adjusted for serial autocorrelation are in parentheses. *, **, ***: Significant at 10%, 5% and 1% levels respectively.

Table D.3: *Price-dividend ratio as a predictor of stock returns and dividends*

	1-year ahead returns and growth			5-year ahead average returns and growth		
	(1) r_{t+1}	(2) er_{t+1}	(3) dg_{t+1}	(4) $r_{t+1,t+5}$	(5) $er_{t+1,t+5}$	(6) $dg_{t+1,t+5}$
$log(P_t/D_t)$	-0.053***	-0.040**	0.119***	-0.042***	-0.038***	0.075***
	(0.017)	(0.018)	(0.022)	(0.014)	(0.010)	(0.011)
R^2	0.015	0.008	0.052	0.048	0.040	0.135
Observations	2195	2195	2195	2087	2087	2087

Note: Returns and dividend growth are measured in logs. r is total real return, er is excess return over government bonds and dg is real dividend growth. Regressions with country fixed effects. Standard errors clustered by country and year and adjusted for autocorrelation are in parentheses. *, **, ***: Significant at 10%, 5% and 1% levels respectively.

Table D.4: *Horse race against the price-dividend ratio: additional results*

	Real returns		Excess returns		Real dividend growth	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel 1: *Ten-year ahead returns and dividend growth*						
$log(MCAP_t/GDP_t)$	-0.030***	-0.030***	-0.033***	-0.032***	-0.001	-0.022***
	(0.007)	(0.007)	(0.006)	(0.008)	(0.012)	(0.007)
$log(P_t/D_t)$		-0.002		-0.005		0.072***
		(0.009)		(0.010)		(0.009)
R^2	0.127	0.127	0.158	0.159	0.000	0.272
Observations	1823	1823	1823	1823	1823	1823
Panel 2: *Year fixed effects*						
$log(MCAP_t/GDP_t)$	-0.039***	-0.029**	-0.024**	-0.019	-0.031*	-0.062***
	(0.011)	(0.012)	(0.011)	(0.012)	(0.017)	(0.019)
$log(P_t/D_t)$		-0.052***		-0.030**		0.177***
		(0.012)		(0.015)		(0.032)
R^2	0.489	0.498	0.479	0.482	0.173	0.239
Observations	2060	2060	2060	2060	2060	2060
Panel 3: *Detrended market cap and P/D*						
$log(MCAP_t/GDP_t)$	-0.095***	-0.079***	-0.063***	-0.054**	-0.064***	-0.122***
	(0.023)	(0.025)	(0.023)	(0.023)	(0.022)	(0.025)
$log(P_t/D_t)$		-0.073***		-0.038		0.259***
		(0.021)		(0.028)		(0.041)
R^2	0.045	0.059	0.017	0.020	0.014	0.129
Observations	2060	2060	2060	2060	2060	2060
Panel 4: *Post-1985 sample:*						
$log(MCAP_t/GDP_t)$	-0.140***	-0.133***	-0.125**	-0.118**	0.000	-0.030
	(0.044)	(0.044)	(0.049)	(0.049)	(0.045)	(0.040)
$log(P_t/D_t)$		-0.058**		-0.056*		0.261***
		(0.025)		(0.031)		(0.035)
R^2	0.085	0.093	0.047	0.052	0.000	0.111
Observations	504	504	504	504	504	504

Note: Returns and dividend growth are measured in logs. In panel 3, market cap and the price-dividend ratio are detrended using separate linear trends for the 1870–1985 and 1985–2015 periods. Regressions with country fixed effects. Standard errors clustered by country and year and adjusted for autocorrelation are in parentheses. *, **, ***: Significant at 10%, 5% and 1% levels respectively.

Table D.5: *Predictability using the Price-GDP ratio and net issuance: additional specifications*

	Real returns		Excess returns		Real dividend growth	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel 1: *Alternative trend for the Price / GDP ratio*						
$log(P_t/GDP_t)$	-0.094***	-0.087***	-0.052***	-0.045***	-0.061***	-0.098***
	(0.010)	(0.012)	(0.012)	(0.012)	(0.014)	(0.013)
$log(P_t/D_t)$		-0.028*		-0.028**		0.147***
		(0.014)		(0.012)		(0.035)
R^2	0.053	0.057	0.014	0.017	0.015	0.090
Observations	2189	2189	2189	2189	2189	2189
Panel 2: *Actual equity issuance*						
Actual issuance / GDP	-1.870**	-1.771**	-1.812*	-1.718	-0.760**	-1.415**
	(0.892)	(0.886)	(1.066)	(1.095)	(0.317)	(0.585)
$log(P_t/D_t)$		-0.030		-0.028		0.195***
		(0.037)		(0.037)		(0.036)
R^2	0.014	0.018	0.012	0.015	0.002	0.113
Observations	401	401	401	401	401	401

Note: Returns and dividend growth are measured in logs. P/GDP is the detrended log of a cumulative stock price index divided by nominal GDP. The alternative trend estimates separate linear trends for periods 1870–1985 and 1985–2015. Actual issuance data sample covers Finland, Germany, Switzerland and the US. Regressions with country fixed effects. Standard errors clustered by country and year and adjusted for autocorrelation are in parentheses. *, **, ***: Significant at 10%, 5% and 1% levels respectively.

Table D.6: *Predicting equity market crashes: alternative specifications*

	(1) Pre 1945	(2) Post 1945	(3) Post 1985	(4) War Obs.	(5) Credit Growth
$log(MCAP_{t-1}/GDP_{t-1})$	3.25***	0.65***	1.58***	0.71***	0.77***
	(0.94)	(0.14)	(0.35)	(0.12)	(0.11)
$\Delta_3\ log(MCAP_{t-1}/GDP_{t-1})$	1.39**	0.59**	1.29***	0.72***	0.71***
	(0.59)	(0.27)	(0.35)	(0.26)	(0.25)
Country fixed effects	✓	✓	✓	✓	✓
ROC	0.80	0.70	0.79	0.70	0.75
Number of Crashes	25	97	52	143	117
Observations	596	1178	544	2078	1919
	(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***	0.72***	0.89***	0.51***
	(0.22)	(0.22)	(0.13)	(0.11)	(0.10)
$\Delta_3\ log(MCAP_{t-1}/GDP_{t-1})$	0.96***	1.26**	-0.05	1.21***	0.96***
	(0.31)	(0.56)	(0.18)	(0.39)	(0.26)
Country fixed effects	✓	✓	✓	✓	✓
ROC	0.79	0.79	0.69	0.75	0.69
Number of Crashes	122	28	92	104	150
Observations	2037	1668	1887	1887	1887

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 E.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 E.1: *Australia: alternative stock market cap estimates*

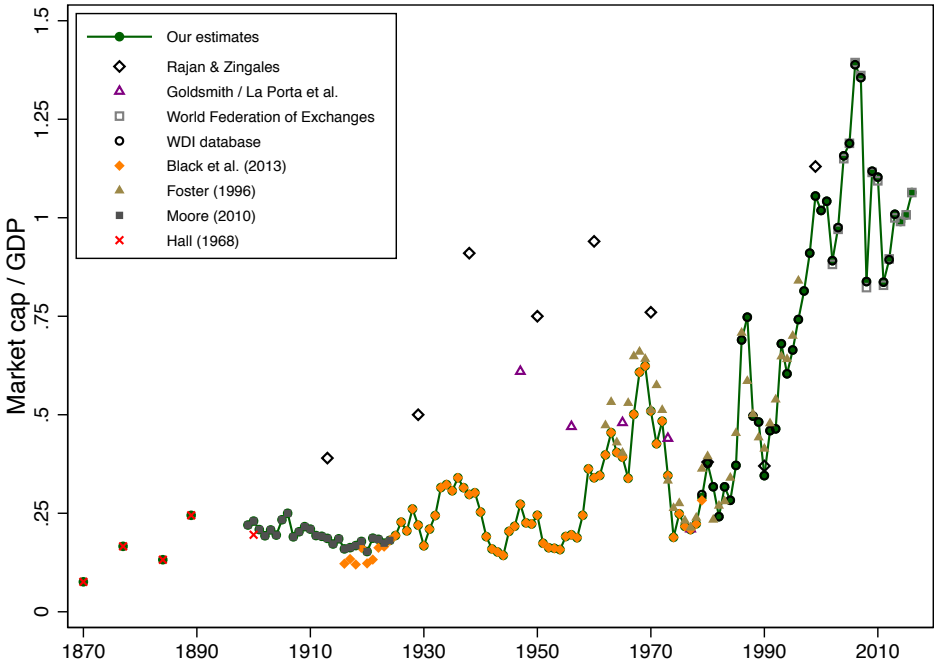


Table E.1 documents the sources of our stock market capitalization data for Australia, and Figure E.1 plots the resulting series alongside alternative existing estimates. The Australian securities market has generally been dominated by two major stock exchanges, located in Sydney and Melbourne. Hall (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.[13]

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 E.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.

[13] 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 E.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 E.2: *Belgium: alternative stock market cap estimates*

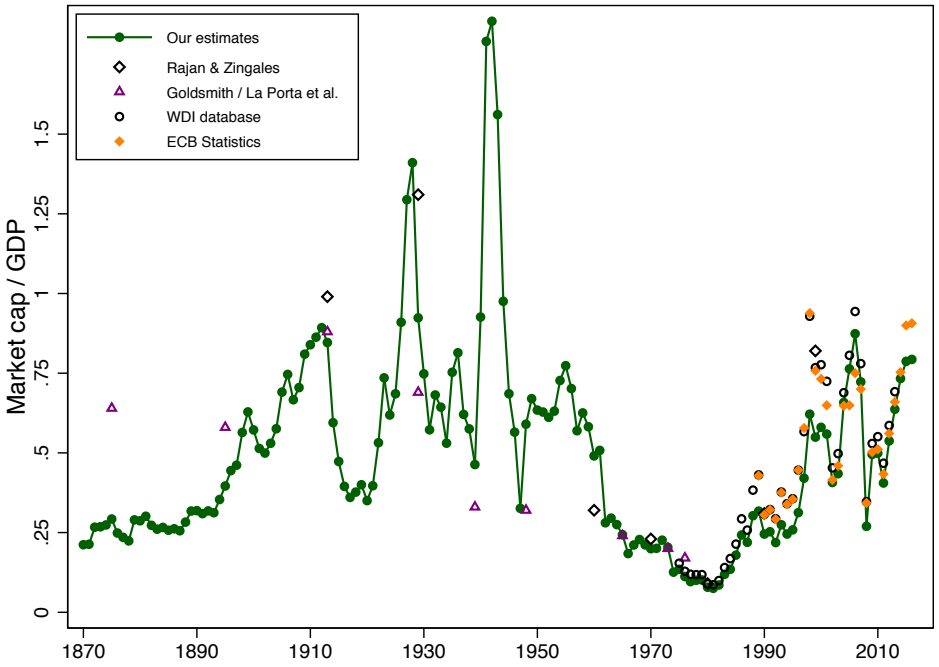


Table E.2 documents the sources of our stock market capitalization data for Belgium, and Figure E.2 plots the resulting series alongside alternative existing estimates. The data cover the Brussels stock exchange, which was the dominant stock exchange throughout the data coverage period in our paper, 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.

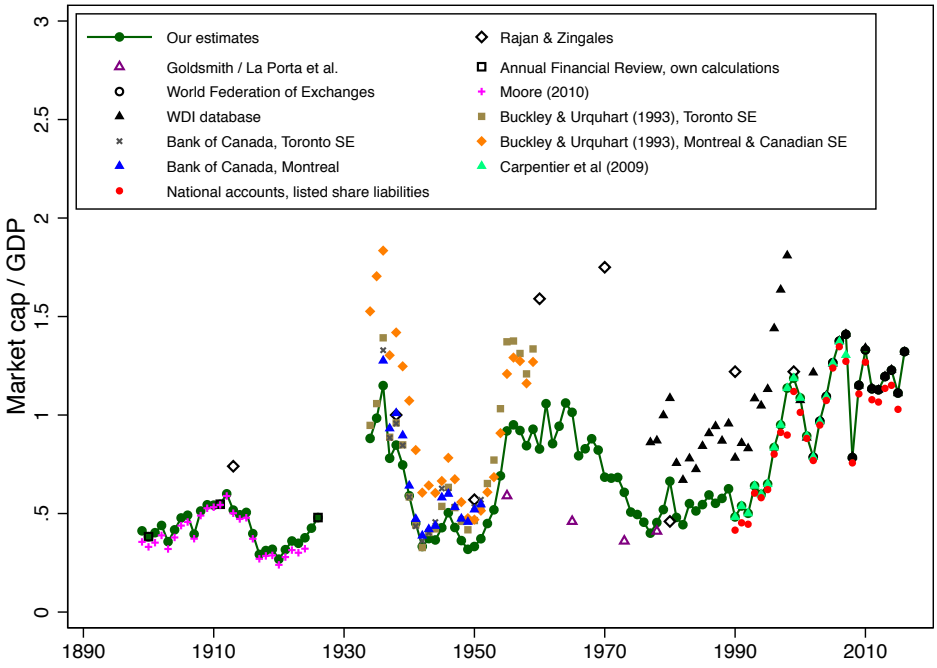
Canada

Table E.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 E.3 documents the sources of our stock market capitalization data for Canada, and Figure E.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 E.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 E.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 E.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.[14] 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 E.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 E.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 E.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

[14] 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.[15] 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 E.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 E.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.

[15]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

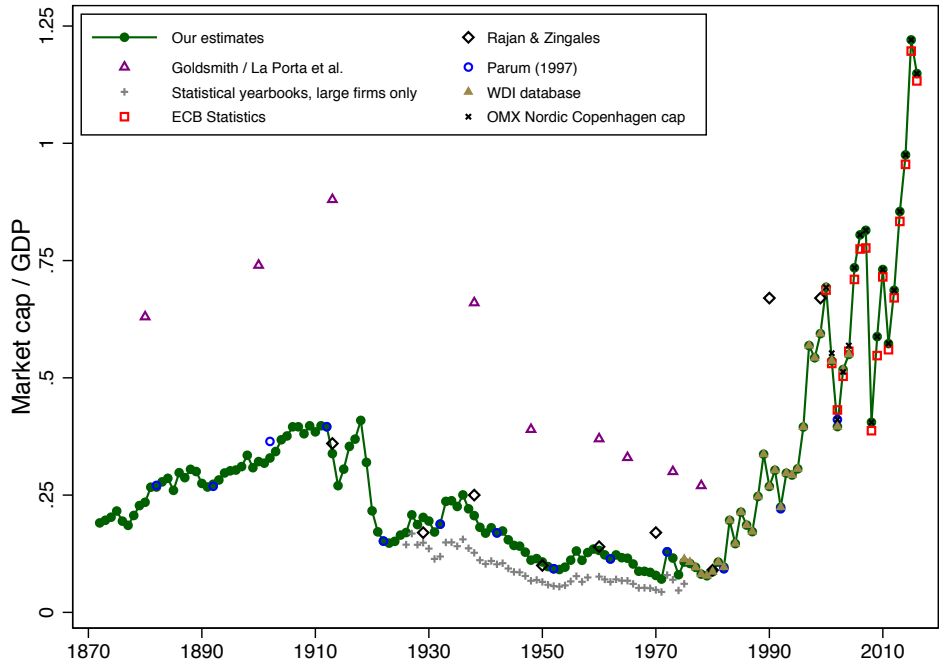
Table E.4: *Data sources: Denmark*

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 E.4 documents the sources of our stock market capitalization data for Denmark, and Figure E.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 E.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 E.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 E.5: *Finland: alternative stock market cap estimates*

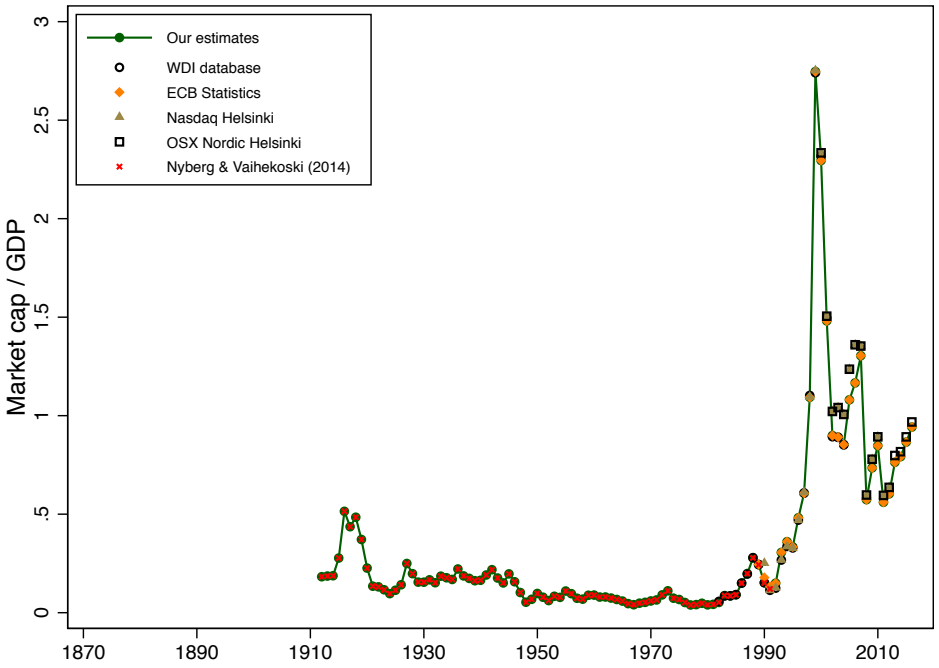


Table E.5 documents the sources of our stock market capitalization data for Finland, and Figure E.5 plots the resulting series alongside alternative existing estimates. The long-run data come from Nyberg and Vaihekoski (2014a), who have compiled a database of returns and capitalization on all stocks listed on the Helsinki exchange between its foundation in 1912 and 1991, when modern capitalization indices are available (see Nyberg and Vaihekoski, 2014b, 2011, 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 E.5. The modern data from the ECB series are very close to Helsinki stock exchange capitalization estimates from Nasdaq and OMX Nordic (Figure E.5).

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

France

Table E.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 E.6: *France: alternative stock market cap estimates*

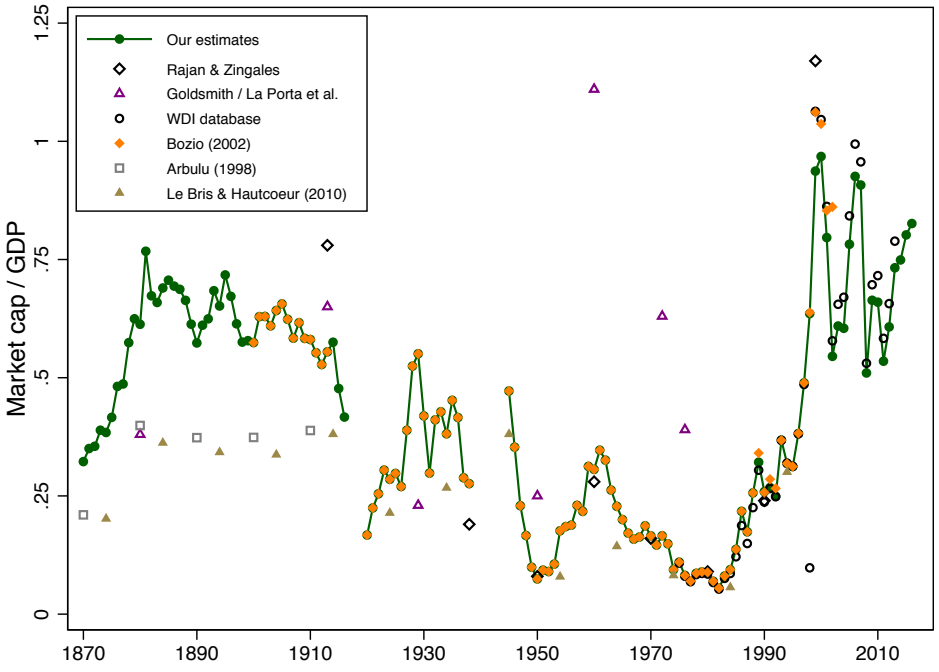


Table E.6 documents the sources of our stock market capitalization data for France, and Figure E.6 plots the resulting series alongside alternative existing estimates. Most of the data are drawn from the comprehensive study of Bozio (2002), which estimated the total capitalization of French shares listed 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.[16] 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 E.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.

[16] 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.

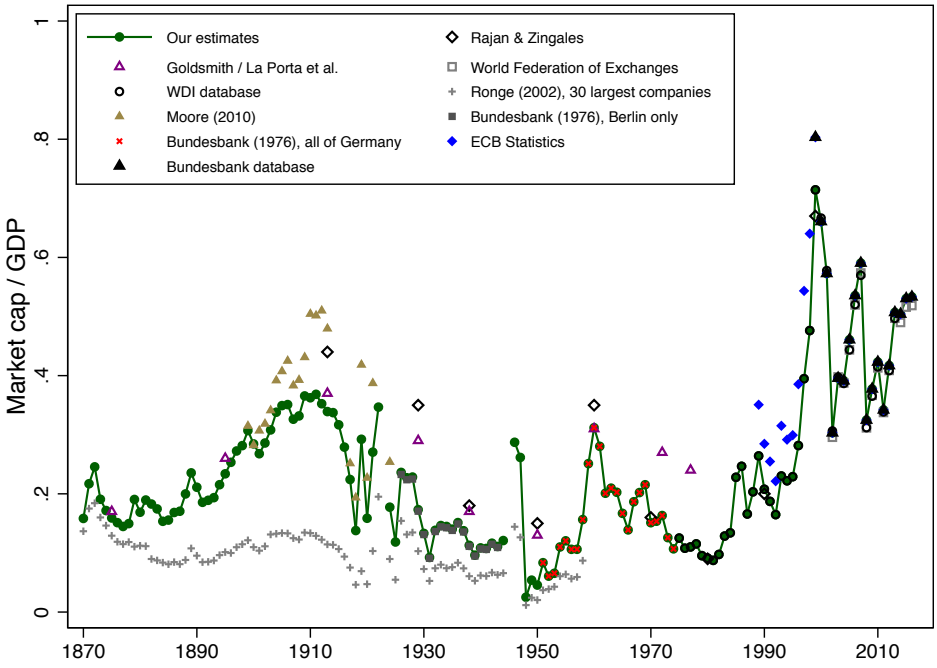
Germany

Table E.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 E.7 documents the sources of our stock market capitalization data for Germany, and Figure E.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 variety of

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



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 E.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 E.8: *Italy: alternative stock market cap estimates*

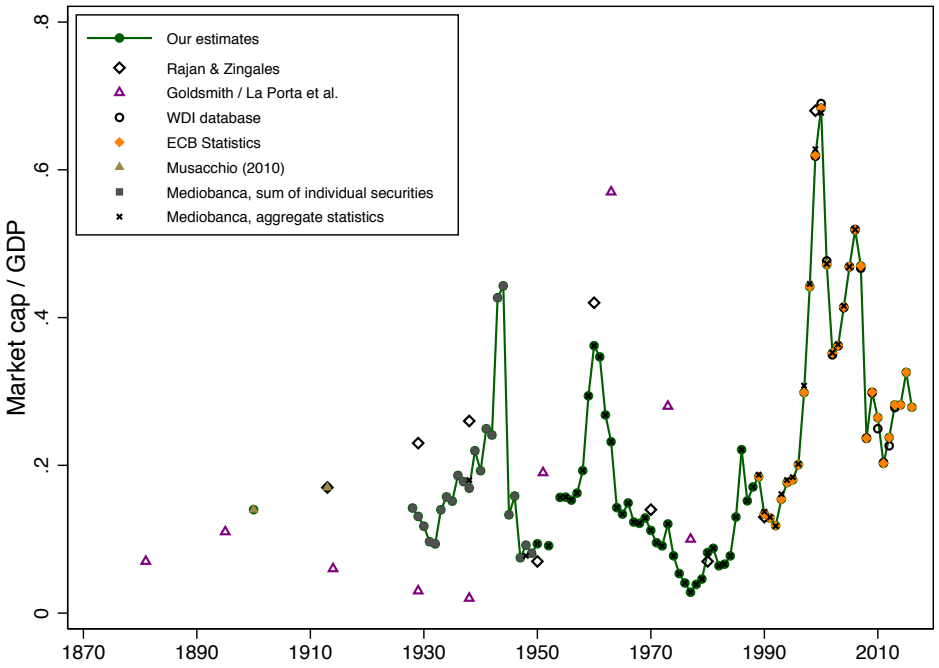


Table E.8 documents the sources of our stock market capitalization data for Italy, and Figure E.8 plots the resulting series alongside alternative existing estimates. Most of the data are sourced from the *Indici e Dati* publication, Mediobanca (Various years), which presents various aggregate and security-level 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 E.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 E.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 E.9: *Japan: alternative stock market cap estimates*

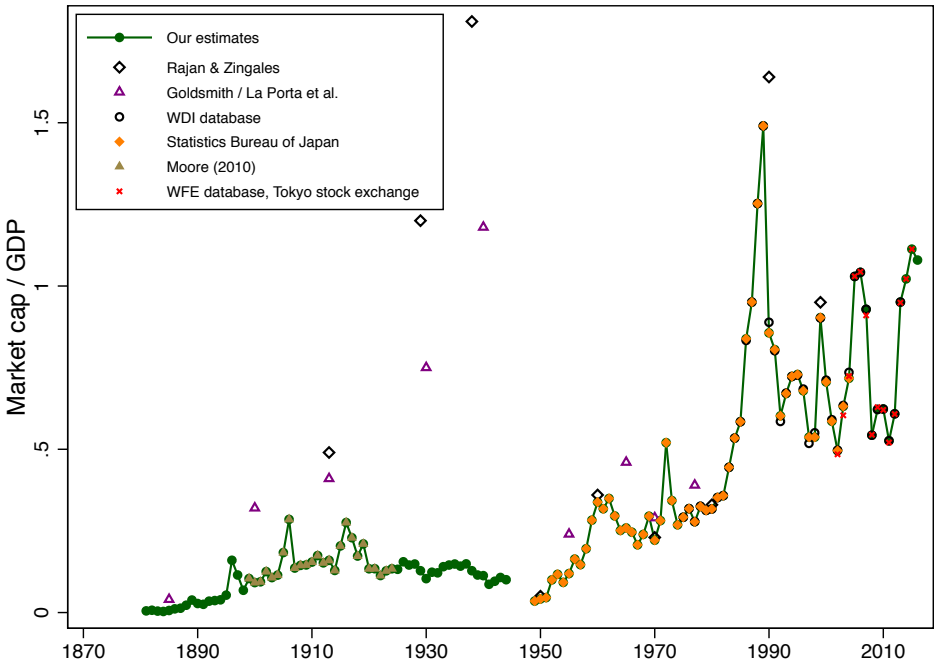


Table E.9 documents the sources of our stock market capitalization data for Japan, and Figure E.9 plots the resulting series alongside alternative existing estimates. For the early historical period, our

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 E.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 E.10: *Netherlands: alternative stock market cap estimates*

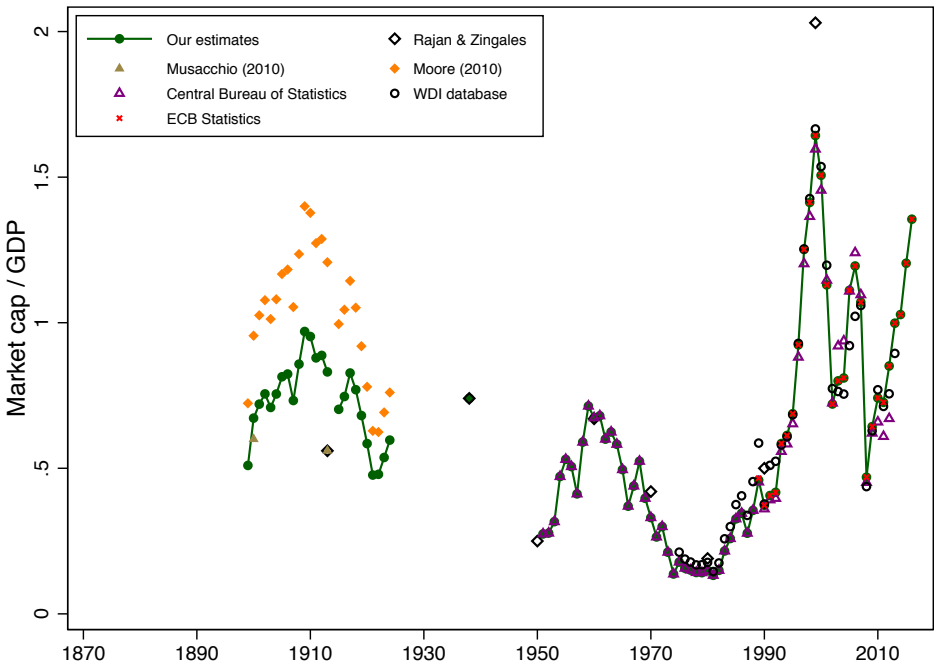


Table E.10 documents the sources of our stock market capitalization data for the Netherlands, and Figure E.10 plots the resulting series alongside alternative existing estimates. In the early period, our main source are the Moore (2010b) estimates of the total capitalization of the Amsterdam stock exchange. 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

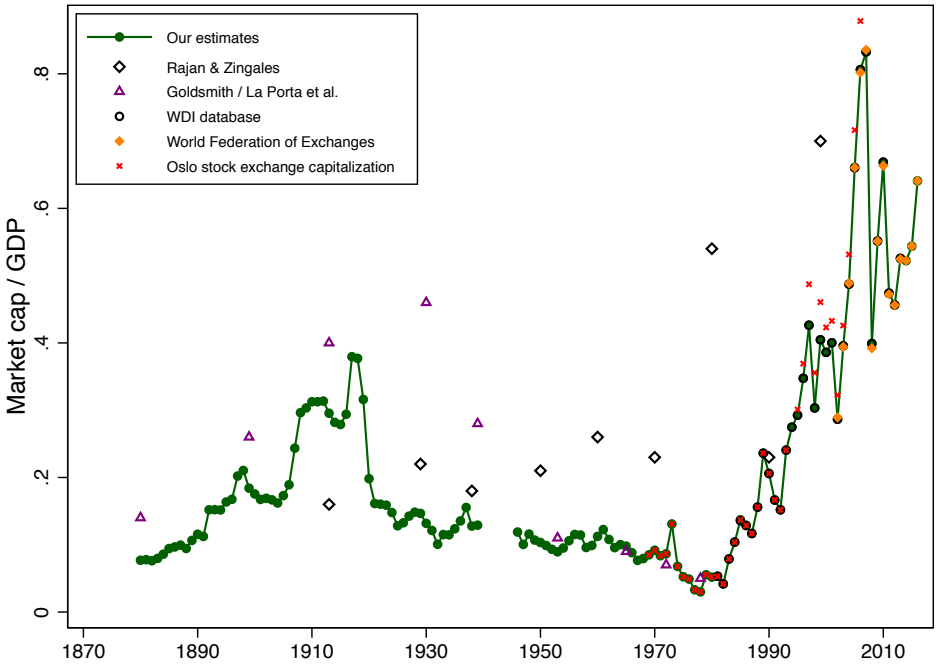
Table E.11: *Data sources: Norway*

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 E.11 documents the sources of our stock market capitalization data for Norway, and Figure E.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 E.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 E.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 E.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 E.12: *Portugal: alternative stock market cap estimates*

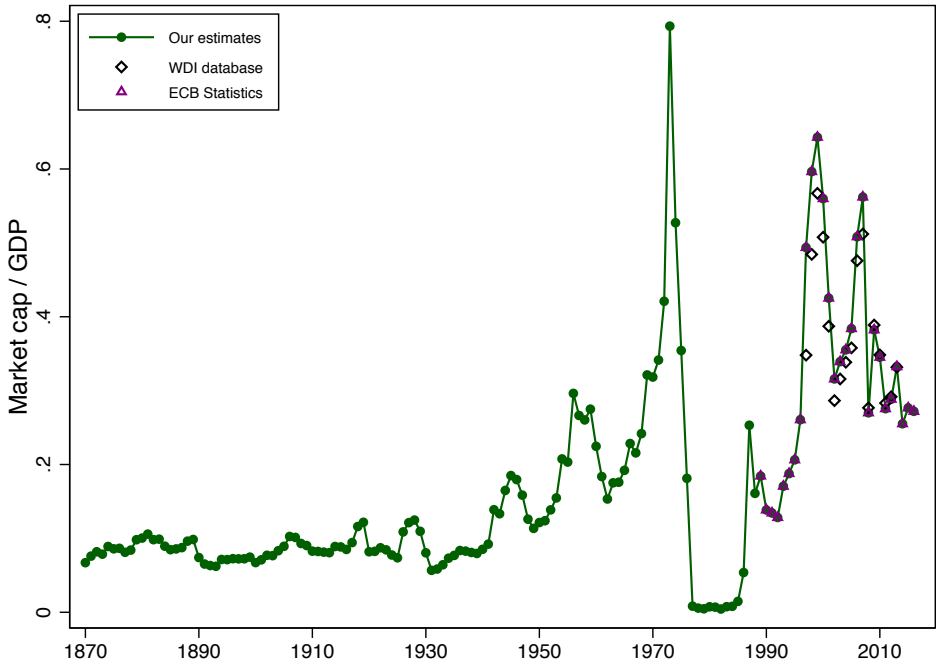


Table E.12 documents the sources of our stock market capitalization data for Portugal, and Figure E.12 plots the resulting series alongside alternative existing estimates. Very few estimates of the Portuguese market capitalization exist, particularly for the period before 1990. Therefore we construct 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 E.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 E.13: *Spain: alternative stock market cap estimates*

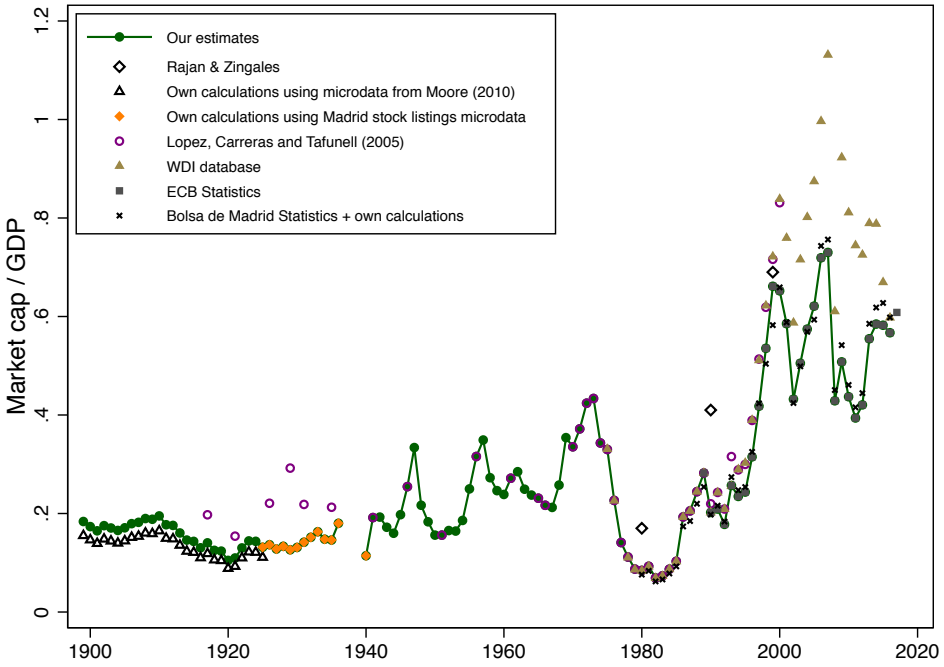


Table E.13 documents the sources of our stock market capitalization data for Spain, and Figure E.13 plots the resulting series alongside alternative existing estimates. For the early historical period, we

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 E.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 E.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 E.14: *Sweden: alternative stock market cap estimates*

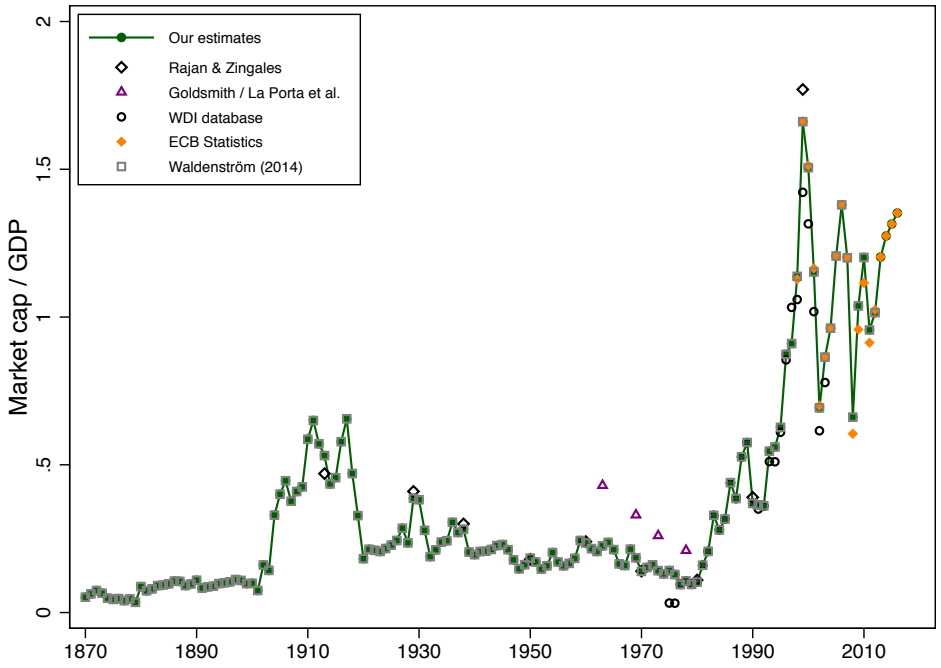


Table E.14 documents the sources of our stock market capitalization data for Sweden, and Figure E.14 plots the resulting series alongside alternative existing estimates. The main source for our series are the data compiled by Waldenström (2014), who put together a long-run series of Swedish stock market 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 E.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 E.15: *Switzerland: alternative stock market cap estimates*

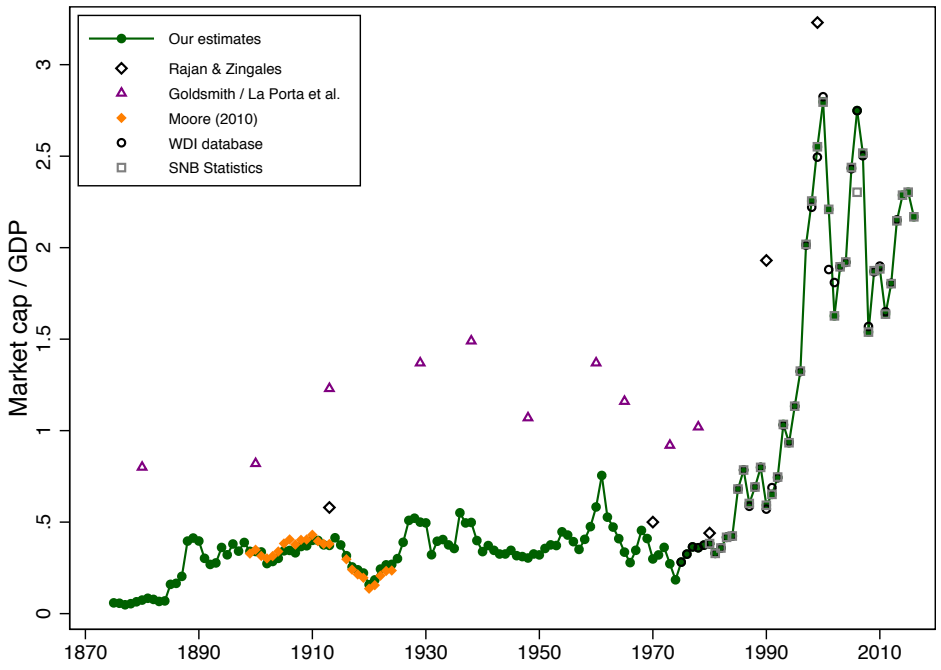


Table E.15 documents the sources of our stock market capitalization data for Switzerland, and Figure E.15 plots the resulting series alongside alternative existing estimates. The early estimates of the Swiss stock market capitalization are based on the Moore (2010b) data for the capitalization of the 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

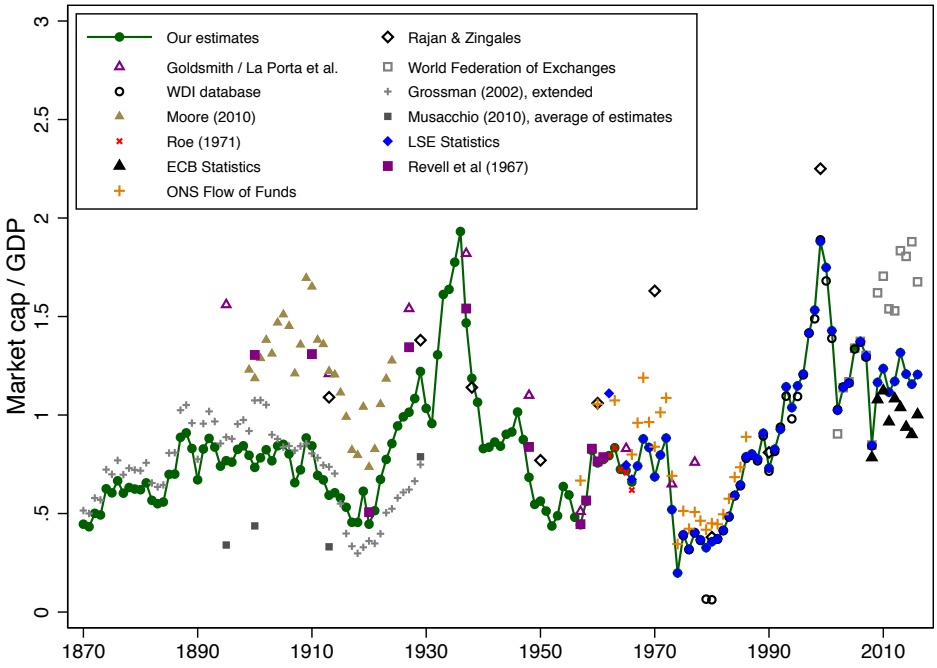
Table E.16: *Data sources: United Kingdom*

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 E.16 documents the sources of our stock market capitalization data for the United Kingdom, and Figure E.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 E.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 E.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).[17]

[17] 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 Moore, 2010b; Grossman, 2002) 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 E.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 E.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 E.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 E.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

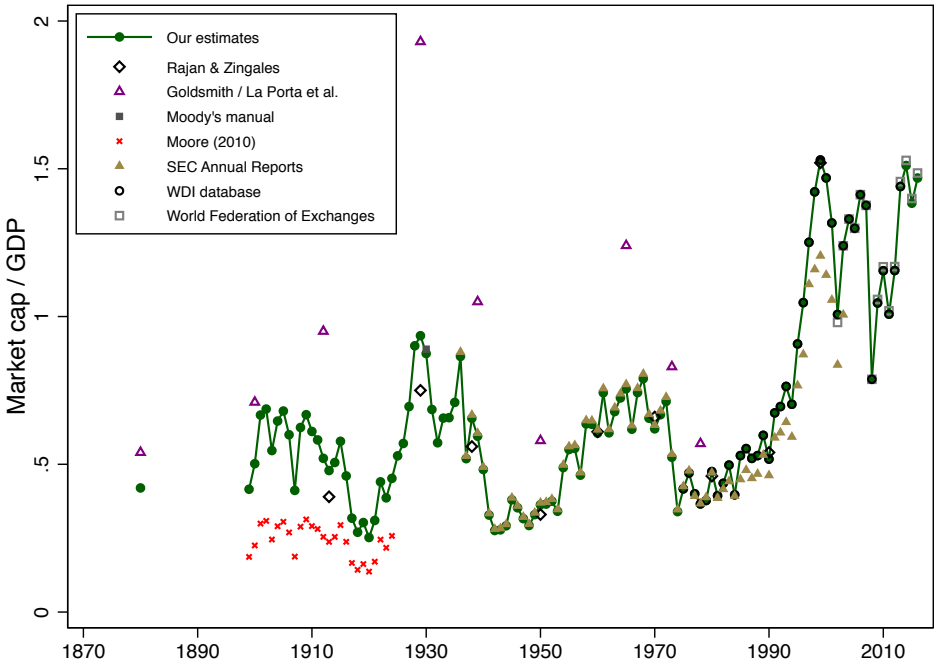
Table E.17: *Data sources: United States*

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 E.17 documents the sources of our stock market capitalization data for the United States, and Figure E.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 E.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 E.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.

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