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21 August 2018

European
Historical
Economics
Society

EHES Working Papers in Economic History | No. 136

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AUGUST 2018

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Abstract

This paper presents annual stock market capitalization data for 17 advanced economies from 1870 to today. Extending our knowledge beyond individual benchmark years in the seminal work of Rajan and Zingales (2003) reveals a striking new time series pattern: over the long run, the evolution of stock market size resembles a hockey stick. The stock market cap to GDP ratio was stable for more than a century, then tripled in the 1980s and 1990s and remains high to this day. This trend is common across countries and mirrors increases in other financial and price indicators, but happens at a much faster pace. We term this sudden structural shift "the big bang" and use novel data on equity returns, prices and cashflows to explore its underlying drivers. Our first key finding is that the big bang is driven almost entirely by rising equity prices, rather than quantities. Net equity issuance is sizeable but relatively constant over time, and plays very little role in the short, medium and long run swings in stock market cap. Second, much of this price increase cannot be explained by more favourable fundamentals such as profits and taxes. Rather, it is driven by lower equity risk premia – a factor that is linked to subjective beliefs and can be quite fickle, and easily reversible. Third, consistent with this risk premium view of stock market size, the market cap to GDP ratio is a reliable indicator of booms and busts in the equity market. High stock market capitalization – the "Buffet indicator" – forecasts low subsequent equity returns, and low – rather than high – cashflow growth, outperforming standard predictors such as the dividend-price ratio.

JEL Classification: E44, G10, G20, N10, N20, O16

Keywords: Stock market capitalization, financial development, financial wealth, equity issuance, equity valuations, risk premiums, equity bubbles.

* This work is part of a larger project kindly supported by a research grant from the Bundesministerium für Bildung und Forschung (BMBF). We are grateful to Leslie Hannah, Kristian Rydqvist, Moritz Schularick, and the participants of the Bonn Macrohistory Seminar for providing helpful comments. We are indebted to a large number of researchers who helped with individual country data.
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1. Introduction

This paper introduces, for the first time, a dataset on annual stock market capitalization across 17 advanced economies from 1870 to today. One key fact stands out: the evolution of stock market cap over time resembles a hockey stick. Between 1870 and 1985, stock market size was roughly flat at around one-third of GDP. In the 1980s and 1990s, the stock market underwent a rapid, sustained and historically unprecedented expansion. This expansion took place in every country in our sample, and leaves today's market cap to GDP ratios at around 1, three times the historical norm. We term this rapid increase in stock market size "the big bang". Early 20th century levels of market capitalization were not especially high, and all the time series variation pales in comparison to this recent structural break. This paper documents the big bang and the various underlying trends and movements in stock market cap, and tries to understand what it is that ultimately drives them.

A wide range of structural macroeconomic phenomena are directly connected to the size of the equity market. Listed equity is the financial asset held by the very wealthy. Rising stock market capitalizations, therefore, directly feed into wealth inequality and wealth-to-income ratios, whose historical trends are subject to much recent debate (Alvaredo, Atkinson, and Morelli, 2018; Kuhn, Schularick, and Steins, 2017; Piketty, 2014; Saez and Zucman, 2016). Since capitalization of individual firms often determines CEO salaries, stock market size also influences the inequality of income (Gabaix and Landier, 2008). Furthermore, the size of the stock market is a key component of economy wide measures of corporate valuations such as Tobin's q (Tobin and Brainard, 1976) and dictates the importance of aggregate wealth effects arising from valuation changes (Case, Quigley, and Shiller, 2005; Coronado and Perozek, 2003; Poterba, 2000). Long-run trends in stock market capitalization have also become a standard measure of a country's financial development and underlying market efficiency (Atje and Jovanovic, 1993; Levine and Zervos, 1996).

That being said, we know relatively little about the evolution of stock market cap beyond individual benchmark years. The seminal work of Rajan and Zingales (2003) established the "great reversals" hypothesis: that stock markets were larger, and hence more developed in 1913 than in 1980, and are again more developed today than several decades ago. Rajan and Zingales (2003) explained these changes with a political economy model in which domestic incumbents oppose financial development to protect their rents, but are weakened by rising cross-border capital flows. Equating market capitalization with financial development, however, implicitly assumes that long-run movements in stock market size are driven by changes in quantities and market access. But this need not be the case. Market capitalization is a product of share prices and quantities – the amount of listed capital times its valuation. Since valuation changes can induce long-run structural breaks in other risky assets such as housing (Knoll, Schularick, and Steger, 2017), why should this not be the case for stocks? Up to this point, it has been impossible to test these hypotheses because of a lack of comparable cross-country annual data on market capitalization and stock returns.

We are not the first to study structural trends in stock market size. A number of papers, including Atje and Jovanovic (1993), La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997) and Musacchio (2010), have equated stock capitalization with financial development and equity issuance, and sought to link market capitalization movements to legal norms and broader market-friendly regulations. A different strand of the macroeconomics literature attributes a greater importance to changes in stock valuations. McGrattan and Prescott (2005) argue that the recent increase in equity wealth of US corporations is primarily driven by lower corporate taxes. De Loecker and Eeckhout (2017) emphasise the role of higher mark-ups in driving up the real value of listed US firms.

Firm valuations, however, are a forward-looking measure. This means that they depend not only on fundamentals such as taxes and mark-ups, but also on the rate at which the future realizations of these fundamentals are discounted (Campbell and Shiller, 1988). The discount rate, in turn, is a combination of the safe rate and the equity risk premium. Some authors, including Summers (2014), have argued that equilibrium risk-free rates have declined since the 1980s. Lettau, Ludvigson, and Wachter (2008), in turn, document a structural decline in the US equity premium over a similar time period. Both lower risk premiums and risk free rates would drive up stock valuations and market cap even if the underlying fundamentals or issuance remain unchanged. Taken together, we can identify five potential drivers of the big bang, and structural increases in market capitalization more generally: high net equity issuance, high profits, low taxes, low risk premiums and low risk-free rates. We study historical data on each of these five variables in order to gauge the relative importance of these different factors. The equity return and risk premium data come from Jordà, Knoll, Kuvshinov, Schularick, and Taylor (2017a), and the other data were newly collected for this project, much of it drawing on the work of Piketty and Zucman (2014).

Our first major finding is that throughout history and including the big bang, almost all the movements in market capitalization are accounted for by changes in prices, not quantities. The big bang in stock market cap is not a story of financial development, or lower entry barriers to the stock market. Neither is it a story of capital accumulation and increased physical investment in corporate stocks. Equity issuance is sizeable but relatively constant over time, and plays very little role in the short, medium and long-run swings in stock market cap.

Second, the structural increase in stock valuations cannot be fully attributed to fundamental factors such as cashflows and taxes. Corporate and income taxes did fall during the big bang, but their levels have remained much higher than in the first half of the 20th century, a time when stock market capitalization was close to its historical average. Changes or levels of taxes also show no correlation with past or current market capitalization, regardless of the type of tax and time horizon used. Higher equity cashflows are likely to have made a contribution: total dividend payments have increased from 1% of GDP in 1985 to 2.5% of GDP in 2015. These higher cashflows are, however, unlikely to tell the whole story behind the big bang. First, even though dividend payments have increased, corporate profits have remained flat at roughly 11% of GDP throughout the historical period. Market capitalization is also only correlated with current, but not future dividends, whereas firm valuations should depend on expected future, rather than realised past cashflows.

This leaves an important role for lower discount rates, and in particular lower equity risk premia, in explaining the big bang. Indeed, over the last 30 years the dividend-price ratio – a proxy for the equity discount rate – has fallen from a historically stable average of 4.5% to less than 3%. Dividend-price ratios are also strongly correlated with changes and levels of stock market capitalization. Ex-post real risk-free rates, on the contrary, are currently close to their long-run average and generally do not explain levels and changes of stock market cap.

Third, we find that risk premiums not only matter for structural movements in market cap, but also drive much of its cyclical variation. Flipped around, market capitalization is a reliable indicator of booms and busts – or bubbles and crashes – in the equity market. High stock market capitalization forecasts low subsequent equity returns, and low – rather than high – cashflows. In fact, market cap substantially outperforms the standard dividend-price ratio variable as an equity return predictor. Warren Buffet called stock market capitalization "the best single measure of where valuations stand at any given moment" (Buffett and Loomis, 2001). Once again, his impressive intuition seems to be ex-post validated by the data.

One reason why market capitalization does so well at predicting returns is that it contains information on quantities as well as prices. In our historical dataset, high net equity issuance predicts low future returns, but tells us nothing about future cashflows. These issuance changes can act as a proxy for investor sentiment: when equity markets are "hot" and investors – overoptimistic, companies can time the market to issue more securities (Baker and Wurgler, 2000). But this elevated sentiment eventually unwinds, leading to, on average, low expected returns for investors. Accounting for quantities makes stock market capitalization a better measure of investor sentiment than the traditional price-based metrics. Taking this analysis further reveals that rapid increases in stock market capitalization share many characteristics with stock market bubbles: they are accompanied by high returns and rising equity valuations, and followed by low equity returns and a higher risk of an equity market crash. Taken together, our results put the "Buffet indicator" at center stage of the time-varying return predictability literature.

Stock markets today are larger than at any point in recent history. This, however, does not mean that financial markets are substantially more developed. Rather, this means that stock valuations are unusually high, and have been for the best part of the last three decades. These high valuations could harbour positive news and be seen as a sign of high future cashflows, high corporate profitability, or low future risk. But our analysis suggests that the rise of the stock market entails a darker side. Much of the increase in valuations is driven by low equity risk premiums – a factor that can be quite fickle and unconnected to economic fundamentals, and hence, easily reversible. Indeed, the structural increase in market capitalization during the big bang has been accompanied by higher volatility, with several large surges in market cap followed by reversals to the structurally higher post-1980 mean.

2. A new dataset on historical stock market capitalization

This paper introduces a new dataset on the historical size of the stock market 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. For most historical series, we rely on data from the major stock exchange in each country. For countries with several large exchanges, we either aggregate the data across the exchanges, excluding cross listings, or gross up the major exchange capitalization to proxy the contribution of other domestic stock markets.

We use a wide range of primary and secondary sources to construct the data series, many of these new and previously unused. The secondary sources consist of financial history books and research articles, and publications of stock exchanges, statistical agencies, central banks and trade bodies. Where reliable secondary sources were not available, we construct the capitalization measure by aggregating the total market values of individual stocks, using data on stock prices and number of shares or listed capital value from stock exchange bulletins and gazettes, stock exchange handbooks and companies' published accounts. 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 statistics on book capital of listed companies and their valuations.

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, 2017, offers a discussion of these issues in the early London Stock Exchange data). Some of the earlier statistical estimates bundle these different securities together, or sometimes only provide figures for both unlisted and listed equity liabilities. We therefore ensure that our estimates capture ordinary shares only, by where necessary constructing our own benchmark year estimates, or using supplementary stock exchange data and research publications to make this distinction.

The second challenge is that the capitalization measure should sum the securities listed on all domestic stock exchanges, net of any cross listings. Wherever possible, we therefore rely on data that cover all the major stock exchanges in the country, constructing our own estimates from microdata when necessary, such as the case for pre World War 1 German stock market cap. 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 the stock markets tend to be centralised, especially by late 19th century, and many securities that are chiefly traded on smaller markets are 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.

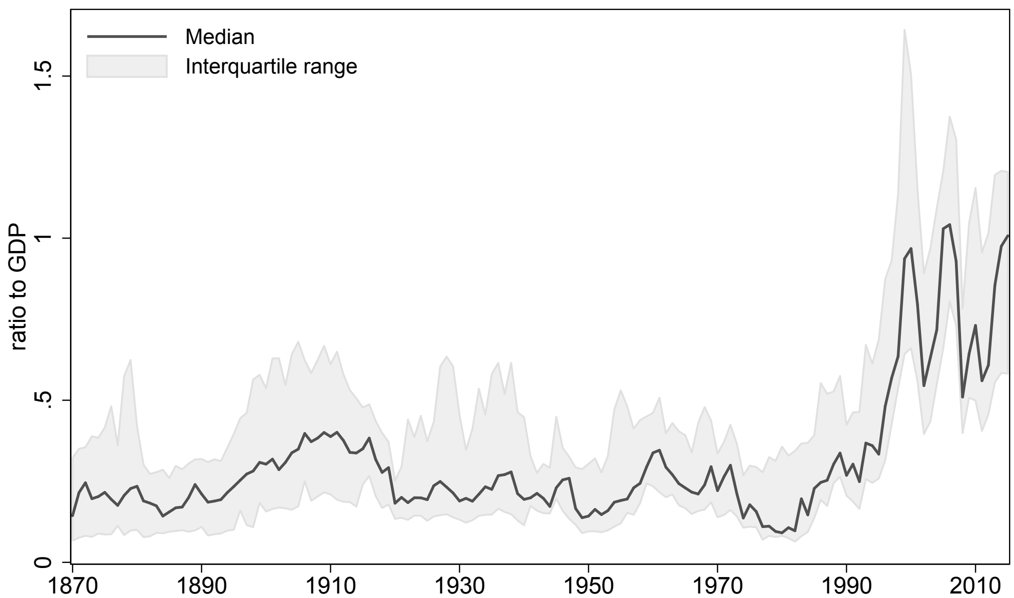
The size of the domestic stock market has long been of interest to scholars of economics, finance and economic history. The earliest efforts to document stock market size probably date back to surveys of stock market activity by wealthy financiers, public officials or the stock exchange itself, such as the work of Green (1887) for the Copenhagen and Burdett (1882) for the London stock exchanges. Such publications were, however, often highly irregular and generally not comparable across time and markets. The incorporation of the stock market into the broader national balance sheet and national accounts offered one way to improve the comparability and frequency of the earlier estimates. Goldsmith (1985) was probably the first to systematically document the cross-country national balance sheet data, building on earlier work on individual country data such as that of Hoffmann (1965) for Germany and Roe (1971) for the UK. Recent work by Piketty and Zucman (2014) has further improved the availability, comparability and coverage of historical national wealth data. The focus of these studies on aggregate national wealth has, however, meant that the wealth of listed companies was often measured imprecisely – for example, combined with unlisted businesses or holdings of preferred stock and corporate bonds.

The recent work in finance has sought to document the size of the stock market more precisely, with Rajan and Zingales (2003) producing the first systematic effort to compare historical market capitalizations across a large group of countries throughout the 20th century. These studies, however, have only documented stock market wealth at discrete benchmark periods, and often relied on secondary sources with varying degrees of consistency and comparability. Our dataset advances on existing research by, for the first time, constructing market capitalization on an annual basis and a consistent definition, for a consistent group of countries, going back to the 19th century.

3. The Big Bang

Figure 1 shows the size of the stock market relative to GDP across the 17 economies in our sample from 1870 to today. The solid black line is the median across the sample, and the shaded area indicates the interquartile range.

Figure 1: *Stock market capitalization in advanced economies*

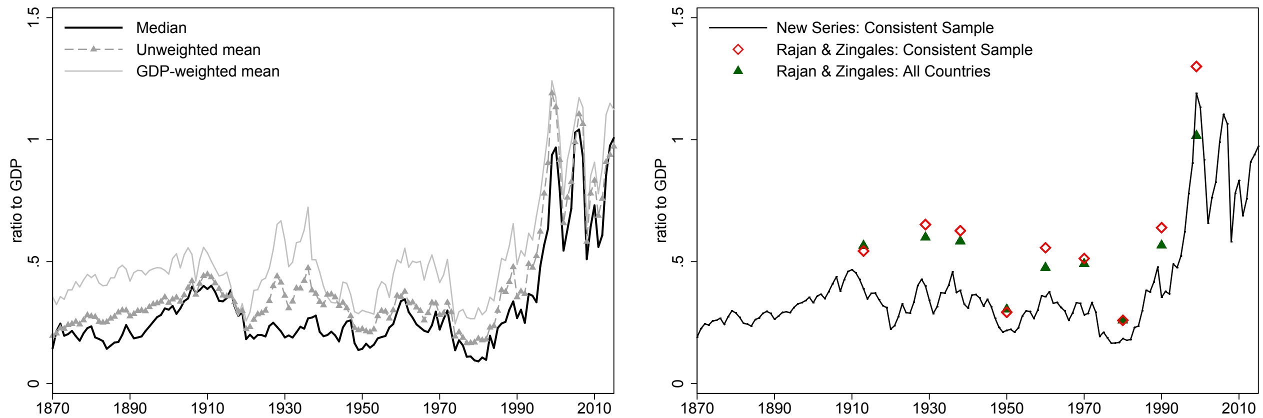


Notes: Stock market capitalization to GDP ratio, 17 countries. The solid line and the shaded area are, respectively, the median and interquartile range of the individual country capitalization ratios in each year.

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

Figure 2: *Alternative market capitalization estimates*



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

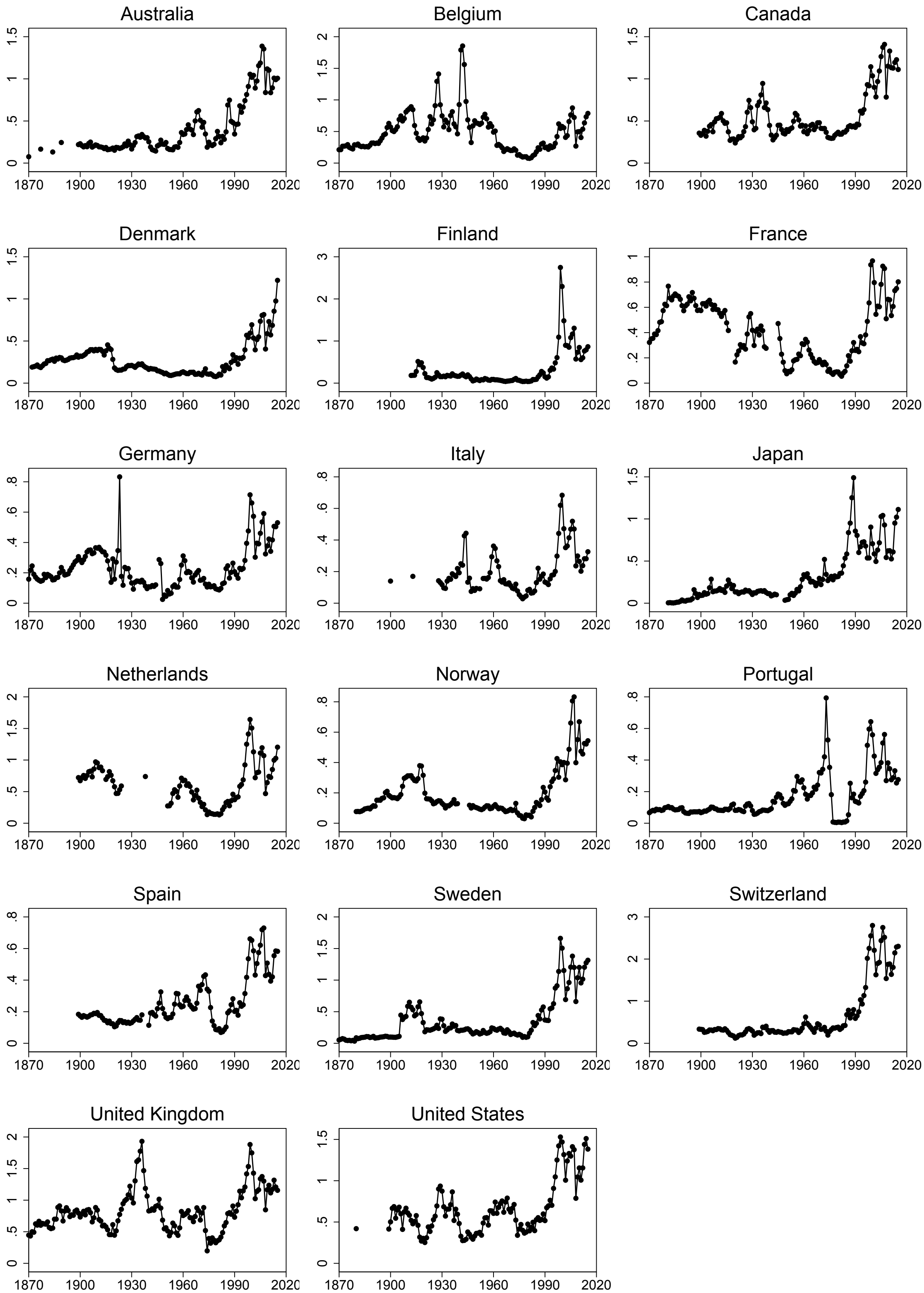
Notes: Stock market capitalization to GDP ratio. Left-hand panel: Median, unweighted and GDP-weighted averages of 17 countries. Right-hand panel: Estimates in our data compared to those of Rajan and Zingales (2003), unweighted averages. The consistent sample includes all countries in our dataset apart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

the early 1900s. We loosely term this sudden and rapid growth of the stock market in the 1980s and 1990s as "the big bang".

Figure 2a shows that this hockey stick pattern holds regardless of how we aggregate the individual country data: the time pattern 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 three countries in our dataset – France, United Kingdom and Portugal, the big bang can be seen as a return to some previously high level of market capitalization that was in place before mean reversion after a prolonged boom, or economic shocks – such as the two world wars or, in case of Portugal, the Carnation revolution – reduced the size of the respective stock markets, only for it to experience a renaissance over the recent decades.

In comparison to existing literature, the big bang hockey stick differs from the U-shape "great reversals" pattern documented by Rajan and Zingales (2003) (henceforth RZ). RZ compiled data on market capitalization and other financial development indicators at benchmark years between 1913 and 1999, and argued that markets were well developed during the early 20th century, subdued during the mid-20th century, and bounced back over the more recent period. Figure 2b compares our market capitalization estimates to those of RZ. To improve comparability, we have excluded Finland, Portugal and Spain, which are present in our sample but not that of RZ, from our series

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



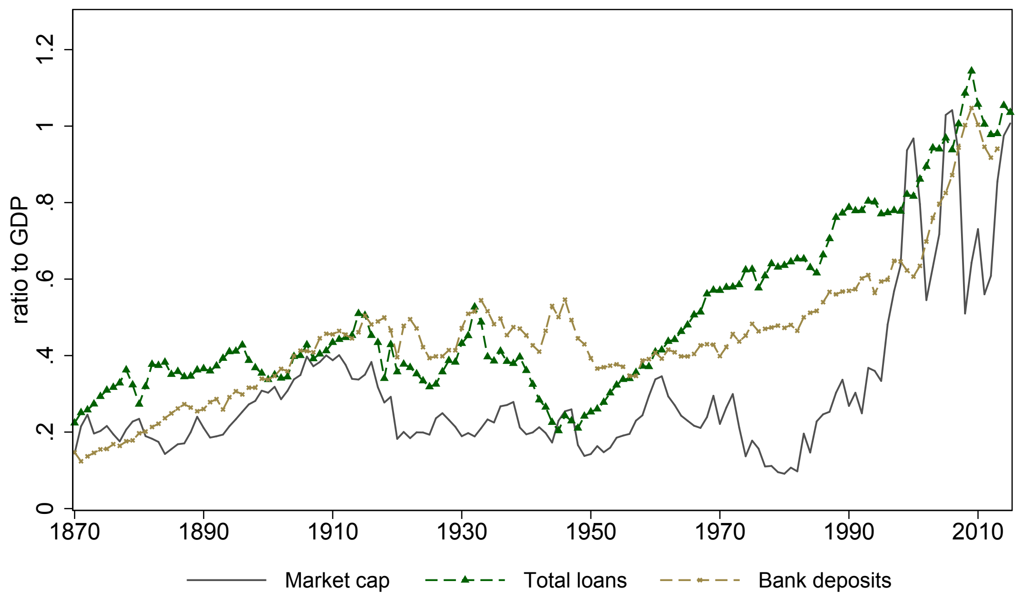
(solid black line). The figure also presents the original RZ estimates for 22 countries (green triangles), and their estimates for the 14 countries in our reduced consistent sample (red diamonds).

We can see that the differences between our estimates and those of RZ is not driven by sample composition. Even though their sample includes some countries that are absent in ours, this makes little difference: countries with high market capitalization to GDP ratios in the 1913 RZ data – such as Cuba and Egypt – are counterbalanced by others with relatively low ratios, such as Russia and India. Some of the differences can be attributed to the improved quality of our data. Following on from the discussion in Section 2, 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 averages in Figure 2b do obscure some larger differences in individual countries and time periods, such as in the early data for Australia and Japan, shown in the Appendix Figure A.3.

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, and can obscure the underlying trends in the data. For their comparison, RZ mostly relied on years 1913, 1980 and 1999. But Figure 2b shows that 1980 was a trough of the equity price cycle, while 1913 and 1999 were peaks. Focussing only on these individual years makes the long-run market cap pattern more similar to a U shape. Adding the 18 years of data beyond 1999 further helps establish that the increase in market capitalization in the 1980s and 1990s was a persistent structural shift, rather than a short-lived equity boom.

Does this mean that financial markets in the early 20th century, and as recently as 1980, were far less developed than they are today? We postpone the detailed discussion of this question until the next section, but some of the broad patterns in the data indicate that this may not be the case. First, the evolution of other measures of financial development points to a far more gradual and slow-moving improvement between 1870 and today. Figure 4 shows the evolution of total credit to the non-financial sector (green triangles), and total bank deposits (brown crosses) alongside market cap, all expressed as a ratio to GDP. The credit data come from Jordà, Schularick, and Taylor (2016), and deposit data – from Jordà, Richter, Schularick, and Taylor (2017b). Both of these measures show a steady growth in the late 19th century, followed by a plateau and a fall around World War 2, before a steady rise starting in the 1950s and continuing until today. The time pattern of the changes is quite different to stock market cap: the 20th century trough occurs around the time of World War 2 rather than World War 1, and the recovery starts much earlier, and continues for a longer time and

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



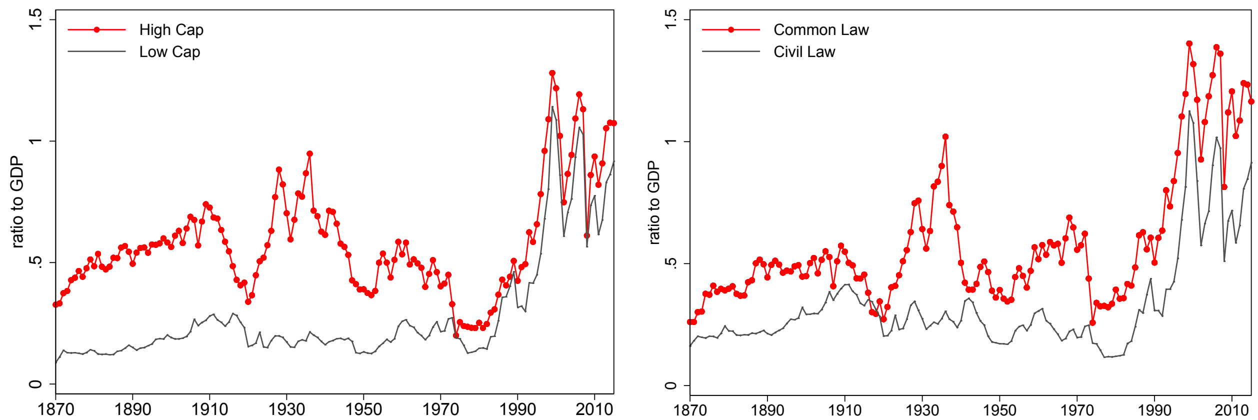
Notes: Median ratio of stock market capitalization, total loans and bank deposits to GDP, 17 countries.

at a slower pace than the big bang.

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

A similar convergence pattern emerges when we group the countries according to their legal norms, shown in Figure 5b. La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997) hypothesised that stock markets in common law countries tend to be more developed because of the more market-friendly legal norms. This pattern is largely borne out by the evidence in Figure 5b: common law countries (red circled line) – which, in our dataset, consist of Britain, Canada, US and Australia

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



(a) *High vs low initial market cap*

(b) *Legal origin*

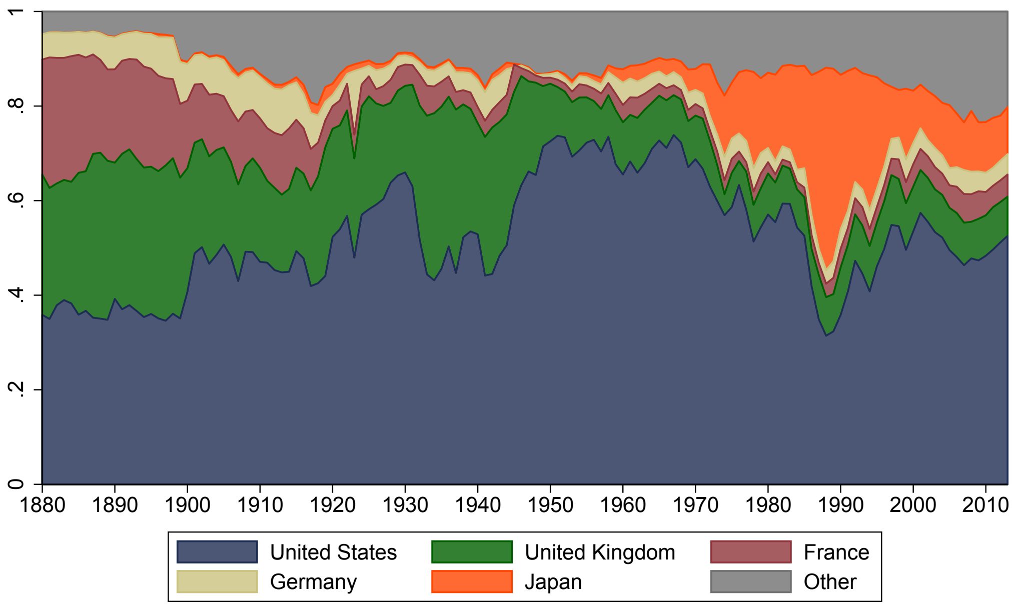
Notes: Stock market capitalization to GDP ratio by country group, unweighted averages. Left-hand panel: High cap countries are Belgium, Canada, France, Netherlands, the UK and the US. Low cap countries are all other countries in our dataset. Right hand panel: Common law countries are Australia, Canada,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

– have generally had larger market capitalization than civil law countries (solid black line), in particular during the mid-20th century.[1] But the differences had not always been large, and the two groups of countries have converged somewhat during the big bang. Furthermore, market capitalization in both the "high-cap" group of countries in Figure 5a, and the common law countries in Figure 5b tends to be more volatile, or cyclical, with large peaks in the 1930s and 60s, and troughs around the two world wars and in the 1970s.

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

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

Figure 6: *World market capitalization shares*



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

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, the Japanese stock market bubble of the 1990s left its mark on the country's global market share. Capitalization of Japanese listed companies grew from 5% of the global market in 1970 to 40% in 1989 – comparable in size to the US – and collapsed thereafter.

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

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

4. Decomposing the Big Bang

We first seek to understand whether stock market cap growth is driven by quantities or prices – i.e. stock market issuance, by both new and existing firms, or the valuation of issued stocks. To do this, we decompose the market cap to GDP growth into issuances, valuations and GDP growth using a similar technique to the Piketty and Zucman (2014) decomposition of growth in wealth-to-income ratios.[2] To derive the decomposition, we first note that total market capitalization $MCAP$ is simply the the sum of the capitalizations – or quantity Q times prices P – of each individual share listed on the exchange:

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

where N is the total number of listed shares. Rewriting equation (1) in difference terms, the change in market cap either comes about from higher quantities Q – i.e. issuance, or higher prices P:[3]

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

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

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

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

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

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

Table 1 shows this decomposition in our data, for the full sample and three different subperiods, which roughly correspond to the trend in market capitalization shown in Figure 1.[4] The subperiods

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

[3] To clarify thinking, it helps to think of P as the market-to-book ratio, and Q as the listed book capital of each firm.

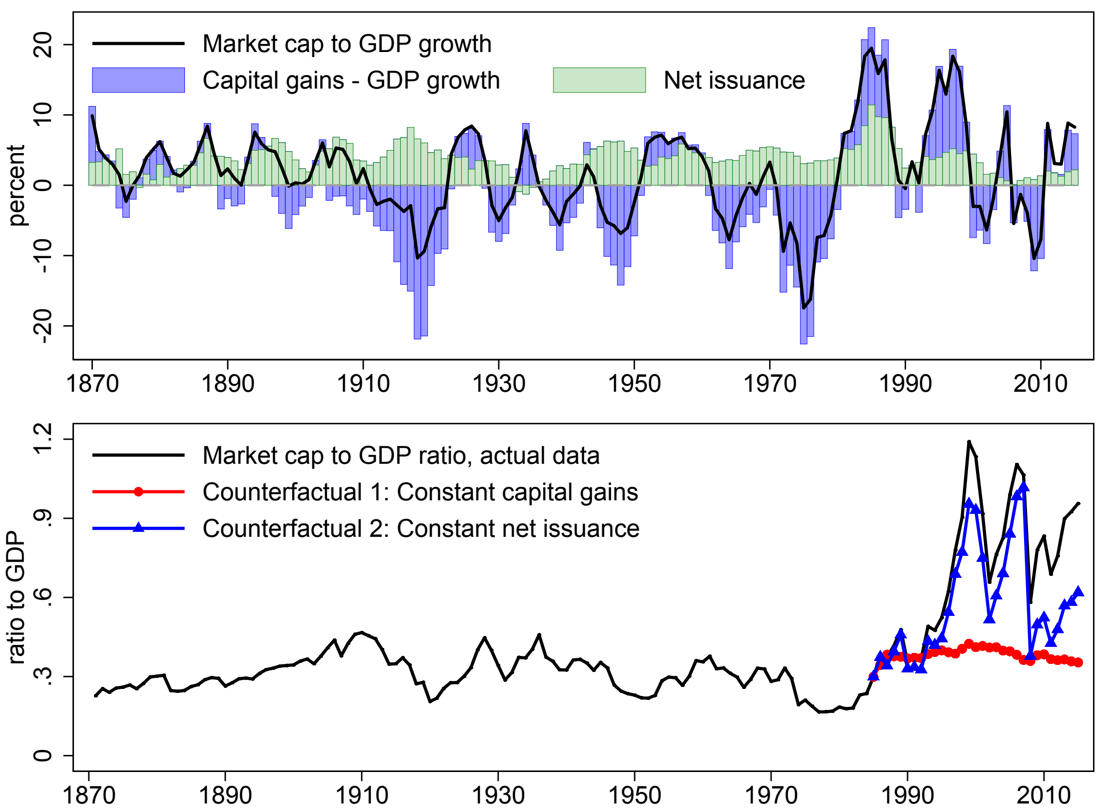
[4] Table 1 also includes a small approximation error, which arises because of the log approximation, and because real GDP and real equity price growth use different deflators.

Table 1: *Market capitalization growth decomposition*

	(1) Full sample	(2) Pre 1914	(3) 1914–1985	(4) Post 1985
Market capitalization growth	1.55	2.44	-0.12	4.49
Decomposition of market capitalization growth into:				
Implied issuance to market cap	3.86	3.74	4.08	3.49
+ Real capital gain on equity	0.41	0.96	-1.15	3.41
− Real GDP growth	2.82	2.41	3.23	2.27
+ Approximation residual	0.10	0.15	0.19	-0.14
Observations	2076	448	1124	504

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

Figure 7: *Decomposition trends and counterfactual*



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

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

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

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

Moving on to the market cap stagnation during 1914–1985, Table 1 column 2 shows that, indeed,

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

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

[7] Capital gains and GDP growth are combined to reduce complexity, but Appendix Figure A.4 presents all three series separately.

the average post-1985 market cap to GDP growth during this time period was roughly zero. The relatively robust net issuances (on average, 4.1% of market cap) were held back by negative real capital gains (-1.2% p.a.), and higher than average real GDP growth (3.2% p.a.). Figure 7 shows that these negative capital gains were a result of several large shocks that hit the equity market during this period. The largest aggregate shocks occurred during World War 1 and the 1970s stagflation. World War 2 and the Great Depression also had a negative, but smaller, effect on the stock market. These aggregate trends mask further shocks that hit individual countries, with the largest of these occurring during the Portuguese Carnation Revolution of 1974. In its aftermath, the Portuguese stock market lost roughly 98% of its value (see Figure A.3 and discussion in Jordà et al., 2017a). The impact of other political shocks, such as the Spanish Civil war and the Nazi occupation was sometimes negative, but generally small (see Le Bris, 2012, for the case study of occupied France).

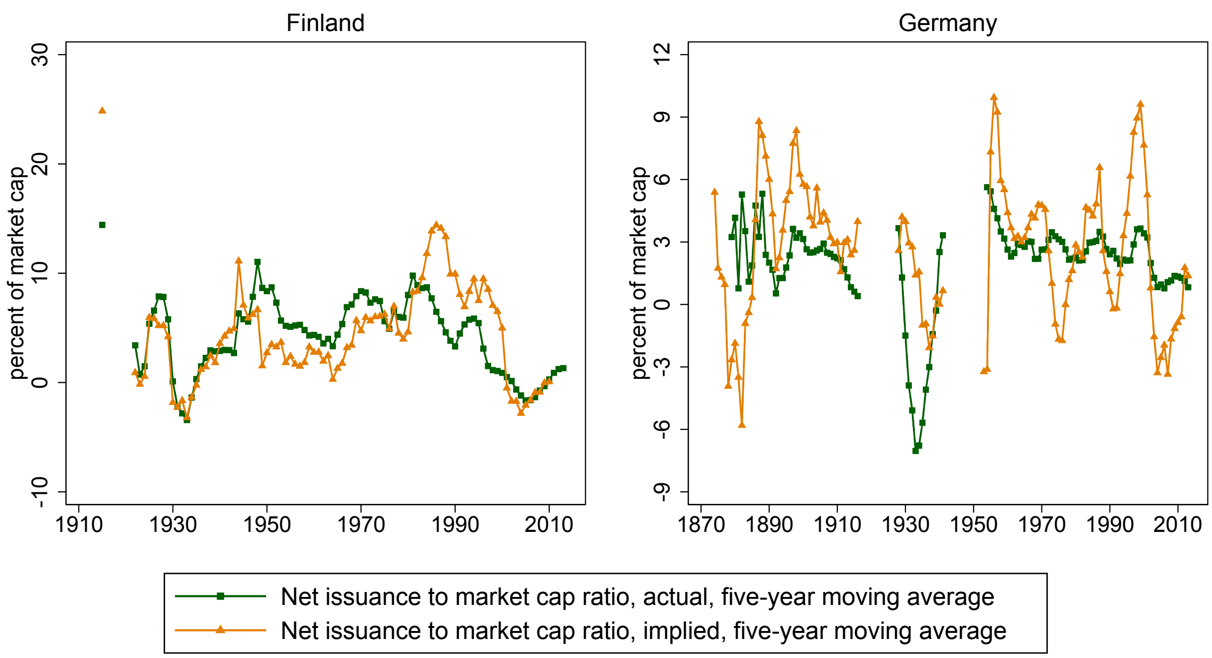
Column 4 of Table 1 captures the period of the big bang, or explosive and persistent growth in market capitalization in the 1980s and 1990s. On average, market cap to GDP ratios grew by around 4.5% per year, or 3.3% of GDP (4.5% times the average market cap to GDP ratio of 0.7). This growth was not driven by net issuances: these were on average slightly lower than over the full sample.[8] Lower real GDP growth made a positive, but relatively small contribution (2.3% p.a. vs 2.8% p.a. full-sample average). Instead, the big bang is largely driven by higher real capital gains. Stock prices grew at a rate of 3.5% per year in real terms, almost ten times the full sample average. Figure 7 shows that these increases largely occurred in the 1980s and 1990s, and were only partially tempered by the burst of the dot-com bubble in 2000 and the Global Financial Crisis.

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

How robust are the findings in Table 1? The first thing to note is that our net issuance data are simply a proxy, or residual: the change in market capitalization that is not accounted for by capital gains. It is, therefore, subject to measurement error. This measurement error would arise if there is an inconsistency between the equity price index and the stock market capitalization measure. This inconsistency tends to be driven by either timing, or coverage differences. In terms of timing, we seek to measure both market capitalization and equity prices at the end of each calendar

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

Figure 8: *Implied and actual net equity issuance*



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

year. But this is not always possible, especially with the historical data. If, for example, the market capitalization is measured at end-of-year, equity prices at mid-year, and the stock price increases during the second half of the year, this increase would be interpreted as higher net issuance. In terms of coverage, market capitalization, by definition, covers all listed firms. The stock price index, however, may be based on a subsample of firms, or an unweighted average of all firms, which means that the price gain in the index may not be reflected of the all-firm market cap weighted average. For the vast majority of the sample, we use best-practice all-firm value weighted equity price indices, as detailed in Jordà et al. (2017a). But for some countries and years, we rely on a subsample of firms, or weights other than market capitalization, which may create a discrepancy.

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

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

We also check whether aggregate trends in Table 1 mask cross-country heterogeneity. In particular, as discussed in Section 3, the US stock market is by far the largest globally, so the big bang on a global scale would largely be influenced by developments in the US, rather than the cross-country averages in Table 1. Table 2 presents the decomposition results for each country, for the periods before (columns 1 - 3) and after the big bang (columns 4–6), with aggregate market cap growth (columns 1 and 4) made up by net equity issuance (columns 2 and 5) and the $r_t^{eq} - g_t$ gap (columns 3 and 6).

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

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

Figure 9 graphically illustrates the cross-country correlation of market capitalization growth (y axis) with changes in net issuance (x axis, Figure 9a), and capital gains less GDP growth (x axis, Figure 9b), again, for the pre and post big bang periods. We exclude Japan and Portugal from the sample, so that the analysis is not overshadowed by the effects of the Japanese stock market bubble and the Portuguese revolution. Both before and after the big bang, the cross-country differences

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

Country	(1)	(2)	(3)	(4)	(5)	(6)
	Pre 1985			Post 1985		
	$g_t^{MCAP/GDP}$	iss_t	$r_t^{eq} - g_t$	$g_t^{MCAP/GDP}$	iss_t	$r_t^{eq} - g_t$
Australia	.61	2.28	-1.72	3.33	4.47	-.99
Belgium	-.15	2.85	-3.36	4.93	2.91	2.74
Canada	.11	2.46	-2.98	3.47	2.39	.71
Germany	1.09	2.64	-1.66	2.82	1.86	1.13
Denmark	.1	2.98	-2.98	5.81	1.08	4.87
Finland	-.76	5.17	-5.16	7.02	4.86	3.43
France	-.46	5.55	-6.34	5.89	4.1	2.05
Italy	1.11	6.91	-5.22	3.06	4.88	-1.65
Japan	5.88	10.21	-4.46	2.15	2.02	-.29
Netherlands	.96	3	-2.21	4.35	3.37	1.54
Norway	.67	5.64	-4.69	4.59	3.61	.73
Portugal	-1.32	4.81	-5.05	9.79	15.27	-2.87
Spain	-.15	4.5	-5.18	5.78	4.79	1.05
Sweden	1.56	3.88	-2.31	4.32	.24	3.96
Switzerland	.82	2.58	-1.71	4.06	.9	2.86
UK	.32	1.35	-1.23	1.94	2.08	.07
USA	.28	1.97	-2.16	3.2	.3	2.89

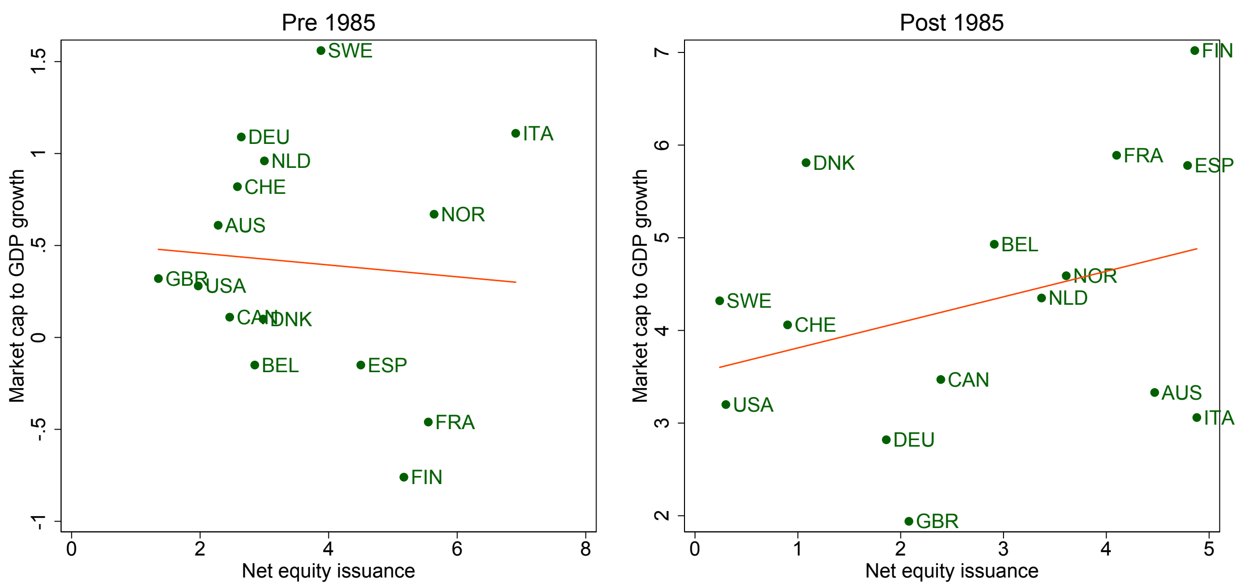
Notes: Decomposition of log market cap to GDP growth into issuances, capital gains less GDP growth using equation (5). $g_t^{MCAP/GDP}$ is the growth in stock market capitalization, iss_t is net issuance relative to last period's market cap, and $r_t^{eq} - g_t$ is the difference between capital gains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

in the market cap to GDP ratio are largely explained by capital gains, not issuances. Net equity issuance shows no correlation with cross-country market cap growth before 1985, and only a small positive correlation after 1985 (Figure 9a). By contrast, capital gains show a large positive correlation (Figure 9b). After 1985, market capitalization grows almost one for one with the $r_t^{eq} - g_t$ gap, as shown by the near-45 degree slope of the line in the right-hand panel of Figure 9b.

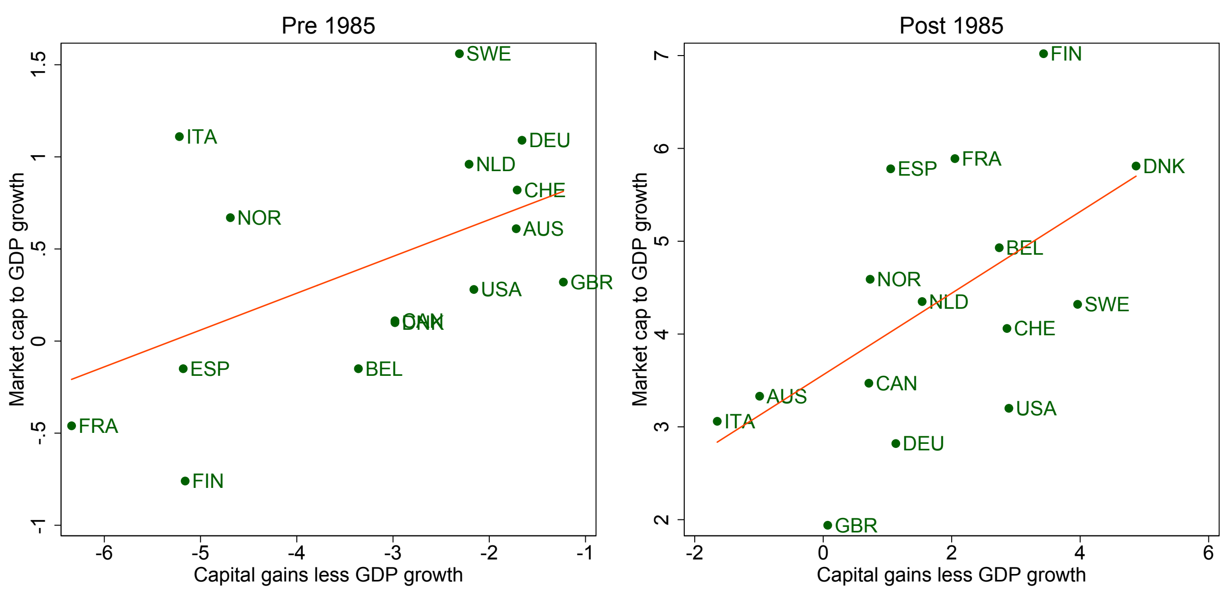
The decomposition of stock market cap growth into issuance, capital gains and GDP growth suggests that even at long horizons, the time trends and cross-country differences in market capitalization are largely a result of changing prices, not quantities. This is particularly true for the period that saw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

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

(a) *Market cap growth and equity issuance*



(b) *Market cap growth and capital gains*



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

5. Structural drivers of stock valuations

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

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

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

5.1. Pre-tax cashflows

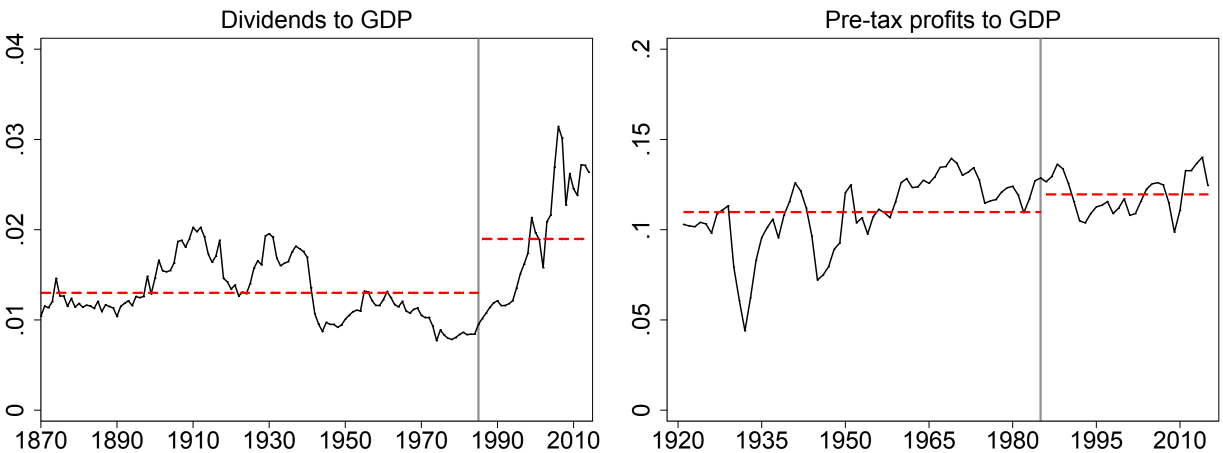
Over the long run, listed equity cashflows CF_t should correspond to total dividends paid by listed firms. The left-hand panel of Figure 10 shows the evolution of dividend payments of listed companies relative to GDP.[9] The big bang coincided with a structural and persistent increase in dividends, which rose by a factor of 2.5 between 1985 and 2015, from 1% to 2.5% of GDP. This substantial increase in dividends to GDP occurred virtually universally across countries, with the notable exception of the US.[10] The dividend-to-GDP ratio also shows positive co-movement with market cap over the earlier historical period.

But in one sense, the dividend measure is too narrow: an equity share is a claim to all future profits of the firm, not just those distributed as dividends. Even though distributed and total profits should be roughly equal in the long run, they can deviate substantially over prolonged time periods as a result of changes in payout policies of firms, or intertemporal substitution between current and future payouts. This means that the underlying firm profitability may offer a better measure of the long-run expected future cashflow payments. The right-hand panel of Figure 10 displays the total pre-tax profits of private corporations, again relative to gross output. The dividend-to-GDP data cover the full sample, whereas profits to GDP cover four countries – Canada, France, Japan and the US – and start in 1920. The vertical line in 1985 indicates the approximate start date of the big bang. When it comes to corporate profits no trend is evident. Pre-tax profits have remained more or less flat after 1980, and close to their historical level of around 11% of GDP. Similarly, Gutierrez (2017)

[9] 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, $MCAP_t/GDP_t$.

[10] This means that on a GDP weighted or market cap weighted basis, the post-1980s increase in dividends is much smaller.

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



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

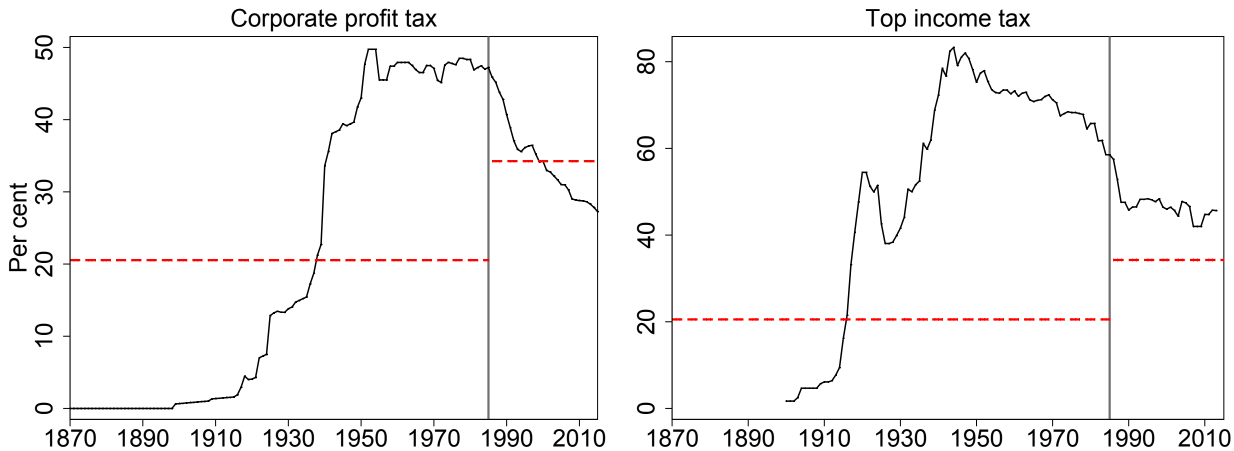
shows that profit shares are surprisingly constant across countries.[11] We discuss the changes in corporate taxation in Section 5.2, but for now Appendix Figure A.5 shows that post-tax profits have also remained flat since 1980.

Taken together, the evidence in Figure 10 suggests that cash distributions to shareholders have increased around the time of the big bang, but it is unclear whether this increase corresponds to higher expected future cashflows. The fact that profits have changed little while dividends have increased sharply is puzzling. On the one hand, dividends paid may be a poor proxy of expected future cashflows. The post-1980 dividend increase may be measuring a temporary increase in payouts at the expense of future distributions – in fact, has to be if we believe that profitability has not increased. On the other hand, it could be the case that the corporate profit data in Figure 10 is a poor measure of the underlying profitability of listed firms. The profit data cover all firms, rather than only those that are listed, and could be subject to measurement error, because they come from national accounts rather than firms' financial statements.[12] In particular, listed firm profitability may have increased at the expense of unlisted firms, especially if listed firms are on average larger and have increased their market power (see De Loecker and Eeckhout, 2017, for evidence of rising market power for the US). Further to this, firms in advanced economies have increasingly declared a large of their profits off-shore to minimise corporate tax payments (Zucman, 2014).

[11] Profits after corporate tax recorded a small increase in the USA, but as we show in Section 5.4, tax changes play little role in explaining the big bang.

[12] A part of capital income in national accounts is attributed to "factorless income". Some authors have interpreted a recent increase in factorless income in the US as a sign of higher corporate profits (Eggertsson, Robbins, and Wold, 2018). However, Karabarbounis and Neiman (2018) show that a large part of the increase in factorless income in the US since the 1980s is driven by lower risk premiums, which is precisely what we want to exclude from our economic cashflow measures. Therefore, for the purpose of Figure 10 we stick to the narrower and more standard definition of corporate profits in national accounts.

Figure 11: *Taxation and the big bang*



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

5.2. Taxes

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

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

Both corporate and top income taxes were close to zero in the late 19th and early 20th century, before rapidly shooting up to reach levels of close to 50% and 80% respectively shortly after World

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

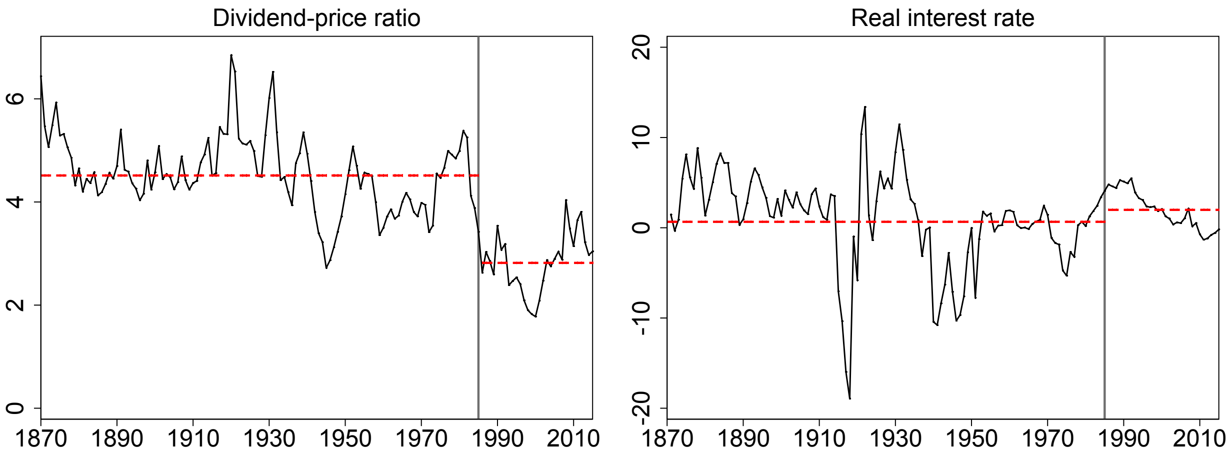
5.3. Discount rates

Ex ante discount rates on equities are not directly observable. But Campbell and Shiller (1988) show that the discount rate can be proxied by the dividend-price ratio, as long as this ratio helps forecast future stock returns. Kuvshinov (2018) shows that high stock valuations – or low dividend-price ratios – do forecast low future stock returns at short and medium term horizons in our historical sample. This means that the dividend-price can be used to proxy the equity discount rate ($1 + r_t$ in equation (6)).

The left-hand panel of Figure 12 plots the long-run evolution of the dividend-price ratio. The vertical line marks the start of the big bang in 1985, and the two dashed lines plot the pre- and post- big bang sample averages of the series. Discount rates were stable until the 1980s at around 4–5% p.a. Around the start of the big bang, discount rates fell sharply and reached the all-time historical trough of 2% at the height of the dot-com bubble in 2000. Since then, discount rates recovered somewhat and increased in the Global Financial Crisis, but remain substantially below the pre-1980 mean. This is also clearly evident when comparing sample means before and after 1985. Consistent with this, structural break analysis suggests that most countries in the sample experienced a structural break in the dividend-price ratios in late 1980s or 1990s (see Lettau and Van Nieuwerburgh, 2008 for the case of US, and Kuvshinov, 2018 for the other countries). These facts suggest that at least part of the increase in stock valuations, and hence market cap, since the 1980s can be attributed to lower discount rates.

The fall in the discount rate since the 1980s could correspond to either lower risk premiums, or a lower risk-free. The right-hand panel of Figure 12 plots the ex post real risk-free rate: the short-term safe rate minus the rate of inflation. The short-term real rate data come from Kuvshinov (2018) and Jordà et al. (2017a), and are primarily short-term government bill rates, complemented with deposit and money market rates for the historical periods. Once again, the vertical black line signals the start of the big bang in stock market cap around 1985. Consistent with the evidence on ex ante risk-free rates in Holston, Laubach, and Williams (2017), the real risk-free rate has fallen across advanced economies since the start of the big bang. This fall, however, is neither particularly large nor unprecedented in light of historical developments further back in time. Ex post real rates had been much lower both during wars and peacetime, and the real rates during the 1990s were around the historical peacetime average. Many of the historical troughs in ex ante expectations – in

Figure 12: *Discount rates and the big bang*



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

particular, those during wars – are likely to correspond to inflation surprises rather than shifts in the ex ante rate. Still, the risk-free rate in the 1990s was close to that in the 1950s and 1960s, a time period without substantial positive inflation surprises, and one where stock market cap was close to the historical average (Figure 1). This suggests that even though lower ex ante safe rates may have contributed to the big bang, much of the fall in the equity discount rate is likely attributable to lower risk premia.

5.4. Quantifying the contribution of different drivers

The long-run evidence in Figures 12, 10 and 11 suggests that the big bang is driven by a combination of more favourable stock market fundamentals, and lower ex ante compensation for risk demanded by equity investors. To quantify the relative contribution of potential drivers, we turn to cross-country explanatory regressions. Table 3 regresses the stock market cap to GDP ratio on dividends to GDP, dividend-price ratio, real interest rates and corporate taxes. In order to capture structural trends, we analyse the relationship in levels and changes happening over a medium (5-year) and long (10-year) horizon.[13]

Consistent with the long-run trends in Figures 12 and 10, stock market cap is strongly correlated with changes in discount rates and cashflows. On the contrary, market cap shows no correlation with current or future corporate taxes, and real interest rates. Contemporaneously, a one percentage point increase in the dividend to GDP ratio predicts around 20–25 percentage points higher market cap to

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

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

	Levels		5-Year Changes		10-Year Changes	
	(1)	(2)	(3)	(4)	(5)	(6)
D_t/GDP_t	25.26***	26.21***	23.63***	30.39***	24.98***	26.40***
	(2.4)	(2.8)	(2.8)	(6.1)	(2.3)	(4.3)
D_{t+1}/GDP_{t+1}	1.33	0.89	0.43	2.35	3.30*	-1.45
	(1.9)	(1.9)	(1.0)	(2.5)	(1.8)	(2.6)
D_t/P_t	-8.89***	-9.89***	-6.74***	-8.44***	-5.86***	-6.73***
	(1.2)	(1.8)	(1.2)	(1.8)	(1.1)	(1.9)
r_t	0.03	-0.19	-0.05	-0.32	-0.16	-0.42
	(0.1)	(0.2)	(0.1)	(0.3)	(0.1)	(0.3)
τ_t^{corp}		-0.09		0.16		0.11
		(0.2)		(0.1)		(0.2)
τ_{t+1}^{corp}		0.00		0.05		-0.33*
		(0.2)		(0.1)		(0.2)
R^2	0.743	0.718	0.476	0.486	0.608	0.509
Observations	1879	849	1652	681	1475	520

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

GDP, consistent with the average price-dividend ratio of 20–25 in our sample. But market cap shows little co-movement with future dividend payments. One percentage point lower dividend-price ratios predict 7–10 percentage point higher market cap.

The lack of correlation with taxes and real interest rates is relatively robust: for example, it also holds for income taxes, effective corporate tax rates – i.e. total taxes paid as a share of corporate profits – and under a variety of alternative regression specifications.[14] Nevertheless, several caveats are in order. First, even though tax policy seems to have little impact on the aggregate size of listed equity holdings, it may still affect the form in which these equities are held. Rydqvist, Spizman, and Strebulaev (2014) show that tax policy has played an important role in the increasing indirect equity ownership across advanced economies since the 1950s. Second, our ex post real interest rate is an imperfect measure of the forward looking expectations of safe asset returns. That being said, the long-run evidence in Figure 12 and a lack of correlation at long horizons in Table 3 (columns 5 and 6) suggest that even the ex ante real rate movements may only play a modest role in the big bang.

Turning to pre-tax cashflows and risk premiums, since the early 1980s, dividend payments have

[14]Results are available from authors upon request.

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

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

It is likely that rising market power has contributed to higher stock valuations and the big bang, but it is also unlikely to tell the whole story. Gutierrez (2017) shows that there is little evidence of increasing firm profitability outside the US. Indeed, the relative stability of corporate profits before and after the big bang, shown in Figures 10 and A.5, holds both in and outside of the US. Much of the discrepancy between the stability of corporate profits and the declining labour share is driven by rising residual factorless income in national accounts. But recent work by Karabarbounis and Neiman (2018) suggests that this factorless income has more to do with lower risk premiums than higher economic profits. Finally, the evidence on mark-ups only goes back to the 1980s, but historical narrative suggests that monopoly power and mark-ups were at least as high during the late 19th century, a time when stock market cap and dividends relative to GDP were both much lower than today.

All this suggests that a large part of the big bang is driven not by fundamental factors, but by lower discount rates and risk premiums (see also Figure 12). There are a number of reasons as to why risk premiums might have fallen since the early 1980s. Equity premia may have declined because investors' consumption has become less volatile, as argued by Lettau, Ludvigson, and Wachter (2008) for the US. But as Appendix Figure A.6 shows, consumption volatility has been steadily declining since the late 19th century, while the global equity premium decline and the big bang are much more recent phenomena. Bianchi, Lettau, and Ludvigson (2016), instead, link the structural fall in the equity risk premium to the emergence of inflation targeting as the dominant monetary regime. Another potential force behind falling risk premiums is a higher demand for risky assets, either domestic – driven by lower market regulations and easier market access via institutional investors – or global, manifesting emerging markets' desire to save for a rainy day (Bernanke, 2005). Indeed, data from the Survey of Consumer Finances in Appendix Figure A.7 show that stock market participation in the US has increased substantially since the 1980s.

Putting risk premiums at the center of the story sheds a different light on the rise in dividend payments around the big bang. It could be that this increase in dividends, rather than driving market cap, was itself driven by higher market valuations, and firms targeting fixed or slow-moving payout ratios. The higher dividends may have then come at a cost of lower retained earnings, higher corporate leverage (see Graham, Leary, and Roberts, 2015, for the evidence in the US), and hence higher macroeconomic and financial risk which, perhaps, eventually materialised during the Global Financial Crisis. But is this link between high stock market cap, low risk premiums, and high subsequent financial risk, a general pattern, or just a possible one-off coincidence that took place over the recent years? The next section helps answer this question by more formally evaluating the link between cyclical movements in stock market capitalization, and equity market returns and risks.

6. Stock market capitalization and equity market risk

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

6.1. Market capitalization as a predictor of stock returns

Stock market capitalization is correlated with equity risk premium measures such as the dividend-price ratio (Figure 12 and Table 3). This correlation, however, does not fully capture the link between market cap and cyclical movements in risk premiums. On the one hand, dividend-price ratios can change in response to changes in expected cashflows (i.e. future dividends), and stock market capitalization may in turn also react to these cashflow, rather than risk premium movements. On the other hand, it may be that stock market cap itself is a better measure of the equity risk premiums than the dividend-price ratio – a finding that would be consistent with the fact that book-to-market ratios are powerful predictors of individual stock returns (Fama and French, 1993). In this case, the correlations in Figure 12 and Table 3 would understate the importance of risk premiums in determining the size of the equity market. These propositions can be easily tested within the framework of return predictability regressions (see Cochrane, 2011, for a summary). If market cap is driven by future cashflows, high market cap should forecast high future dividend growth. If it is driven by discount rates, high market cap should forecast low future equity returns. We test these

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

	Real returns		Excess returns		Real dividend growth	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel 1: *One-year ahead returns and dividend growth*						
$log(MCAP_t/GDP_t)$	-0.037***	-0.029**	-0.032***	-0.027***	-0.008	-0.053***
	(0.007)	(0.010)	(0.005)	(0.008)	(0.009)	(0.015)
$log(D_t/P_t)$		0.030		0.018		-0.161***
		(0.017)		(0.017)		(0.035)
R^2	0.015	0.019	0.011	0.012	0.000	0.065
Observations	1987	1987	1987	1987	1987	1987
Panel 2: *Five-year ahead average returns and dividend growth*						
$log(MCAP_t/GDP_t)$	-0.039***	-0.035***	-0.033***	-0.029***	-0.004	-0.032***
	(0.006)	(0.007)	(0.004)	(0.005)	(0.006)	(0.009)
$log(D_t/P_t)$		0.014		0.013		-0.102***
		(0.012)		(0.010)		(0.016)
R^2	0.083	0.087	0.062	0.066	0.001	0.181
Observations	1884	1884	1884	1884	1884	1884

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

two hypotheses by running the following predictive regressions:

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

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

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

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

First, high stock market capitalization forecasts low equity returns, and hence is a measure of low discount rates. The estimated coefficient β_1 is negative for both real and excess returns, and at a one-year as well as five-year horizon. Using the richer specifications in column 2, a 10 percentage point increase in the stock market cap to GDP ratio (25% in relative terms) forecasts 0.8 percentage points lower returns 1 year ahead ($0.25 \times (-0.03) \times 1.048$), and 5.2 percentage points lower returns 5 years ahead ($0.25 \times (-0.04) \times 1.048 \times 5$). As discussed, discount rates can be driven by the risk-free rate or the equity risk premium. Columns 3 and 4 show that stock market cap predicts *excess* equity returns with a similar statistical significance, sign and magnitude of the coefficient. Consistent with the long-run evidence in Figure 12, this suggests that stock market cap reflects movements in the equity risk premium, rather than the risk-free rate.

Second, market cap is a better predictor of equity returns than the more commonly used dividend-price ratio. Once included in the same specification (columns 2 and 4), the coefficient on the dividend-price ratio becomes insignificant, and the R^2 stays roughly the same as with market cap alone. This is especially true for longer horizon regressions, and those for excess equity returns.

Finally, high stock market capitalization is not a sign of high future cashflows. The coefficient γ_1 on real dividend growth in column 5 is statistically insignificant. Once the dividend-price ratio is added to the regression (column 6), the coefficient even turns significantly negative. 10 percentage point higher stock market cap forecasts 1.4 ppts lower real dividend growth one year ahead ($0.25 \times (-0.055) \times 1.003$), and 4.8 ppts lower dividend growth five years ahead ($0.25 \times (-0.038) \times 1.003 \times 5$). High price-dividend ratios are, on the contrary, a sign of high future cashflows.

Appendix Table A.1 presents the predictability regression estimates for the longer 10-year horizon, and for the post-1985 period. These are particularly important for our understanding of the long-run trends and structural breaks that underly the big bang. If anything, the patterns in the data discussed above become stronger. A 10 percentage point increase in stock market cap to GDP forecasts 26 ppts lower cumulative real equity returns, and 14 ppts lower real dividend growth 10 years ahead. After 1985, a 10 ppt increase in stock market cap to GDP forecasts 3.2 ppts lower returns one year ahead.

Warren Buffett famously called stock market capitalization the "the best single measure of where valuations stand at any given moment" (Buffett and Loomis, 2001). Our findings largely confirm his priors. But why does market capitalization do so well as an equity return predictor? The natural explanation is that unlike the other commonly used valuation measures, it contains information on quantities as well as prices. Even though quantity changes play a relatively small role in long run structural trends (Section 4), cyclical swings in net equity issuance may still tell us something about future returns. Indeed, existing evidence for the US suggests that high equity issuance tends to precede periods of substandard market returns (Baker and Wurgler, 2000; Nelson, 1999). With our new data, we can test whether such patterns hold in our richer cross-country setting.[15]

Table 5 tests whether net equity issuance predicts future equity returns and dividend growth.

[15]The superior performance of the market cap to GDP ratio when compared to the dividend-price ratio could also be because GDP is a better measure of fundamentals than dividends. Since dividends are often criticised for not incorporating all future cashflows to the shareholder and for being excessively smooth relative to firm profitability (also see Figure 10), this explanation is likely to have some merit, but is difficult to formally test in our data.

Table 5: *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*						
Issuance/GDP	-0.860**	-0.786*	-0.616**	-0.545*	-0.215	-0.413
	(0.398)	(0.384)	(0.288)	(0.286)	(0.337)	(0.381)
$log(D_t/P_t)$		0.046***		0.043***		-0.121***
		(0.010)		(0.012)		(0.029)
R^2	0.011	0.021	0.006	0.015	0.000	0.048
Observations	1907	1907	1907	1907	1907	1907
Panel 2: *Five-year ahead average returns and dividend growth*						
Issuance/GDP	-0.362**	-0.311*	-0.380***	-0.331**	-0.053	-0.162
	(0.161)	(0.150)	(0.119)	(0.119)	(0.103)	(0.104)
$log(D_t/P_t)$		0.034***		0.033***		-0.074***
		(0.009)		(0.009)		(0.013)
R^2	0.010	0.040	0.012	0.040	0.000	0.120
Observations	1810	1810	1810	1810	1810	1810

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

The format follows that of Table 4: we regress log real and excess returns, and real dividend growth, one and five years ahead, on net issuance relative to GDP, alone and alongside the dividend-price ratio. Because net issuance is derived as a residual, it is subject to measurement error (see Section 4), and we average net issuance over the preceding three years to guard against this. Returns and dividend growth are expressed in logs, but as before, the results in levels are very similar.

Our findings support the intuition spelled out above. Net equity issuance robustly predicts low future real and excess returns, one and five years ahead, but it does not predict high future cashflows. A 1% of GDP increase in net equity issuance signals 1 percentage point lower returns one year ahead, and 2 percentage points lower returns five years ahead.[16] The return coefficients on the issuance to GDP ratio remain significant once the dividend-price ratio is added to the regression, but unlike the market cap regression in Table 4, the dividend-price ratio retains its predictive power. This confirms our prior that these variables measure two different things, quantities and prices, both of which help predict future returns. The strength of the market cap to GDP ratio is that it combines these two metrics.

The fact that high net equity issuance predicts low future returns suggests that changing investor sentiment plays a role in driving cyclical market cap movements. Baker and Wurgler (2000) argue

[16] The calculation for one year is 1*0.79 = 0.8% relative increase in the real total equity return, from 1.04 to 1.05.

that firms time the market to issue equity when investors are overoptimistic, and sentiment – elevated, even though these periods are subsequently followed by poor investor returns. Compared to traditional price-based valuation metrics, the market cap to GDP ratio is likely to better capture such swings in sentiment. Greenwood and Hanson (2013) also argue that times of elevated sentiment open the market up to poorer quality issuers. Deteriorating issuer quality can help explain why, conditional on price valuations, high market capitalization forecasts low, rather than high dividend growth.

We have shown that risk premiums and sentiment, as measured by the market cap to GDP ratio, help reliably predict average future returns. Next we turn our attention to the more extreme tails of the return and market cap distribution, and examine the link between rising levels of market capitalization, equity bubbles and crashes.

6.2. Equity bubbles and crashes

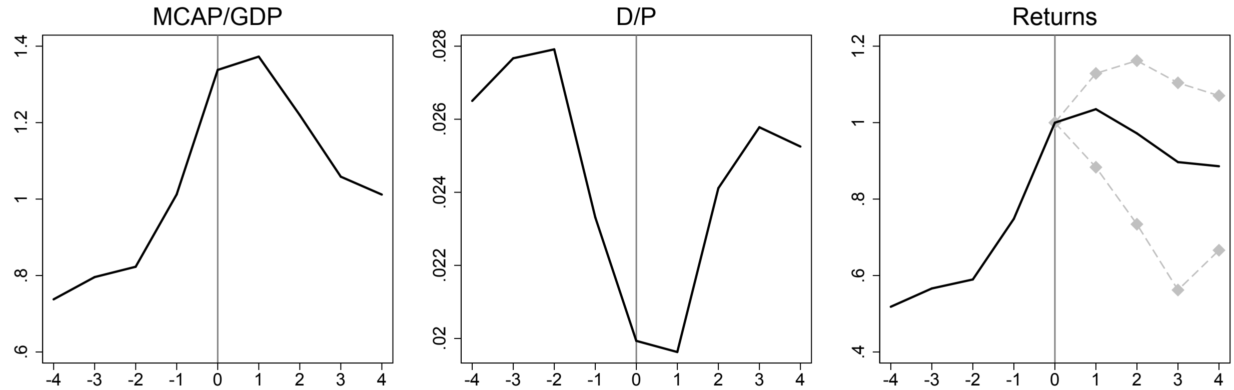
To test whether changes in market capitalization can inform us about stock market bubbles and crashes, we investigate how the equity market behaves during and after sharp increases in stock market cap. To define a "sharp" increase, we follow existing literature, and in particular the Greenwood, Shleifer, and You (2018) definition of sector-specific equity market bubbles. Greenwood et al. (2018) define equity market run-ups as sharp increases in real equity returns over two years, that follow persistently high returns over a longer time period. In a similar vein, we define a market cap run-up as a 35% GDP or more increase in market cap over 2 years, that follows a cumulative increase of at least 17.5% GDP over 5 years. Adding the 5-year growth assumption allows us to focus on run-ups and exclude recoveries from temporarily low market cap levels. This definition gives us roughly the same number of run-ups as the Greenwood et al. (2018) definition that is based on growth in the total return index.[17]

Figure 13a shows the trends in stock capitalization, dividend-price ratios and stock returns during and after such run-ups in market cap. The typical market cap increase during the run-up is around 60% of GDP (Figure 13a left-hand panel). The middle panel of Figure 13a shows that a run-up in market cap is accompanied by increases in more conventional measures of stock valuations: the dividend-price ratio, on average, falls by almost a percentage point (one-quarter of its long-run mean) during these episodes. Stock returns (right-hand panel) are also high. The boom, however, quickly runs out of steam and is typically followed by a sharp correction in market cap. After the sharp increase, stock market cap falls on average by 40% of GDP, dividend-price ratios increase, and real returns are on average negative over the subsequent four years. The average geometric equity return in the sample is around 4.5% p.a., so a 10% cumulative fall in the four-year return

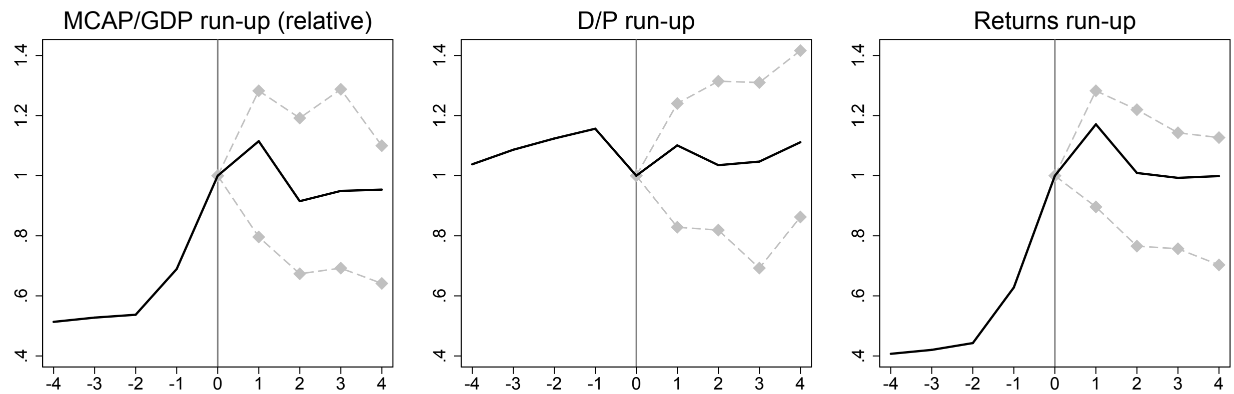
[17]Greenwood et al. (2018) define a stock market run-up as 100% growth in the sector specific stock return index over two years, and at least 50% growth over 5 years. Applied to our aggregate data, this gives us around 30 run-up observations, a number that we target with the thresholds for increases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

Figure 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 dividend-price ratio fall of 2.5 ppts or more over 2 years, and 1.25 ppts 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 $t = 0$.

represents an almost 30 percentage point drop relative to the counterfactual of mean return growth ($4.5 \times 4 + 10$). The low average real returns also come with a higher risk of equity market crashes. The grey lines in Figure 13a show the 75th and 25th percentile of cumulative equity returns after the run-up in stock market cap. Within the one-quarter of the worst outcomes, returns fall by as much as 40% in cumulative terms over 4 years.

Figure 13b shows the evolution of equity returns under alternative definitions of stock market run-ups. The left-hand panel looks at *relative* increases in stock market cap – i.e. a doubling of the market cap to GDP ratio over two years, and at least a 50% increase over five years. This places less emphasis on the events where market cap was already high before the run-up – such as the dot-com boom – and a greater emphasis on increases from low values of stock market cap. The returns

Table 6: *Predicting equity market crashes*

	(1)	(2)	(3)	(4)
$log(MCAP_{t-1}/GDP_{t-1})$	0.50^{***}		0.75^{***}	0.53^{***}
	(0.15)		(0.14)	(0.16)
$\Delta_3\ log(MCAP_{t-1}/GDP_{t-1})$		1.11^{***}	0.76^{**}	0.57^{*}
		(0.33)	(0.31)	(0.35)
$log(D_{t-1}/P_{t-1})$				-0.77^{***}
				(0.17)
Country fixed effects			✓	✓
ROC	0.62	0.64	0.71	0.71
Number of Crashes	127	125	125	125
Observations	1930	1857	1857	1804

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.

follow a similar pattern to Figure 13a, even though the average fall is not quite as pronounced. The middle panel shows returns after steep declines in the dividend-price ratio (2.5 ppts or more over 2 years and at least 1.25 ppts over 5 years). The real returns are flat, but do not generally come with overly high tail risk. The comparison of market cap and dividend-price ratio run-ups echoes the findings of Section 6.1: in general, market cap seems to be a better measure of discount rates, and stock market over- or under-valuation than the dividend-price ratio. Finally, Figure 13b right-hand panel focuses on run-ups in real returns, with the definition from Greenwood et al. (2018): a 100% increase in real returns over 2 years, and at least a 50% increase over 5 years. The results are similar to market cap run-ups, although again, the bubble aftermath is slightly less severe, with on average flat rather than declining returns, and slightly lower losses in the "market crash" tail.

Table 6 formally tests whether high levels, or growth in market cap signals a higher probability of a market crash. We define an equity market crash as a return realisation in the bottom 5th percentile of the return distribution, for one and 2 year ahead returns, which gives us a threshold of -25%.[18] To assess the link between market capitalization and equity crash risk, we estimate the following logit model:

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

where C is the equity crash dummy, X are control variables, β is the estimated coefficient vector, Λ is the logistic distribution function, and i and t are country and time indices. Table 6 reports the estimated β coefficients and standard errors. Consistent with the stylised facts in Figure 13, high

[18]We set the crash dummy $C_{i,t}$ equal to 1 if there is a -25% equity return in year t, or a -25% cumulative equity return in years t and $t+1$. Appendix Table 6 evaluates the results under a number of alternative crash definitions, and finds them more or less unchanged.

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 the dividend-price ratio (column 3), and country fixed effects (column 4). The ROC of 0.65–0.7 compares the predictive performance of our regression with a random sorting into crash and non-crash observations, and shows that our model does substantially better than the naive prediction (ROC of 0.5).[19] Appendix Table A.2 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 or growing stock market capitalization, such as that observed during the big bang, is a sign of brewing trouble in the equity market. During these times, stock markets show several characteristics consistent with a bubble: sharp increases in valuations and returns during the run-up, followed by low returns and a large risk of a stock market crash. These findings suggest that high market capitalization has a dark side. The low risk premiums that drive up equity valuations and market capitalization levels are, to an extent, rooted in investor sentiment and perceptions of market return and risk. When investor beliefs become more pessimistic, the rise in market capitalization quickly reverse, generating a market crash. Indeed, the evolution of stock market capitalization after the big bang reveals two distinct trends: the long-run structural increase, and a volatile boom-bust cycle, with multiple sharp run-ups eventually ending up as market crashes and reversals to the structurally higher post-1985 mean.

7. Conclusion

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

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

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

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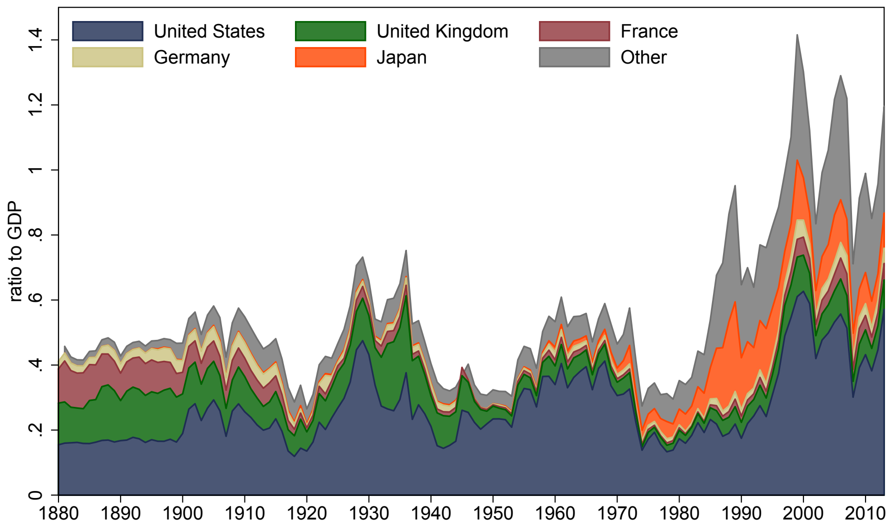
Appendix

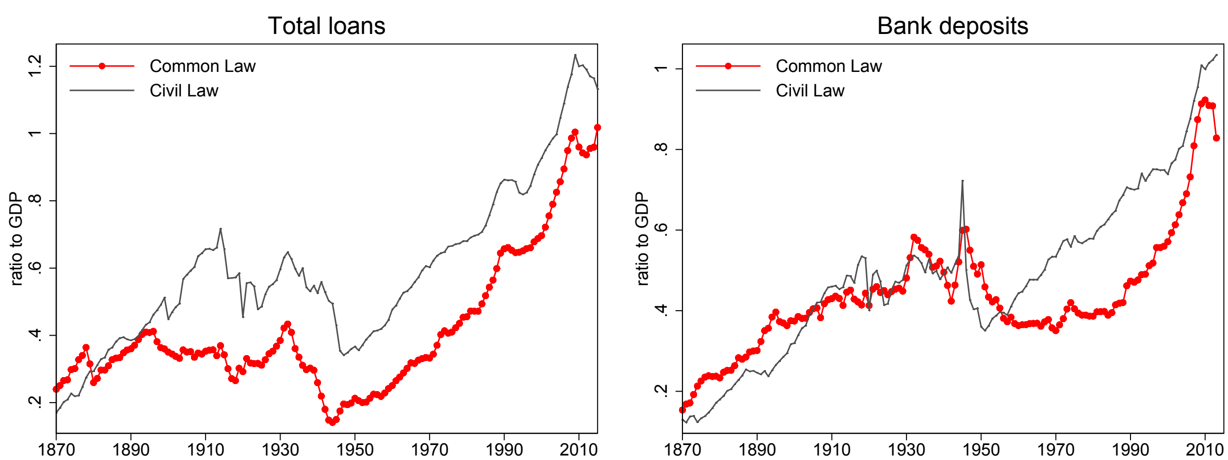
A. Trends in market capitalization

Figure A.1: *World market capitalization*



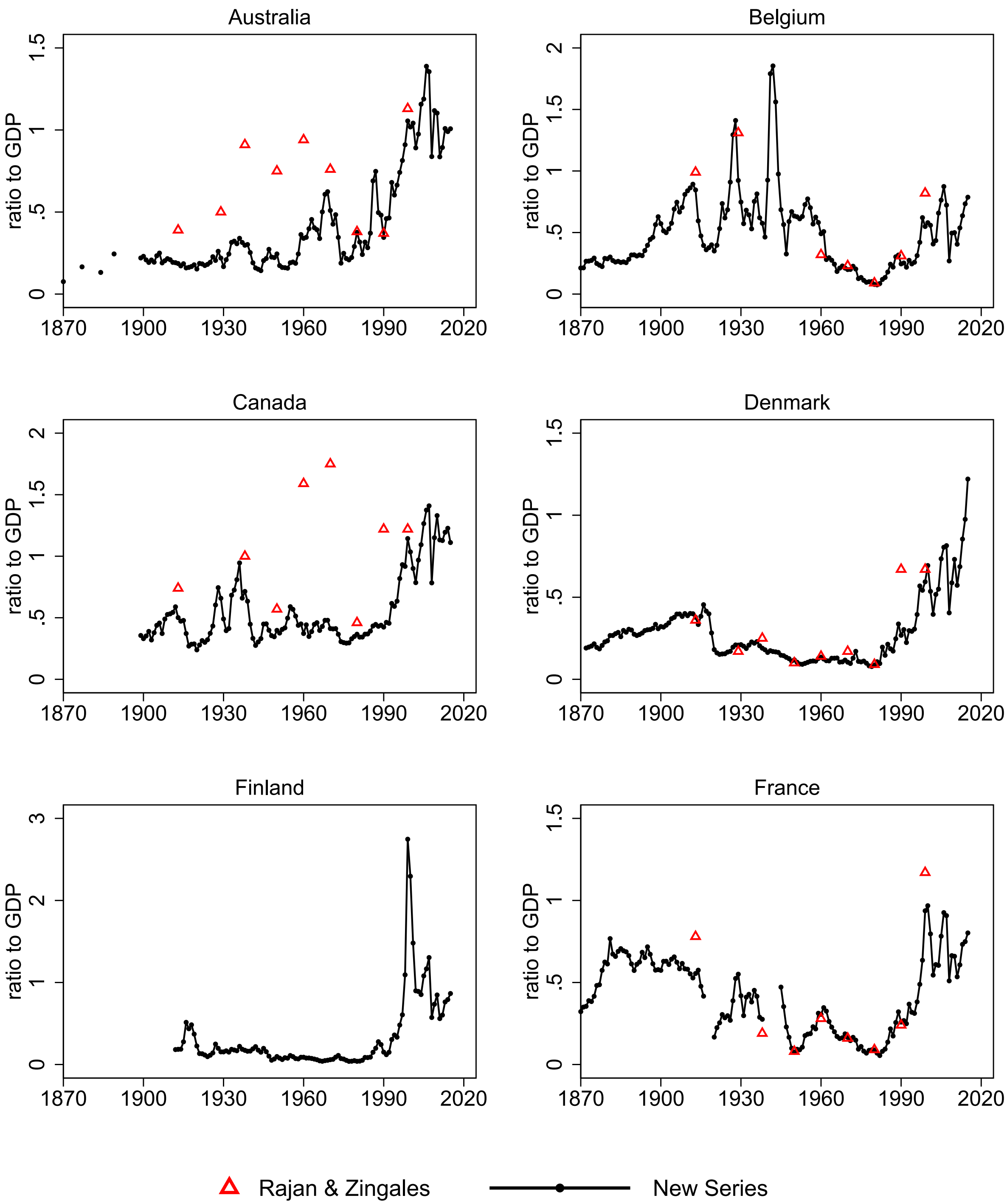
Notes: The ratio of global market capitalization to global GDP. Global variables are the sum of the 17 countries in our sample, converted to US dollars. Missing values are interpolated to maintain sample consistency. Country shares correspond to the US dollar value of the specific country's stock market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

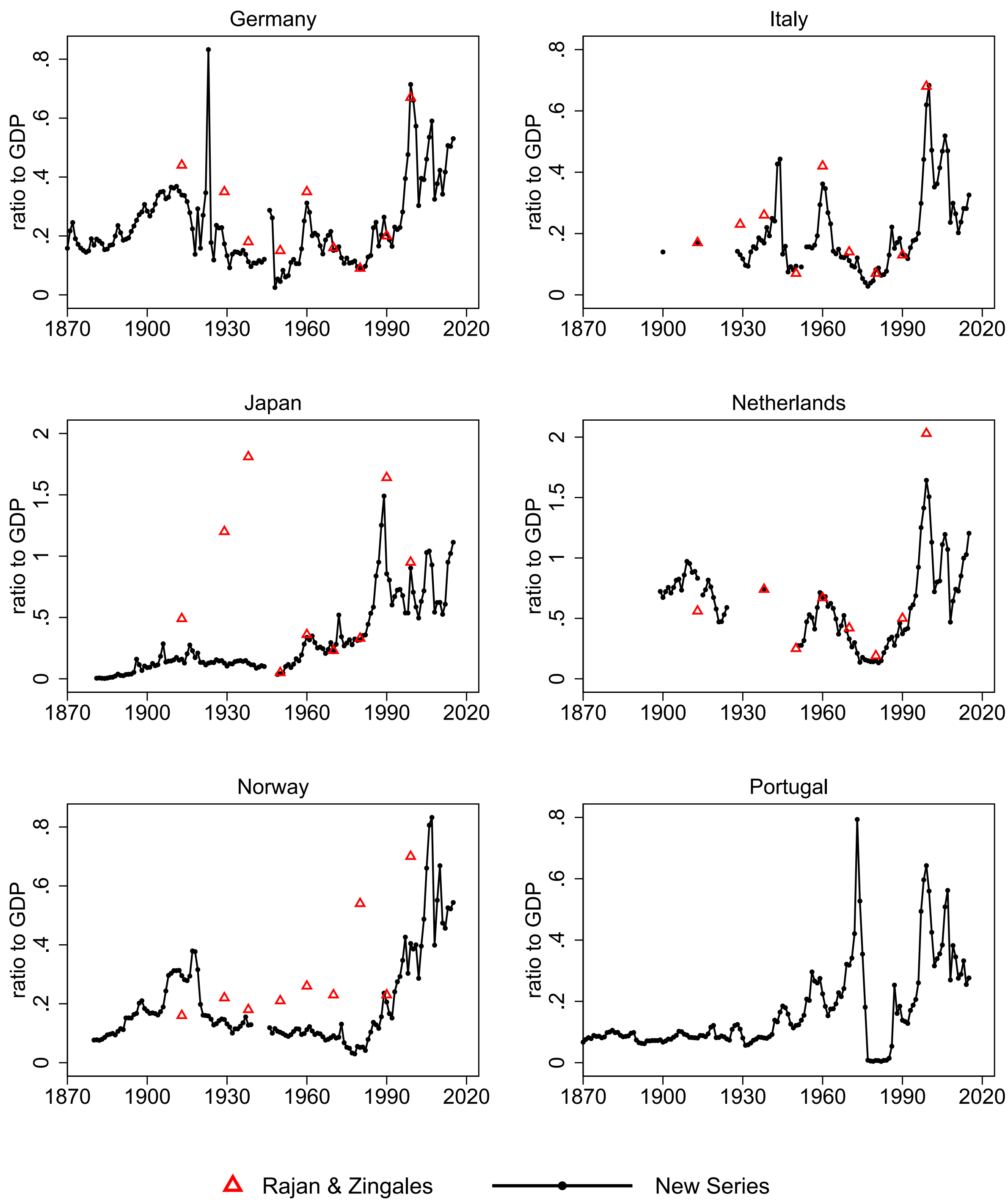
Figure A.2: *Loans, deposits and legal norms*



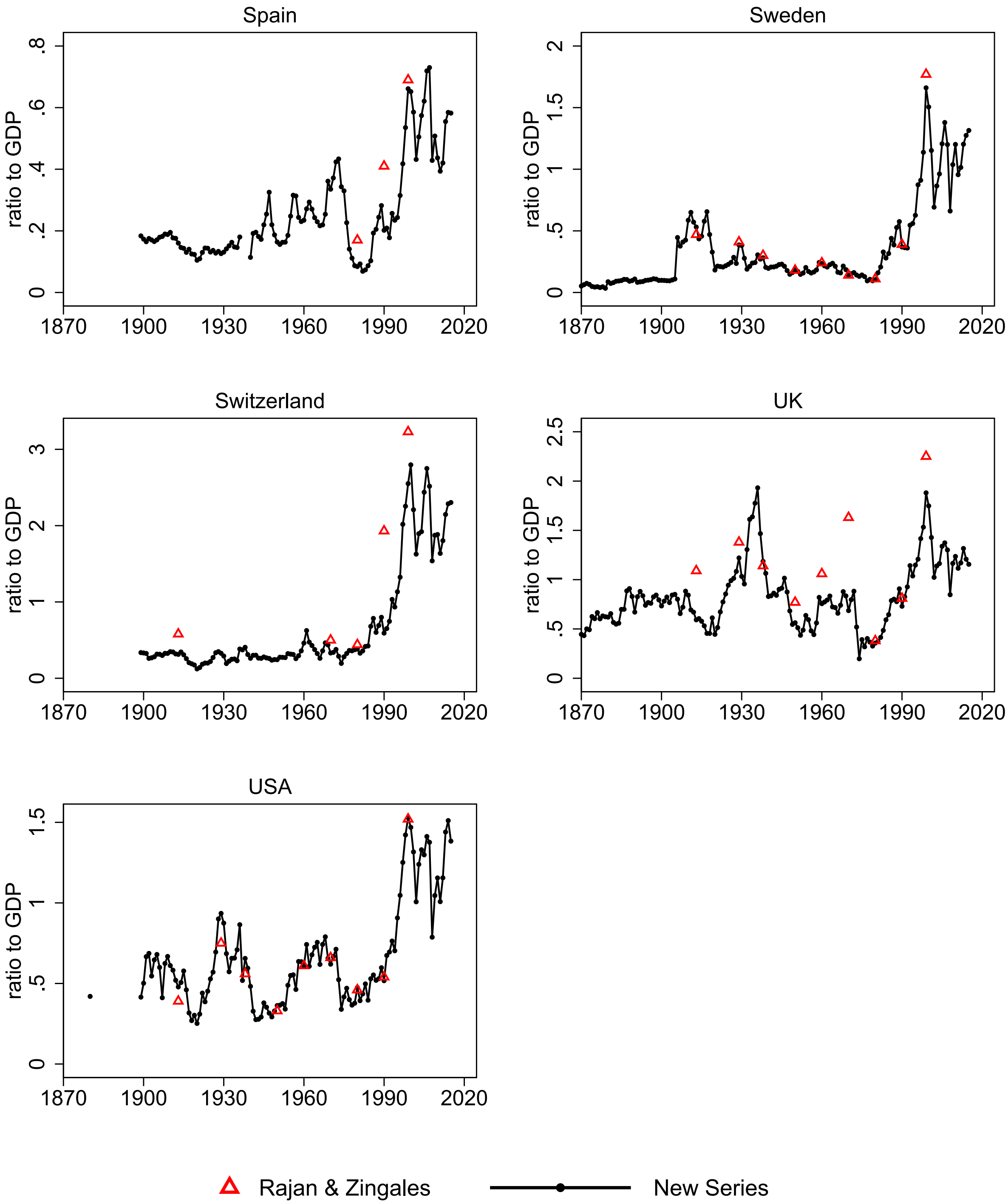
Notes: The ratio of total loans and bank deposits to GDP by country group, unweighted averages. Common law countries are Australia, Canada, the UK and the US. Civil law countries are all other countries in our dataset.

Figure A.3: *New series compared to existing sources*



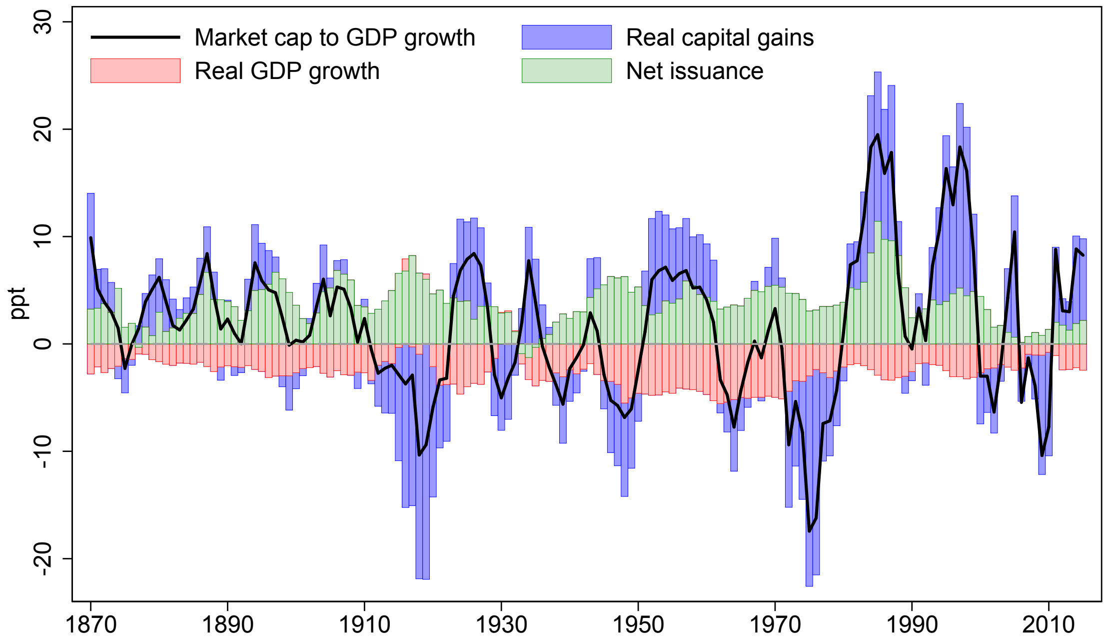


Germany
Italy
Japan
Netherlands
Norway
Portugal
ratio to GDP
1870
1900
1930
1960
1990
2020
Rajan & Zingales
New Series


Spain
Sweden
Switzerland
UK
USA
ratio to GDP
1870
1900
1930
1960
1990
2020
Rajan & Zingales
New Series

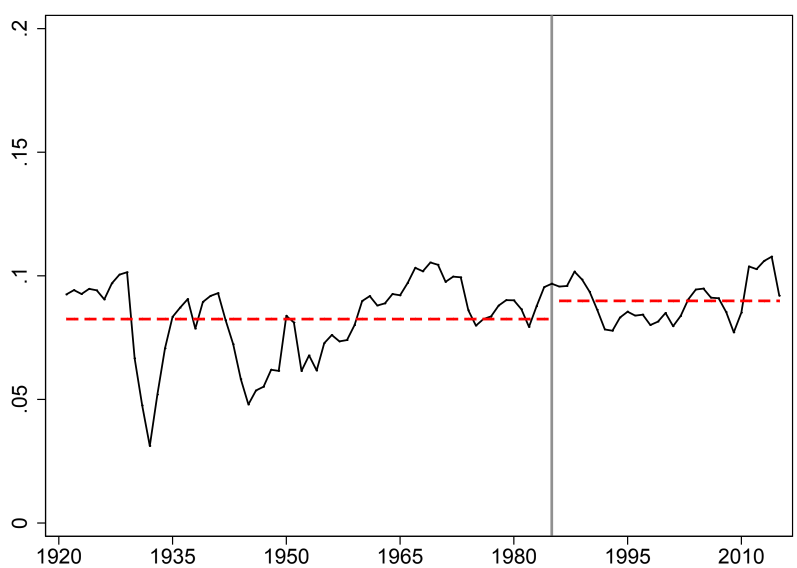
B. Drivers of stock valuations

Figure A.4: *Decomposition Trends with 3 Components*



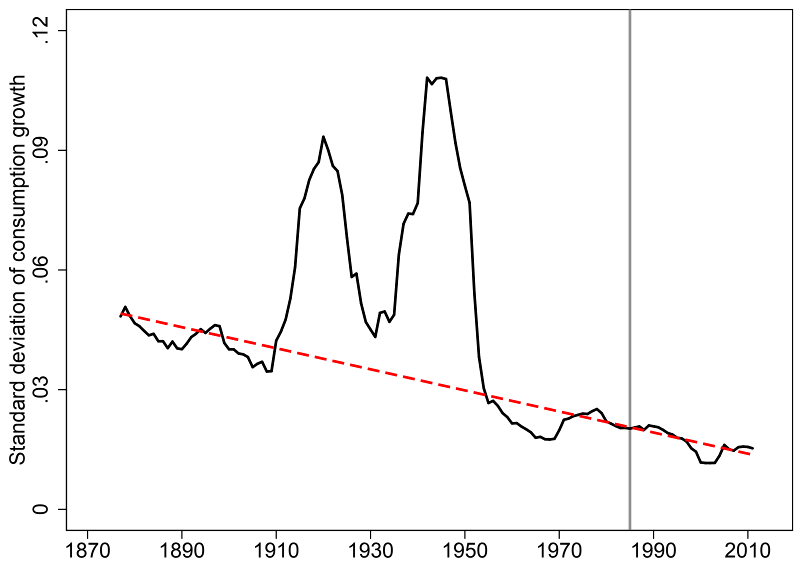
Notes: Decomposition of annual stock market cap to GDP growth into issuances, real capital gains and real GDP growth, using equation (5). Five-year moving averages. Market cap growth is the change in the log of market cap to GDP ratio. Implied issuance is the change in market cap not explained by equity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

Figure A.5: *Post-tax profits relative to GDP*



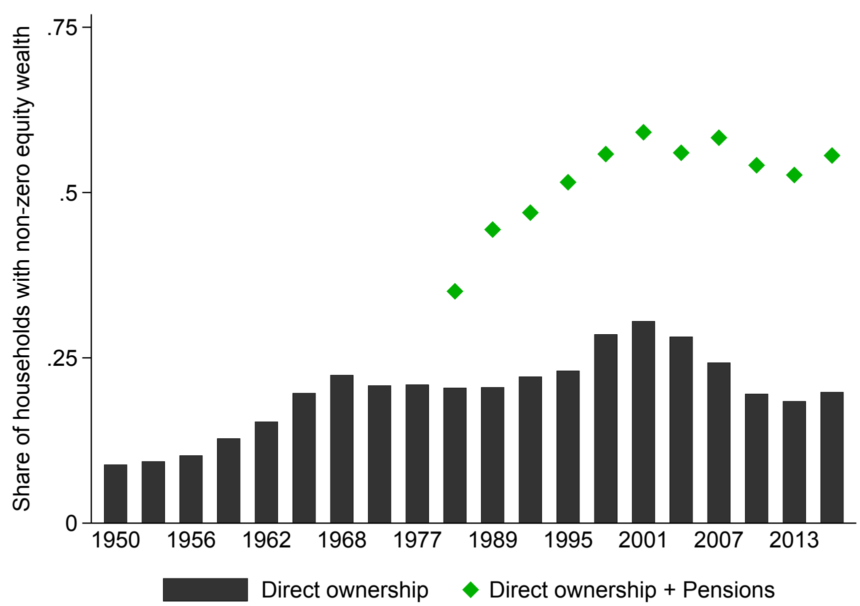
Note: Unweighted average of four countries. Black vertical line indicates the start of the big bang in 1985. Dashed horizontal lines show the average of the series before and after the big bang.

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



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

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



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

C. Predicting equity returns and market crashes

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

	Real returns		Excess returns		Real dividend growth	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel 1: *Ten-year ahead average returns and dividend growth*						
$log(MCAP_t/GDP_t)$	-0.062***	-0.064***	-0.043***	-0.044***	-0.002	-0.049***
	(0.010)	(0.012)	(0.007)	(0.007)	(0.011)	(0.012)
$log(D_t/P_t)$		-0.007		-0.003		-0.158***
		(0.015)		(0.013)		(0.019)
R^2	0.123	0.124	0.069	0.069	0.000	0.274
Observations	1754	1754	1754	1754	1754	1754
Panel 2: *One-year ahead returns and dividend growth after 1985*						
$log(MCAP_t/GDP_t)$	-0.126***	-0.118***	-0.100***	-0.091***	-0.028	-0.055**
	(0.014)	(0.015)	(0.015)	(0.017)	(0.022)	(0.025)
$log(D_t/P_t)$		0.073***		0.090***		-0.254***
		(0.017)		(0.019)		(0.054)
R^2	0.062	0.073	0.035	0.051	0.002	0.109
Observations	487	487	487	487	487	487

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

Table A.2: *Predicting equity market crashes: alternative specifications*

	(1) Pre 1945	(2) Post 1945	(3) Post 1985	(4) War Obs.	(5) Credit Growth
$log(MCAP_{t-1}/GDP_{t-1})$	3.04^{***}	0.69^{***}	1.55^{***}	0.74^{***}	0.79^{***}
	(0.86)	(0.14)	(0.35)	(0.12)	(0.11)
$\Delta_3\ log(MCAP_{t-1}/GDP_{t-1})$	1.42^{**}	0.50^{**}	1.25^{***}	0.69^{***}	0.63^{***}
	(0.60)	(0.24)	(0.32)	(0.26)	(0.24)
Country fixed effects	✓	✓	✓	✓	✓
ROC	0.80	0.70	0.79	0.70	0.75
Number of Crashes	27	98	53	145	119
Observations	583	1161	527	2043	1888
	(1) Decade	(2) Large Crashes	(3) 1-year Crashes	(4) 3-year Crashes	(5) MCAP Crashes
$log(MCAP_{t-1}/GDP_{t-1})$	0.65^{***}	1.05^{***}	0.75^{***}	0.92^{***}	0.55^{***}
	(0.24)	(0.22)	(0.14)	(0.12)	(0.11)
$\Delta_3\ log(MCAP_{t-1}/GDP_{t-1})$	0.87^{***}	1.36^{**}	0.01	1.27^{***}	0.98^{***}
	(0.29)	(0.59)	(0.21)	(0.40)	(0.29)
Country fixed effects	✓	✓	✓	✓	✓
ROC	0.78	0.80	0.69	0.76	0.70
Number of Crashes	125	30	94	106	147
Observations	2003	1730	1857	1857	1857

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.

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