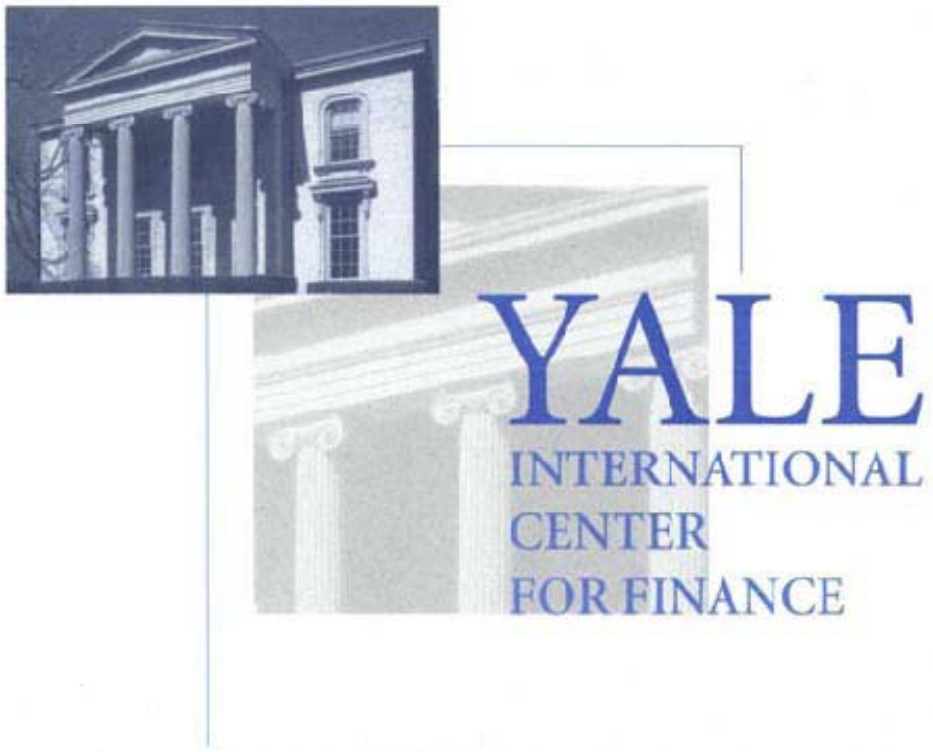

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New Evidence on the First Financial Bubble

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Abstract

The first global financial bubble in stock prices occurred 1720 in Paris, London and the Netherlands. Explanations for these linked bubbles primarily focus on the irrationality of investor speculation and the corresponding stock price behavior of two large firms: the South Sea Company in Great Britain and the Mississippi Company in France. In this paper we examine a broad cross-section of security price data to evaluate the causes of the bubbles. Using newly collected stock prices for British and Dutch firms in 1720, we find evidence against indiscriminate irrational exuberance and evidence in favor of speculation about two factors: the Atlantic trade and the incorporation of insurance companies. We study the role of innovation in the insurance market by examining market betas and volatilities of new insurance company shares, like (Pastor & Veronesi, Technological Revolutions and Stock Prices, 2009). We find strong evidence for a revolution in the insurance business in 1720. Our findings are consistent with the hypothesis that financial bubbles require a plausible story to justify investor optimism.

JEL Classifications: G01, G15, N13, N23

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Introduction

Asset bubbles are important puzzles in financial economics – important because of their extraordinarily potential for disruption; puzzles because they defy standard notions of rationality. Recent research in the wake of the NASDAQ bubble and the global housing bubble has highlighted the role of uncertainty and technological innovation in the development of asset bubbles. In particular, (Pastor & Veronesi, Was There a Nasdaq Bubble in the Late 1990s?, 2006) and (Pastor & Veronesi, Technological Revolutions and Stock Prices, 2009) argue that technological innovation and investor uncertainty can explain high security valuations and the rapid rise and fall of stocks related to potentially transformative technological innovations. Their papers make cross-sectional empirical predictions about securities during periods of technological change. They show that imputed growth rates in innovative industries can appear irrationally high *ex post* and that industries in which bubbles occur will be characterized by high return volatility, high uncertainty and rapid adoption of the new technology. They test these predictions on 19th century railroad securities listed on the New York Stock Exchange.

In this paper we revisit one of the most famous events in financial history: the South Sea Bubble of 1720. Along with the earlier Dutch Tulipmania, of the 17th century, the South Sea Bubble is often regarded as an example *par excellence* of investor irrationality. However, unlike Tulipmania, which was confined to the futures market in tulip bulbs, the South Sea Bubble involved many stocks traded in three different countries. Although 1720 is not generally viewed as a period of technological novelty, we argue in this paper that there were at least three critical innovations that took place in a very short span of time; two of which were financial innovations, the other was a major potential shift in the configuration of global trade. All three are candidates for a transformative "revolution" as modeled by Pastor and Veronesi.

The first innovation was financial engineering at a national scale. The Mississippi Company and the South Sea Company issued equity shares in exchange for government debt; in effect converting the national debt into corporate stock. This

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novelty appeared to be a new model for government finance: a heavily politically-influenced corporation that also had exclusive rights and patents to pursue other ventures. This has been the most widely researched theme in the literature on the bubbles of 1720, perhaps because it represents such a novel form of public finance, and commanded the attention of so many writers and analysts at the time. It was clearly perceived at the time as a new and transformative financial technology.

The second innovation was an incipient shift in global trade. There were several companies in the early 18th century set up to exploit trade in the Americas, however the two largest such ventures were the Mississippi Company, which effectively owned the Louisiana territory, and the South Sea Company which owned the *asiento*, the exclusive right to export African slaves to Spanish America, and rights to establish a number of trading stations in South and Central America. Both France and Britain had ambitions at the time to challenge Spanish domination of the Atlantic trade. Spain's dominant position was weakened as a result of the War of the Spanish Succession [1701-1714], and the War of the Quadruple Alliance [1718-1720], opening the door to increased competition from Britain, France and the Netherlands. These geopolitical conditions offered great possibilities and great uncertainty, and it is logical to posit that these expectations and risks would manifest themselves in the prices of securities related to New World ventures.

The third innovation was institutional. Maritime insurance was a fundamental technology for risk-sharing, and maritime nations such as Great Britain, and the Netherlands depended heavily on a functional market for insuring sea trade. The first publicly traded insurance corporations were chartered in Great Britain in 1720, as a result of the famous Bubble Act. As such, they represented a new model of capital formation and risk-sharing for maritime insurance firms in a nation built on maritime trade. (Kingston, Marine Insurance in Britain and America, 1720-1844: A Comparative Institutional Analysis, 2007) and (Kingston, Adverse Selection and Institutional Change in Eighteenth Century Marine Insurance, 2008) show that a shift occurred in the institutional equilibrium for provision of maritime insurance as a result of the creation of the British corporations. He notes that the institutional

corporate form for insurance took hold outside of Great Britain, most notably in North America, in the decades following this innovation. He also observes that, paradoxically, the regulatory limits on corporations in Britain in the wake of the Bubble Act led to the emergence of Lloyds – a marketplace for insurance contracts rather than a corporation - as a sustained equilibrium. It is thus also logical to consider financial market effects of a shift in a major institutional structure – particularly in light of evidence that it was rapidly imitated – spreading within months to the Netherlands and Germany.

Ex post, two of these three innovations had a transformative effect on the global economy. Although government debt for equity swaps did not survive the financial crisis when the South Sea bubble burst, the Atlantic trade did. The triangle trade between Europe, Africa and the Caribbean eventually became the dominant international trade system of the 18th and early 19th centuries. Finally, the emergence of publicly financed, limited liability insurance companies ultimately transformed risk sharing. The publicly traded insurance companies founded in 1720 survived and flourished and became models for the insurance trade in both the old and the new worlds. The public insurance corporation is now the dominant institutional form.

In this paper we examine the extent to which the bubble of 1720 might be explained by current models of technological innovation and share price dynamics. We document industry differences in share price dynamics related to the three "revolutionary" shifts in financial markets indicated above, and we test the predictions of (Pastor & Veronesi, Technological Revolutions and Stock Prices, 2009) on stock market prices from the period.

To perform our analysis, we collect security price information for a number of stocks traded in London and the Netherlands in the early 18th century. Some of the security price data are new to scholarship. We use these data to measure cross-sectional differences in the timing, steepness and magnitude of share price increases

in 1720, and to test the changing covariance predicted by models of "new technology" stocks.

We find strong evidence that the dynamics of the South Sea Bubble differed by industry. We also document the extent to which these industry effects extended across national boundaries. Our results suggest that speculation about the Atlantic trade with the Americas was an important factor in investor expectations. We also find evidence that market prices and new issues in Britain and the Netherlands were driven in part by investor expectations about the financial innovations in the insurance trade. On the other hand, we find little evidence that the debt-conversion function of the Mississippi and South Sea companies was an important factor. We find some qualified support for the hypothesis that investors were simply enthusiastic about stocks in general. Most shares rose in the British and Dutch bubbles, but the growth in those not associated with the Atlantic trade or with the insurance trade was significantly less.

Our tests of the predictions from the (Pastor & Veronesi, Technological Revolutions and Stock Prices, 2009) models find dynamics over the period of the introduction of new financial technology that are consistent with their predictions about changing factors for security pricing as investor understanding about the prevalence of new technology evolves.

Background

Most early writers treat the bubbles of 1720 as evidence of investor irrationality. [1] (Dale, Johnson, & Tang, 2005) seek to test this theory using violations of the law of one price.[2] Others have argued that the bubbles were not necessarily evidence of irrational expectations on the part of investors, but rather the result of plausible

[1] Cf. (Mackay, 1852), (Vissering, 1863), (van Rijn, 1899), (Kindleberger, 1978).

[2] In response, (Shea, 2007) argues that the (Dale, Johnson, & Tang, 2005) test of the law of one price using share subscriptions is infeasible.

expectations of future returns,[3] or a reasonable response to such financial innovations as the liquidity of shares and the potential of companies to exploit new capital markets and investment opportunities.[4] (Garber, 1990) shows how the high price for the South Sea Company might have been justified by plausible expected returns on invested capital. On the other hand, (Velde, 2009) comes to opposite conclusions for the Mississippi Company, arguing that in the short-term it was financially over-extended.

An important challenge for financial historians is to understand how investor expectations at the time could have driven stock prices up by many multiples in the space of a few months. What could have made investors suddenly willing to pay so much for shares in these companies? In this paper we do not seek to test the rationality of investors but rather to provide more information about what factors may have influenced their beliefs.

For example, if the bubbles in the South Sea Company and the Mississippi Company were driven by expectations about the future profitability of Atlantic trade – in which both firms held patents – then other firms engaged in Atlantic trade should also have experienced high price run-ups in 1720, and conversely, prices of firms not engaged in the trade should not have grown as much. If the speculation was about the debt-conversion operations of the companies then other financial firms should have experienced comparable price run-ups. Thus, the cross-sectional variation in stock returns of the 1720s may reveal the factor-specific basis for investor aspirations that created the bubble – whether rational or not. The contrary hypothesis is that irrational exuberance in 1720 might simply have been indiscriminate, affecting all stocks. In this case we would not expect to find systematic differences across industries.

The barrier to examining the 1720 bubble in cross-section has always been one of data. Up to this point, the prices for some very important companies such as the

[3] Cf. (Garber, 1990).
[4] Cf. (Scott, 1910) and (Neal, The Rise of Financial Capitalism, 1990).

Dutch East Indies and Dutch West Indies companies have not been available to researchers. Scholars have also not had access to prices for the considerable number of initial public offerings from the London and Dutch markets that were floated in 1720. While excellent British price data for several companies has been collected and studied[5] no one has yet made a comparative study of the prices for British insurance companies for that period, despite the fact that they were the focus of the main Parliamentary legislation regulating financial markets in 1720, commonly known as the Bubble Act.

In this paper we collect share prices for Dutch and English companies from a Dutch newspaper published in 1720, the *Leydse Courant*. We also collect price data for Royal Exchange Assurance and the London Assurance from the leading London financial periodical of the time, The Course of the Exchange. Together with the British data from (Neal, The Rise of Financial Capitalism, 1990) we are able to track the course of 26 Dutch company stocks through the entirety 1720, including the Dutch East and West Indies Companies, and a set of eight British companies over the same interval. These British firms include banks, insurance companies and trade companies. In addition to times-series data, we use a sample of 35 British companies for which we have "trough to peak" ranges during the South Sea Bubble. This broader cross section allows us to test for industry effects. Finally, we use Dutch company archives to provide institutional details about mechanisms of share speculation.

Using this data, we find evidence against indiscriminate irrational exuberance and evidence in favor of speculation about two factors: the Atlantic trade and the incorporation of insurance companies. The fundamentals of both sectors may have led to high expectations of future growth. The Atlantic trade was the focus of considerable political and economic activity around 1720 and the insurance business was undergoing a transition towards the corporate form. Other sectors,

[5] Cf. (Parsons, 1974), (Neal, The Disintegration and Re-integration Of International Capital Markets in the 19th Century, 1992), (Temin & Voth, 2004), (Shea, 2007), (Dale, Johnson, & Tang, 2005), (Carlos, Maguire, & Neal, 2006).

such as the financial industry and firms engaged in the Asian trade evidently did not inspire the same scale or investor enthusiasm. The South Sea and Mississippi bubbles were clearly not limited to major firms operating to refund government debt.

The main contribution of this paper is the introduction of a cross-sectional analysis of share prices in 1720 in order to test competing theories about investor expectations in the first great crash of the world's stock markets. It also introduces a hitherto unstudied source of Dutch company prices that documents the scale and timing of the crash in the Netherlands. This dataset allows us to study an early and important example of the international propagation of a financial crisis.

Data

We collected prices reported for Dutch and British companies from the *Leydse Courant* (preserved in the National Library of the Netherlands in the Hague) over the period November 1719 to December 1720. [6] These include London transactions of British companies, as well as occasional prices for the same firms on exchanges in the Netherlands. We added these prices to those collected by Larry Neal and used in (Neal, The Rise of Financial Capitalism, 1990) to study capital market integration in the 18th century.[7] We augmented the Neal data with daily quotation series' from the *The Course of the Exchange* for the two major British insurance companies. We collect peak to trough data for 35 British companies from a satirical print from 1721 entitled "The Bubblers Mirror." Industry information about these firms is obtained by cross-reference to (Scott, 1910).

Evidently no previous scholarship had looked at a complete sequence of the *Leydse Courant*, and no study so far has used regular Dutch price information for the period

[6] Our database, including exchange rates as well as equity quotes is available online at: http://icf.som.yale.edu/DutchData/index.shtml. More data including price quotes in different cities is available upon request.

[7] http://webapp.icpsr.umich.edu/cocoon/ICPSR-STUDY/01008.xml or http://www.le.ac.uk/hi/bon/ESFDB/NEAL/neal.html

1720 to 1723, although scholars had been able to gather occasional references to prices.[8] British stock prices are available for the late 17th and early 18th century in Castaing's *The Course of the Exchange* and two other sources, but Dutch data in general has been lacking for this turbulent period. The British insurance company prices in 1720 have been used to construct market indices,[9] but not studied separately.

Leydse Courant prices were not quoted in currency but as percentages of par value net of paid-in capital. Share issues at the time were offered as subscriptions that required an initial payment that secured the subscription rights. In effect, issuing companies financed the purchase of their shares with a loan, using the shares as collateral.[10] The initial payment was typically a small fraction (1% to 10%) of the par value of the share and came with obligations to make future payments to the company over a period of time – sometimes on a monthly basis, but other times at irregular intervals. This convention made comparisons across companies straightforward, since it had the effect of normalizing the prices. We were able to verify this reporting convention by matching share loan transactions in the books of one of the Dutch firms founded in 1720, Maatschappij van Assurantie, Discontering en Belening der Stad Rotterdam [hereafter Stad Rotterdam, its modern name], with share quotes in the *Leydse Courant*. Appendix 3 discusses this interpretation in some detail.[11]

By similar means we were also able to verify the assertion by (Shea, 2007) that, at least in Holland, subscribers in shares were not obligated to pay the firm if they

[8] See (Gelderblom & Jonker, 2008 and updated 2009), concurrent with the first draft of own work, they report Dutch prices for the second half of 1720. (Neal, The rise of the financial press: London and Amsterdam, 1681 -1810, 1988) mentions the *Leydse Courant*, but notes that only a few issues are extant for the period. In fact, he implores scholars to search Dutch libraries for a complete run of them.

[9] Cf. (Parsons, 1974)

[10] (Dale, Johnson, & Tang, 2005) and (Shea, 2007) disagree on the question of whether South Sea Company investors were obligated to continue loan payments when shares dropped in value.

[11] Although the convention is useful for interpretation of the economic scale of the events of 1720 in the Netherlands, it does not significantly affect the estimates of the bubble in share prices, since these are calculated as percentages normalized either to previous prices or previous quotes.

chose to forego the shares. Shareholder subscription obligations were closed out when shares were returned to the company in lieu of payment.

Prices in the *Leydse Courant* were often quoted as a daily range. In these cases, we took the average of the range as the daily price. Prices for companies were also quoted in more than one city. In these cases we used the prices for the market with the most liquidity, defined as the market with the largest number of quotes during the period of study.[12] Prices for the major British companies: The Bank of England, the South Sea Company, the East India Company, the Royal Exchange Assurance Company, the London Assurance Company, the York Building Society and a few others were also quoted, suggesting that Dutch investors followed – and likely traded in – British shares. This is consistent with the hypothesis in (Neal, The Rise of Financial Capitalism, 1990) that Dutch investment capital flowed into Great Britain in 1720, pursuing equity investment opportunities. News of the finances of France was also regularly reported in the paper, and prices for the shares and related financial claims on the Compagnie des Indes were quoted frequently. This suggests that Dutch investors were interested in the daily fluctuations of the French firm and may have been actively investing, at least in the year 1720. We are lacking the price information before November 1719, so it is not possible to trace earlier Dutch investor interest through this periodical.

The *Leydse Courant* also contains extensive interest rate and exchange rate information on the same frequency. It quoted the *agio* (discount rate between currency and money of account) for the Bank of Amsterdam, and exchange rates between Amsterdam and a number of other cities, including London, Paris, Lisbon and Hamburg. These are useful for future research as well.

[12] Our database preserves the range and prices for multiple markets, allowing future research analysis of such things as intra-day volatility and information diffusion and investor bias among cities, however these topics are not the focus of the current study.

Cross-sectional Differences in the South Sea Bubble

Figure 1 shows the stock price growth of the eight major London companies regularly quoted in *The Course of the Exchange* and the other major price list, *Freke's Price of Stocks Etc.* over the period from November, 1719 through December, 1720. The scale is logged to represent percentage changes and indexed to 1 at the beginning of the available quotations for each series.[13] There are three striking features of the graph. First, during the year 1720 all firms experienced, at a minimum, a doubling of their share price. However, for three companies the prices at the end of the year were at or below their beginning of year levels.[14] For these firms the increase in share price during the first part of 1720 was a purely temporary phenomenon, while for the others the run-up had a permanent component. Secondly, there is considerable cross-sectional variation in the degree of price run-up. Although the events of 1720 are historically associated with the South Sea Company, a few firms "bubbled" more dramatically than the South Sea Company, when measured by price growth. In particular, the two marine insurance companies, Royal Exchange Assurance and London Assurance rose to much higher multiples of their original price during 1720. The Royal African Company (which, like the South Sea Company, was engaged in the Atlantic slave trade) rose as high as the South Sea Company in percentage terms as well. By contrast, the two banks, Bank of England and Million Bank, as well as the East India Company (engaged in the South Asia trade) rose much less than the other four. Our price data for the York Building Company, a scheme that involved the development of waterworks in London, the purchase of confiscated estates in Scotland and the sale of life insurance and annuities, only starts half-way through the year. Thus, we cannot measure the increase over the first part of the year, although we know from other evidence that

[13] Quotes for two companies, Royal Exchange Assurance and London Assurance begin January 1st, 1720 under different names.

[14] Since quotations for the York Building Society only begin in June, we do not know whether it finished up or down for the year.

the extent of its rise from its initial offering price was similar to that of the marine insurance companies.

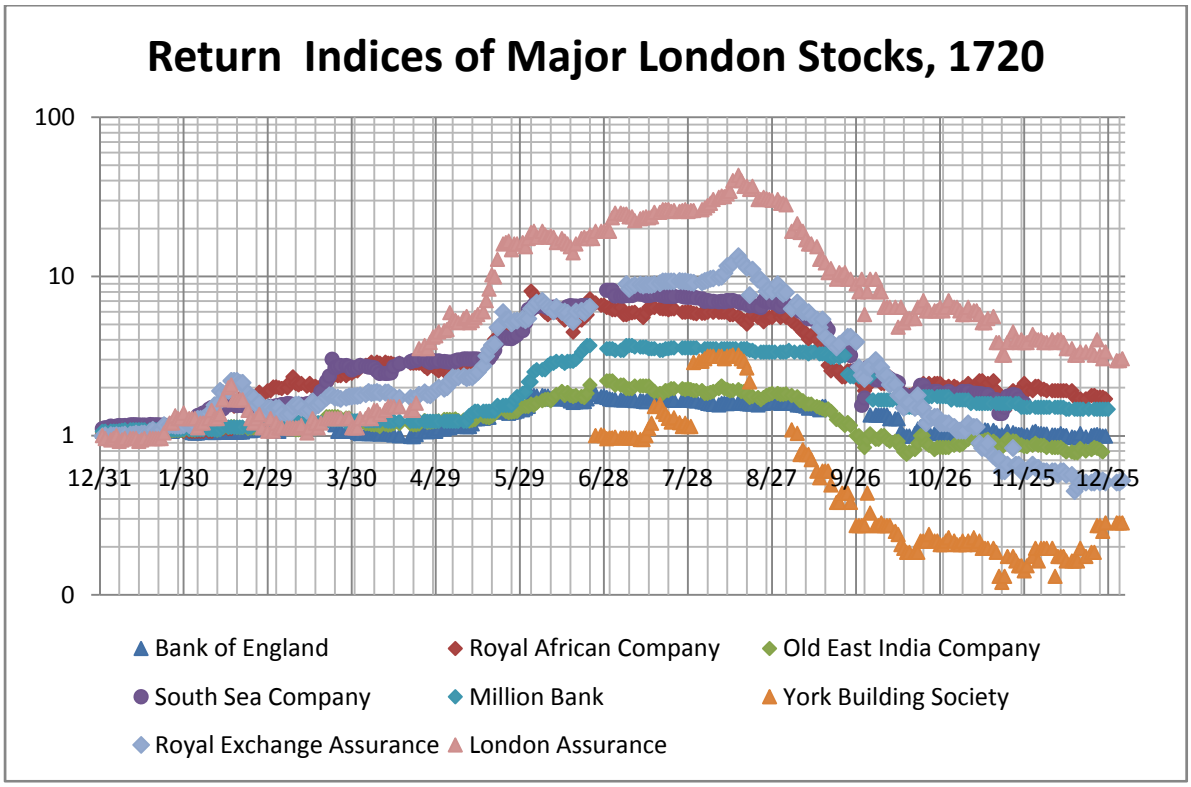

Figure 1

A final feature of interest in Figure 1 is the timing differences in the bubbles. The two marine insurance companies and the York Building Company reached their peak simultaneously in mid-August of 1720 and then dropped sharply at least two weeks before the crash spread to other major British firms.

The differences in scale and timing suggest that the price bubble in 1720 was not perfectly coincident with, or even necessarily driven by the rise and fall of the South Sea Company shares. For example, it is natural to attribute the difference between the high growth of the South Sea Company and Royal African on the one hand, and the modest growth of the East India Company on the other, to the expectations

about the Atlantic trade as opposed to the South Asian trade. The new Dutch price data give us an opportunity to test this. If there were different causes of the price run-ups in Figure 1, reflecting differential expectations of investors about the relative fortunes of companies trading with the East versus the West, then these differences are likely to show up in the Dutch market as well. On the other hand, if the price run-ups of share prices in London were largely idiosyncratic, it is unlikely to find a similar pattern overseas.

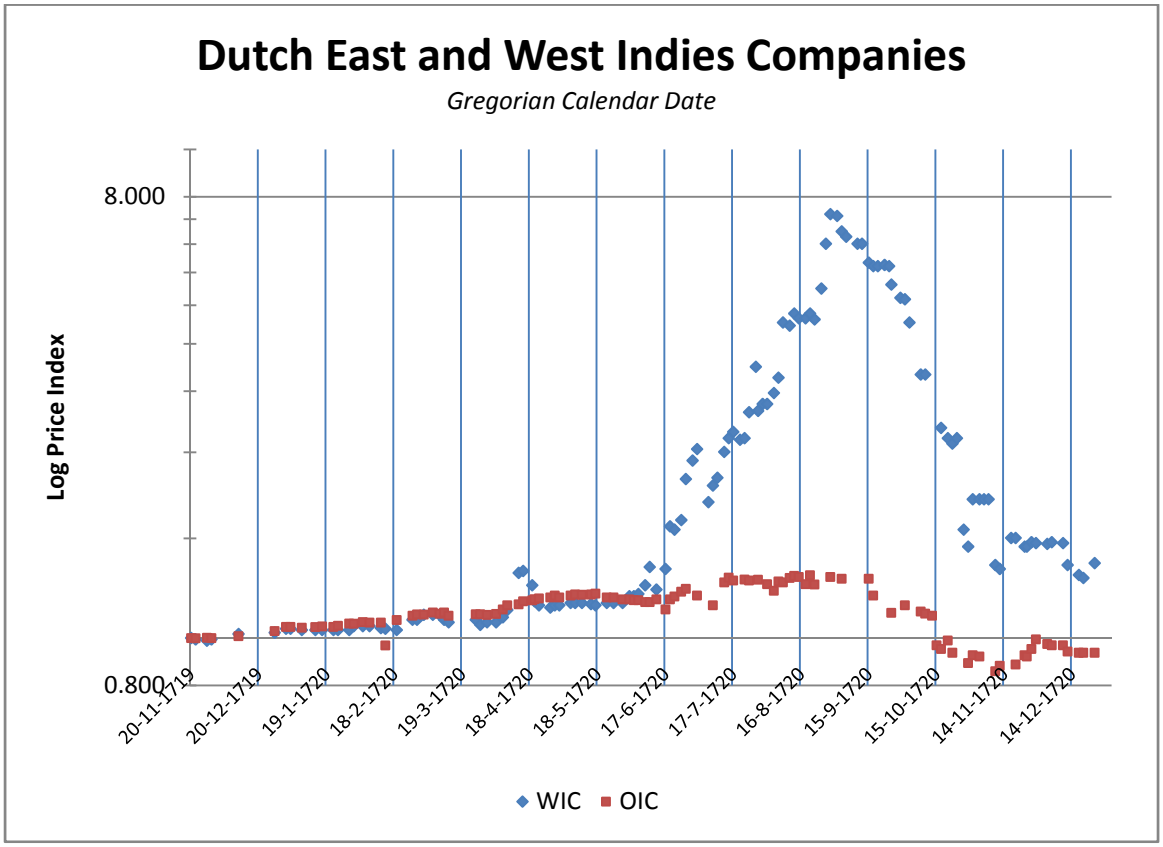

Figure 2

Figure 2 shows the rise and fall of investment in the Dutch East Indies Company and the West Indies Company over the period of November, 1719 through December, 1720. The data are reported three times per week, so unlike the daily London prices, they are discontinuous, and represented by markers in the figure rather than by lines. The similarities between the Dutch and London markets are striking. First, the run-up in the Dutch market was much larger for the West Indies Company than

the East Indies Company. Second, the relative top-to-bottom variance of prices is strikingly similar in both markets. The Dutch West Indies Company clearly bubbled on the same scale as the South Sea Company and the Royal African Company, rising by a factor of 7 over a very short interval. By comparison, the price of the Dutch East Indies Company did not double and, like its British counterpart it fell below its beginning of year value by the end of 1720.

The four major firms in Northern Europe engaged in Atlantic trade; the Mississippi Company, the Royal African Company, the South Sea Company and the Dutch West Indies Company all rose by factors of 7 to 10 in the global bubble. The two major firms engaged in Asian trade, the Dutch and British East India companies, rose by much less. This is evidence in favor of the hypothesis that investor expectations (or at least sentiment) differed with respect to Atlantic vs. Asian trading companies, supporting the theory that the South Sea Bubble may have been partly a function of expectations about future Atlantic trade.

There is some supporting historical evidence for this hypothesis. The triangle trade that brought manufactured goods to Africa, Africans as slaves to the New World and plantation-produced commodities to Europe was one of the most important international economic institutions in the early modern era. It was just getting underway in 1720 and thus future profits were a long way off at the time of the bubble. Nevertheless, like the modern tech bubble, perhaps this future promise sparked current investor enthusiasm.

Other international events at the time might have also directed investor attention to the Atlantic trade and encouraged broader commercial aspirations in the New World. The short War of the Quadruple Alliance [1718-1720] pitted Spain against Britain, France, Austria and the Netherlands over control of Italy. The New World territories from Texas to Florida were an important secondary theater of the conflict. France fought to extend control over Spanish lands in Texas and New Mexico from her settlement at the mouth of the Mississippi; the British in Carolina threatened Spanish Florida. While a treaty in February, 1720 concluded the

hostilities in favor of the alliance, there was no major realignment of control in the Americas.[15] Never-the-less, Spanish dominance in the New World was explicitly challenged, potentially raising interests and expectations among French, British and Dutch investors about future New World inroads.[16]

The commonality in the patterns of price run-ups in Amsterdam and London suggest a high degree of financial integration between these markets.[17] However, as noted above, the West Indies Company rose later than the South Sea Company or the Royal African Company. Part of the difference can simply be attributed to time keeping: there was an eleven-day difference between the older Julian calendar used in London and the newer Gregorian calendar used on the continent. But even accounting for this time lag, there remains at least a month difference in the beginning of a bubble trend. This suggests that any spill-over of irrational (or rational) exuberance ran from Britain to the Continent, not vice-versa.

International Stock Market Crash

As we have seen, share prices in several companies rose dramatically in 1720, but the timing of their take-off differed. In this section we examine the timing of the crash. Figure 3 shows the Dutch West Indies Company, Stad Rotterdam, the South Sea Company and the two British insurance companies. The trading dates for the British companies have been adjusted to the Gregorian calendar. Hereafter a G will indicate a Gregorian date, and J a Julian date.

[15] In fact the concluded peace likely heightened the prospects for South Sea Company and Royal African Company profitability, as the South Sea company expected to have the Spanish *Asiento* reinstated following the war – the document granting rights to supply African slaves to Spanish America. The South Sea Company had previously sourced slaves from the Royal African Company.
[16] See (Weber, 1992) p.165 ad ff.
[17] See also (Neal, The Rise of Financial Capitalism, 1990) for a discussion between the integration of Dutch and British stock markets in the 18th century

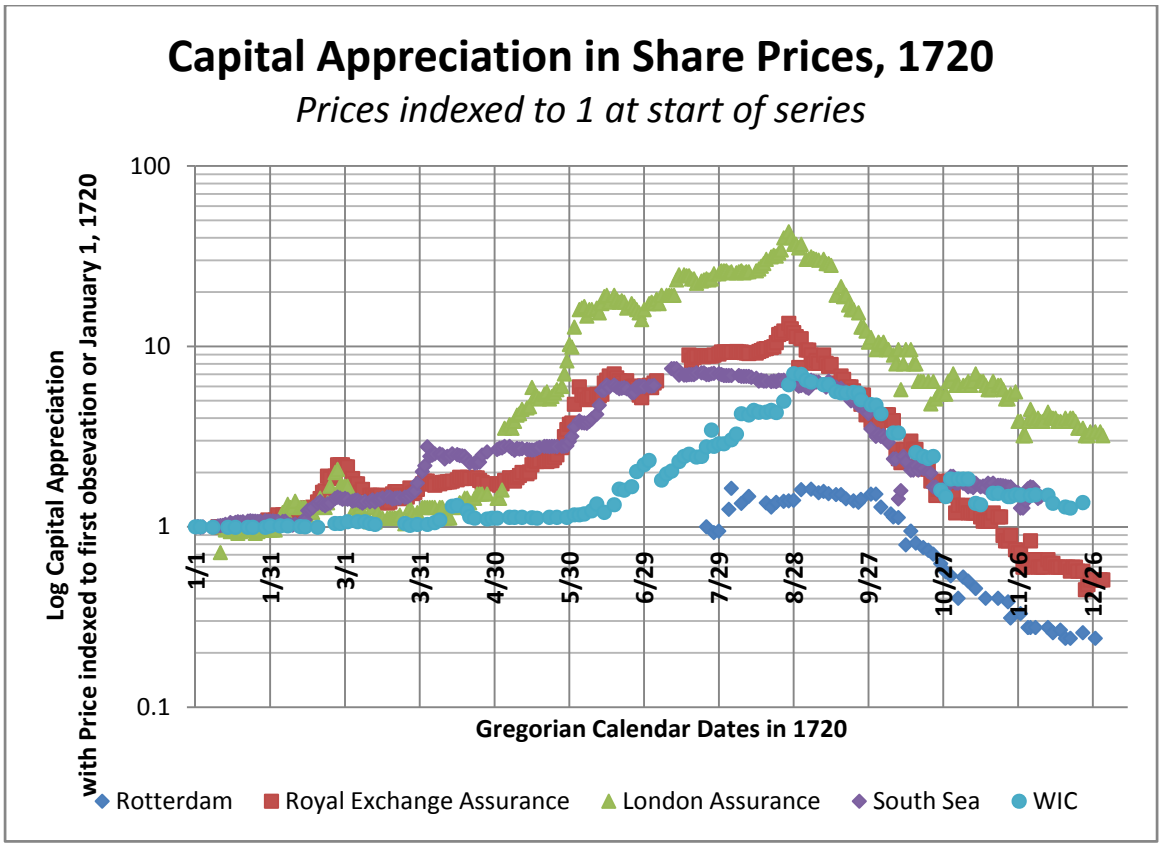

Figure 3

The prices are indexed to one at the start of each series, and the vertical axis is logarithmic to allow comparison of the scale of the price changes on a percentage basis. The two British insurance companies reached their peak on the same day – August 26th [G], and began their drop on the 27th [G]. They both fell significantly over the following four trading sessions. The Dutch West Indies Company reached its peak on August 28th [G] and began its drop on the following trading day, August 31st. It, too, continued to fall significantly over the flowing several trading sessions. Together, these three firms – aside from the Mississippi Company in France – were the first major companies to crash in price in 1720. The crash in Royal African Company shares began three weeks later on September 14th [G] and the crash in South Sea Company shares began on September 19[G]. Since late August seems to have been the important turning part in the London and Dutch stock markets, a natural question to ask is what happened around August 27th [G], or August 16th [J]?

The *Leydse Courant* reported news about both the British insurance companies in its edition of August 28th [G] noting that, on the 23rd of August [G] the Royal Assurance Company was planning a new issue of shares for the following week, presumably to raise the 50,000 pounds payment to the Exchequer promised by September 11 [G]. This payment was a condition of their charter granted as a result of the Bubble Act.[18] The London Assurance Company was also required to deliver the same sum on that date. The news also noted cryptically that the London Assurance Company "kept silent and sought to learn the secrets of the other firm" presumably alluding to some scandal.[19] This suggested that there was some asymmetric information of potential importance to investors.

Not reported in the *Courant*, but known from the *London Gazette* of August 23rd [J] is that the Attorney General issued a writ of *scire facias* on August 29th [G] against four firms (including the York Building Company) seeking to expand their business beyond their charter. This writ represented a serious risk to firms seeking broad latitude. Although they were not named in the writ, it likely fed negative speculation about the potential constraints to the aspirations two marine insurance firms to expand into fire and life insurance. Although the writ was ultimately annulled, the reprieve came after the market crash.

Non-legal factors may also have come into play around this time. The *Leydse Courant* of September 2 [G] reported news from London dated August 30th [G] that a fleet of twelve ships from Jamaica had been lost and they were insured by the London Assurance Company for 72,000 pounds.[20] It noted the burglary of the home of one of the directors of the company. [21] The insurance claim from the fleet and possibly the burglary would have raised concerns about the capability of the firm to meet its September payment deadline.

[18] (Supple, 1970), p. 37.
[19] *Leydse Courant*, vol. 121, p. 2, July 28th, 1720.
[20] The date of this event is incorrectly reported in (Postlethwayt, 1757) as occurring in October.
[21] *Leydse Courant*, vol. 125, p. 1, September 2nd, 1720.

Thus, over the course of four days in late August, 1720, adverse news about the York Building Company and the two major insurance companies hit the market and quite likely triggered their rapid decline in price. Over the course of a week, all three British firms declined roughly 30%. This decline is large enough to have caused financial distress to speculators on margin. In this way it may have led to a broader financial crisis caused by borrowers liquidating securities to cover obligations.

Because they are reported in the *Leydse Courant*, we can track the dates on which these same news items reached the Netherlands. The lag of three to four days between the crash in London insurance companies and the Dutch West Indies Company is not surprising. (Koudijs, 2009) calculates that the average 18th century travel time of packet boats between London and Amsterdam was about three or four days. Likewise, the lag of three to four days is confirmed by the *Leydse Courant's* dated bylines vs. publishing dates for London news. We might expect, however, that some reports reached the Dutch capital markets through other channels.

Thus, through public information sources, Dutch investors in the British bubble companies as well as the Dutch West Indies Company would have known by August 29th about the financial plans and troubles of the British insurance firms. Also they may also have known through private information sources that the Jamaica fleet was wrecked.[22]

It is not clear whether these reports were good news or bad for Dutch investors. The West Indies Company was not engaged in the insurance trade, and the only value-relevant news about the new world (apart from the shipwrecks) might have been the August 30 [G] report in London of the discovery of gold in Jamaica, reported in the September 2 [G] *Leydse Courant*. The only source of propagation of the crash is through the channel of financial distress. Investors in the West Indies Company who held British insurance shares on margin might have had to raise cash

[22] The Amsterdam insurance market would have had the same capabilities of learning about Caribbean shipwrecks in a timely manner as the London market, since these affected underwriting decisions regardless of who insured the ships.

by selling their Dutch assets. The *Leydse Courant* reported the prices of Royal Exchange Assurance and the London Assurance intermittently for the trading days July 6 [G] to August 24th [G], and for the York Building Company from July 19th [G] to August 17th [G]. It seems reasonable to interpret this demand for news about these firms as evidence of speculative interest in these securities among Dutch investors. Interestingly enough, shares in Stad Rotterdam jumped by 15% from August 28th to August 31st. Since the firm was created to compete with the British insurance companies, the problems of a rival might have been viewed as an opportunity. Stad Rotterdam did not crash until the end of September.

The coincidence of the price peaks for three British firms and the West Indies Company seems best explained by the onset of a liquidity crisis in the international stock markets – a crisis that overwhelmed the capital markets in the following two months. The coincidence of the *scire facias* writ limiting British companies to their charters seems to be the leading culprit in the events that sparked the crash, although negative news about one of the British insurance firms also likely played a role.

Beyond the micro-question about what sparked the global financial crash, the one thing we can determine from the time-series of various stock prices is that, while British and Dutch firms rose at different times over the course of the first eight months of 1720, September and October were terrible months for all stocks. The crash overwhelmed all stocks regardless of whether investor expectations were based on prospects of Atlantic trade, maritime insurance or real estate deals.

One thing the rise in Dutch share prices reveals is that government re-funding could not have been the sole basis for the British bubble. No Dutch firm was launched to imitate the financial operations of the Mississippi Company or the South Sea Company. The fact other types of firms bubbled – including the West Indies Company – suggests that the Mississippi and South Sea bubbles were not primarily due to speculation about the debt-equity swap as a financial innovation.

Cross-sectional Evidence from New Company Issues

The price bubbles in 1720 were accompanied in Britain and the Netherlands by a wave of new company issues. The *Leydse Courant* provides price information for many of the new firms launched in the Netherlands, however regular price quotations for the new companies in London have not survived. Never the less, some information remains to allow an analysis of the cross-sectional differences in the magnitude of the run up in individual share prices. A satirical British print *The Bubbler's Mirror*, appeared in 1721. It lists a number of the well-known London issues along with the par value of the shares and the maximum percentage over par achieved during the bubble.[23] This information is sufficient for us to further quantify the cross-sectional differences noted for the larger firms and to determine the extent to which differences observed across industries – i.e. Atlantic trade, insurance and banking carry through more generally. The data from *The Bubbler's Mirror* is reported in Appendix 1.

Table 1 shows the average growth by industry. The first column includes the large firms previously studied. In the second column, we removed the Bank of England, the Million Bank, the South Sea Company, the Royal African Company, the Royal Exchange Assurance Company and the London Assurance Company from the calculations. The one exception is the inclusion in both columns of the East India Company as a basis for comparison.

[23] Reported in (Scott, 1910) vol. 1 p.410.

Table 1: Maximum Percentage Price Increase of British Firms over par by Industry, 1720			
Industry	Total	Total (less large firms)	Number
Insurance	2013%	1717%	8
Real Estate	1625%	1625%	2
Commodity	1208%	1208%	12
Manufacture	1166%	1166%	6
Atlantic	895%	948%	4
Marine	875%	875%	6
Service/Utility	567%	567%	3
Pacific	349%	349%	1
Bank/Finance	335%	500%	3
Total	1172%	995%	45

In order to test the hypothesis that the British firms associated with the Atlantic trade reached higher premia over par values, we performed a t-test on the log growth rates of the Atlantic trade firms and tested the null that the growth rate for the East India Company was drawn from the same distribution. Despite the few degrees of freedom, we were able to reject the null with greater than 85% confidence for both specifications.[24] When the South Sea and Royal African Companies were removed, the t-test returned a probability value of 10.6%. This is not surprising since the test in this specification has the minimum feasible degrees of freedom.

Table 1 shows that insurance was the highest growth industry, although it also had the highest cross sectional variation in rates: Four of the top seven firms ranked by growth were insurance companies, and two of the last seven were insurance

[24] The test was performed for two specifications: simple growth rates and logged growth rates. In growth rates, the t-value was 4.25 on 3 df. For log growth the t-value was 6.15 on 3 df. The important caveat is that the small sample and its unknown distributional properties potentially limits the interpretation of parametric tests.

companies. Column two shows that excluding the two top marine insurance companies, Royal Exchange and London Assurance reduced the scale of the bubble in insurance firms, but did not change its top rank. This is due to the fact that two firms (General Insurance and British Insurance) bubbled on a comparable scale to their more widely traded cousins. A t-test of the difference in mean growth rates between insurance companies and all other firms in the sample yielded mixed results.[25]

This cross-sectional industry-level evidence suggests that the exuberance of London investors was driven by certain industries. While the Atlantic trade is the obvious candidate given the fame of the South Sea Company, the data suggest that there was a major bubble – perhaps even a larger bubble – in insurance. The prominent position of the insurance companies in the bubble was noted by contemporary observers; most famously, John Aislabie, Chancellor of the Exchequer who took a bribe of 20,000 pounds of South Sea stock in return for his political support of the firm. In his unsuccessful defense before the House of Lords, Aislabie exclaimed of the two insurance firms: "these two projects were founded in greater iniquity and contributed more to the publick calamity than anything else." [26]

An interesting feature of the Bubble Act of June 9, 1720 which asserted governmental control over chartering companies for limited purposes is that it did not directly concern the South Sea Company. Rather, it chartered the London Assurance and the Royal Exchange Assurance companies and explicitly limited the chartering of competitors.[27] It thus makes sense to look at the bubble in 1720 through the lens of financial innovation in the insurance sector as much as from the

[25] A t-test assuming differences in unknown variance between the samples yielded a probability value of 22% for logged growth rates and .3% for raw growth rates.
[26] Mr. Aislabie's second speech on his defense in the House of Lords, London (1721) p. 14 quoted in (Scott, 1910) p. 405.
[27] This may account for some of the spread observed within the insurance industry.

perspective of an event driven by massive government debt conversion, or indiscriminant speculation in company shares. [28]

The IPO Wave in the Netherlands

In the Netherlands, a number of new firms were capitalized in 1720, beginning in July with the creation of Stad Rotterdam and extending through October of that year. We collected data from the *Leydse Courant* for many of these new firms.

[28] For a view of the effect of the Bubble Act on business organization, see (Harris, The Bubble Act: Its Passage and Its Effects on Business Organization, 1994) and (Harris, dustrializing English Law: Entrepreneurship and Business Organization, 1720 1844, 2000).

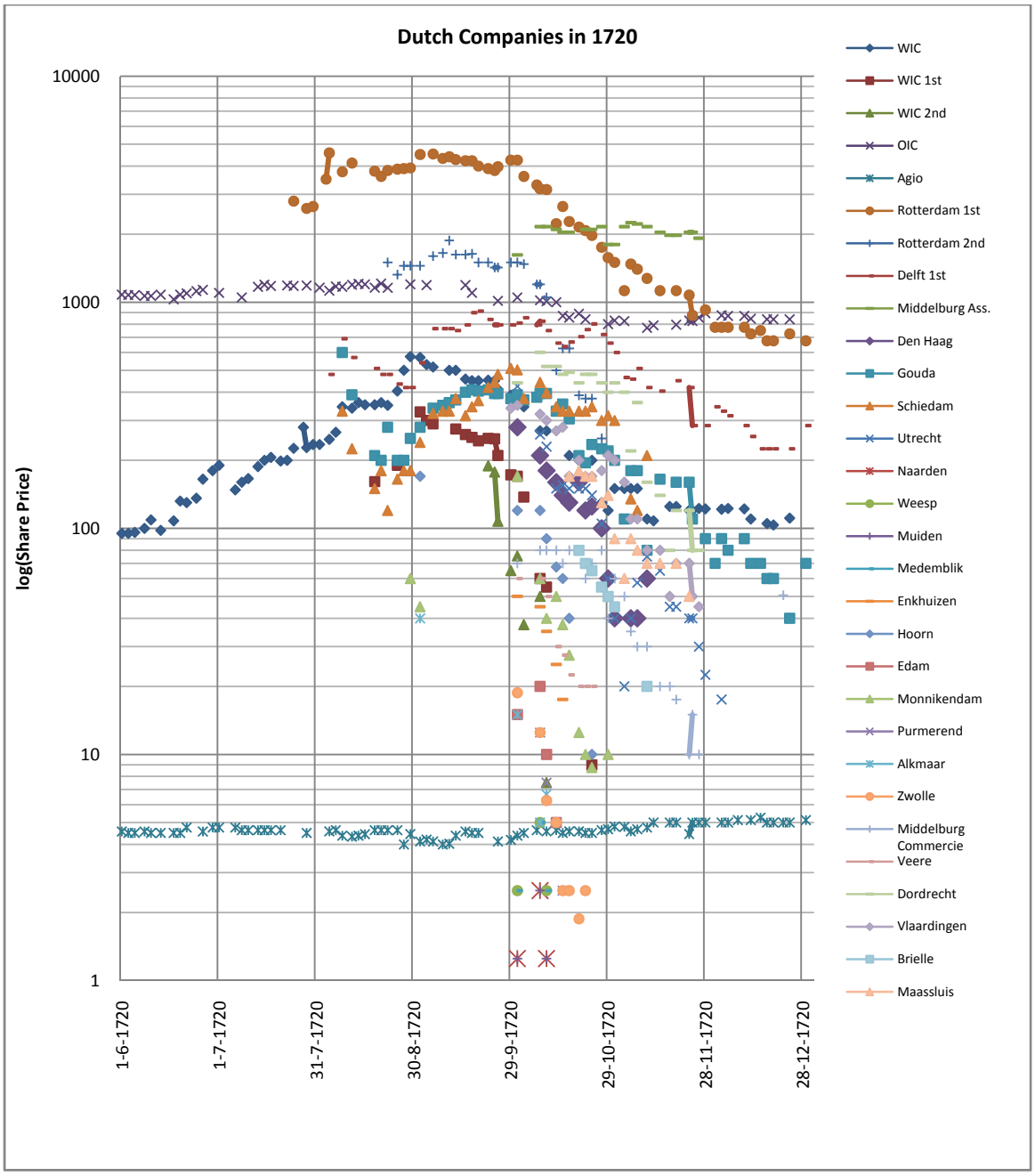

Figure 4

Figure 4 shows the major Dutch price series' as well as a number of the additional issues over the last six months of 1720. As noted previously, the East India Company [OIC] rose only a little through the year and then dropped below its June level by the end of 1720. The West Indies Company rose quite dramatically and raised additional capital in two subscriptions in 1720 as its stock price rose. The most striking feature

of the figure is that, with the exception of Middelburg, which floated both an insurance company and a commercial company, all the Dutch projects were singularly associated with its own city. (Gelderblom & Jonker, 2008 and updated 2009) point out that this reflects the history of Dutch corporate development. The East India Company resulted from a consolidation of trading companies in different cities. Gelderblom and Jonker hypothesize that Dutch cities may have anticipated a similar consolidation of the insurance trade, and thus the first move of Rotterdam might have stimulated a rush to create similar projects that would result in a share of the consolidated firm. If this were so, it would suggest that the Dutch viewed the publicly traded corporate insurance company as an important and potentially transformative financial innovation that had the power to become a dominant organization. No city wished to be left out of the potential future gains to the consolidation of the Rotterdam company into a huge national enterprise. This is consistent with our hypothesis that speculation about the new insurance company form was a major driver of the international bubble in share prices in 1720.

If the expectation of consolidation motivated the flurry of Dutch public offerings, such a consolidation never materialized. The shares of Stad Rotterdam began trading in mid-July, after the peak of the South Sea Company, but a month before the peak of the London and Royal Exchange Assurance companies. The firm made a secondary offering a month later, and by that time many other companies had been launched. Gouda, Delft and Schiedam were next, and they all followed a trajectory in August and September. After a drop following their initial offerings their shares rose sharply – increasing from the pre-September lows by as much as 100% to 300%. These brief spikes may not have been comparable in scale and duration to the bubble in West India Company shares, but they were evidently perceived by some market participants as such.

Following the entry of Gouda, Delft and Schiedam came a flood of new issues at the end of September and the beginning of October; just as the global crisis hit London and the Netherlands. Note the density of initial public offerings and transactions in the Netherlands in September in this brief interval. The Dutch new issues market

lasted a brief two months. All shares traded down in November and towards the close of the month trading dried up. Share quotations are virtually lacking in December. The *Leydse Courant* stopped quoting share prices in January, 1721.

The financial bubble in Holland began later than the bubbles in France or Britain, and it came to a conclusion with the crash in Britain with nearly precise correlation to the fall in British insurance company shares. Except for the dramatic run up in West Indies Company shares, the scale of the Dutch bubble was also somewhat smaller. Appendix 2 reports the maximum trough to peak percentage gain for the full sample of Dutch firms. The average was 127%; much lower than the average maximum percentage gain in the London bubble. This is consistent with the claim of (Gelderblom & Jonker, 2008 and updated 2009) that the Dutch bubble was smaller in scale than the British and French bubbles.

Assessing the economic significance of the bubble in the Netherlands based upon the peak to trough range of prices may be misleading, however. The new Dutch data support the relative importance of speculation about insurance. In Appendix 2 we report the stated intent of the new Dutch firms launched in 1720, gathered from their founding documents. Unlike the new British firms, which varied considerably in their industrial classifications, most of the Dutch companies were established to conduct commerce and trade. However, a majority of the companies included insurance as one of their proposed lines of business. It is telling that the charter of Stad Rotterdam mentions the competitive challenge of the new British insurance companies in motivating the need to launch the firm.[29]

The crash in the equity markets was a significant setback to this new financial technology. The success of the public insurance corporation depended on the external demand for shares and the availability of public investment capital. These dried up with the global contraction of securities markets following the crash in Great Britain. Had the global crash not occurred, public investment in marine insurance underwriting might have continued. After 1720, many of the new Dutch

[29] Anonymous, 1720, *Het Groote Tafereel de Dwaasheid*, p. 25.

firms closed and returned shareholder capital (or issued financial substitutes such as life annuities). A few firms survived and prospered. The Middelburg commerce company became a major player in the Atlantic economy – including the slave trade – in the late 18th century. Stad Rotterdam also fulfilled the promise of the potential of a publicly capitalized insurance corporation. It survived and prospered to become one of the largest insurance companies in continental Europe, eventually merging with the financial giant Fortis.

The survival of Stad Rotterdam, London Assurance and Royal Exchange Assurance into the modern era proved the long-term viability of incorporated insurance companies. Given that the average peak to trough price increase for most of the Dutch companies was comparatively modest, it is difficult to view investors of the time wild speculators. The underlying rationale for investing at the time – i.e. an innovation in the financing of marine insurance underwriting, does not appear to have been unreasonable.

Revolutions and Stock Prices

(Pastor & Veronesi, Technological Revolutions and Stock Prices, 2009) build a theoretical model for share price development during times of technological revolutions. When an innovation takes place, it is optimal for companies to invest a small amount in the new technology. They learn about possible productivity gains of the innovation. If the gain is sufficiently large the new technology is gradually adopted across firms. This strategy of gradual adoption has important implications for both risk and share prices during the set up phase of financial discoveries. (Pastor & Veronesi, Technological Revolutions and Stock Prices, 2009) explain that the cash flow effect dominates in the early stage. The expected productivity gain drives share prices up through increased expected cash flows and firm betas consequently decrease. However, in the second stage, the discount rate effect dominates the cash flow effect. The broad adoption of the new technology increases systematic risk and drives up discount rates and betas of the new economy. As the character of risk changes from idiosyncratic to systematic, share prices also begin to

fall. The evolution of risk is also studied through volatilities of the new and old shares in the economy. (Pastor & Veronesi, Technological Revolutions and Stock Prices, 2009) predict that the volatilities of the new and old economy both bubble, but that the bubble in share price volatility of new technology stocks is much larger than the old stock price volatility. In addition to their theoretical model, they test their model empirically on the NASDAQ bubble in the nineties and the railroad mania halfway the nineteenth century and find that the empirical patterns in share prices, betas and volatilities closely follow their predictions.

In this section we study the role of innovation in the 1720 bubble. We examine the patterns in betas and volatilities through the year 1720 in the British stock market. To construct market factors and compute betas and volatilities for the different sections (new and old) of the economy, we first remove outliers and interpolate missing observations in the return series[30]. We classify the new insurance companies (London and Royal Exchange Assurance) and the South Sea Company as new companies and the remaining (Old East India, Million Bank, Bank of England and Royal African Company) companies as old. We compute market betas and volatilities for both sections over a rolling window of 45 daily returns.

[30] We remove returns larger than 90% or smaller than -90% and maximally interpolate over a period of three weeks.

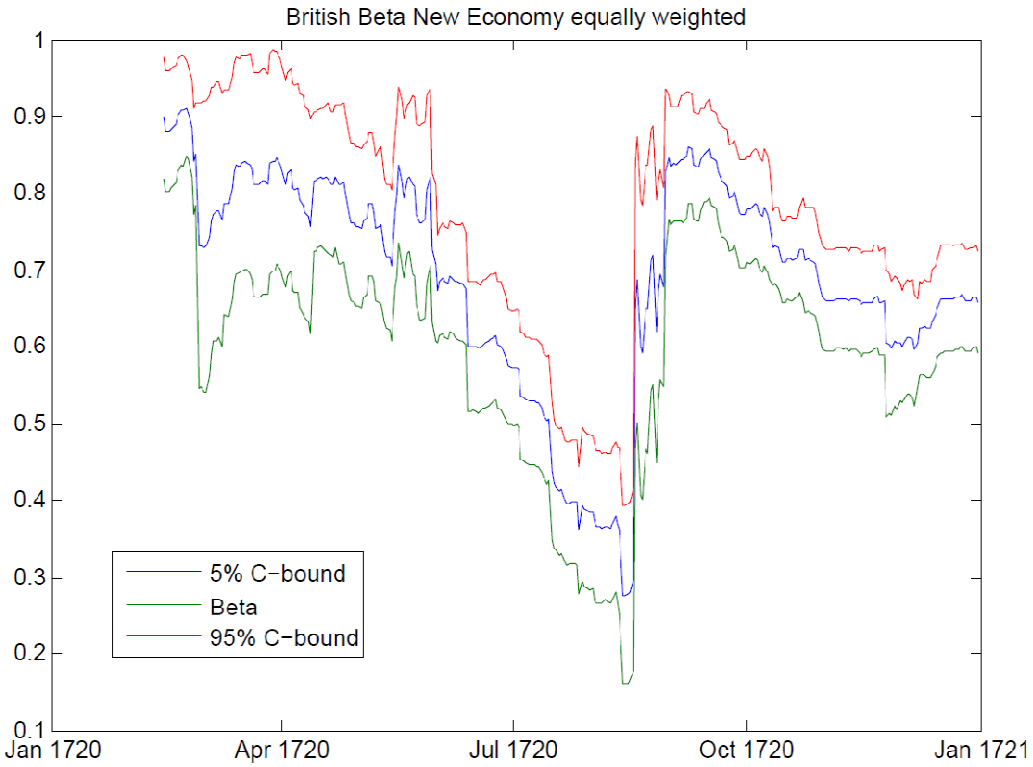

Figure 5

Figure 5 displays the beta of the new economy stocks over the year 1720 with corresponding confidence bounds. The development in beta over the year 1720 is strikingly similar to the theoretical prediction by Pastor and Veronesi (2009) in their Figure 4C. As the cash flow effect dominates, the betas gradually drop. Thereafter the discount rate effect takes over and an increase in betas is documented. After the full-scale adoption of the new technology, betas decrease again.

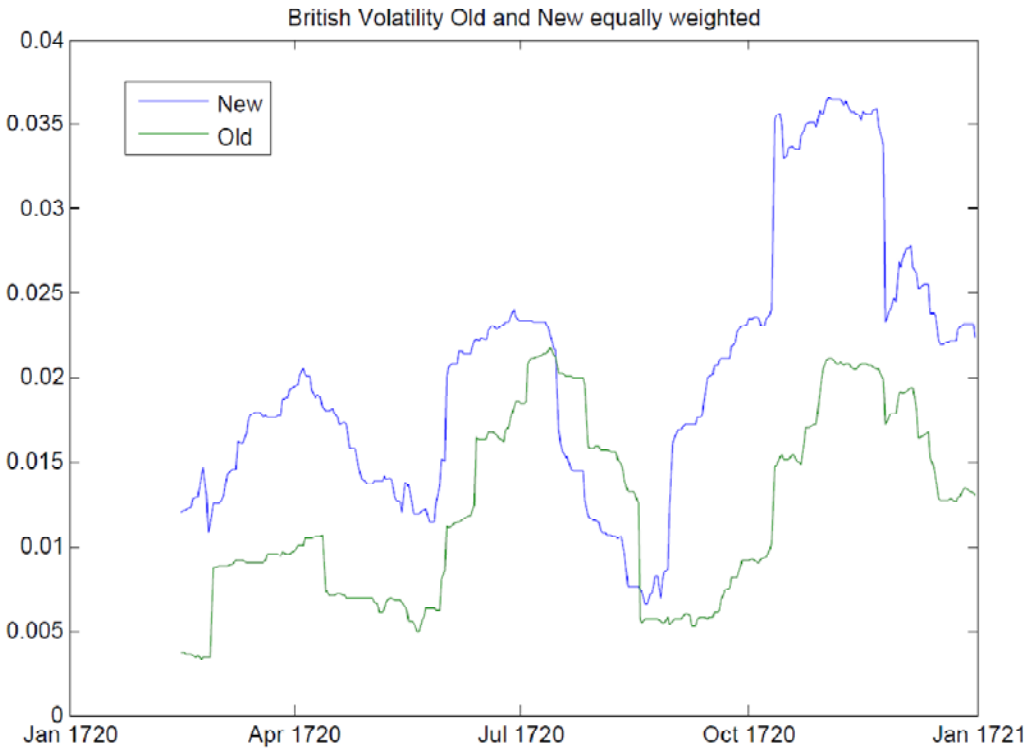

Figure 6

Figure 6 also shows remarkable similarities with the predictions of the theoretical model. As expectations of future cash flows are most important in the early stages, volatilities are expected to drop, as documented in Figure 6. Thereafter the new technology is gradually taken on and the risk of the new technology transforms from idiosyncratic to systematic, increasing stock return volatilities of both old and new stocks. More specifically, the bubble in the new shares is larger than the bubble in volatility of the other shares. Finally, the full adoption of the new technology leads to a drop in share price volatilities, where the drop in new shares exceeds the drop in old shares.

Also from a perspective of timing, figures 5 and 6 show similar trajectories through 1720, beginning with try-outs in early June and ending in full-scale adoption by the end of November. We have tested the robustness of the results and find that the findings are robust to the length of the estimation window, subsampling,

interpolation periods, outlier removal, classifications of old and new and weighting of the market factors[31].

Conclusion

The cross-sectional evidence from British and Dutch firms in 1720 does not directly allow a test of whether investment in shares at the time was economically rational. Instead, it provides more information about the nature and timing of investor expectations.

The data for major British companies suggests that expectations (rational or not) about the Atlantic trade may have been an important factor. The differential between the South Sea Company and the East India Company in the British market is matched by the differential between the Dutch East and West Indies Companies. This hypothesis is supported by a test of the size of the bubble using another data set of "bubbles." The bubble in other Atlantic-trade firms, excluding the Royal African Company and the South Sea Company, also exceeded the maximum growth in East Indies Company shares in 1720.

We have price records for nine major firms over the year 1720; two from the Netherlands and seven from Britain. Of these, the share prices for the three firms engaged in the Atlantic trade: the South Sea company, the Royal African Company and the Dutch West Indies Company were higher at the end of 1720 than at the beginning.[32] Although their prices increased by multiples in the middle of the year and the dropped considerably from their highs in 1720, as a group, they experienced a permanent price improvement. Firms engaged in other industries had mixed results. This cross-sectional evidence suggests that the "bubble" may have been based upon some fundamental common factor that justified a value increase. While investor irrationality may have carried prices to many multiples of their post-crash value, the bubble speculation may have anticipated some long-term permanent effect.

[31] The results of the robustness tests are not reported but available on request.

[32] South Seas = 45% gain, Royal Africa = 91% gain and West Indies Company 51% gain.

The cross-sectional data also show that speculation in insurance companies was another important factor in the bubble. The chartering and incorporation of insurance companies in the early 18th century was a financial innovation. It extended the potentially valuable feature of limited liability to firms that dealt in risk. Before this transition, insurance was provided by underwriters operating alone or in syndicates that pooled capital. With the transition to corporations came broader access to public capital. The new, liquid stock markets gave the public insurance firms the capacity to increase their capital base and to diversify their risks. These may have been perceived as valuable financial innovations at the time. Our data provide an opportunity to test recent theory about the evolution of security prices during periods of technological change. Within the limits of our data we test two implications of Pastor and Veronesi's theory and find support for both.

In summary, a view of the stock prices of more than thirty traded companies, and the price gains in 1720 of another forty additional firms provides a useful perspective on the bubbles in South Sea Company and Mississippi Company shares. While the actions and price dynamics of these two major companies have dominated the historical study of the period because of their major scale, a cross-sectional perspective suggests that the basis for speculative enthusiasm at the time may have been connected to long-term prospects for Atlantic commerce, and the recent innovation in the organizational form of insurance companies. Our test of theory suggests that the price dynamics interpreted as a bubble may reflect the rapidly changing understanding of the economic effects of innovation.

Appendix I: Maximum Growth for London Companies, 1720
Highest price paid and nominal value of share

Company	*Industry*	*Nom. Value or Lowest Mkt Value*	*High Price*	*Growth*
Manuring of Land	Service/Utility	1/8	1 1/2	1100%
Furnishing of Funerals	Service/Utility	2 1/2	15	500%
Liverpool Water Supply	Service/Utility	10	20	100%
York Buildings Co.	Real Estate	10	305	2950%
Improvement of Land	Real Estate	5	20	300%
East India Company	Pacific	100	449	349%
Building or Buying ships for Freight	Marine	1	15	1400%
Navigation of the River Douglas	Marine	5	70	1300%
Grand Fishery	Marine	1/2	5	900%
Orkney Fishery	Marine	25	250	900%
Whaling Co.	Marine	1/2	3 1/2	600%
Royal Fishery	Marine	10	25	150%
Temple Brass Mills	Manufacture	10	250	2400%
Royal Lustering Co.	Manufacture	5 1/8	105	1949%
Water Engine	Manufacture	4	50	1150%
Stockings Frame-work Knitters Co.	Manufacture	2 1/2	30	1100%
Irish Sail Cloth	Manufacture	1/4	1	300%
Puckle's Machine Gun	Manufacture	4	8	100%
General Insurance	Insurance	1/8	8	6300%
London Assurance Co.	Insurance	5	175	3400%
Royal Exchange Assurance	Insurance	10	250	2400%
British Insurance	Insurance	1/8	3	2300%
Rose Insurance	Insurance	1/2	4	700%
Life Insurance	Insurance	1/2	4	700%
Marine Insurance	Insurance	1	3	200%
Sun Fire Office	Insurance	10	20	100%
Gold Mining Co.	Commodity	1/2	16	3100%
Welsh Copper Co.	Commodity	4 1/8	90	2082%
English Copper Co.	Commodity	5	105	2000%
Rock Salt	Commodity	1 1/4	15	1100%
Hemp and Flax	Commodity	1/8	1 1/2	1100%
Melioration of Oil	Commodity	5	60	1100%
Saltpetre	Commodity	1/8	1 1/2	1100%
Flax and Hemp Growing in Pennsylvania	Commodity	2 1/2	28	1020%
Trading with Hamburgh	Commodity	15	120	700%

Drying Malt by Air	Commodity	1/8	1	700%
Supplying Coals from Newcastle	Commodity	1/4	1	300%
Holy Island Salt	Commodity	5	15	200%
Westley's Actions	Bank/Finance	2	12	500%
Million Bank	Bank/Finance	100	440	340%
Bank of England	Bank/Finance	100	265	165%
Bahama Islands	Atlantic	3	40	1233%
South Sea Company	Atlantic	100	1050	950%
Royal African Company	Atlantic	24	200	733%
Pennsylvania	Atlantic	5 1/4	40	662%
Based on the Bubbler's Mirror print	Means:	13 1/4	102	1172%
from Scott vol.1 page 420	Mean (par-weighted)			670%

Appendix II: Maximum Growth for Dutch Companies, 1720

Date	*increase*	*Primary*	*Mention Insurance*
WIC	647%	Itl. Trade	
Middelburg Commercie	406%	Commerce	
Schiedam	325%	Commerce	Insurance
Edam	300%	Commerce	
Monnikendam	278%	Commerce	Insurance
Utrecht	275%	Commerce	Insurance
Delft 1st Subscription	118%	Insurance	Insurance
Gouda	106%	Insurance	Insurance
WIC 1st Subscription[33]	103%	Itl. Trade	
Naarden	100%		Manufacture
Weesp	100%	Commerce	Insurance
Muiden	100%	Commerce	Insurance
Medemblik	100%	Commerce	Insurance
Rotterdam 1st Subscription	76%	Insurance	Insurance
Dordrecht	64%	Commerce	Insurance
Den Haag	50%	Finance	Insurance
Maassluis	50%	Commerce	Insurance
Rotterdam 2nd Subscription	42%	Insurance	Insurance
Vlaardingen	40%	Marine	Insurance
OIC	39%	Itl. Trade	
Middelburg Assurantie	39%	Insurance	Insurance
WIC 2nd Subscription	33%	Itl. Trade	
Alkmaar	33%	Commerce	Insurance
Zwolle	33%	Marine	Insurance
Hoorn	0%	Commerce	
Veere	0%	Commerce	
Brielle	-7%	Commerce	
Enkhuizen	-10%	Commerce	Insurance
Purmerend	-17%	Commerce	Insurance
Mean	127%		

[33] (Gelderblom & Jonker, 2008 and updated 2009) note that the West Indies Company had applied to offer insurance.

Appendix III

The interpretation of price quotes

One of the problems in the analysis of the price data from Holland in 1720 is the question of how the price quotations should be interpreted. Share or subscription prices were not quoted in currency, but in a percentage in excess of some value. Scholars to date have disagreed on the interpretation of this value. We address this basic question through examination of the language used in the price lists in 1720, and by matching share loan transactions in the books of one company to the documented market quotations. The benefit of matching price quotes to company transactions in their shares is that the books were kept in units of currency.

Price quotes in the *Leydse Courant* typically were given in sentences such as: "Rotterdam: Today the shares of our company were traded for prices ranging from 52 to 56 percent *avans*". Intervals like this are not uncommon due to the high daily volatility; especially in the rise of the bubble the morning prices differed substantially from evening quotes. A key question posed by these quotes is of course, what is meant by "*avans*"? What amount in the quotation in excess of? This question is more challenging than it appears. Shares were issued through subscriptions that required capital calls. Thus, the relevant multiplicand might be interpreted as the capital paid in to the company up to that date [the paid in capital] or it might be interpreted as the face value of the share after all the shareholder installments are paid -- something we now often refer to as the par value or nominal share value.

It is therefore not surprising that previous authors have debated the interpretation of these quotes. For example:

(van Rijn, 1899) presumed that the *avans* referred to the nominal (or fully paid in) value of the share, and that additional paid-in capital represented a fraction that incremented the quoted price.[34]

There is logical because newspaper percentages could not practically be based on the amounts paid-in. The paid-in capital increased over time and the exact amount paid-in was therefore uncertain until the books were closed and the paid-in amounts computed. If newspaper percentages were based on the amount paid-in, the newspaper percentages would have to drop after the payment of an installment; if the market share price does not change and more capital is paid-in, the percentage decreases by construction.

(Smith, 1919) concurs with this interpretation: "The share price was recorded in percentages "avans", i.e. it indicated the percentages to be paid in excess of par value, calculated based on the amount which, with respect to the nominal amount traded by the company as installment was demanded."[35] Likewise, (Slechte, 1982): "In the first two months the prices fluctuated between 100 and 80%, but dropped in September and October to 60%. The Rotterdam shares … were therefore on average priced at 4000 guilders in this period."

[34] "The furnishment up till 80% of the shares of the first subscription is also foolish and absurd, since the amount furnished in these shares exceeds the market value of the original shares, i.e. 15% has been paid in on the subscription shares, to demand an additional 65% would be highly unfair ... The shares of the first subscription have already been traded at 38%, together with the paid-in amount of 15% this makes 53 percent, if an additional 65% were to be paid in then these shares would be worth 118%, this would be unreasonable …If … on the old shares 75% had been paid in, these would now be worth 3750 guilders, so a share of 1000 guilders would be worth 750 guilders."

[35] Original Dutch text:"De koers werd genoteerd in procenten "avans", dus men gaf aan hoeveel procenten boven pari betaald moest worden, te berekenen over de geldsom, die, met betrekking tot het verhandelde nominaal bedrag, door de compagnie als storting was geëischt."

Despite their general agreement, none of the earlier authors offered empirical evidence supporting their interpretations. Thus, we sought to reject or verify their calculations of monetary share prices by matching transactions in the *Leydse Courant* with company records.

After the burst of the bubble at the end of September 1720, the directors of Stad Rotterdam made non-recourse loans to directors using their shares as collateral. If share prices fell during the maturity of the loan, the company incurred the loss. This arrangement could be interpreted as beneficial to shareholders because it was a means to reduce the "float" of shares by keeping directors from dumping into a falling market. It could also be interpreted as pure self-dealing by directors. In either case, these transactions allow us to link the market quotes to currency-valued transactions.

On pages 37 and 142 of the general ledger of Stad Rotterdam, some of these share loans are recorded in prices that match quotations reported in the *Leydse Courant* for the same day.[36] Since the ledger accounts are recorded in guilders, we can ascertain that the newspaper prices are reported in percentages of the nominal share value (5000 guilders for the Rotterdam company). The losses incurred in these loan transactions also appear on the profit and loss account of the Rotterdam company (page 9 of the general ledger account).

A simple example of our interpretation is useful. Suppose that Rotterdam shares [with 5,000 guilders nominal value] are trading for 2,500 guilders on a certain date and that up until that date 1% had been paid in. Then the *Leydse Courant* would quote of 49% a*vans* would imply the following: 'Rotterdam is trading today at 50% (2,500/5000 * 100%) or 49% of the par value of the share above the paid-in capital ((2,500-1%*5,000)/5,000)*100%= 49%'.

[36] Gemeentearchief Rotterdam, archive no. 199 inventory no. 451, pages 37 and 142.

This convention was convenient during weeks of installment payments. It allowed investors to distinguish between shares on which the installment has been paid and shares on which the installment still needed to be paid.

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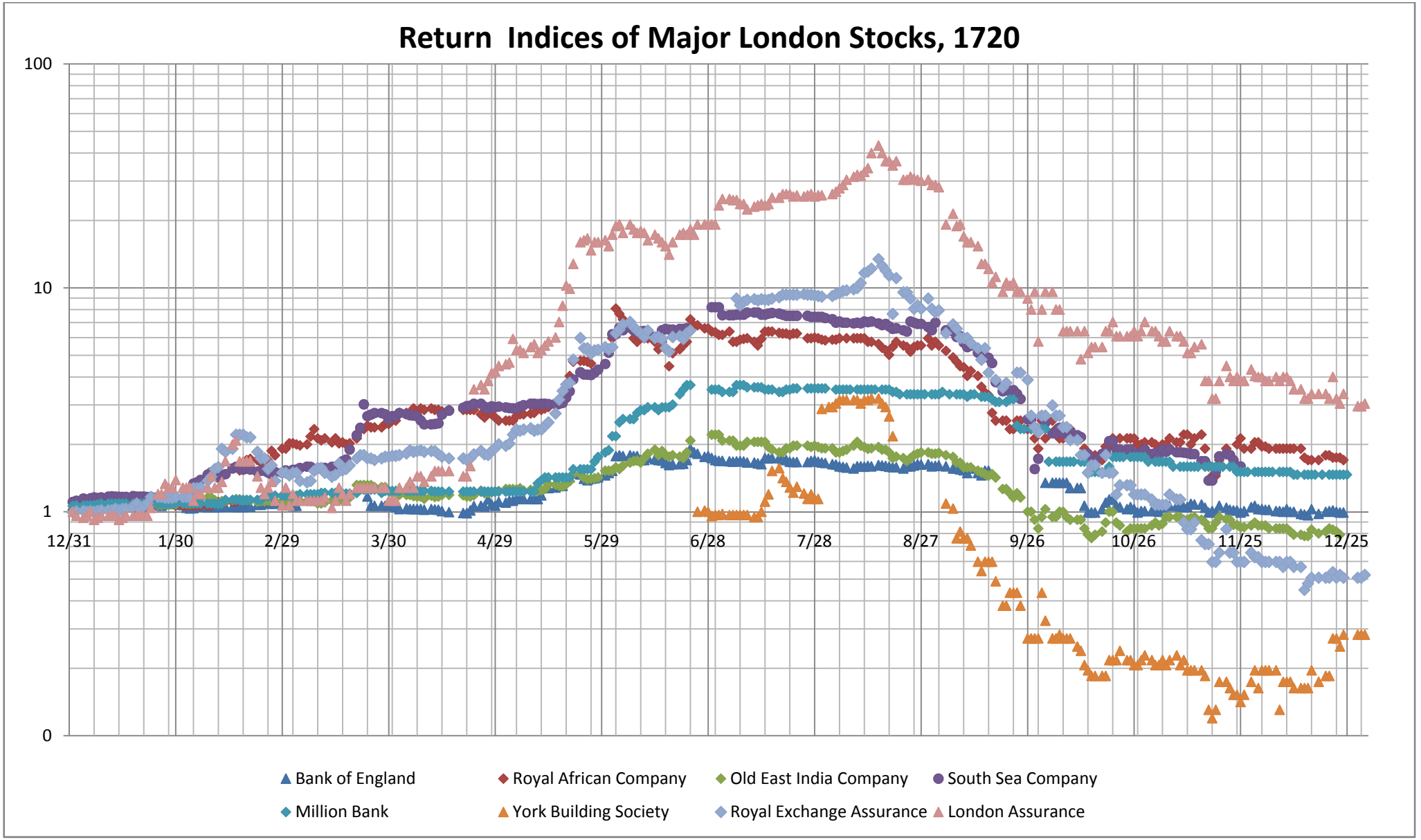
Return Indices of Major London Stocks, 1720
100
10
1
0
12/31
1/30
2/29
3/30
4/29
5/29
6/28
7/28
8/27
9/26
10/26
11/25
12/25
Bank of England
Royal African Company
Old East India Company
South Sea Company
Million Bank
York Building Society
Royal Exchange Assurance
London Assurance

Figure 1

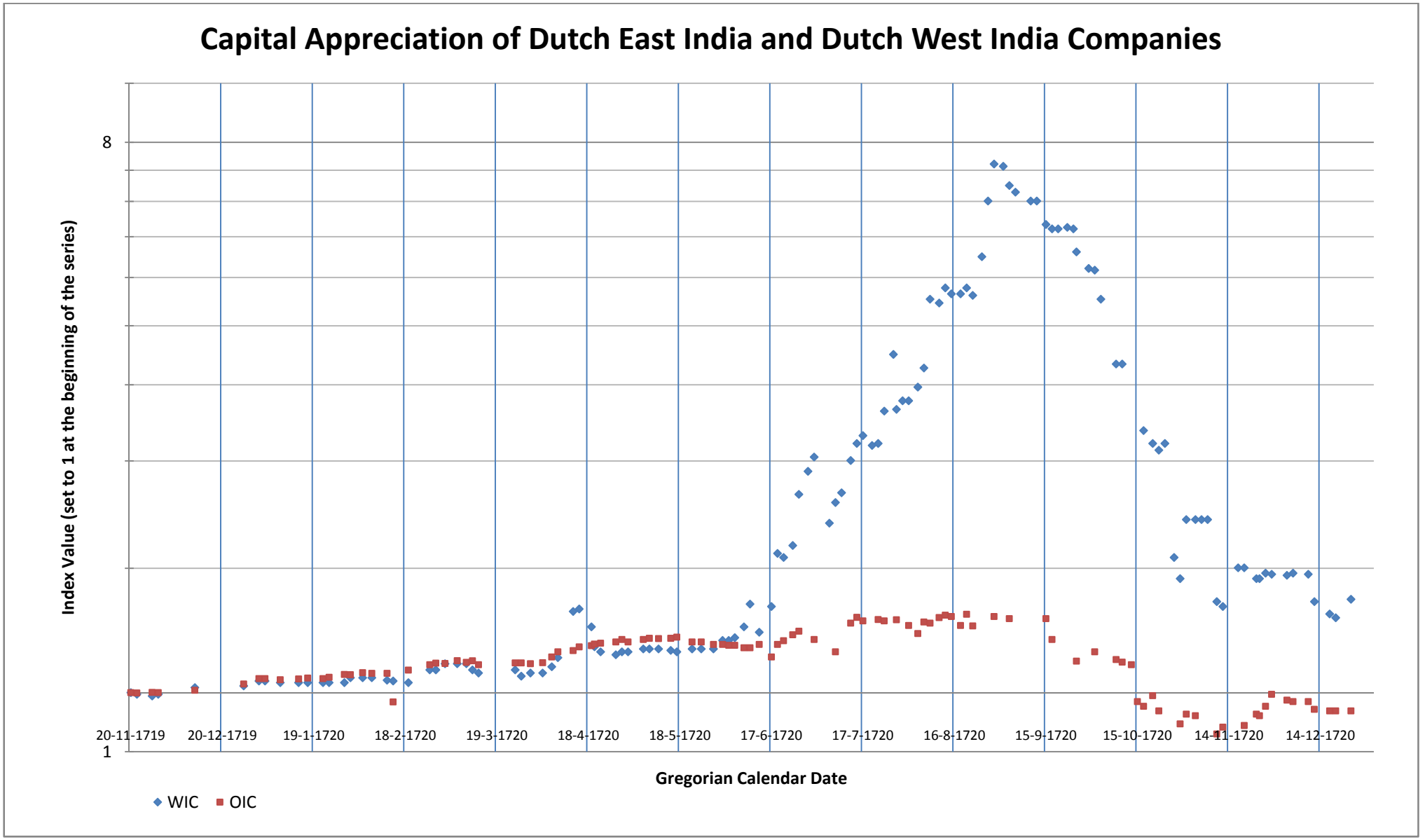
Capital Appreciation of Dutch East India and Dutch West India Companies
Index Value (set to 1 at the beginning of the series)
8
1
20-11-1719
20-12-1719
19-1-1720
18-2-1720
19-3-1720
18-4-1720
18-5-1720
17-6-1720
17-7-1720
16-8-1720
15-9-1720
15-10-1720
14-11-1720
14-12-1720
Gregorian Calendar Date
WIC
OIC

Figure 2

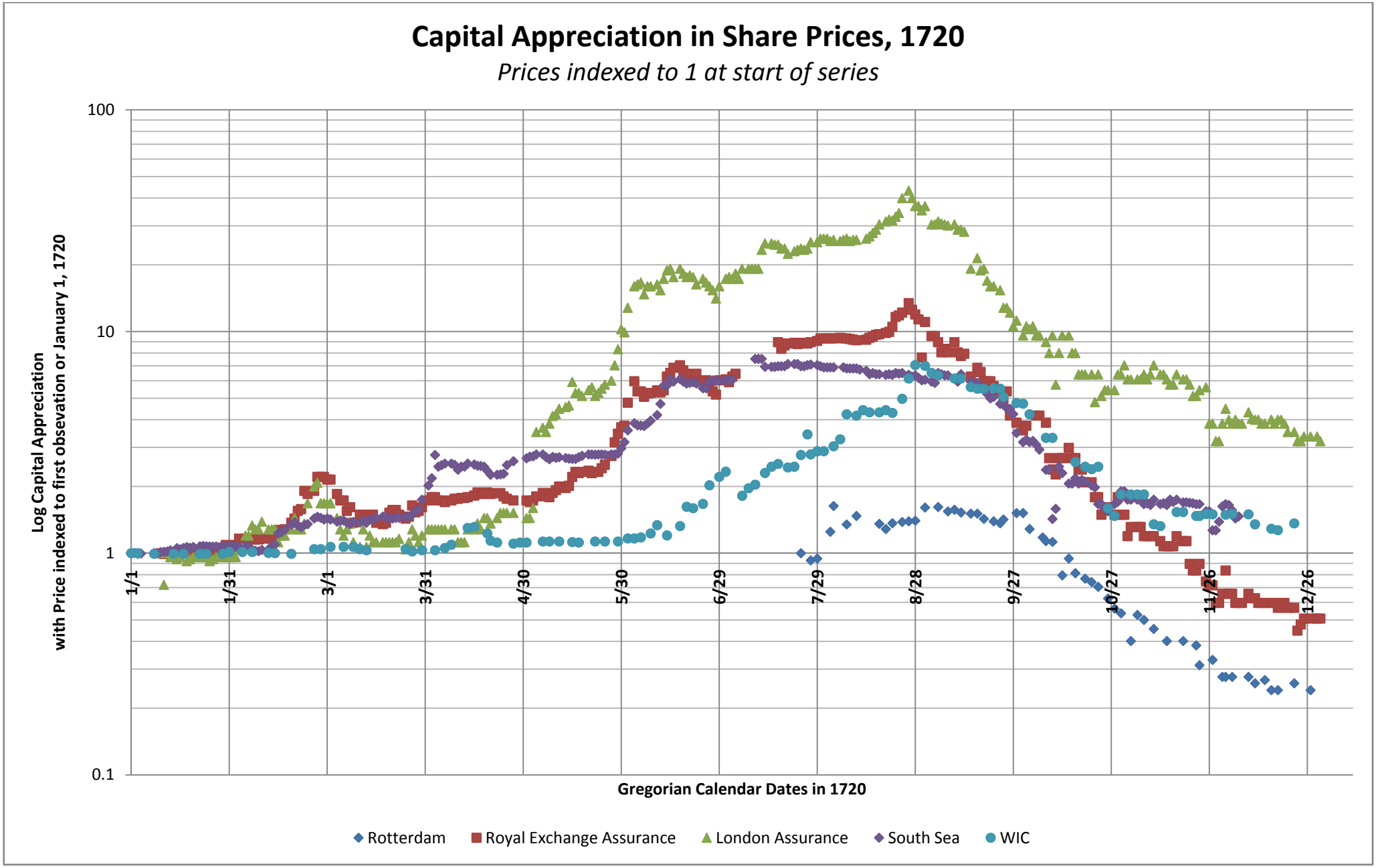
Capital Appreciation in Share Prices, 1720
Prices indexed to 1 at start of series
Log Capital Appreciation
with Price indexed to first obsevation or January 1, 1720
100
10
1
0.1
1/1
1/31
3/1
3/31
4/30
5/30
6/29
7/29
8/28
9/27
10/27
11/26
12/26
Gregorian Calendar Dates in 1720
Rotterdam
Royal Exchange Assurance
London Assurance
South Sea
WIC

Figure 3

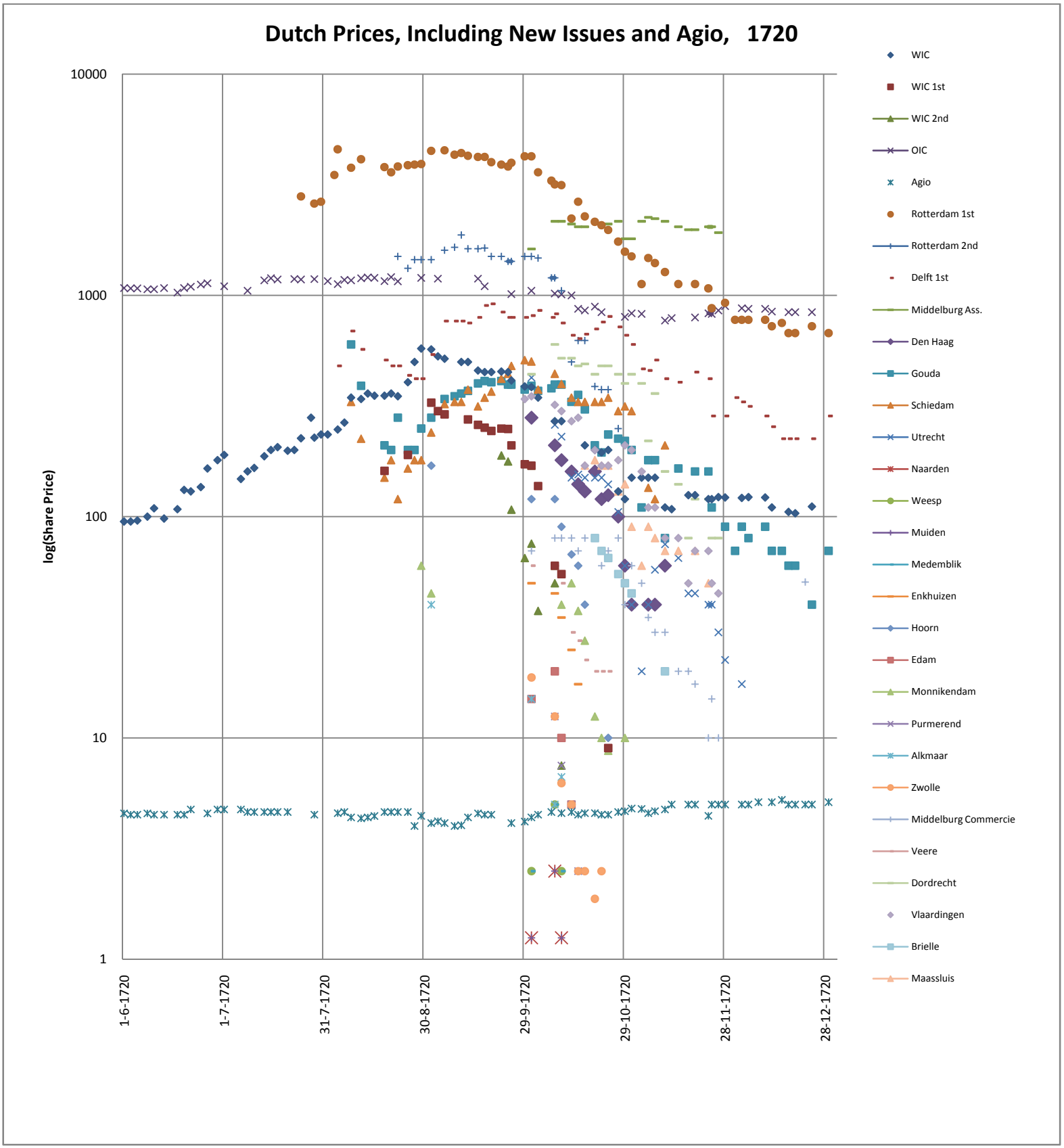
Dutch Prices, Including New Issues and Agio, 1720
log(Share Price)
10000
1000
100
10
1
1-6-1720
1-7-1720
31-7-1720
30-8-1720
29-9-1720
29-10-1720
28-11-1720
28-12-1720
WIC
WIC 1st
WIC 2nd
OIC
Agio
Rotterdam 1st
Rotterdam 2nd
Delft 1st
Middelburg Ass.
Den Haag
Gouda
Schiedam
Utrecht
Naarden
Weesp
Muiden
Medemblik
Enkhuizen
Hoorn
Edam
Monnikendam
Purmerend
Alkmaar
Zwolle
Middelburg Commercie
Veere
Dordrecht
Vlaardingen
Brielle
Maassluis

Figure 4

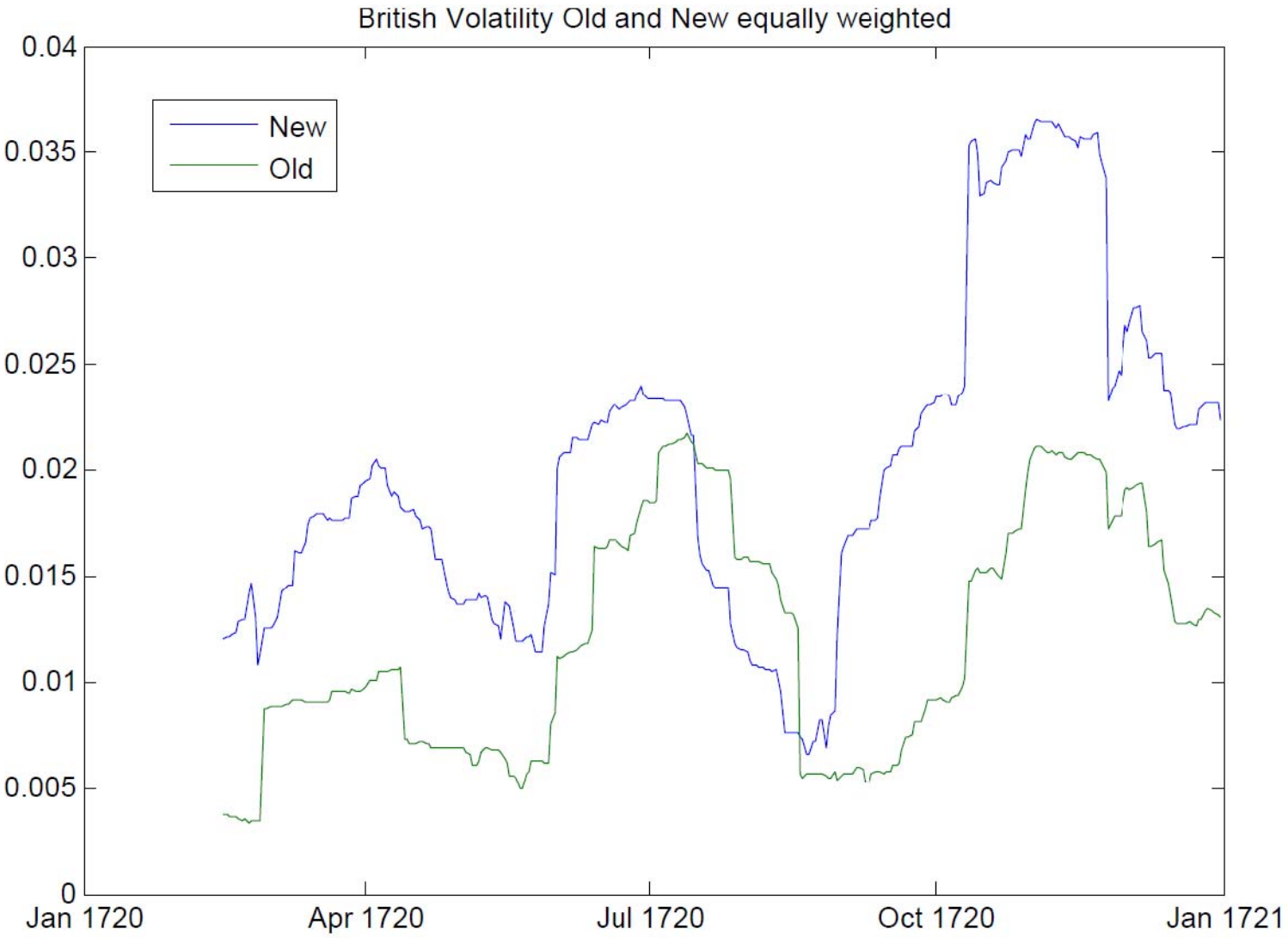
British Volatility Old and New equally weighted
New
Old
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Jan 1720
Apr 1720
Jul 1720
Oct 1720
Jan 1721

Figure 5

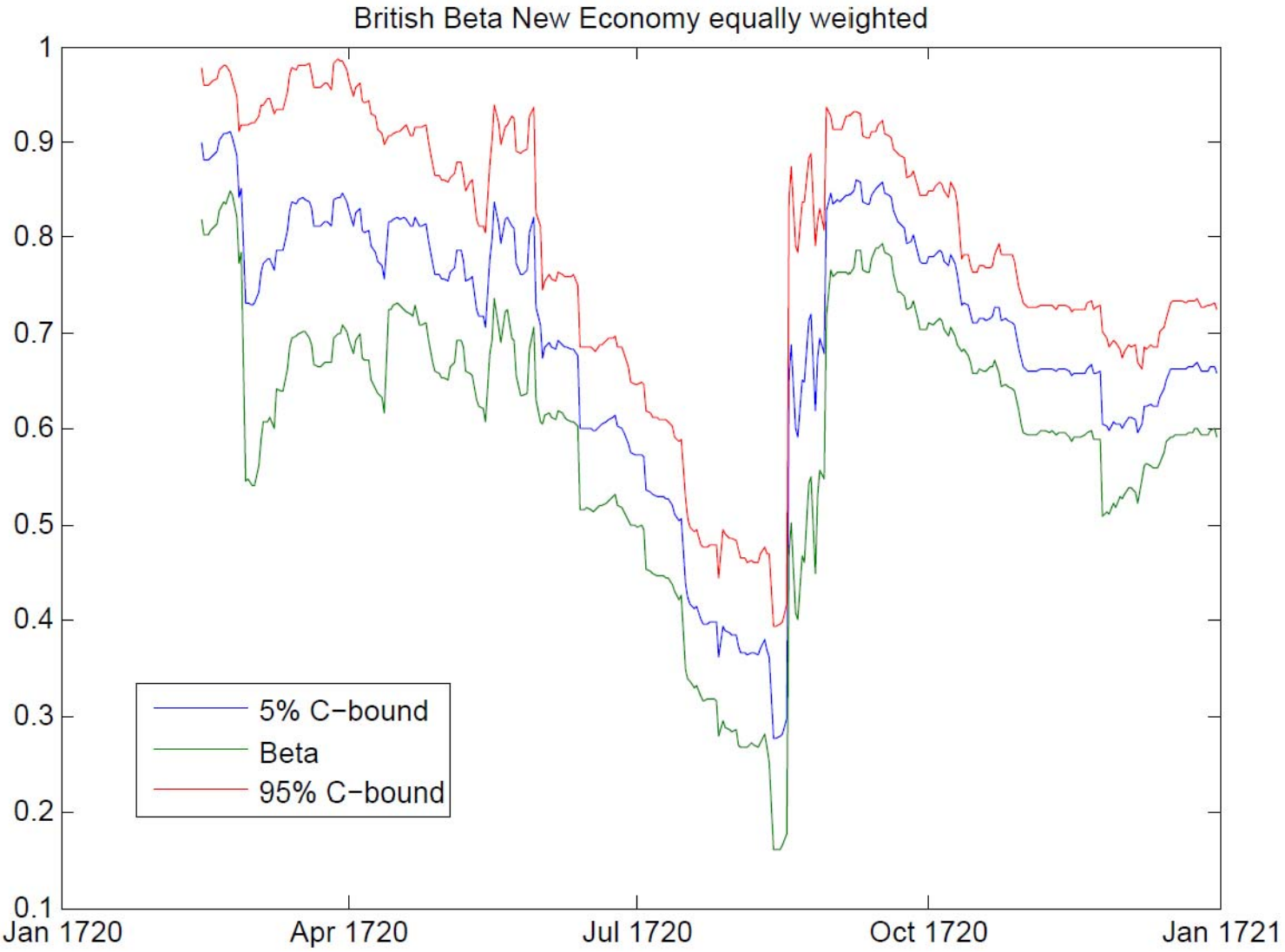
British Beta New Economy equally weighted
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
Jan 1720
Apr 1720
Jul 1720
Oct 1720
Jan 1721
5% C−bound
Beta
95% C−bound

Figure 6