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BUBBLE INVESTING: LEARNING FROM HISTORY

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ABSTRACT

History is important to the study of financial bubbles precisely because they are extremely rare events, but history can be misleading. The rarity of bubbles in the historical record makes the sample size for inference small. Restricting attention to crashes that followed a large increase in market level makes negative historical outcomes salient. In this paper I examine the frequency of large, sudden increases in market value in a broad panel data of world equity markets extending from the beginning of the 20th century. Markets that doubled in real terms in a single year had a 6.9% probability of halving in value the following year and a 17.2% chance of halving in value over the subsequent five years. In simple terms, bubbles are booms that went bad. Not all booms are bad.

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I. Introduction

The attention given to financial history seems to correlate to extreme market events. For example, the Dot-Com bubble of the 1990's is often compared to the run-up in U.S. stock prices in the 1920's. During the 2008 financial crisis, the financial press frequently referenced past bubbles– periods of market euphoria followed by sharp price declines. In this paper I argue that using past crashes in this way may be misleading to both investors and policy-makers. Focusing attention on a few salient crashes in financial history ignores the base rate for bubbles, and may cause observers to overestimate the probability of a crash following a boom. In simple terms, bubbles are booms that went bad but not all booms go bad.

To illustrate this last point, I present empirical evidence drawn from more than a century of global stock market data. I define a bubble as a large price decline after a large price increase or, a crash after a boom. I find that the frequency of bubbles is quite small. In the annual database of global markets, comprising 3514 market-year observations, I found only four cases in which a market more than doubled in value in a calendar year, and then dropped by more than half in the next. This count increased to ten when the post-boom horizon is extended to five years.

Not only are bubbles rare, but conditional upon a market boom (i.e. a 100% increase in a calendar year) crashes occurred only 7% of the time. Loosening the definition of a bubble to a 100% price increase over three years decreases the probability of a crash the following year to 4.6%, and to 9.8% after five years. These rates are somewhat higher than the unconditional probabilities of a crash in the global stock market sample, but similar to the probability of a subsequent doubling in value. In other words, following a boom, the market is as likely to double again as it is to crash.

Prior to the empirical analysis, I present evidence about bubbles in very early equity investments. Thus, the next section discusses some of the first bubbles in financial history. Section III describes the databases used in the study and the empirical analysis. Section IV discusses the implications of the results for investors and regulators.

II. Early Bubbles

The first bubbles preceded the development of organized stock exchanges. Stuart Jenks reports evidence of a bubble in speculative German mining shares, *kuxe*, at the end of the 15th century.[1] Fractional equity interest in individual silver mines in the Hartz mountain district were evidently freely traded, purchased on credit and occasionally had option-like features. Transactions were settled at market fairs between which share prices could fluctuate dramatically. These were famously condemned by Martin Luther in 1554: *"Ich will kein kuks haben! Es ist spiegelt, und es will nicht wudeln [gedeihen] dasselbige gelt."* – "I will have nothing to do with kuxen. They are play money and will not generate hard cash."[2]

In 1502, on the eve of sailing on his final voyage, Christopher Columbus expressed a desire that his son use his inheritance to purchase shares in the Casa di San Giorgio in Genoa which he observed would generate "6 % interest and constitute a very safe investment."[3] The firm was a financial institution that owned and managed government contracts and ultimately became a bank. Its board regularly declared dividends and these, as well as the shares themselves, were actively traded.[4]

Shares in Genoa's Casa di San Giorgio fluctuated considerably in the 16th century. Figure 1 shows an index of prices and yields. The dramatic doubling of prices in 1602 looks like a bubble to the modern eye because yields declined from 3% to 1 ½%. This bubble sustained itself for a long time however. Prices did not drop back to their former level until 1683. Likewise, a peak in 1622 looks *ex post* like a bubble, although the fortunes of Genoa as a financial power in the early 17th century also fluctuated considerably. The variation on both occasions might be due to rational expectations about events of the time. Nevertheless, they appear to fit a price-based definition of a bubble.

This bubble pattern is not ubiquitous in the early history of equity shares. In Le Bris et al. (2014) we found little evidence of a bubble in the trading history of an even older corporation, the Honor del Bazacle of Toulouse. Stock prices for the Bazacle milling company over an extended

[1] See Jenks (2010). He cites Werner (1936) and Laub (1974) for empirical price evidence.
[2] In Braudel (1982), p. 456.
[3] In Harrisse (1888).
[4] Fratianni (2006).

period from the 1372 to 1946 moved fairly closely with dividends although they were as volatile as modern corporate shares.

The first discussions in England of a stock market bubble centered on the speculation in shares for start-up companies during the 1690's. Macleod (1986) argues that intellectual property rights were more likely an excuse for stock market speculation rather than the basis for real valuation in this first English market bubble.

The first global stock market bubble began in France with the creation of the Mississippi Company by John Law who merged a bank empowered to issue currency with companies chartered for overseas trade– hence the name Mississippi Company. Share prices grew by a factor of 10 over the years 1719 to 1720. The Mississippi Bubble burst in the spring of 1720 when shares were made exchangeable with paper currency at a fixed rate.[5] The Mississippi Bubble was followed shortly by the South Sea Bubble in London and a smaller but significant bubble for shares in the Netherlands. The British and Dutch bubbles subsequently burst in late 1720, and by the end of the year, the boom in stock market speculation in those countries was effectively over.

My co-authors and I have worked to understand the basis for this remarkable sequence of international stock bubbles in 1719-1720.[6] We found evidence that regulatory enforcement following the Bubble Act in London triggered a crash in the prices of insurance company stocks and that this ultimately spread to the large trading companies and banks in the UK and then overseas to the Dutch West India Company and a number of recently launched companies in the Netherlands.

Figure 2 illustrates the parallel growth in share prices for selected companies in London and Amsterdam in this period. The three London companies are Royal Exchange Assurance, London Assurance Company and the South Sea Company. The two Dutch companies are the Dutch West India Company and Stad Rotterdam– an insurance company that still exists today. The figure shows the scale of the London and Amsterdam bubbles. The South Sea Company rose by a factor of 7.5 over the year leading to the eponymous South Sea Bubble. The two British insurance companies grew by multiples of more than 10 and 13. Only the Dutch West India Company grew at a comparable scale, by a factor of 7. Stad Rotterdam did not quite double before declining in price. The graph also shows how inter-connected the Dutch and British bubbles were.

[5] C.f. Murphy (1997) & Velde (2009).
[6] Cf. Frehen et al. (2013).

Although they rose at different times in the year 1720, the crash in the prices of the London insurance firms and the Dutch West India Company occurred at about the same time; a few days lag is consistent with travel times between the two financial centers.[7]

In the United Kingdom, the Bubble Act curtailed the issuance and trading of unauthorized company shares. The legal enforcement of the Act, and a parliamentary review of company funding proposals in August of 1720, triggered the decline in stock prices. The crash following the boom in stock prices in 1720 set back the development of the public equity market in Great Britain as a vehicle for a financing enterprise.

In the Netherlands, there was no such governmental response but nevertheless initial public offerings stopped after the bubble and a cultural re-examination of stock market speculation occurred. Stock schemes were ridiculed and speculators were caricatured. One curious legacy of the 1720 international stock market bubble was a lavishly illustrated volume, *Het Groote Tafereel Der Dwaasheid,* or *The Great Mirror of Folly*, a book of satirical poems, prints, plays and engravings specifically intended to preserve the memory of the folly of speculation during the crisis.[8]

Bubbles make interesting stories. Charles MacKay's classic book, *Memoires of Extraordinary Popular Delusions and the Madness of Crowds,* was first published in 1852 and is still in print. Using illustrations redrawn from *The Great Mirror of Folly,* MacKay poked fun at both the South Sea Bubble and the Mississippi Company, including them along with chapters on alchemy, fortune-telling and "magnetizers." MacKay regarded stock speculation as a "madness which infected the people of England."

In Frehen et al. (2013) we use cross-sectional evidence from the 1720 bubble to argue that the stock boom in 1720 was founded on economic fundamentals including the economic potential of trans-Atlantic trade, innovations in maritime insurance and the potential of the publicly traded corporation itself as a vehicle for enterprise. Nicholas (2008) argues for a rational basis for speculation in new technology during the 1920's boom. He uses cross-sectional evidence for companies with patents in the 1920's and shows that, *ex-post*, the stock prices of firms with valuable patents rose relatively more. In seeking to understand the economics underlying the NASDAQ bubble of the 1990's, Pastor and Veronesi (2006) build a model of technological

[7] Cf Koudijs (2009)

[8] Cf. Goetzmann et. al. (2013)

innovation and test it on cross-sectional historical data from the 19th century railroad boom in the U.S. Carlotta Perez (2009) explores the relationship between technological innovation and financial innovation in five major bubbles that occurred in the 19th, 20th and 21st centuries. In each of these cases she suggests that there was at least some method to the madness of investors. While potentially overly-optimistic about valuations for new technology companies, she finds that investors in these bubbles identified, *ex ante,* the potential transformative value of innovation.

III. Analysis

III.1 Data

This brings us to the empirical analysis of market booms and busts. Dimson, Marsh and Staunton [DMS] have constructed an annual database of equity returns for 21 of the world's stock markets by collecting stock and dividend data beginning in 1900 and extending through 2014. We use their total real equity return indexes denominated in dollars as our market measures for these countries. We augment these with the annualized real stock market indexes used in Jorion and Goetzmann (1999) [JG]. For countries in DMS, we drop the JG indexes resulting in 20 remaining JG indexes. The adjustment to real terms is obviously important due to periods of hyperinflation in various countries over the time period.

The JG indexes are taken mostly from sources that published indexes in real time. The League of Nations [LofN] maintained indexes for several countries beginning in 1919. These were continued by the United Nations [UN]. We collected these indexes in a "follow forward" manner from the published periodicals and linked them to International Financial Corporation [IFC] indexes that were available to us in the 1990's. The advantage of augmenting the DMS series is that the JG database contains a number of markets that failed or disappeared during the 20th century due to wars, revolutions and various other reasons.

Reliance on LofN and UN sources means that we do not control the manner in which the indexes were created and cannot be sure that the capital appreciation returns actually represent investor experience. On the positive side, the JG indexes derive from documentary data widely available in libraries through much of the 20th century. Hence, the frequency of past bubbles since at least 1919 has been available for establishing a "base rate" for price run-ups and crashes and their coincidence in time.

We include two additional series constructed for the International Center for Finance (ICF) at the Yale School of Management. The Saint-Petersburg Stock Exchange and the Shanghai Stock Exchange are both dollar-denominated, total return indexes. Finally, we augment both the JG and ICF series' with FTSE dollar-denominated price appreciation series available in the Morningstar EnCorr database. Because the JG indexes end in the 1990's, we linked them to return series' from IFC and FTSE available since that time. We do not add additional markets from the IFC or FTSE, even though these could potentially provide an even broader set of indexes. The reason is sample selection bias. Taking markets that exist today and tracing them back may result in a sample whose returns are mean-reverting or display more complex time-series behavior (cf. Goetzmann and Jorion, 1999).

Table 1 lists the markets and calculates summary statistics separately for the DMS and the JG/ICF databases. Note that the JG/ICF series are discontinuous and start and stop at various intervals. Most are emerging markets and include a number of South American, Central American and Eastern European countries. The JG/ICF series' are more volatile by far, with a median standard deviation of 41% per year, compared to 26% per year for the DMS data. On the other hand, the median annual return for the JG/ICF series is no higher than the DMS series. This includes an adjustment for series known to have been expropriated– a minus 99% return for the expropriation is included. The greater volatility and greater frequency of extreme returns of the JG/ICF series' leads us to expect that most of the booms and crashes will appear in this sub-sample.

III.2 Booms and Crashes

For the purposes of this analysis, a bubble is defined as a boom followed by a crash. A boom is defined as a large, rapid increase in stock prices. A crash is defined as a large, rapid decline in market prices. What is large? What is rapid? The analysis defines booms in two ways: (1) a single year in which a market increased by at least 100%; or (2) a period of three years over which the market increased by 100%. This second definition is chosen so as to include the famous U.S. bubbles of the 1920's and 1990's.

A crash is defined as: (1) a drop of at least 50% in the following year; (2) a drop of at least 50% over the next five years. There are other ways to use price dynamics to define a bubble. For example, a high price-earnings ratio is a common bubble indicator. Long-term data for dividends are not available for most of the markets examined here. However, most people would agree that

a doubling in market prices followed by a halving in value is a significant reversal, absent further details about economic fundamentals. Thus, this study can be interpreted as focusing on one common notion of a bubble, but not the only one.

One important issue in the use of annual data is that we undercount booms, crashes and bubbles. For example, the annual data do not pick up 100% returns that occur within all 12 month periods. This presents a problem for inferring the unconditional frequency of events, as opposed to conditional frequencies. For example, we cannot infer the absolute frequency of bubbles from the annual data, since finer intervals of observation can only increase the count within the 115 year period of the study.

On the other hand, the calendar-year booms we document represent an unbiased sample from the population of booms that occurred over any contiguous 12 month period. The frequency of booms and crashes over the 12 months and 6o months that follow are reliable estimates of the conditional frequency of events regardless of whether the initial boom or crash occurred over a non-calendar-year horizon.

Table 2 reports results for a one-year boom of 100% or more in real stock returns, and a one-year crash of 50% or more. Row 1 reports the count and frequency of one-year booms with columns that show the conditional counts and frequencies for the one and five year event-horizons that followed. Row 2 does the same for a one year crash, and row 3 reports the results for all market-years. 58 out of 3514 calendar market years had real returns in excess of 100% in a calendar year period– a frequency of 1.7%. Of these, 4 boomed again by more than 100% the following year and 4 crashed by more than 50%. Both events had a conditional frequency of 6.9%. Both conditional crash and boom frequencies are higher than the unconditional frequency in the population of market-years. Column B shows that there were 56 instances of a "Next year boom," i.e. a boom for which a prior year return exists in the sample. Thus the conditional frequency of a boom (or a crash) is elevated for markets that had a 100% increase in the prior year. On the other hand, the 6.9% probability is still relatively small (smaller than the probability of successfully drawing to an insight straight in poker), and a crash is no more likely than another boom.

Over the five year horizon following a 100% boom, the probability of an extreme outcome obviously increases. The conditional probability of a crash is 17.1%, or roughly twice the unconditional probability. The probability of doubling over the five year period is 22.4% which

is greater than the probability of a crash.[9] A natural interpretation of these results is that an extreme return, either doubling or halving in a given year, is indicative of a volatile market, which is more likely to have subsequent extreme returns. This higher risk alone could make it relative unattractive to a mean-variance optimizer. On the other hand, there is not much evidence in Table 2 that a boom, even one as dramatic as a doubling in a calendar year, has a high likelihood of being a bubble that will burst either one year later or over the next five years.

Table 3 shows the five year real price indexes for the markets that experienced a 100% increase, sorted by terminal value. Years for which the market exceeded 100% growth are highlighted in green and years for which it had declined by more than 50% are highlighted in pink. Most of the country-years in the sample are emerging markets, with the notable exceptions of pre- and post-war Germany and Japan. Together they represent a potential sample for study of the factors associated with sustained booms and market reversals. The list of bubbles by our definition is short and relatively unfamiliar– it includes, for example, Germany, 1940, Argentina, 1979 and Norway, 1973.

Another approach to defining a bubble is to choose a definition that results in a set that includes events commonly regarded as bubbles, such as the US stock market booms of 1928 and 1997. Table 4 loosens the definition of a boom to include cases in which the market rose by 100% in real terms over three calendar years. This broader definition of a boom generates 346 events of a doubling over three years– roughly 10% of the overlapping three year return periods in the data. In the context of global equity markets, the historical US booms were thus not that unusual.

This broader definition results in selecting less volatile markets with a lower frequency of subsequent booms and busts at the one-year horizon. Only 4.6% of these markets crashed in the following year, which is not much different from the unconditional frequency of 2%. Likewise the probability of a crash after five years is 9.8%, comparted to an 8.4% unconditional probability of a crash following all three-year return periods. Thus, for booms comparable to those in the US in the 1920's and 1990's, the probability of a crash is quite small.

Table 5 lists the subset of the 346 market years that either doubled or halved in the subsequent five-year period. The markets with sustained booms (indicated in green) provide potentially useful counter-examples to bubbles. They are historical instances in which markets

[9] If the market is expropriated, this is interpreted as a crash. If the data are missing for unknown reasons, then the returns up to the missing year are taken to be the total return over the five year interval.

went on to double again following a boom. The bottom half of the list are the instances that meet the criteria for bubbles. For econometricians interested in studying bubbles, this latter group represents a sample not conditioned by prior research. They present an opportunity for out-of-sample hypothesis testing about bubbles.

IV. Conclusion

The most important thing a financial historian can tell investors about bubbles is that they are rare. Indeed any discussion of bubbles quickly turns to history because recent evidence is lacking. Most models and analysis of stock market bubbles focuses on a few well-known instances. Gathering data about the world's stock markets helps to fill in this lack of empirical evidence. The DMS and JG/ICF data provide some insight into the rarity of bubbles. The overwhelming proportion of price increases in global markets were not followed by crashes.

There are many studies of stock market dynamics that find evidence of mean-reversion. These can be naively interpreted as support for the notion that a large boom should significantly increase the probability of a future decline. However, focusing on the rejection of the null of no association between past and future multi-year market returns can be misleading for economic decision-making.

Investor decision making under uncertainty involves a consideration of the probabilities of future outcomes and attitudes about these outcomes. The bubbles that did not burst are just as important for investors to know about as the bubbles that did burst. Placing a large weight on avoiding a bubble, or misunderstanding the frequency of a crash following a boom, is dangerous for the long-term investor because it foregoes the equity risk premium. If investors in the shares of the Casa di San Giorgio had sold out in 1603, they would have missed a 20 year boom in prices and would have had to wait 80 years to be proven right.

For regulators, the evidence raises the question of whether deflating a bubble is the right course of action. If a bubble is associated with investment in new technologies with high economic potential as well as high economic uncertainty, it forces a choice between guarding against a financial crisis vs. allowing productive investment.

This paper presents a preliminary examination of bubbles in stock markets around the world over the last 115 years. While economists often focus on a few representative and memorable bubbles, the analysis presented here suggests there are dozens more we should

investigate. The lists in this paper may be starting points for financial historians seeking to understand what factors determine whether a boom turns into a bust. Learning something about the fundamentals underlying these other bubbles may help to more rationally assess the causes of booms and crashes and their consequences– economic, financial and regulatory.

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Table 1: Summary Statistics for 41 Global Markets, 1900-2014

Data sources: (1) Real total return indices for stock markets in 21 countries over the period 1900 to 2014, converted to U.S. dollars, provided by Dimson, Marsh and Staunton [DMS]. (2) Real capital appreciation indices for 18 countries from 1919 onwards used in Jorion & Goetzmann (1999), available on the website of the International Center for Finance, Yale School of Management [ICF]. (3) Total return indices in U.S. dollars for Russia and China from the ICF, constructed from official publications and/or newspaper sources. The Jorion-Goetzmann & ICF indices are augmented for recent years by the FTSE and IFC country dollar-denominated stock market appreciation indices accessed via Morningstar EnCorr.

Country	Source	period	median	mean	std	max	min	Country	Source	period	median	mean	std	max	min
Australia	DMS	1900-2014	0.12	0.10	0.24	1.06	-0.53	India	JG&FT	1940-2014	0.01	0.04	0.29	1.01	-0.65
Austria	DMS	1900-2014	0.03	0.06	0.38	1.89	-0.73	Pakistan	JG&FT	1961-2014	0.03	0.05	0.34	1.22	-0.75
Belgium	DMS	1900-2014	0.04	0.06	0.26	1.26	-0.50	Philippines	JG&FT	1955-2014	-0.03	0.09	0.89	6.54	-0.63
Canada	DMS	1900-2014	0.08	0.08	0.19	0.71	-0.47	Argentina	JG&FT	1948-2014	0.00	0.18	0.92	4.56	-0.72
Denmark	DMS	1900-2014	0.06	0.08	0.23	0.99	-0.51	Brazil	JG&FT	1952-2014	0.03	0.15	0.59	2.03	-0.70
Finland	DMS	1900-2014	0.06	0.10	0.33	1.22	-0.76	Chile	JG&FT	1928-2014	0.03	0.08	0.34	1.02	-0.50
France	DMS	1900-2014	0.06	0.07	0.29	0.89	-0.78	Colombia	JG&FT	1937-2014	-0.02	0.04	0.38	1.90	-0.45
Germany	DMS	1900-2014	0.05	0.15	0.80	7.15	-0.80	Mexico	JG&FT	1935-2014	-0.01	0.09	0.33	1.06	-0.60
Ireland	DMS	1900-2014	0.05	0.07	0.25	0.97	-0.67	Peru	JG&FT	1942-1977, 1989-2014	-0.05	0.05	0.35	1.48	-0.42
Italy	DMS	1900-2014	0.02	0.07	0.33	1.47	-0.62	Uruguay	JG&FT	1937-1943	0.08	0.06	0.13	0.26	-0.13
Japan	DMS	1900-2014	0.06	0.10	0.32	1.30	-0.92	Venezuela	JG&FT	1938-2007	-0.02	0.05	0.51	3.76	-0.65
New Zealand	DMS	1900-2014	0.07	0.09	0.26	1.39	-0.50	Czech	JG&FT	1920-1944, 1995-2014	0.01	0.05	0.30	0.77	-0.99
Norway	DMS	1900-2014	0.08	0.08	0.30	1.51	-0.63	Greece	JG&FT	1930-1939, 1998-2014	0.04	0.08	0.44	1.18	-0.67
Portugal	DMS	1900-2014	0.02	0.10	0.42	2.01	-0.77	Hungary	JG&FT	1926-1940, 1995-2014	-0.04	0.09	0.44	1.05	-0.99
South Africa	DMS	1900-2014	0.07	0.10	0.30	1.84	-0.43	Poland	JG&FT	1922-1938, 1993-2014	0.09	0.23	1.24	7.45	-0.99
Spain	DMS	1900-2014	0.05	0.07	0.28	1.48	-0.51	Romania	JG&FT	1938-1940, 2006-2014	-0.02	-0.10	0.43	0.54	-0.99
Sweden	DMS	1900-2014	0.08	0.08	0.24	0.71	-0.50	Egypt	JG&FT	1938-1961, 1995-2014	0.08	0.12	0.51	1.55	-0.99
Switzerland	DMS	1900-2014	0.05	0.07	0.21	0.96	-0.43	Israel	JG&FT	1951-2014	0.06	0.09	0.34	0.80	-0.67
Netherlands	DMS	1900-2014	0.09	0.08	0.25	1.28	-0.69	China	ICF & IFC	1900-1940, 1994-2014	0.02	0.05	0.31	1.21	-0.99
United Kingdom	DMS	1900-2014	0.06	0.08	0.23	0.98	-0.54	Russia	ICF & IFC	1900-1913, 1998-2014	0.12	0.17	0.67	2.85	-0.99
United States	DMS	1900-2014	0.11	0.09	0.20	0.56	-0.38								
		mean	0.06	0.08	0.30	1.51	-0.60			mean	0.02	0.08	0.49	2.11	-0.72
		median	0.06	0.08	0.26	1.26	-0.54			median	0.02	0.08	0.41	1.21	-0.68
		std	0.03	0.02	0.13	1.35	0.15			std	0.05	0.07	0.26	1.98	0.24
		min	0.02	0.06	0.19	0.56	-0.92			min	-0.05	-0.10	0.13	0.26	-0.99
		max	0.12	0.15	0.80	7.15	-0.38			max	0.12	0.23	1.24	7.45	-0.13

Table 2: Frequency of booms and busts conditional on a stock market index increasing by 100% or decreasing by 50% in a single calendar year

Table 2 reports the counts and percentages of conditional boom and bust events following a boom, a crash or any prior year return. A boom is defined as a return of more than 100% within a single calendar year in real or dollar-valued and terms. A crash defined as a return of less than -50% within a single calendar year in real or dollar-valued and terms. If total return is unavailable, real or dollar-valued capital appreciation is used. Missing observations due to lack of data for an unknown reason or the end of the sample period are deleted from the frequency calculation. Markets for which an expropriation is known to have occurred are given a -99% return. "All market-years" reports the number and frequency of booms and crashes for market-years. Data sources are reported in Table 1. For purposes of the paper, a bubble is defined as a boom followed by a crash: for example, cell B1 reports the count and conditional frequency of a bubble that occurred over a two calendar-year period. Cell E1 reports the count and conditional frequency of a bubble that began with a single year return of at least 100% and then declined by at least 50% by the end of the subsequent five years.

		(A) Full sample	(B) Next year boom (+100%)	(C) Next year crash (-50%)	(D) Five year boom (+100%)	(E) Five year crash (-50%)
(1)	One-year boom	58	4	4	13	10
		1.7%	6.9%	6.9%	22.4%	17.2%
(2)	One-year crash	67	9	1	22	2
		1.9%	13.4%	1.5%	32.8%	3.0%
(3)	All market-years	3514	56	74	592	298
		1	1.6%	2.1%	16.9%	8.5%

Table 3: Markets that doubled in value in dollar (or real) terms in a calendar year

This table reports the cumulated real return (or dollar-valued if real is unavailable) to markets following a calendar year in which the dollar-valued index level at least doubled. Subsequent event-years in which the index value doubled again are highlighted in green. Subsequent event years in which the index gave back all or more of its one year gain at some point in the next five years are highlighted in pink. Values are sorted on event-year five cumulative capital appreciation returns.

Country	year	0	1	2	3	4	5	Country	year	0	1	2	3	4	5
Germany	1949	1	0.95	2.1	3.11	3.9	7.14	Spain	1939	1	0.93	1.18	1.17	0.96	1.16
Portugal	1985	1	3.01	8.36	5.67	6.97	4.98	Colombia	1991	1	1.19	1.57	1.55	1.13	1.11
Mexico	1986	1	0.85	1.19	2	2.35	4.56	Brazil	1969	1	1.25	2.31	1.19	1.1	1.09
Germany	1951	1	1.48	1.85	3.4	3.95	3.62	India	2009	1	1.19	0.74	0.92	0.87	1.06
Chile	1973	1	0.6	0.75	1	1.97	3.38	Philippines	1986	1	1.21	1.37	1.5	1.16	1.04
Colombia	2004	1	2.02	2.24	2.53	1.83	3.22	Belgium	1940	1	1.62	1.6	1.42	1.08	1.03
Russia	1999	1	0.68	1.05	1.46	2.54	2.91	New Zealand	1933	1	1.12	1.13	1.11	1.13	1.02
Pakistan	2002	1	1.31	1.42	2.23	2.19	2.9	Argentina	1991	1	0.7	1.13	0.81	0.87	1
Egypt	2004	1	2.55	2.92	4.53	2.09	2.77	Japan	1972	1	0.77	0.6	0.65	0.79	0.87
Austria	1985	1	1.21	1.14	1.18	2.51	2.67	Portugal	1942	1	0.91	1.09	1.21	1.12	0.87
Peru	1992	1	1.86	2.56	2.07	2.13	2.51	Austria	1989	1	1.06	0.86	0.67	0.86	0.84
Colombia	2005	1	1.11	1.25	0.9	1.59	2.24	Argentina	1976	1	0.43	0.77	1.92	1.33	0.79
Brazil	2003	1	1.31	1.96	2.75	4.82	2.05	Norway	1979	1	0.72	0.56	0.39	0.67	0.7
Brazil	1991	1	0.88	1.61	1.73	1.45	1.87	Austria	1923	1	0.48	0.35	0.47	0.6	0.64
Italy	1985	1	1.7	1.38	1.49	2.04	1.78	Portugal	1980	1	0.58	0.34	0.25	0.24	0.62
Germany	1923	1	1.09	0.69	1.65	1.57	1.76	Finland	1999	1	0.82	0.53	0.41	0.53	0.59
Japan	1952	1	0.99	1.01	1.46	1.99	1.75	Russia	2009	1	1.23	0.97	1.08	1.11	0.59
Australia	1933	1	1.12	1.34	1.51	1.8	1.66	Netherlands	1940	1	0.66	0.67	0.78	0.58	0.52
Finland	1933	1	1.1	1.2	1.73	1.69	1.64	Brazil	2009	1	1.04	0.78	0.75	0.61	0.51
Portugal	1986	1	2.77	1.88	2.31	1.65	1.54	Poland	1993	1	0.45	0.43	0.67	0.51	0.47
Spain	1986	1	1.32	1.49	1.65	1.38	1.52	Venezuela	1990	1	1.33	0.6	0.6	0.49	0.46
China	2003	1	0.91	1.02	1.97	3.18	1.5	Portugal	1987	1	0.68	0.83	0.6	0.56	0.44
South Africa	1933	1	1.29	1.45	1.83	1.48	1.49	Germany	1926	1	0.95	1.06	0.81	0.62	0.43
Germany	1985	1	1.36	1.04	1.15	1.58	1.43	Pakistan	1991	1	0.8	1.02	0.83	0.62	0.39
Greece	1933	1	1.14	1.11	1.16	1.3	1.37	Italy	1944	1	0.52	0.41	0.32	0.35	0.39
Argentina	1989	1	0.29	1.61	1.13	1.82	1.31	New Zealand	1986	1	0.61	0.52	0.56	0.33	0.39
Hungary	1996	1	1.95	1.77	1.96	1.42	1.28	Norway	1973	1	0.53	0.42	0.46	0.34	0.33
Italy	1933	1	1.24	1.27	1.12	1.23	1.26	Argentina	1979	1	0.69	0.41	0.26	0.35	0.3
Egypt	2005	1	1.15	1.78	0.82	1.09	1.19	Germany	1940	1	1.05	0.89	0.71	0.6	0.12

Table 4: Frequency of booms and busts conditional on a stock market index increasing by 100% or decreasing by 50% over a three-year calendar period

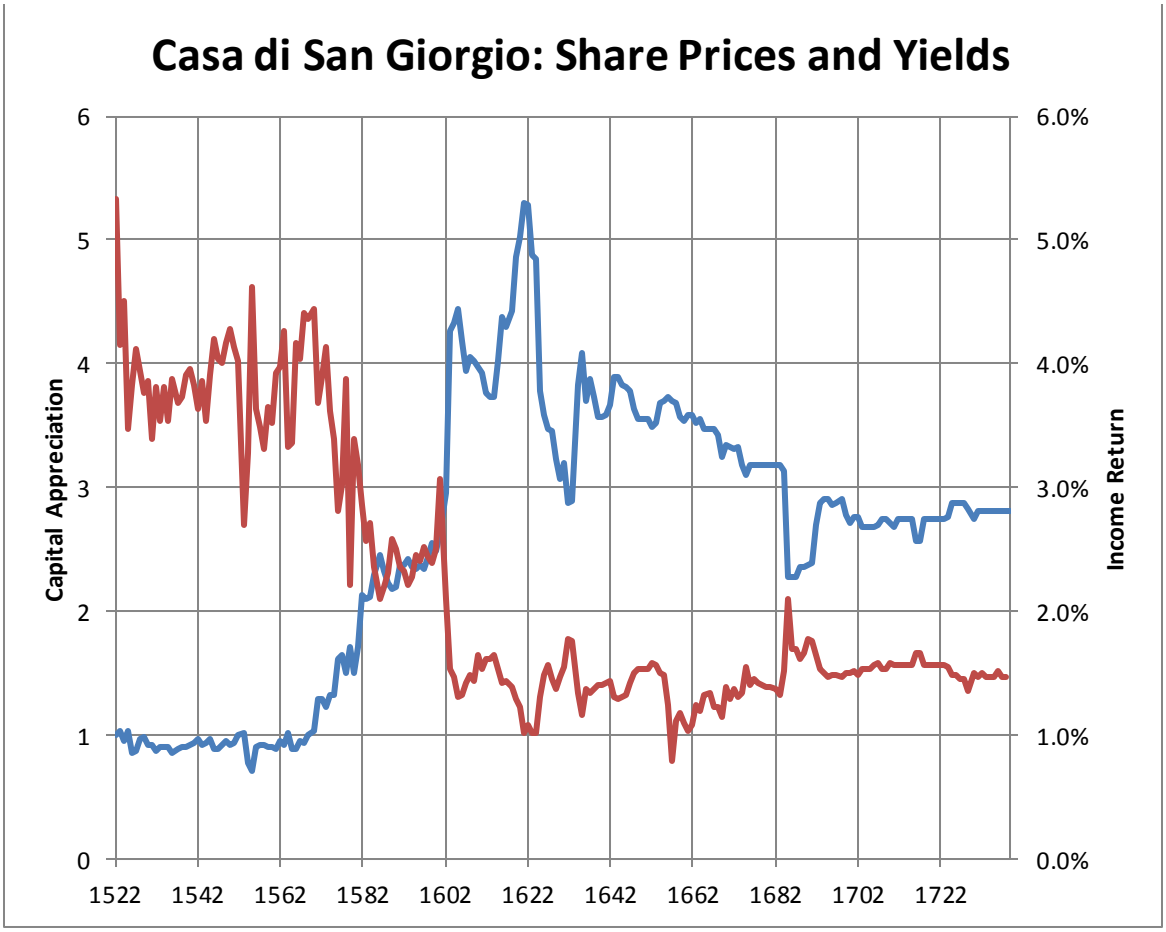
Table 3 reports the counts and percentages of conditional boom and bust events following a boom, a crash or any prior year return. A boom is defined as a return of more than 100% within a single calendar year in real or dollar-valued and terms. A crash defined as a return of less than -50% within a single calendar year in real or dollar-valued and terms. Where total market return is unavailable, real or dollar-valued capital appreciation is used. Missing observations due to lack of data for an unknown reason or the end of the sample period are deleted from the frequency calculation. Markets for which an expropriation is known to have occurred are given a -99% return. "All market-years" reports the number and frequency of booms and crashes for market-years. Data sources are reported in Table 1. For purposes of the paper, a bubble is defined as a boom followed by a crash: for example, cell B1 reports the count and conditional frequency of a bubble that occurred over a four-year calendar-year period: i.e. a three-year appreciation in real price followed by a one year decline. Cell E1 reports the count and conditional frequency of a bubble that began with a three year return of at least 100% and then declined by at least 50% by the end of the subsequent five years.

		(A) Full sample	(B) Next year boom (+100%)	(C) Next year crash (-50%)	(D) Five year boom (+100%)	(E) Five year crash (-50%)
(1)	Three-year boom	346 10.1%	12 3.5%	16 4.6%	57 16.5%	34 9.8%
(2)	Three-year crash	202 5.9%	12 5.9%	12 5.9%	68 33.7%	23 11.4%
(3)	All market-years	3412 100%	54 1.6%	68 2.0%	587 17.2%	287 8.4%

Table 5: Markets that doubled in value in dollar (or real) terms over a three-year calendar period

This table reports the cumulated real return (or dollar-valued if real is unavailable) to markets following a three-year calendar period in which the dollar-valued index level at least doubled. Only markets that either doubled or halved over the subsequent five-year period are shown, with the exception of the USA which is provided below for comparison. The table thus shows the results for 83 out of 346 events. "t1" represents the growth in excess of 1 by the index in the next calendar year. Subsequent event-years in which the index value doubled again are highlighted in green. Subsequent event years in which the index gave back all or more of its three year gain at some point in the next five years are highlighted in pink. Values are sorted on event-year five cumulative capital appreciation returns.

Country	year	t1	t2	t3	t4	t5	Country	year	t1	t2	t3	t4	t5
Germany	1950	2.20	3.26	4.09	7.49	8.72	Belgium	1985	1.77	1.83	2.36	2.72	2.35
Russia	2001	1.38	2.41	2.77	4.68	7.67	Austria	1953	1.52	2.35	2.70	2.22	2.33
Germany	1949	0.95	2.10	3.11	3.90	7.14	Australia	1922	1.17	1.47	1.59	1.93	2.31
Mexico	1987	1.40	2.35	2.77	5.38	6.05	Ireland	1985	1.72	1.89	2.31	2.99	2.28
Mexico	1988	1.68	1.97	3.83	4.31	5.95	Australia	1923	1.26	1.36	1.65	1.97	2.26
Peru	1991	2.48	4.62	6.35	5.13	5.30	Colombia	2005	1.11	1.25	0.90	1.59	2.24
Finland	1995	1.37	1.54	2.80	6.22	5.11	Colombia	2007	0.72	1.28	1.80	1.67	2.20
Mexico	1985	2.06	1.75	2.45	4.12	4.85	Austria	1954	1.54	1.77	1.46	1.53	2.19
Chile	1986	1.24	1.98	2.73	3.02	4.71	Austria	1935	1.34	1.22	0.53	0.27	0.50
Mexico	1986	0.85	1.19	2.00	2.35	4.56	Egypt	2007	0.46	0.61	0.67	0.34	0.50
China	2001	0.99	2.18	1.99	2.22	4.31	Israel	1982	0.33	0.41	0.43	0.46	0.48
Colombia	2003	2.26	4.57	5.06	5.70	4.13	Venezuela	1991	0.45	0.45	0.37	0.35	0.47
Peru	2005	1.52	2.83	1.63	2.76	4.12	Austria	2006	1.07	0.42	0.62	0.70	0.47
Chile	1987	1.60	2.20	2.44	3.80	4.09	Mexico	1942	0.97	0.73	0.72	0.59	0.46
Germany	1955	0.91	0.98	1.57	2.77	3.71	Ireland	2005	1.42	1.15	0.38	0.50	0.46
Germany	1951	1.48	1.85	3.40	3.95	3.62	Austria	1936	0.91	0.39	0.20	0.37	0.45
Peru	2004	1.29	1.96	3.64	2.09	3.55	Portugal	1987	0.68	0.83	0.60	0.56	0.44
Spain	1985	2.48	3.27	3.71	4.09	3.42	Chile	1979	1.49	0.95	0.65	0.47	0.43
Japan	1954	1.45	1.98	1.74	2.57	3.41	Brazil	1971	0.52	0.48	0.47	0.49	0.43
Germany	1953	1.83	2.13	1.95	2.09	3.35	Hungary	2006	1.13	0.43	0.74	0.66	0.43
Netherl's	1935	0.99	1.56	1.50	1.44	3.27	Australia	1969	0.73	0.68	0.87	0.71	0.43
Colombia	2004	2.02	2.24	2.53	1.83	3.23	Argentina	2007	0.45	0.72	1.22	0.70	0.43
Germany	1954	1.16	1.06	1.14	1.83	3.22	Poland	1928	0.71	0.58	0.36	0.41	0.43
Portugal	1981	0.59	0.43	0.42	1.06	3.18	Finland	1987	1.22	1.02	0.74	0.51	0.42
Chile	1988	1.38	1.52	2.38	2.56	3.17	Denmark	1917	0.88	0.51	0.36	0.42	0.40
Chile	1989	1.11	1.73	1.86	2.30	2.97	South Africa	1980	0.72	0.85	0.83	0.54	0.40
Italy	1954	1.27	1.29	1.40	1.68	2.81	N Zealand	1986	0.61	0.52	0.56	0.33	0.39
Egypt	2004	2.54	2.92	4.53	2.09	2.77	Chile	1980	0.64	0.44	0.32	0.29	0.37
Chile	1990	1.56	1.68	2.08	2.69	2.77	Greece	2005	1.32	1.70	0.56	0.69	0.37
Czech	2003	1.77	2.53	3.28	4.98	2.74	Belgium	1941	0.99	0.88	0.67	0.64	0.36
Austria	1956	0.82	0.86	1.23	1.73	2.70	Egypt	1997	0.68	1.23	0.67	0.37	0.35
Austria	1985	1.21	1.14	1.18	2.51	2.68	Argentina	1955	0.86	0.58	0.64	0.33	0.33
Colombia	1987	0.79	0.70	0.77	2.25	2.66	Norway	1973	0.53	0.42	0.46	0.34	0.33
Japan	1956	0.88	1.30	1.73	2.81	2.66	Mexico	1979	0.80	0.36	0.14	0.21	0.20
Germany	1952	1.25	2.30	2.67	2.44	2.62	France	1941	0.52	0.88	0.99	0.90	0.20
Japan	1953	1.01	1.47	2.00	1.76	2.61	Belgium	1942	0.88	0.67	0.64	0.36	0.19
China	2005	1.94	3.13	1.47	2.47	2.60	Pakistan	1993	0.82	0.61	0.39	0.48	0.19
Peru	1992	1.86	2.56	2.07	2.14	2.51	Brazil	1985	0.64	0.21	0.39	0.44	0.13
Chile	2005	1.26	1.53	0.96	1.74	2.46	Greece	2006	1.29	0.43	0.52	0.28	0.10
India	2004	1.35	2.02	3.45	1.21	2.42	Portugal	1973	0.65	0.55	0.45	0.34	0.08
Brazil	2005	1.41	2.46	1.04	2.31	2.40	Poland	1938	0.01	0.01	0.01	0.01	0.01
USA	1935	1.31	0.83	1.09	1.13	1.04							
USA	1997	1.21	1.46	1.26	1.1	0.85							
USA	1928	0.85	0.65	0.4	0.41	0.64							


Casa di San Giorgio: Share Prices and Yields
Capital Appreciation
Income Return
0
1
2
3
4
5
6
0.0%
1.0%
2.0%
3.0%
4.0%
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1522
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1722

Figure 1

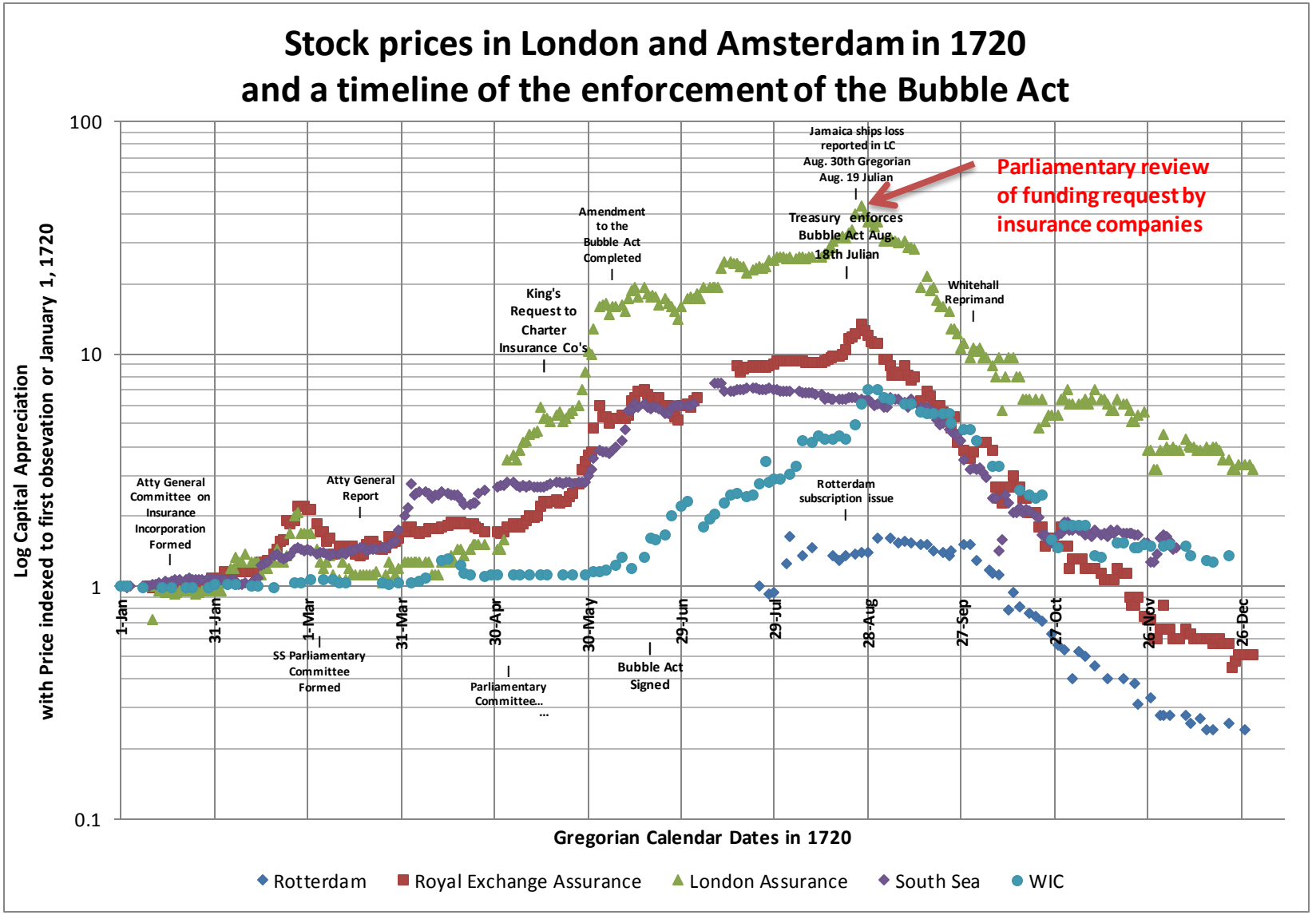
Stock prices in London and Amsterdam in 1720
and a timeline of the enforcement of the Bubble Act
Log Capital Appreciation
with Price indexed to first obsevation or January 1, 1720
100
10
1
0.1
Gregorian Calendar Dates in 1720
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Atty General Committee on Insurance Incorporation Formed
Atty General Report
SS Parliamentary Committee Formed
King's Request to Charter Insurance Co's
Parliamentary Committee...
...
Amendment to the Bubble Act Completed
Bubble Act Signed
Jamaica ships loss reported in LC Aug. 30th Gregorian Aug. 19 Julian
Treasury enforces Bubble Act Aug. 18th Julian
Rotterdam subscription issue
Whitehall Reprimand
Parliamentary review of funding request by insurance companies
Rotterdam
Royal Exchange Assurance
London Assurance
South Sea
WIC

Figure 2