Price momentum and the 1719-20 bubbles: A method to compare and interpret booms and crashes in asset markets

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Abstract

This paper attempts to address one major problem with bubble studies: the difficulty to rigorously compare assets bubbles (that is to say compare them via quantitative data, rather than simply anecdotal evidence). The idea of the paper is to use a metric that is not the level of price itself, but that is connected to it. This metric is price momentum (i.e. the magnitude and speed of price changes). Momentum is measured with a technical indicator: the Relative Strength Index (RSI). The RSI is popular among traders, yet it is not normally used as a tool of comparison. In particular, there appears to be no academic study that has hitherto employed the RSI as a metric to compare different booms and crashes. Likewise, it seems that the RSI was never applied to early modern markets (such as the Mississippi and South Sea Bubbles), or to early 20th century markets (such as the 1929 crash). The paper does all this (based on historical securities prices). Furthermore, it develops news concepts and metrics (such as "strong momentum with low volatility", "momentum efficiency", and accumulated RSI readings) that are connected to the notion of momentum. These concepts, in turn, are interpreted through the lens of archival evidence. The result is a new method of analysis – which is not concerned with market forecasting, but only with comparison and historical interpretation – that sheds new light on the 1719-20 bubbles themselves.

Keywords: Financial history, South Sea Bubble, Mississippi Bubble, Dutch Wind Trade, bubbles and crashes in asset markets, Relative Strength Index, technical analysis, momentum, volatility, euphoria. (JEL F31, G01, G10, G14, G15, G19, N23).

Abbreviations

AuM	accumulated upward momentum (sum of RSI readings ≥ 70)
AdM	accumulated downward momentum (sum of RSI readings ≤ 30)
uSMLV	upward strong momentum with low volatility
dSMLV	downward strong momentum with low
mP	maximum price increase during the boom (in percentage)

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Introduction

Although widely used among academics and practitioners, the notion of asset bubbles presents a number of problems. First, there is no consensus among economists about the very existence of asset market bubbles.[1] Second, there is no commonly agreed definition of the term: in particular, if the classic meaning of bubble is a boom followed by a crash, some scholars consider that it is possible and useful to employ the word even when a boom does not end in a sudden and abrupt way.[2] Third, precise measures of bubbles have proved elusive.[3] Fourth, as a consequence of above, it is difficult to rigorously compare asset bubbles, that is to say compare them via quantitative data (rather than simply anecdotal evidence).[4] In fact, few studies have taken that path.[5] And no study, hitherto, has attempted a quantitative comparison of bubbles from different centuries and different asset classes.

This paper addresses this fourth problem. It proposes a method that can be used to compare systematically all types of booms and crashes. The paper applies this method to 1719-20 equity and foreign exchange markets, including the famous Mississippi and South Sea Bubbles. A second paper will enlarge the analysis to the XXth and XXIst centuries and to other asset classes (commodities and housing market).

The consideration underpinning this work is that comparative analysis is an indispensable tool of investigation in social science research. As long as we cannot compare all market booms and crashes (big and small, rational or irrational, from whatever century, country, and asset class) there is a strong probability that we may miss some crucial features of these phenomena.

The question, however, is what to compare. Comparing price levels – the primary method followed in the field of bubble studies – presents major difficulties. Even setting aside the obstacle of fundamental value (i.e. measuring how much all these assets, in all these countries and centuries, deviated from their "fundamental" value), there is simply too much diversity in terms of price levels among the different bubbles.[6] The idea of the paper is to use a metric that is not the level of price itself, but that is connected to it. This metric is price momentum. Momentum measures the magnitude and speed of price changes. Magnitude is self-explicatory; speed of price changes is nothing else than the steadiness in the directionality of prices, the consistency in the trend. A hypothetical market with only up (or down) days would have an

[1] Proponents of the efficient market theory question the existence of asset bubbles. See for instance Fama, E.F., "Two pillars of asset pricing", *The American Economic Review*, 104, 6 (2014).

[2] Shiller, R. J., "Speculative asset prices", *The American Economic Review*, 104, 6 (2014).

[3] For an overview of the question: White, E. N., "The Fundamental Things Apply: How to Face Up to Asset Market Bubbles", in Chambers, D. & Dimson, E. (eds.), *Financial Market History: Reflections on the Past for Investors Today* (Charlottesville, 2016).

[4] For the latter approach, e.g. Kindleberger, C. P. & Aliber, R. Z., *Manias, Panics and Crashes. A History of Financial Crises* (Basingstoke, 2015) [1978].

[5] E.g. White, E. N., "Bubbles and Busts: The 1990s in the Mirror of the 1920s", *NBER working papers* (2006); Goetzmann, W. N., "Bubble Investing: Learning from History", in Chambers, D. & Dimson, E. (eds.), cit.

[6] For example, the metric used by Goetzmann, "Bubble Investing", cit., to identify booms and crashes in equity markets would not work equally well with foreign exchange or housing markets.

extremely strong momentum, whatever the magnitude of the price changes. Magnitude and speed are two typical characteristics of price movements during a bubble: booms and busts are by definition markets with strong momentum.

Technical analysts have developed several indicators to calculate price momentum: the Relative Strength Index (RSI), the Moving Average Convergence/Divergence, the Williams % Range, the Stochastic Oscillator, etc.[7] Any of them could suit our analysis, and it would be interesting to understand if they would provide significantly different results. This study, however, will only use the RSI, probably the most popular among traders.[8]

A few academic papers have analysed the effectiveness of the RSI as a trading tool;[9] other papers employ it as a proxy for market sentiment.[10] However, there appears to be no academic study that has hitherto employed the RSI as a metric to compare different booms and crashes. Likewise, it seems that the RSI was never applied to early modern markets (such as the Mississippi and South Sea Bubbles), or to early 20th century markets (such as the 1929 crash).

The first contribution of this paper, therefore, is to bring together two fields that, although not entirely disconnected, are usually separated: technical analysis and financial history. To say it more accurately, technical analysts certainly look back to historical series of prices, but it is uncommon for financial historians, especially historians of early modern finance, to open the toolbox of technical analysis. And yet, it is a heuristic experiment to study markets from three centuries ago with today's tools. Does the RSI work exactly in the same way when applied to eighteen-century equity and foreign exchange markets? Does it follow the same kind of patterns? That would be interesting if that were the case, because that would suggest that, in spite of all sorts of massive transformations (in the cultural attitudes towards speculation, communication systems, financial contracts enforcements, risk management, accumulated secular experience of investors, etc.), the fundamental mechanisms of securities markets have not significantly changed in the last three centuries. Anyhow, although it uses a technical analysis tool, the present study is not concerned with market forecasting; it is only concerned with analysis, comparison, and understanding.

The second contribution is specifically about the 1719-20 bubbles. In a practical, visual way, price momentum analysis changes our perspective on the trajectory followed by the stocks that were part of these bubbles.

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[7] See for instance Murphy, J. J., *Technical Analysis of the Financial Markets* (New York, 1999).

[8] To give an example, the RSI is one of the two only technical indicators that J.C. Parets, a reputed technical analyst, uses in all his charts.

[9] E.g. Biondo, A. E. *et al.*, "Are random trading strategies more successful than technical ones?", *PloS one*, 8, 7 (2013); Anderson, B. & Li, S. ,"An investigation of the relative strength index", *Banks and Bank Systems*, 10, 1 (2015); Hudson, R. *et al.*, "Sampling frequency and the performance of different types of technical trading rules", *Finance Research Letters* (2017).

[10] Chen, H *et al.*, "A principal-component approach to measuring investor sentiment", *Quantitative Finance*, 10, 4, (2010); Kim, T. & Ha, N., "Investor sentiment and market anomalies", *SSRN Working Paper*, (2010); Yang, C., & Zhou, L., "Investor trading behavior, investor sentiment and asset prices", *The North American Journal of Economics and Finance*, 34 (2015).

I. The momentum model and toolbox

1. The standard RSI equation

The RSI was created by J. W. Wilder in his 1978 book, *New concepts in technical trading systems.* Wilder wanted to improve the momentum indicators existing at the time, by providing a tool that would produce fewer erratic results. The RSI was thus designed as a range-bound exponential moving average. The time frame first suggested by Wilder – 14 days – has become standard and is used today by most practitioners. The initial equation is the following:

RSI = 100-(100/1+RS)
RS = average gain/average loss
Average gain = (sum of gains over the past 14 days)/14
Average loss = (sum of losses over the past 14 days)/14

To prevent the RSI from overreacting to sharp price changes, from the 15th day on, the calculation becomes similar to an exponential moving average:

Average gain = ((previous average gain X 13) + current gain)/14
Average loss = ((previous average loss X 13) + current loss)/14

For any security, gains or losses are simply computed by subtracting the closing price of day n to the closing price of day n-1. Losses are expressed as positive numbers, in order to let the RSI fluctuate between 0 and 100. Although the RSI is rarely used for that purpose, it is interesting to note that Wilder had explicitly devised it to be range-bound to facilitate comparisons between different types of securities.[11]

The key levels in the RSI are 70 and 30. When the RSI goes beyond 70, the security is deemed "overbought"; when it falls below 30 it is deemed "oversold".[12] In both cases, practitioners consider that a reversal in the price will take place soon or later. This is consistent

[11] Wilder, J. W., *New concepts*, cit., p. 67: "The RSI value must always fall between 0 and 100. Therefore, the daily momentum of any number of commodities [assets] can be measured on the same scale *for comparison to each other* and to previous highs and lows within the same commodity. The most active commodities are those in which the RSI is showing the greatest vertical movement – either up or down." Italics are mine.

[12] See for instance Di Lorenzo, R., *Basic Technical Analysis of Financial Markets* (New York, 2013). Some practitioners (such as Murphy, *Technical Analysis*, cit.) reckon that 80 is the "overbought" threshold in a bull market; 20 the "oversold" threshold in a bear market.

with the evidence that momentum and mean-reversion occur in the same assets.[13] For that reason, the RSI is a prominent indicator for mean-reversion trading strategies.[14]

The 70 and 30 levels are based on empirical evidence: the RSI, most of the time, does not breach them, and it is rare that it stays beyond them for many days in a row. Between 7 October 1896 and 12 January 2018, the average RSI for the Dow Jones Industrial Average (DJIA) was 53, slightly more than the "neutral market momentum" level of 50: a reading consistent with the secular bullish trend of the index. There were 32,932 trading days during that time, including 3,438 days (10% of the time) when the RSI was above 70, and 1,358 days (4% of the time) when it was below 30. But there were only few occurrences (see table below) when the RSI was above 70, or below 30, for 15 days or more in a row.

Table 1. RSI of the DJIA (7 Oct. 1896-12 Jan. 2018)

	Number of occurrences	Number of days	% of total trading days
RSI ≥ 70 for 15 days or more	42	852	2.59%
RSI ≥ 70 for 25 days or more	6	170	0.52%
RSI ≥ 70 for 30 days or more	2	64	0.19%
RSI ≤ 30 for 15 days or more	5	93	0.28%
RSI ≤ 30 for 20 days or more	2	43	0.13%

Considering that the DJIA increased by 90,310% during those 122 years, with long-lasting booms and sharp crashes, it is safe to say that it was not that common for the RSI to hover above 70 or below 30 for extended periods. A simple look at the RSI graph from any asset (stocks, commodities, exchange rates) presents the same pattern: readings above 70 or below 30 are relatively uncommon; most of the time, the indicator fluctuates between 40 and 60. This is the key point for comparative analysis: that recurring pattern means that it is meaningful to compare RSI graphs – especially the 70 and 30 levels – across all types of assets. And this is true also for 1719-1720 markets.

2. Building upon the standard equation: the notion of strong momentum with low volatility

Building upon the RSI equation, the paper proposes a model with three distinct momentum phases: a) weak momentum; b) strong momentum; c) strong momentum with low volatility.

[13] Balvers, R. J. & Wu, Y., "Momentum and mean reversion across national equity markets", *Journal of Empirical Finance*, 13, 1 (2006).

[14] See for instance Zhang, X. *et al.*, "An evolutionary trend reversion model for stock trading rule discovery", *Knowledge-Based Systems*, 79, (2015); Lan, Y. W. *et al.*, "The Stock Investment Strategy at Company Acquisition", *International Journal of Management Science and Business Administration*, 2 (3) (2016); Hudson, R. *et al*, "Sampling frequency and the performance of different types of technical trading rules", *Finance Research Letters*, 22 (2017).

Strong momentum is simply defined as the RSI reaching overbought (≥70) or oversold (≤30) levels. Strong momentum with low volatility (low volatility in the RSI, as well as in the underlying price) is defined here as the situation where the RSI stays in overbought or oversold territory for 15 days or more. A 15 days threshold seems a good compromise: it corresponds to a relatively rare situation (only 42 occurrences for the DJIA in over 122 years), but not so rare as to become irrelevant. Examples drawn from the 1719-1720 can illustrate each of these phases.[15]

a) A weak momentum phase (WM) does not represent necessarily a sideways trend; it may characterize an upward (or downward) trend with a slow rate of price change. The speed of price change represents the steadiness in the directionality of prices (see above). A slow rate of price change is, therefore, typically the result of sharp fluctuations in the price. The Dutch East India Company (VOC), between 22 May and 14 September 1720, is a good example. From trough (17 Jun.) to peak (19 Aug.), its price rose by 18%, yet it was so volatile that the RSI did not reach overbought level (Figure 1).

Figure 1. Weak momentum: VOC price and RSI (22 May-15 Sep. 1720)[16]

b) A strong momentum phase (SM) typically characterizes a market trending with a fast rate of price change; a sustained (upwards or downwards) pressure in the price. The South Sea Company, from 8 March to 31 May 1720, is an example of such a phase. During that period, its share rose by 134%. As the price surged sharply, the RSI stayed 13 days (28 Mar.-9 Apr.)

[15] I am considering putting online a spreadsheet with examples of calculations, in order to illustrate some of the difficulties, choices, and (sometimes) extrapolations involved.

[16] Unless indicated otherwise, the source of all the price data is the *FGR 1720 price database* by R.G.P. Frehen, W.N. Goetzmann & K.G. Rouwenhorst, "New evidence on the first financial bubble", *NBER working paper* (2011).

above 70, briefly reaching the extremely high level of 96. It then fell to 54, went back to 74, fell to 61, and finished the month of May at 84 (Figure 2). The volatility in the RSI mirrored the volatility in the price.

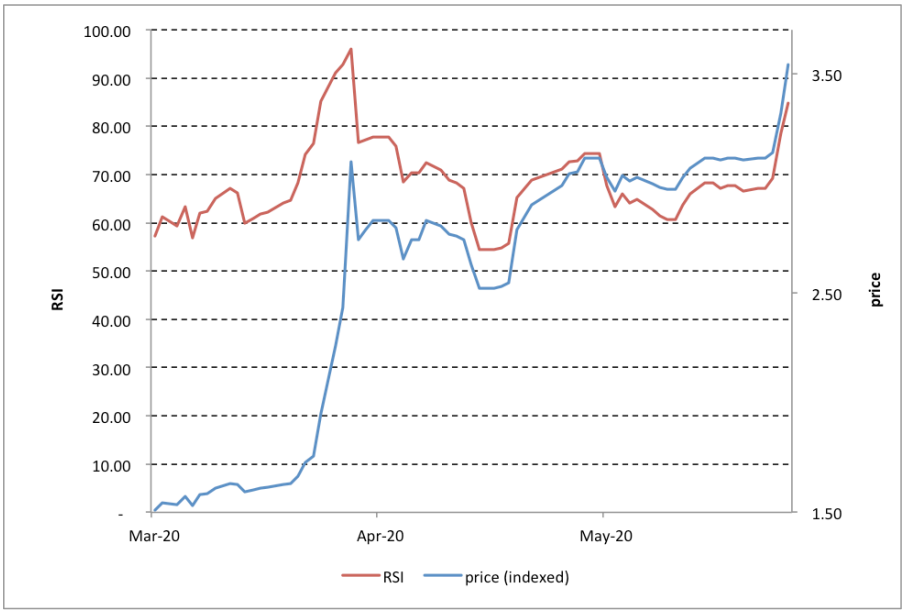

Figure 2. Strong momentum: South Sea Comp. price and RSI (8 Mar.-31 May 1720)

c) A strong momentum with low volatility phase (SMLV) is the hallmark of a very strong trend. The Mississippi Company, between 17 June and 22 September 1719, is a remarkable illustration of such a situation. During those 98 days, the stock surged by 785%, with the RSI constantly over 70 (Figure 3).[17] The RSI spiked five times above 90 and hovered 59 days (21 Jul.-17 Sep. 1719) over 80. After a pause of little more than one month, the Mississippi entered a new SMLV that lasted 48 days (23 Oct.-9 Dec. 1719). Although less impressive, the Amsterdam and London indexes (see below) represented two other outstanding cases of a SMLV: the first stayed 61 days (13 Jul.-11 Sep. 1720) above 70; the second 50 days (5 Mar.-21 Jun. 1720). In comparison, the record upward SMLV for the DJIA was only 34 trading days (23 Mar.-1st May 1915).

In general, SMLVs tend to be shorter on the downside compared to the upside. The Mississippi remained 36 straight days below 30 (11 Dec. 1720-15 Jan. 1721); the London index 23 days (19 Sep.-11 Oct. 1720); the Amsterdam index 45 days (12 Oct.-23 Nov. 1720). The record for the DJIA was only 22 trading days below 30 (31 May-21 Jun. 1921).

In the following pages we will use abbreviations to distinguish an upward SMLV (uSMLV) from a downward SMLV (dSMLV).

[17] According to the available data, I sometimes calculate in days, rather than trading days. I consider that the results are, nonetheless, entirely comparable. See note 15.

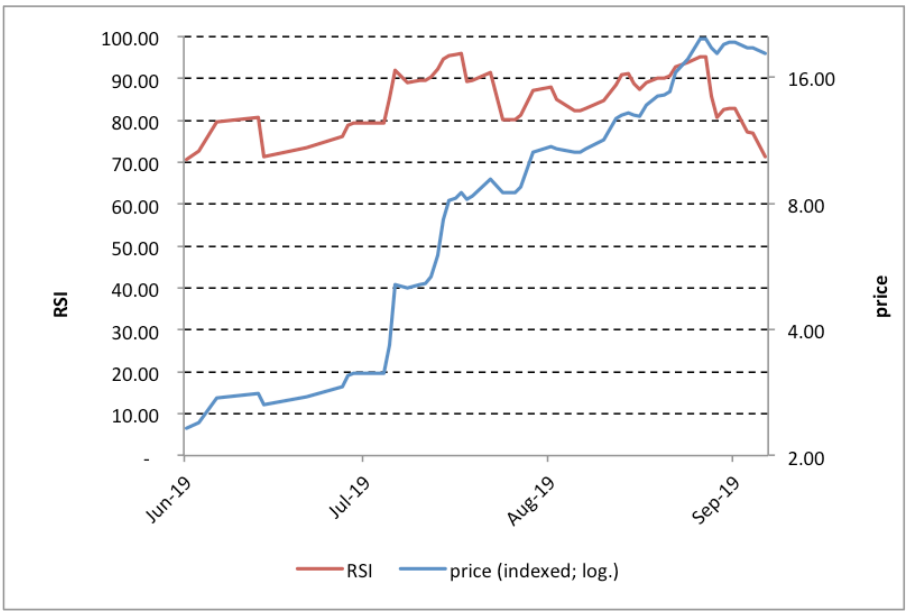

Figure 3. Strong momentum with low volatility: Mississippi Comp. price and RSI (Jun.-Sep. 1719)

3. How did historical actors perceive SMLV phases?

The Mississippi Bubble's massive momentum was a great source of astonishment for the contemporaries. Archival evidence shows that this feeling of astonishment evolved as the SMLV appeared to last indefinitely. There were, obviously, idiosyncrasies among the many historical actors, yet it is possible to discern nonetheless an overall common pattern. A pattern made of three stages. The first stage was – depending on the experience of the person – surprise or incomprehension: simple surprise for the most naïve observers; a mixture of surprise and incomprehension for the others. For instance, early July 1719, the marquis de Dangeau noted that the "daily increase" (i.e. the fact that there were almost only up days) of the Mississippi share price "seemed incomprehensible to many people" (including himself).[18] In October 1719, as the stock was about to enter its last SMLV phase, a well-informed diplomat of the British embassy in Paris wrote: "in all appearance those [shares] will run higher according to the fury that seem to be in the people. Our stock jobbers that are here can not well comprehend that matter."[19] The second stage was a mixture of incredulity, scepticism, and (for Mississippi shareholders) apprehension. This is well documented in the archival sources, for instance in an early November 1719 letter from the duke of Chandos to one of his agents in France:

[18] Dangeau, marquis de, *Journal du marquis de Dangeau* (Paris, 1860), XVIII, p. 74, 6 July 1719.

[19] National Archives, SP 78/165, 289, 17 October 1719, Crawford to Craggs.

> I own, Chandos wrote, that I can't but have a diffidence of that stock [Mississippi] & apprehend a sudden downfall. I don't mean [that] it will come soon, but that whenever it do fall, [it] will go down at once, so that if it comes to a good handsome rise I shou'd not be in my own opinion for staying to the last.[20]

The final stage – during the last leg of the Mississippi SMLV – looked like true amazement. Here too, the archival evidence is plentiful, for example in the press. Mid-November 1719, the London newspaper *Daily Post* wrote: "The actions [shares] of the Bank [Mississippi Company] are every day more and more the surprize of the world. The [stock] r[o]se last Saturday morning to 1800, and there is no question but it will be up in a day or two more at 2000."[21] A few days later, the Parisian informer of a Viennese newspaper reported: "the surge of the shares causes here, among persons of all conditions, an inexpressible amazement".[22]

Given the recent example of the Mississippi Bubble, the SMLVs of the South Sea Bubble probably caused relatively less surprise and amazement.[23] Nonetheless, there is ample evidence that contemporaries were increasingly puzzled as the momentum of the English boom protracted itself. To give only one example, from February to June 1720, the London-based banker George Middleton repeated in his letters that it was "impossible" for the English stocks to "hold" at those increasingly higher levels they were reaching almost every day.[24] Besides being a sceptic, he was also a "bear" (he was short the East India Company on behalf of John Law, the director of the Mississippi Company), so he was particularly distressed that the market was not behaving according to his forecasts. Late June (thirteen days before the peak in the South Sea and East India share prices), Middleton finally started to doubt his own scepticism. He wrote to Law: "I own I think 'tis impossible this can hold, but yet so many miracles have happened of late, that confound my thoughts".[25]

To sum up, historical actors were astonished because stock prices were acting differently from what they were expecting. It was strange for them to see a market going almost only upwards, and shares raising so much in a single day. Middleton, to take this example, resorted to irrational thinking (a "miracle") in the attempt of making sense of what was happening. Thus, we could say that the 1719-20 SMLVs represented a double anomaly: an anomaly in the eyes of contemporaries and an anomaly in the sense of an apparent contradiction (the so-called "momentum anomaly") to the efficient-market hypothesis.[26] May we say that the historical

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[20] Huntington Library, Stowe 57, 16, f. 341, Chandos to Arbuthnot, 22 October 1719 (according to the Julian calendar, i.e. the 2nd November according to the Gregorian calendar: see below note 40).

[21] *Daily Post*, 17 November 1719. The date of the report sent from Paris was 22 November 1719. It is noteworthy that the author talks about the "actions" of the Bank, although the Bank and the Company were not yet officially merged in mid-November 1719. Yet, the confusion is understandable as they were both run by John Law.

[22] *Corriere di Vienna*, 16 December 1719. The date of the report sent from Paris was 27 November 1719.

[23] In March-April 1720, when the London SMLV was underway, the Parisian bubble had started to burst, but had not collapsed yet.

[24] Coutts Archives, Coutts Letter Book O 14, f. 65, 115, 148, and passim.

[25] *Ibid*. f. 235.

[26] About the efficient-market hypothesis and the "momentum anomaly" see in particular Jegadeesh, N. & Titman, S., "Returns to buying winners and selling losers: Implications for stock market efficiency", *The Journal of*

actors themselves appeared to assume that the market would move according to what we would call today a "random walk"?[27] Yes, at least in the first stages of the 1719-20 bubble. The bulk of evidence suggests that they did not expect to see any type of trend in the market; at least, any trend that might be foreseen. This view clearly emerges, for instance, in the duke of Chandos' correspondence. For example in a letter (June 1720) to the marquis of Monteleon, a Spanish diplomat actively involved in the stock-jobbing of the successive bubbles: "The rise and fall of stocks, wrote Chandos, does not follow a logical reason (*ne se règle pas selon la raison*), but a certain whim of the people, a fatality that cannot be forecasted."[28] However, as his investing experience grew, Chandos started to think that it was possible to forecast the market, in particular market reaction to initial public offering of stocks. Writing to Richard Cantillon (August 1720), he declared:

> I believe buying up subscriptions as soon as they come out & selling them at a reasonable profit is the surest was for getting, for all subscriptions rise upon their being first taken, though sometimes it lasts not long."[29]

4. The full toolbox

The full toolbox that the paper applies is composed of two distinct sets of elements. The first set is simply the standard RSI equation together with the indicators originally developed by Wilder. In Wilder's model, the most significant indicator is what he calls "divergence". Divergence occurs when (at the top or bottom of the market) the price and the RSI move in opposite directions. Here is how Wilder describes this phenomenon:

> Although divergence does not occur at every turning point, it does occur at most significant turning points. When divergence begins to show up after a good directional move, this is a very strong indication that a turning point is near. Divergence is the single most indicative characteristic of the Relative Strength Index.[30]

There are two opposite types of divergence. "Bearish divergence" happens when the price, in an uptrend, reaches a higher high while the RSI makes a lower high. As the name suggests, this

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finance, 48, 1, (1993); Barberis, N. *et al.,* "A model of investor sentiment", *Journal of financial economics*, 49, 3 (1998); Crombez, J., "Momentum, rational agents and efficient markets", *The Journal of Psychology and Financial Markets*, 2, 4 (2001).

[27] See Cootner, P. H., *The random character of stock market prices* (Cambridge MA, 1964); Malkiel, B. G., *A random walk down Wall Street* (New York, 1973).

[28] Huntington Library, Stowe 57, 17, f. 92. 1st June 1720.

[29] *Ibid*., f. 163, 25 August 1720.

[30] Wilder, J. W., *New concepts*, cit., p. 70.

is a bearish signal.[31] "Bullish divergence" is the opposite: it happens when the price, in a downtrend, reaches a lower low while the RSI makes a higher low. As the name suggests, it is a bullish signal. Divergence may be complemented by a "failure swing". In an uptrend, a failure swing occurs when the RSI fails to exceed its previous top, and then falls below the previous low. In a downtrend, it occurs when the RSI fails to exceed the previous low, and then rises above the previous high. According to Wilder, this is another strong indicator of market reversal.[32]

The other set of tools does not come from Wilder: it is the original contribution of the paper, and I present it here for the first time. This is still a work in progress, with margins for improvement and possible further developments. The first key element in this new set is the concept of "strong momentum with low volatility" that we have described above. The second key element is the notion of *accumulated momentum.* I call *accumulated upward momentum* (AuM) the aggregate "overbought" RSI readings, that is to say daily RSI readings equal to or above 70; *accumulated downward momentum* (AdM) the aggregate "oversold" RSI readings (i.e. daily RSI readings equal to or below 30).

AuM = sum of RSI readings ≥ 70
AdM = sum of RSI readings ≤ 30

Accumulated momentum is computed for a given asset and a given length of time. In order to compare different assets, the paper mostly calculates the AuM for the entire booming phase (from the previous low to the top in the price) and the AdM for the entire downfall (from the top to the trough in the price). When analysing chronological momentum distribution (see below section III-2), the paper computes and compares shorter sequences of AuM or AdM for one single asset. It compares, for example, the AuM in the early stage of the boom, from the AuM in the middle and late stages.

The last two metrics that I have devised are the AuM/AdM and mP/AuM ratios. The AuM/AdM simply measures the ratio between the accumulated momentum during the boom and the accumulated momentum during the crash. The mP/AuM measures the ratio between the maximum percentage price increase during the boom (mP) and the accumulated momentum during the same boom. As we will see below, these two metrics generate interesting insights. It would be possible also to calculate the ratio between the maximum price decline during the crash and the AdM, but I keep this for a next paper.

[31] Practitioners pay particular attention to these decoupling between price and RSI. See for instance Brown, C., *Technical analysis for the trading professional:* (New York, 2011), p. 98; Di Lorenzo, R., *Basic Technical Analysis of Financial Markets* (New York, 2013), p. 146.

[32] Wilder, J. W., *New concepts*, cit., p. 68.

II. Using the toolbox to analyse 1719-20 markets

MISSISSIPPI COMPANY

Between August 1718 (first price data) and its peak (late December 1719), the Mississippi Company had an AuM of 1432; from the peak to the bottom (mid-January 1721) an AdM of 412, giving an AuM/AdM ratio of 3.48. In other words, the accumulated strength of the upward momentum was more than three times larger than the strength of the downward momentum.

The fantastic rise of the stock started in May 1719, but the first upward SMLV happened two months before. The RSI stayed above 70 for fifteen days (3-17 March 1719), with the stock nearly reaching par in cash terms. What may explain this first SMLV? In December 1718, the Mississippi Company had acquired the French Senegal Company, and as a result, had significantly enlarged its merchant fleet; ten ships, with soldiers and colonists, were sent to Louisiana. [33] Moreover, around March 1719, John Law demonstrated spectacularly his faith in the Mississippi Company by massively buying call options (with a strike price at par) on its shares. [34] These commercial developments and financial operations probably convinced investors that the corporation was significantly undervalued (the 3 March 1719, its stock was 12% under par).

Between May and August 1719, the Mississippi Company bought out the other French joint-stock firms for overseas trade (Africa, Indies, and China Companies). It also took over the management of the royal mints and of most French taxes. Furthermore, in August, it launched the massive conversion of the whole French sovereign debt into its own stock. As a result, the corporation trebled its nominal capital with five successive shares issues.[35] The second (12-29 May) and third (17 Jun.-22 Sep.) SMLVs happened during that period. Interestingly, that third SMLV – that lasted for a record 98 days – ended on the eve of the two last shares issues (26 and 28 September). On that 22 September 1719, the parabolic surge of Mississippi stock was only half way: the indexed price was then at 18.2 vs. 36.5 at the peak (end of December 1719). Yet, the accumulated upward momentum was already more than two-thirds of its way: the AuM was then at 959 vs. 1432 at the peak. In other words, the Mississippi Bubble constitutes an

[33] Velde, F., "Government Equity and Money: John Law's System in 1720 France", *Federal Reserve Bank of Chicago working papers* (2004) provides one of the clearest overviews of the developments of the Mississippi Company. See also Faure, E., *La banqueroute de Law* (Paris, 1977) and Levasseur, E., *Recherches historiques sur le système de Law* (Paris, 1854).

[34] Forbonnais, Duverger de, *Recherches et considérations sur les finances de France* (Bâle, 1758), VI, 286.

[35] Mid-June 1719, its nominal capital was 100,000,000 livres (L). Five successive *arrêts* of the Conseil d'État increased the firm's capital: 20 June 1719 (25mL); 27 July (25mL); 13 September (50mL); 26 September (50mL); 28 September (50mL). See Hautchamp, Marmont du, *Histoire du système des finances* (La Haye, 1739), V, n. 22, 27, 34, 36, 37.

example where the bulk of the upward momentum happened in the early phase of the boom rather than at the end (see below).

The last SMLV lasted from 23 October to 9 December 1719. The 22 November, when the RSI peaked (94.6), but failed to exceed its previous high (95.16, reached the 12 Sep.), it signaled a potential "failure swing". The failure swing was confirmed the 14 December 1719, as the RSI fell below it previous low (Figure 5).[36] Furthermore, at the end of December, there was a bearish divergence between price and RSI: the former was still in an uptrend, while the latter was clearly in a downtrend. The 25 December, the price reached its apex, while the RSI was 65.86, which is to say below "overbought" territory.

The bearish divergence anticipated the reversal in the price trend. However, the bubble did not burst immediately, as the company officially supported its share price for several months. The crash happened the 22 May 1720, following a royal *arrêt* that officially reduced the value of the shares by almost a half. Such was the public outrage, that the government was forced to back down. The 25 May, the *arrêt* was rescinded; the 27 May, the regent placed John Law under house arrest. That decision generated a major panic in the market. From the 20 to the 27 May, the Mississippi share dropped by 17%; in the four days after Law's downfall, it collapsed by another 45%. The 1st of June, Law was freed and back in command of French finances. His reputation had been seriously tarnished, yet his comeback provoked a (momentarily) rebound in the stock. The RSI stayed under 30 during the whole crisis. But as the crisis lasted less than fifteen days, the May 1720 panic, in spite of its severity, did not qualify for our definition of a downward SMLV.

[36] About the sudden fall of the Mississippi stock mid-December 1719, see Faure, E., *La Banqueroute*, cit., p. 238.

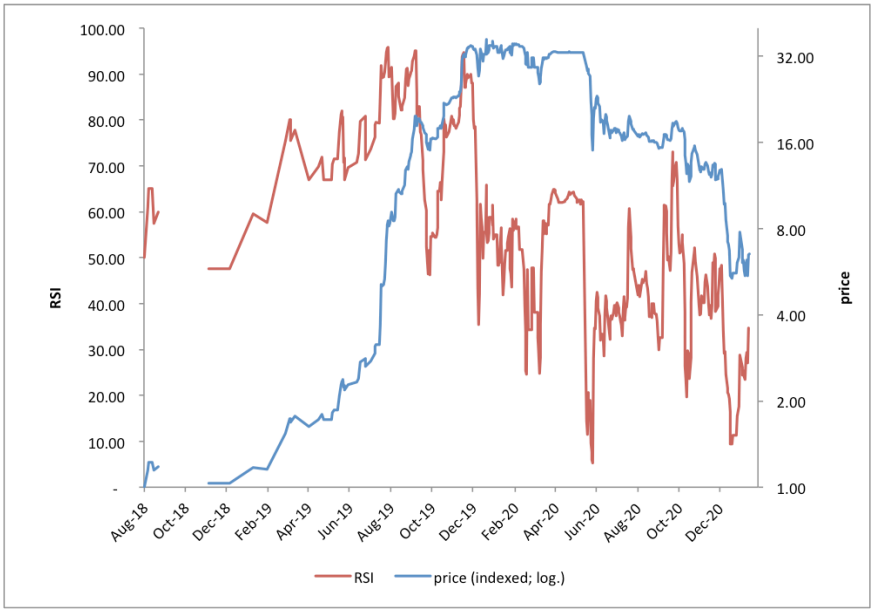

Figure 4. Mississippi Company price and RSI (6 Aug. 1718-31 Jan. 1721)[37]

The Mississippi stock, which was not supported anymore, entered a prolonged downtrend. Late September, following some new bold measures introduced by Law, the RSI spiked above 70 for a few days.[38] In October, there was an apparent bullish divergence (the RSI making a higher low, while the price was making a lower low) that marked a possible trend reversal. Yet, the price resumed its gradual decline, until December 1720, when it crashed for the second time. The second crash, as the first one, was directly connected to Law's downfall. By the 11 December he had lost his position (this time definitely), and the RSI fell below 30 on that same day. There was no bullish divergence, with the RSI and the price reaching the bottom the 23 December 1720, one day after Law had fled France (and probably the same day when the news of his departure reached Paris). Hence, the RSI confirms how much the Mississippi Bubble was connected to John Law himself. There is probably no other example of a major market boom or bust that is, to such an extent, related to a single individual.

The RSI stayed below 30 for more than one month, until the 15 January 1721. Thus, the collapse of the Mississippi Bubble lasted one year (from 25 Dec. 1719 to 23 Dec. 1720), and the only downward SMLV occurred at the very end.

[37] Source: single series of the Mississippi Company share developed by François Velde (private communication), reviewed by myself on the basis of further archival material (price quotes).

[38] Faure, E., *La Banqueroute*, cit., p. 509, has called these measures Law's "chef-d'oeuvre méconnu" (unknown masterpiece).

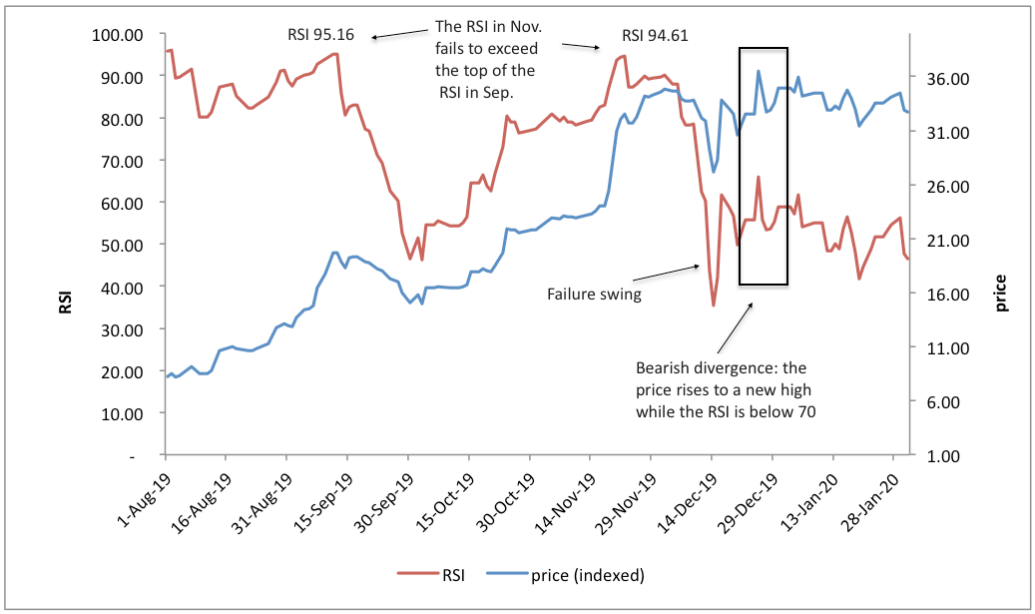

Figure 5. Mississippi Company (Aug. 1719-Jan. 1720): failure swing and bearish divergence

SOUTH SEA COMPANY

Between May 1719 and late December 1720, the South Sea Company had an AuM of 895 and an AdM of 392. This was 5% less AdM than the Mississippi Company, but also one third less AuM. Accordingly, the English giant corporation had a significantly lower AuM/AdM ratio than its French counterpart (2.28 vs. 3.48). It had also a much lower ratio than the overall London index (10.01).[39]

From May to November 1719, while the French equity market was booming, the South Sea stock was still going through a period of weak momentum. The harbinger of the coming bubble occurred the 14 November 1719 (Julian calendar, 25 Nov. in our Gregorian calendar[40]), when the RSI crossed the overbought line and stayed above there for a few days. The South Sea stock had not raised much since its floatation in 1711; this was possibly the first time its RSI went above 70. That 14 November marked the beginning of secret negotiations between the South Sea Company and the British government, negotiations that led to the South Sea scheme officially presented to the Parliament two months later.[41] Since W. R. Scott, scholars have supposed that people in the know had been buying South Sea shares, expecting that these

[39] See below.

[40] Britain used at the time the Julian calendar, which was eleven days behind our own calendar (Gregorian). The historiography about the South Sea Bubble mostly quotes dates according to the Julian calendar.

[41] [Blunt, J.], *A true state of the South Sea Scheme* (London, 1720), p. 1; Carswell, J., *The South Sea Bubble* (London, 1960), p. 99.

negotiations would benefit the firm.[42] The RSI confirms that the market – whoever was behind it – instantly and enthusiastically reacted to the secret talks.

The RSI spiked several times above 70 in December 1719, yet the first upward SMLV happened only mid-January 1720. Interestingly, that first SMLV ended right before the scheme was officially submitted to the South Sea board and to the Parliament (21-22 Jan. Julian). According to P. G. M. Dickson, the South Sea share experienced three major rises: in the second half of March second half of May, and during June 1720 (Julian).[43] The RSI presents a partially different reading of the boom. There were five upward SMLVs: the first in January, the second in February (Feb.-Mar. Gregorian), the third in March-April, the fourth and longest (21 days) in May-June, and the last in June-July (July Greg.) The RSI reached its top (96.16) the 2nd June (13 Jul. Greg.), while the price peaked the 29 June (10 Jul. Greg.)[44] There was, therefore, a bearish divergence. However, the 29 June, the RSI was still extremely high (87.18), which means that the divergence was much less marked in comparison to the Mississippi stock.

As the share collapsed, there was only one long downward SMLV, lasting more than one month, from 12 September to 18 October 1720 (23 Sep.-29 Oct. Greg.) The RSI was at its lowest (11.98) the 28 September (9 Oct. Greg.) The price, on the other hand, found a bottom the 13 December 1720 (24 Dec. Greg.) There was, therefore, a bullish divergence from early October to December. The South Sea and the Mississippi stock bottomed almost the same day. They also experienced a concomitant bullish divergence in October (although, in the Mississippi case, it turned out to be a failed divergence).

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[42] Scott, W. R., *The constitution and finance of English, Scottish, and Irish joint-stock companies to 1720*, (Cambridge, 1911), III, p. 304.

[43] Dickson, P. G. M., *The financial revolution in England* (London, 1967), p. 140.

[44] The South Sea transfer books were closed the 23 June for the summer, and the peak from 24 to 29 June was due to the shift from spot to forward prices. See L. Neal, *The rise of financial capitalism* (Cambridge, 1990), p. 101.

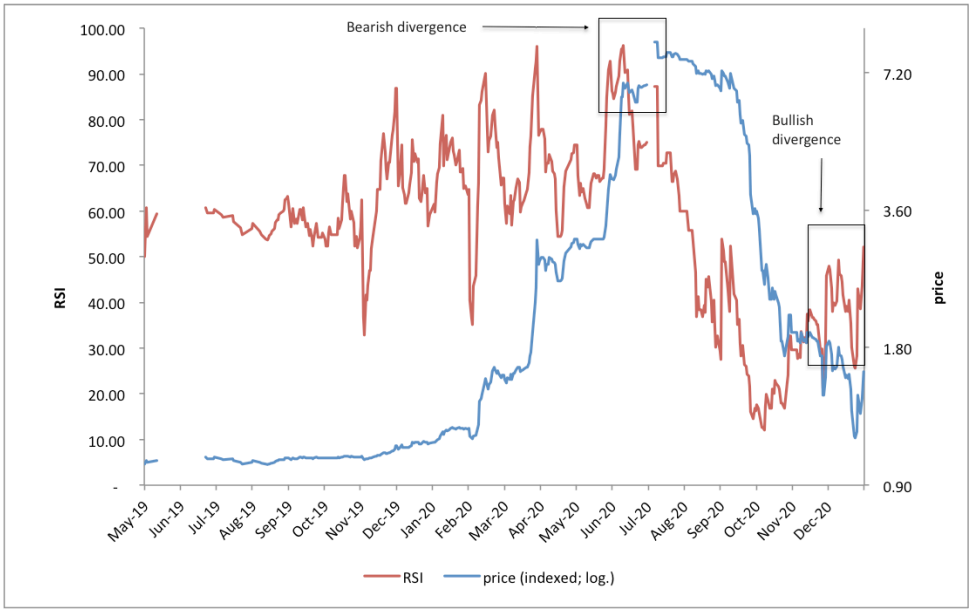

Figure 6. South Sea Company price and RSI (12 May 1719-31 Dec. 1720 Greg.)

BANK OF ENGLAND

Between May 1719 and late December 1720, the Bank of England (BoE) had an AuM of 389 and AdM of 246, that is to say only 40% of the South Sea AuM, and yet 63% of its AdM. As a result, the BoE had a lower AuM/AdM ratio (1.62 vs. 2.28).

The BoE's RSI surged above 70 the 26 November 1719 (Julian), two weeks after the South Sea. This first spike of the RSI supports the hypothesis, formulated by some scholars, that the Bank was also involved in the secret negotiations between the South Sea Company and the government (see above).[45] There was a second RSI spike early January 1720, which did not last long enough to constitute an upward SMLV. The BoE experienced only one uSMLV, in May-June 1720. The RSI was at its highest (90.50) the 21 May; the price peaked the 23 June (4 Jul. Greg.), with a RSI still above 70. There was therefore a bearish divergence (not marked on the chart).

On the downside, the BoE went through a shorter dSMLV (in Sep.-Oct. 1720) compared to the South Sea, but its RSI reached a lower low (6.17 vs. 11.98), and it bottomed more than two weeks later (15 Oct. vs. 28. Sep.) The price of the two stocks, however, bottomed the same day (13 Dec. 1720). From October, the BoE was thus in a bullish divergence, with the RSI trending upward and the price still trending downward.

[45] Scott, W. R., *The constitution and* finance, cit., III, p. 204 and 304; Clapham, J. H., *The Bank of England: a history (1694-1797)* (Cambridge, 1958) p. 83.

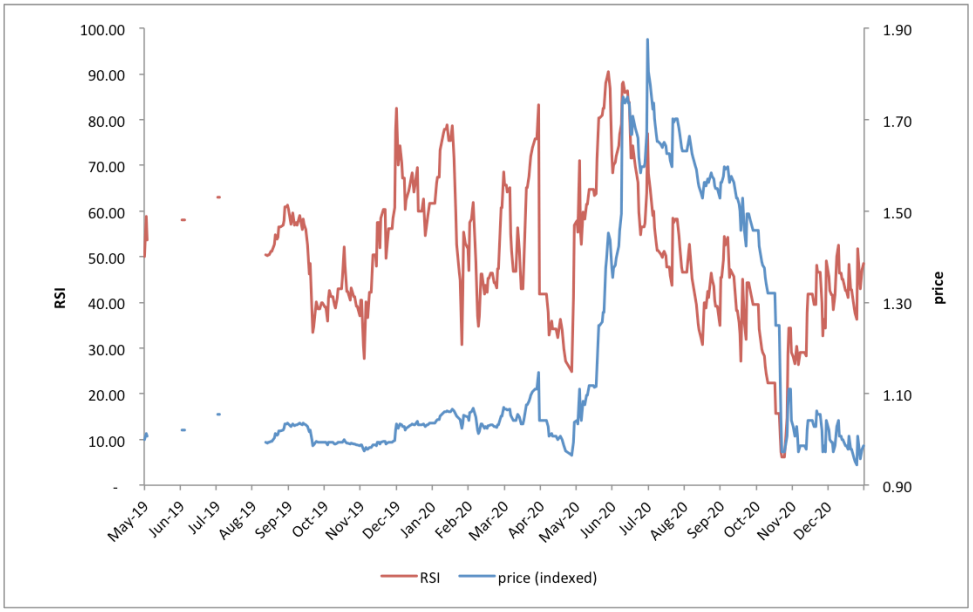

Figure 7. Bank of England price and RSI (12 May 1719-31 Dec. 1720 Greg.)

EAST INDIA COMPANY

The East India Company (EIC) had the lowest AuM/AdM ratio (1.27) among all the English stocks. Between May 1719 and late December 1720, it had an AuM of 364 and an AdM of 287. Compared to the BoE, the EIC had less upward momentum and more downward momentum.

The RSI of the EIC spiked above 70 the 15 November 1719 (Julian), around the same time when it was also spiking for the South Sea and the BoE.[46] After other upward spikes in January, February, March, and May, the EIC entered an uSMLV in June 1720. The RSI reached the top (88.16) very early on, the 21 March, two months before the BoE and the South Sea. On the contrary, the EIC price peaked (29 Jun.) around the same time as the two other "moneyed" companies. There was, therefore, a prolonged bearish divergence between March and June (not marked on the chart).

The EIC experienced a dSMLV (Sep. 1719), shorter than the South Sea, and of a similar length than the BoE. The RSI bottomed (10.06) the 22 September, a week before the South Sea and three weeks before the BoE. The price bottomed the same day (13 Dec. 1720) as the two other stocks. There was, therefore, a long bullish divergence between October and December.

[46] This spike in the RSI supports the hypothesis that the EIC was also involved in the secret negotiations (see above).

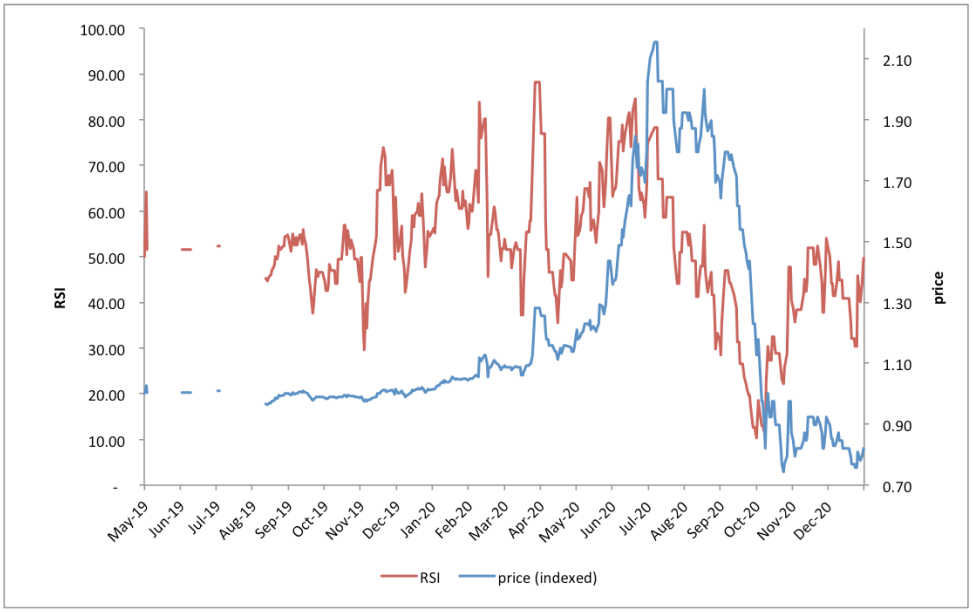

Figure 8. East India Company price and RSI (12 May 1719-31 Dec. 1720 Greg.)

THE MILLION BANK

The Million Bank is generally not considered a major actor of the 1720 bubble. Yet, among all the stocks analyzed here, it achieved the highest score in terms of accumulated momentum, both on the upside (2,014), and on the upside (1,101). Compared to the South Sea, its AuM was 128% higher and its AdM 180% higher. The AuM/AdM (1.85) was therefore lower than the South Sea, although it was higher than the BoE and EIC.

The Million Bank was a virtual investment fund in government securities. As such, it was supposed to benefit from the sovereign debt-to-equity swap implemented by the South Sea Company. Moreover, during the boom, the Million Bank borrowed large sums from the South Sea and used them to buy even more South Sea stock.[47] The Million Bank had two uSMLVs: one in February-March and the other in May-July 1720 (Julian), which lasted 51 days. Its RSI peaked (9 June) twenty days before the South Sea, with the exceptionally high reading of 99.92; the price peaked the 22 June, four days before the South Sea. W. R. Scott writes that the Million Bank was "remarkably fortunate in escaping from being involved in the collapse of the South Sea", and he adds "Evidently the directors had withdrawn from speculation in good time".[48] The RSI, however, tells a different narrative. Although the price remained rather stable until September 1720, the RSI started to collapse immediately after the peak in the South Sea. The firm experienced two dSMLVs (in Sep.-Oct. and in Nov.-Dec. 1720), which suggest that it was in fact heavily involved in the South Sea crash. The RSI bottomed (4.41) the 13 October, but the price was still falling end of December 1720, and it probably only bottomed early 1721.

[47] Scott, W. R., *The constitution and finance*, cit., p. 285.

[48] *Ibid.*, p. 286.

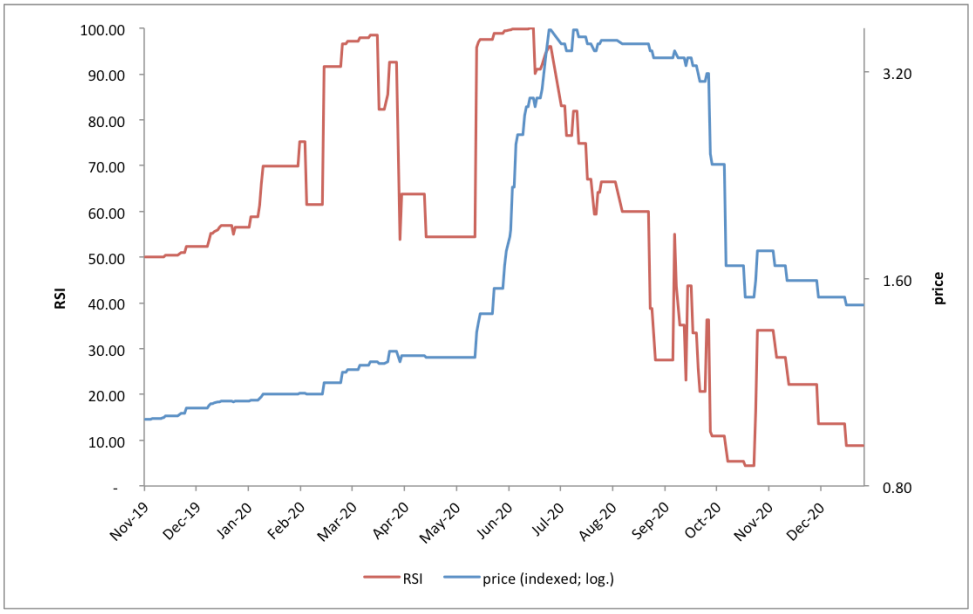

Figure 9. Million Bank price and RSI (13 Nov. 1719-31 Dec. 1720 Greg.)

THE ROYAL AFRICAN COMPANY

The Royal African Company (RAC) held the record of the highest AuM/AdM: 10.68, meaning that the accumulated strength of the upward momentum was more than ten times larger than the strength of the downward momentum. On the upside, its AuM (801) was not too far from the South Sea or the marine insurance firms (see below); on the downside, the RAC had the lowest AdM (75) among all the stocks analyzed in this paper.

The RAC had a first uSMLV in August 1719, with a further spike of the RSI the 9 September (Julian).[49] There were three other uSMLVs: the first in February-March, the second in March-April, and the third in May-June 1720. The February SMLV was clearly connected to the scheme to recapitalize the company, presented by a syndicate led by the duke of Chandos.[50] The RSI (96.34) and the price peaked on the same day, 2 June 1720. Thus, there was no bearish divergence. Afterwards, the RSI fell much faster than the price. Yet, there was only one dSMLV (Sep. 1720). The RSI bottomed (16.13) the 21 September; the price bottomed the 17 November 1719, almost one month before the South Sea. Between September and November, the RAC was therefore in a bullish divergence.

[49] In a coming paper, based on new archival evidence, I present a possible explanation for this first uSMLV of the RAC.

[50] In Chandos correspondence, the scheme about the new RAC is mentioned for the first time the 22 February 1720 (Julian): Huntington Library, Stowe 57, 17, f. 23.

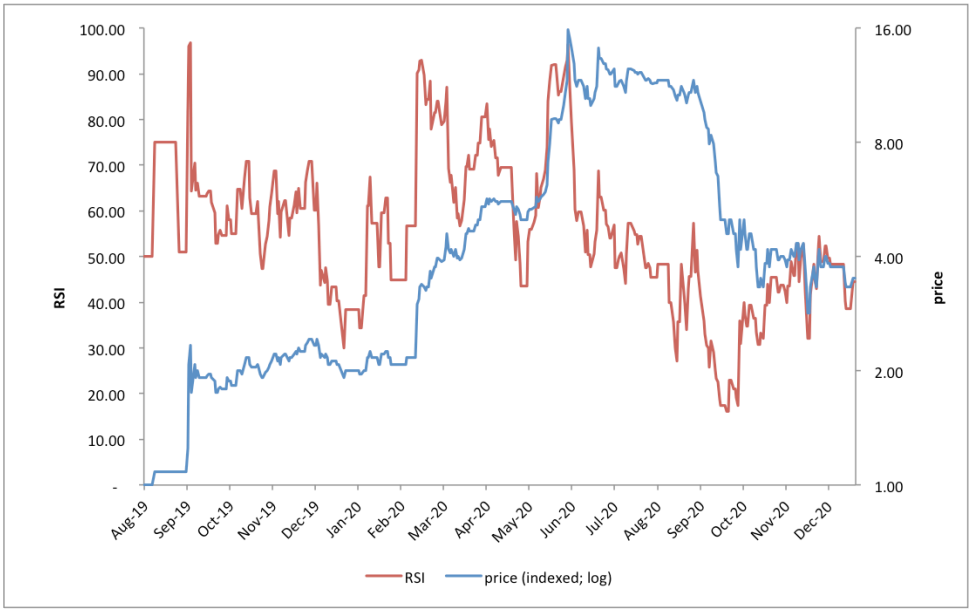

Figure 10. Royal African Company price and RSI (21 Aug. 1719-31 Dec. 1720 Greg.)

ENGLISH MARINE INSURANCE FIRMS

The two marine insurance firms, the Royal Exchange Assurance and the London Assurance, followed a parallel course during the 1720 bubble. It makes sense, therefore, to consider them as a group. Their AuM (877) was slightly lower than the South Sea, with a much lower AdM (110). The AuM/AdM ratio (7.97) was much higher; it was second only to the RAC and the London index (see below).

The marine insurance firms' RSI spiked repeatedly over 70, but it had only one uSMLV, which lasted 46 straight days, from late April to early June 1720 (Julian). Contrarily to all the other English stocks examined here, there was no bearish divergence: the RSI and price peaked the same day, 15 August 1720 (one month and a half after the South Sea price had peaked). There was no plateau at the summit, with the price and RSI collapsing in parallel. The RSI downfall was brief. It had already bottomed the 19 September 1720, ten days before the South Sea, and what is more with a much higher reading (21.71 vs. 11.98 for the South Sea). There was, nonetheless, a downward SMLV from 9 to 29 September. The price bottomed the 17 December 1720, which meant a bullish divergence between September and December.

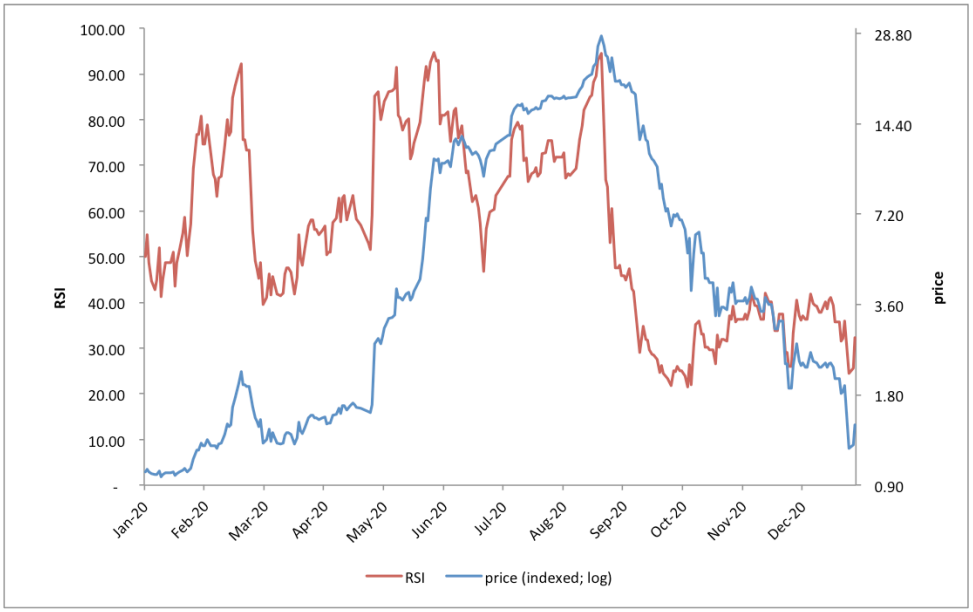

Figure 11. Two marine insurance firms price and RSI (10 Jan.-31 Dec. 1720 Greg.)

LONDON INDEX A

The London index A is an equally-weighted basket of seven stocks: South Sea Company, BoE, EIC, Million Bank, RAC, and the two marine insurance firms, the Royal Exchange Assurance and the London Assurance.[51] From January 1720 on, these were the stocks regularly quoted in the newspapers, both English and foreign. It is thus possible to consider that these seven stocks were the most heavily traded throughout 1720. Hence, they represent the best possible proxy for the whole London equity market. The London index AuM was 1,121; the AdM was 117. Its AuM/AdM ratio (9.58) was four times higher than the South Sea, although smaller than the RAC.

There were four upward SMLV: the first in February, the second and longest (50 days) from late April to early June, the third in June-early July, and the last in late July 1720 (Julian). The RSI was already at its zenith the 23 May (97.62), two days after the BoE, before the South Sea, and much before the marine insurance firms. The price peaked the 15 August, two days after the marine stocks. There was therefore a protracted bearish divergence, from May to August. Price and RSI fell sharply after mid-August, with the RSI bottoming (17.38) the 29 September 1720, one day after the South Sea. The only dSMLV took place in September. October-

[51] The price of the seven stocks is indexed with 10 January 1720 (first quotation for the two marine insurance firms) as the starting value. The basket is calculated adding, for each trading day, the normalized value of each stock, and then dividing the sum by 7. In other words, using percentage change in each stock, and then averaging. Missing data (e.g. for the Bank of England the 4 March 1720) is extrapolated on the basis of the previous and following available prices.

December was a time of bullish divergence, with the price bottoming the 17 December 1720, the same day as the marine insurance firms, and four days after the South Sea.

Figure 12. London index A price and RSI (10 Jan.-31 Dec. 1720 Greg.)

LONDON INDEX B

London index B is built according to the same principles as index A. The only difference is that index B starts earlier. From 21 August 1719 to 12 November 1719, index B is composed of four stocks: South Sea Company, BoE, EIC, and RAC;[52] from 13 November 1719, the Million Bank is added to the basket; from 10 January 1720, index B is the same as index A, i.e. composed of the above-mentioned stocks plus the two marine insurance firms. To facilitate comparisons with index A, the indexed price is unchanged, with 10 January 1720 representing 1. Index B thus starts with a price of 0.82. The AdM (117) was the same as index A; the AuM (1,190 vs. 1,121) was higher, as the RSI spiked above 70 in September and December 1719. The AuM/AdM was higher (10.17 vs. 9.58), second only to the RAC.

[52] No prices were available for the three other stocks during that period.

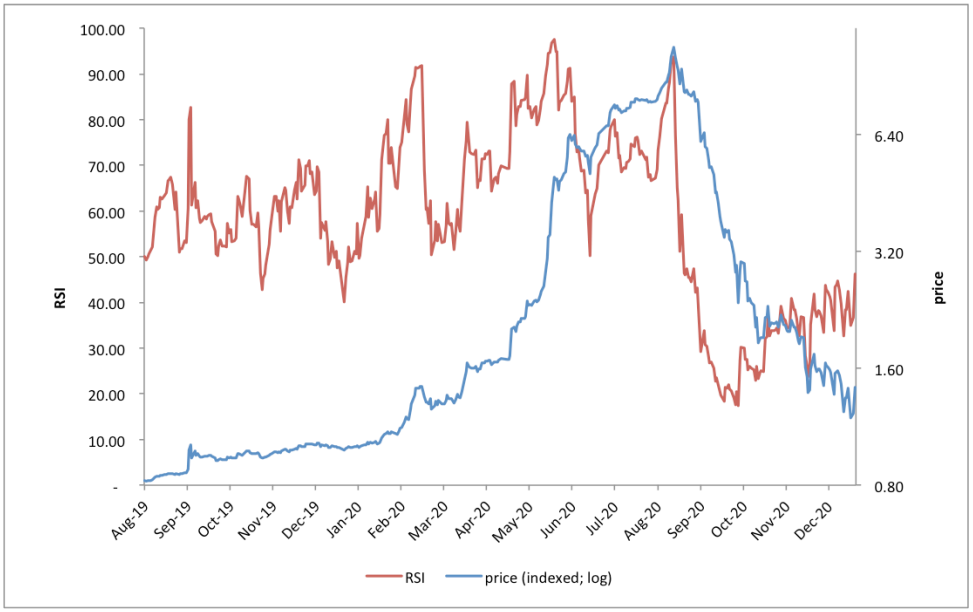

Figure 13. London index B price and RSI (21 Aug. 1719-31 Dec. 1720 Greg.)

DUTCH EAST INDIA COMPANY

The Dutch East India Company (VOC) was the only stock in this study with a negative net accumulated momentum. Between 16 November 1719 and 31 December 1720, the AuM was 90, slightly lower than the AdM (96). The VOC also had the lowest AuM/AdM ratio (0.94) among all the stock analyzed in this paper.

Notwithstanding its low AuM score, the VOC went through a 40-days long uSMLV in April-May 1720. In fact, all the RSI readings above 70 were concentrated during that period. The RSI was at its apex (80.39) the 29 April, more than three months before the apex in the price (12 August). When the price reached the top, the RSI had already spent 94 days under the 70 threshold. The VOC and the Mississippi Company were the two only examples, in this paper, of stocks that reached their top with a RSI that was not in overbought territory. On the downside, there was a 38-day dSMLV (Oct.-Nov. 1720). The RSI bottomed (19.11) the 16 October, earlier than the price (9 Nov. 1720), giving rise to a short bullish divergence.

Figure 14. Dutch East India Company price and RSI (16 Nov. 1719-31 Dec. 1720)

DUTCH WEST INDIA COMPANY

Between 16 November 1719 and 31 December 1720, the Dutch West India Company (WIC) had an AuM of 346 (almost four times larger than the VOC) and an AdM of 92 (smaller than the VOC). The AuM/AdM ratio (3.84) was much higher than the VOC (0.94), but also higher than the Mississippi (3.48) and South Sea (2.2).

There was a first RSI spike above 70 in April 1720, which would need to be explained. The second spike in June and the uSMLV in July-September were certainly connected to the marine insurance schemes and the other ambitious financial projects in which the WIC was involved.[53] Price and RSI (92.2) reached the top the same day (28 August 1720). There was, therefore, no bearish divergence. In fact, the WIC peaked exactly two days after the peak in the English marine insurance stocks (15 Aug. Julian, 26 Aug. Greg.), which seems a further confirmation that the WIC boom was connected to a marine-insurance narrative.[54] On the downside, the WIC experienced a prolonged dSMLV that started in October and was still going on late December. The RSI, however, was at its nadir (19.73) already the 28 October. There was therefore a two-month bullish divergence, with the price bottoming the 18 December 1720.

[53] See Gelderblom, O. & Jonker, J. "Mirroring different follies. The character of the 1720 Bubble in the Dutch Republic", in C. Labio *et al.* (eds), *The "Great Mirror of Folly": Finance, Culture, and the Crash of 1720* (New Haven, 2013).

[54] See Frehen, R.G.P., *et al.*, "New evidence on the first financial bubble", *Journal of Financial Economics*, 108 (2013). About news circulation between London and Amsterdam: Koudjis, P., "The boats that did not sail: Asset price volatility in a natural experiment", *The Journal of Finance*, 71, 3 (2016).

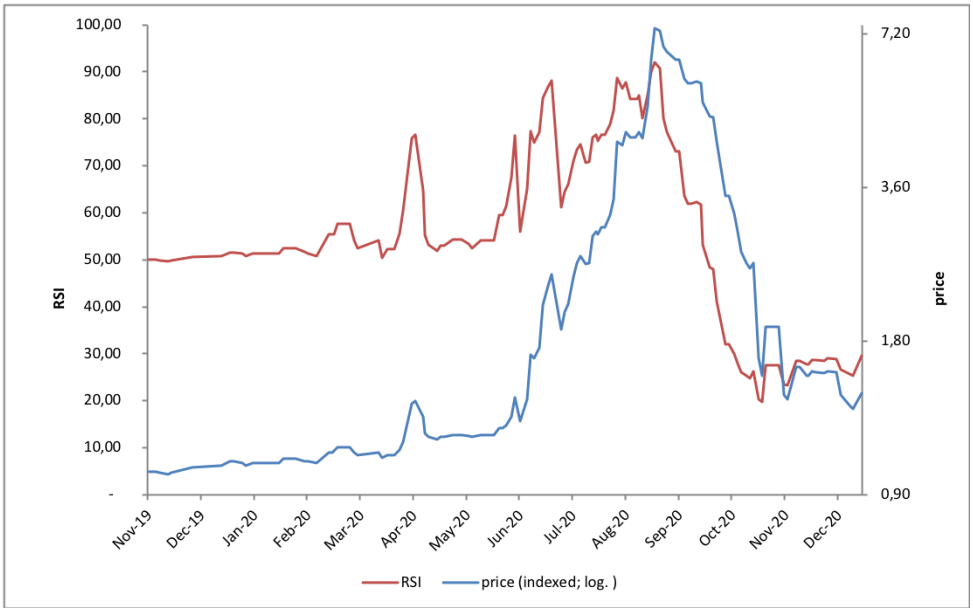

Figure 15. West India Company price and RSI (16 Nov. 1719-31 Dec. 1720)

AMSTERDAM INDEX

The Amsterdam index is an equally weighted basket of two stocks: VOC and WIC.[55] There is little doubt that these were the most heavily traded stocks on the Dutch equity market. Among other things, between November 1719 and December 1720, they were the only Dutch stocks regularly quoted in the Dutch press.[56] Thus, the index represents the best possible proxy for the whole Amsterdam equity market.

Between November 1719 and December 1720, the Amsterdam index had an AuM of 547 (less than half compared to the London index) and an AdM of 97 (17% less than the London index). Accordingly, the AuM/AdM ratio (5.64) was much lower than that of the London index, but higher than the Mississippi Company. Interestingly, the ratio was also higher than that of the two underlying stocks, WIC and the VOC.

The index had three uSMLVs: the first in January, the second in February-March, and the third (and longest: 61 straight days) in July-September 1720. There was no bearish divergence, as price and RSI (80.90) peaked the same day, 28 August (which was also the peak for the WIC). On the downside, there was one dSMLV in October-November 1720. The RSI bottomed (18.78) the 28 October, twelve days after the VOC and the same day as the WIC. The price, on the other hand, found a bottom the 19 December, although it is possible that it fell even further early 1721. There was, thus, a bullish divergence in November and December 1720.

[55] The basket is calculated according to the same method used for the London index (see above): calculating the percentage change for each stock, and then averaging by two.

[56] A dozen other stocks, such as Stad Rotterdam, were also quoted, but just for a few months: not enough time to calculate a RSI.

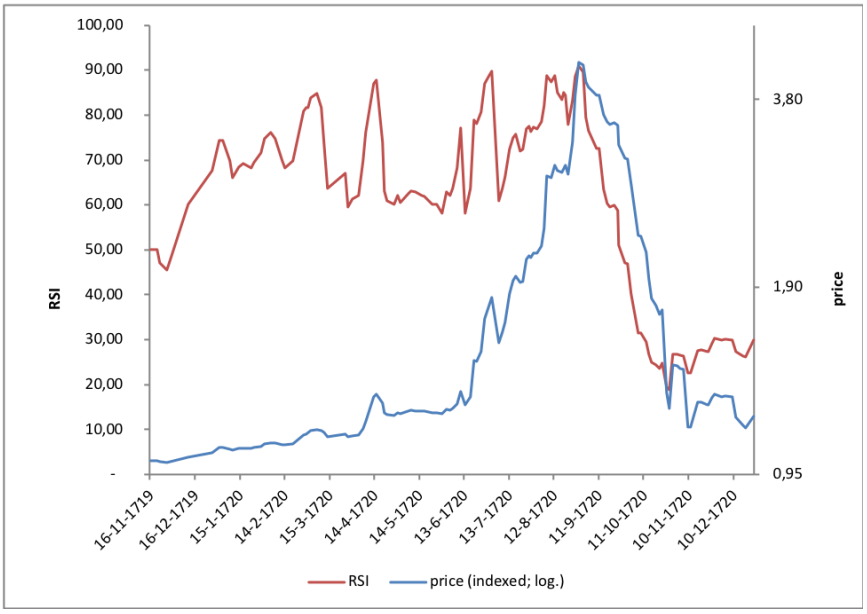

Figure 16. Amsterdam index price and RSI (16 Nov. 1719-31 Dec. 1720)

LISBON ON LONDON EXCHANGE RATE

Between early March and late December 1720, the Lisbon on London exchange rate had an AuM of 37 and no AdM. Thus, the AuM/AdM ratio cannot be calculated. The momentum of the Portuguese exchange rate is not fully comparable to the stocks analyzed here, not so much because of the difference in asset class, but rather because it is based on much fewer daily data.[57] Nonetheless, some comparisons are possible, in particular concerning the SMLV.

The exchange rate briefly spiked above 70 late June 1720, presumably around the time when the Portuguese crown started to seriously consider the possibility of granting a charter to a Brazil Company.[58] The second RSI spike (mid-August) and the uSMLV (late Aug.-early Sep.) were also clearly connected to further Portuguese joint-stock schemes that were discussed around that time. Anticipating a possible initial public offering of shares, international investors sent large sums to Lisbon. These massive inflows of capital left a huge "signature" in the exchange rate and they explain why there was an uSMLV. The apex in the exchange rate and the apex in the RSI (79.99) happened the same day, 3 September 1720. There was no sharp decline afterwards, possibly because discussions about a possible Portuguese firm dragged for the next months and

[57] Less daily data means that the AuM is mechanically lower. In the *FGR 1720 price database*, there are prices about exchange rates approximately every six-eight days, compared to every one-two days in the case of stocks. Using the *Course of Exchange* – that has data approximately every two days – it would be possible to calculate a more accurate AuM.

[58] The first detailed project for a Brazil Company was discussed in the summer 1720: Condorelli, S., "The 1719-20 stock euphoria: a pan-European perspective", *MPRA Paper* (2016).

years. The RSI never reached oversold conditions, but bottomed (46.47) the same day as the exchange rate, 1 November 1720.

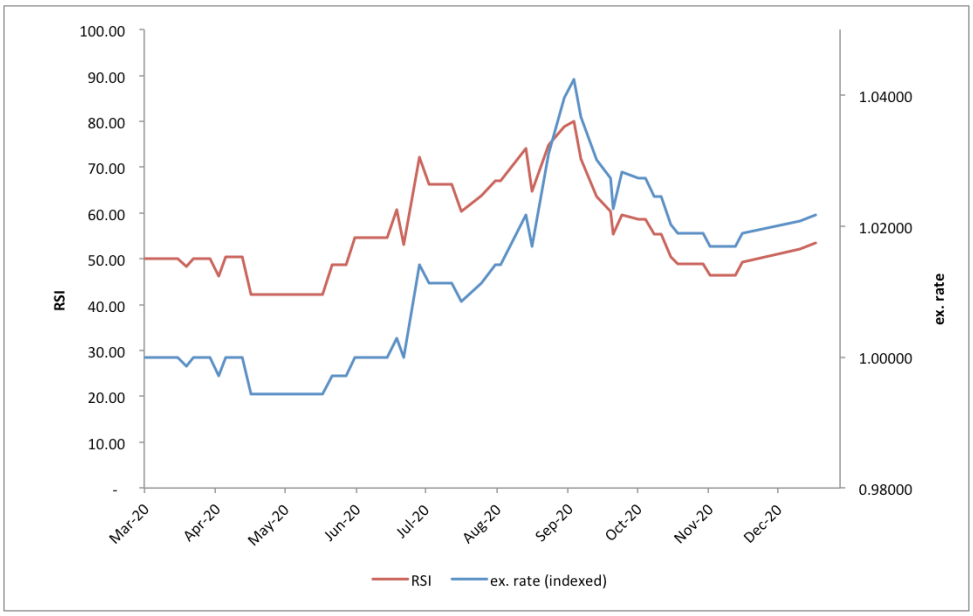

Figure 17. Lisbon on London exchange rate (1st Mar.-20 Dec. 1720)

CADIZ ON LONDON EXCHANGE RATE

Between early March and late December 1720, the Cadiz on London exchange rate had an AuM of 11 (less than one third of the Lisbon exchange rate) and an AdM of 31. The AuM/AdM ratio was 0.35.

The RSI spiked a first time above 70 in March 1720. The only plausible explanation for this first boom is the reopening of trade between Spain and its former enemies (Britain, the Dutch Republic, and France) after the end of the War of the Quadruple Alliance (Feb. 1720). This was followed by a dSMLV in April-May. Then, the RSI spiked again above 70 in June, July, and August, at a time when the government in Madrid was evaluating various schemes for a Spanish joint-stock corporation.[59] The RSI peaked (74.81) the 28 June, two months before the top in the exchange rate. Contrarily to the Portuguese case, there was no SMLV. There was rather a bearish divergence in August-September, as the RSI declined rapidly below 70, while the exchange rate was hovering at its maximum level between. The exchange fell sharply in late September, once it became clear that the crown had rejected all the projects. Yet, the RSI never reached oversold level. Therefore, considering only the momentum connected to speculation about a possible joint-stock scheme (i.e. not the period before June), the AuM was 11 and there was no AdM.

[59] Condorelli, S., "The 1719-20 stock euphoria", cit.

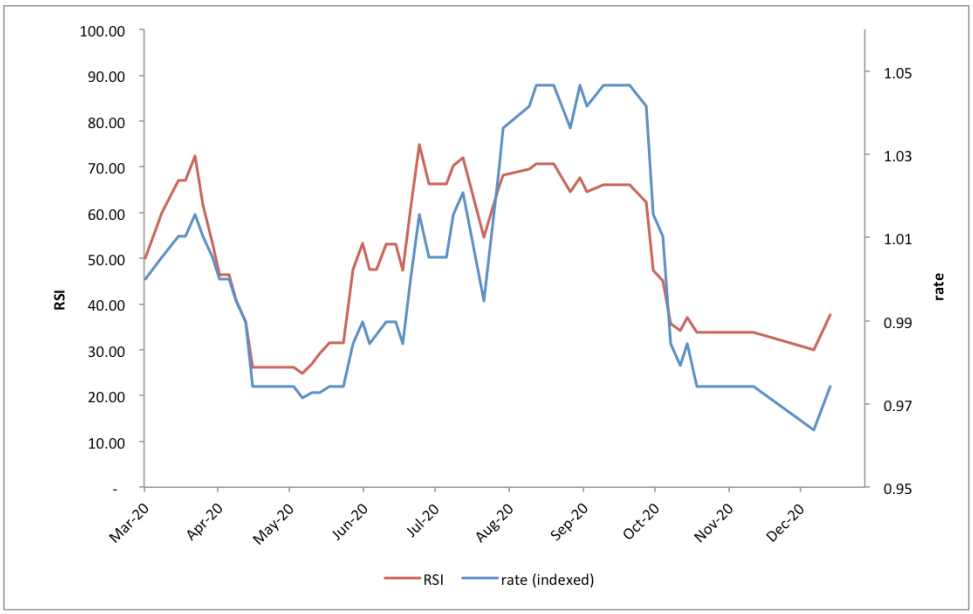

Figure 18. Cadiz on London exchange rate (1st Mar.-20 Dec. 1720)

III. Extending the analysis

We saw that the RSI operates at two different levels. On the one hand, it sheds light on the dynamic followed by a certain stock, index, or exchange rate. On the other hand, it constitutes a tool to compare these financial instruments: as the RSI is normalized (0-100 range), it represents a much better element of comparison than the price itself. This section will extend the analysis in five ways: 1) it will sketch some further comparisons; 2) it will develop a method (the chronological distribution of momentum) to explore the dynamic of some indexes; 3) it will study how RSI divergence can serve both as a tool for comparison and individual analysis; 4) it will consider the relationship between the SMLV and the Minsky-Kindleberger's notion of euphoria; 5) finally, it will investigate how momentum might explain why equity booms spread from one country to the other in 1719-20.

1. Comparisons

The most basic comparison is simply visual: plotting together the RSI graphs of different assets. For example, Figure 19 shows the RSI of the South Sea Company, BoE, and EIC between September and December 1719. The three RSI followed a rather parallel course from September to mid-November, reaching a bottom the very same day, 11 November (31 Oct. Julian). The co-movement between the South Sea Company and the EIC broke apart exactly at the start of the secret negotiations (25 Nov. Greg, 14 Nov. Julian) between the South Sea directors and the British government. By contrast, from early December, the RSI of the South

Sea and the BoE were again moving in parallel. This parallelism supports W. R. Scott's hypothesis that the secret negotiations also involved the BoE.[60]

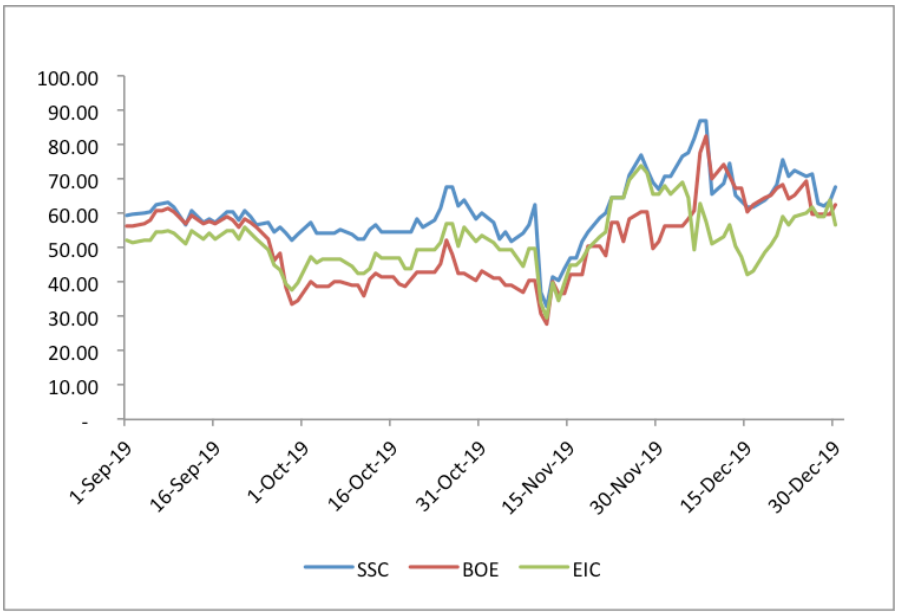

Figure 19. Comparing the RSI of the South Sea, BoE, and EIC (Sep.-Dec. 1719 Greg.)

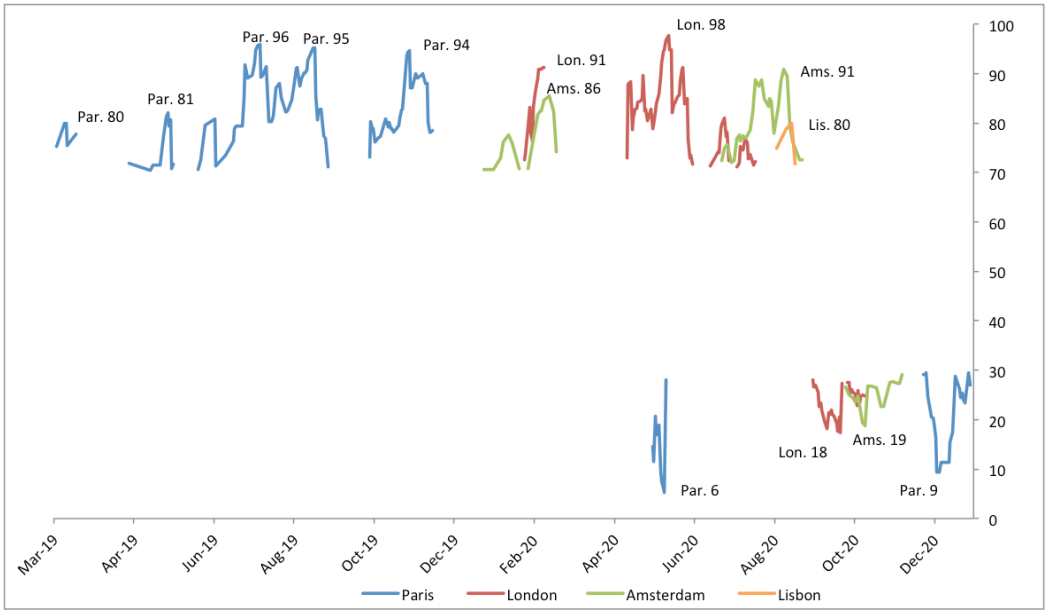

Figure 20. Upward and downward SMLVs in Paris, London, Amsterdam, and Lisbon (Mar. 1719-Dec. 1720)

Other example, Figure 20 depicts the SMLV (both upward and downward) of the Paris, London and Amsterdam index, together with the Portuguese exchange rate. As such, it constitutes a chronological image of the four bubbles. The graph indicates the highest (or lowest) number

[60] See above.

reached by the RSI. For example, in the last uSMLV of the Paris index, the RSI reached 94; in the first dSMLV, the RSI bottomed at 6.

The AuM and AdM metrics offer a different comparative perspective. Table 2 displays the AuM and AdM of the stocks, indexes, and exchange rates studied in this paper. The table appears to confirm what scholars have long supposed: that speculation was more overheated in Paris than in London, and in London than in Amsterdam. Indeed, the Paris index had an accumulated upward momentum (1,432) significantly larger than London (1,190), and much larger than Amsterdam (547). On the other hand, the table contains several surprises. Who would have imagined that the Million Bank (generally considered a sort of "risk-free" asset)[61] had generated an accumulated upward momentum (2,042) so much larger than any other English stock, including the South Sea (895)? Or that the VOC suffered more downward momentum (96) that the WIC (90) during the crash, although it had attracted much less speculative interest during the boom?

Extending the analysis across different centuries, it is remarkable that the AuM of the most famous bubbles were quite comparable: the Mississippi Bubble (1,432),[62] the South Sea Bubble (1,171)[63], the bubble that led to the 1929 crash (1,586),[64] and the dot-com bubble (1,425).[65] The time length of these booms differed significantly: approximately one year in the Mississippi and South Sea cases, approximately six years in the 1920s and dot-com cases. In spite of this difference, and in spite of all sort of other dissimilarities (technological, cultural, political, etc.), the accumulated upward momentum of these booms was surprisingly similar. How shall we interpret this finding? Do all the major historical booms fall in the 1100-1600 AuM range? I will investigate these questions in the second paper. For now, let us note that AuM of the current US equity boom (1,207) 1171 falls perfectly into the said range.[66] This would suggest that the current bull market might still have some room to go, but that it is definitely not in its infancy, as some market analysts argue.

The AuM/AdM ratio underlines that there is not necessarily symmetry between upward and downward momentum (Table 3). As noted above, the South Sea stock had one third less AuM than the Mississippi, but only 5% less AdM. As a result, the Mississippi had a higher ratio (3.48) compared to the South Sea (2.28). There were also cases of stocks having both more AuM and less AdM than others, such as the WIC compared to the VOC.

The AuM/AdM ratio introduces an interesting element of continuity and resilience into the notion of momentum. Let us imagine two stocks that have the same AuM during a bubble. Stock A was a fad: investors, which were eager to buy it, become eager to sell it (strong AdM)

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[61] See Scott, W. R., *Constitution*, cit., III, pp. 279-289; Neal, L., *Rise of Financial Capitalism*, cit., p. 51.

[62] The Mississippi stock may be considered as the equivalent of the Paris index (as this was the only traded stock in Paris between September 1719 and May 1720).

[63] This is not the AuM of the South Sea stock itself, but of the London index B.

[64] This is the AuM of the DJIA from the major previous trough (Nov. 1923) to the top in Sep. 1929.

[65] The AuM of the Nasdaq from the major previous trough (Mar. 1994) to the top (Mar. 2000).

[66] DJIA, calculated from the trough of the market (March 2009) to 12 January 2018 (time of writing).

during the crash. Stock B may have started as a fad, yet (for some reason) the crash does not destroy investors' expectations: they are not eager to sell it (weak AdM). The continuity in investors' expectation in the case of stock B, that is to say the greater resilience of stock B during the crash, translates into a higher AuM/AdM compared to stock A. Another display of resilience would be the case of stock A and stock B having a similar AdM during the crash, although stock A had a much stronger AuM during the boom. It is noteworthy, for instance, that this seems to have been the case for the Mississippi compared to the South Sea, resulting in a significantly higher AuM/AdM for the French firm (Table 2 and Table 3).

Table 2. AuM and AdM

	AuM	AdM
Mississippi Company (Paris index)	1,432	412
South Sea Company	895	392
BoE	398	246
EIC	364	287
Million Bank	2,042	1101
RAC	801	75
Marine insurance firms	877	110
London index A	1,121	117
London index B	1,190	117
VOC	90	96
WIC	346	90
Amsterdam index	547	97
Lisbon on London exch. rate	37	0
Cadiz on London exch. rate	11	0

Exploring the reasons that would explain the differences in AuM/AdM of the 1720 stocks is beyond the scope of this paper. Two comments, nevertheless. The first concerns the WIC. Some scholars consider that the boom in the WIC's price was probably the result of a manipulation of the market engineered by the firm's directors.[67] If the strong AuM had solely been the consequence of market manipulation, there would have been in all likelihood a backlash during the crash, and thus a comparable (if not stronger) AdM. Yet, investors were less eager to sell the WIC than its larger (and historically much more successful) sister, the VOC. The high AuM/AdM ratio of the WIC does not support the market manipulation thesis; it suggests that 1720 events genuinely improved (at least for a time) investors' expectations towards the company. It is remarkable that the WIC had also a higher AuM/AdM than the Mississippi and the South Sea. The second comment concerns the London and Amsterdam indexes. It is noteworthy that they both had a much higher AuM/AdM ratio than their underlying stocks.[68]

[67] Gelderblom, O. & Jonker, J. "Mirroring different follies", cit.

[68] With the exception of the RAC in the case of the London index.

What was the reason for this difference? A hypothesis, that would need further investigation, would be that the higher ratio of the indexes was the result of their diversification.

The last interesting metric is the ratio between the maximum percentage price increase (mP) during the boom and the AuM. The ratio highlights that some financial instruments "consumed" – in proportion of their maximum price increase – more upward momentum than others (Table 3). If we may draw a parallel with the notion of energy efficiency – and considering momentum as a form of "energy" – we may say that some financial instruments were more "efficient" than others. The higher the ratio, the greater was the "AuM efficiency". With its low AuM, and 9.55 ratio, the Cadiz-on-London exchange rate was the lowest consumer of momentum-energy. By contrast, given its exceptionally high AuM, and its 0.18 ratio, the Million Bank was a heaviest consumer. Compared to the South Sea, the Million Bank's AuM was 128% higher, although the price rose 56% less. The case of the marine insurance firms was the opposite: they had a lower AuM than the South Sea, and yet their price raised 240% more. This translated in a mP/AuM ratio of 3.23 vs. 0.94 for the South Sea.

Table 3. AuM/AdM and mP/AuM

	AuM/AdM	mP/AuM[69]
RAC	10.68	1.98
London index B	10.17	0.96
London index A	9.58	0.90
Marine insurance firms	7.97	3.23
Amsterdam index	5.64	0.80
WIC	3.84	2.13
Mississippi Company (Paris index)	3.48	2.55
South Sea Company	2.28	0.94
Million Bank	1.85	0.18
BoE	1.62	0.47
EIC	1.27	0.59
VOC	0.94	1.49
Lisbon on London exch. rate	NA	2.81
Cadiz on London exch. rate	NA	9.55

Table 4. AuM and mP/AuM of three U.S. equity booms

	AuM	mP/AuM
1929 bubble (DJIA)	1,586	0.27
dot-com bubble (Nasdaq)	1,425	0.48
current bull market (DJIA)[70]	1,171	0.21

[69] The formula of the ratio is: (maxP/AuM) x 100.

[70] At the time of writing, 12 January 2018.

Interestingly, the mP/AuM ratio offers an inverted perspective on the Paris-London-Amsterdam hierarchy in terms of overheated speculation (see above). In fact, proportionally to its maximum price increase, Paris "consumed" less AuM than London, and London less than Amsterdam. The Paris index had a much higher ratio (2.55) than London (0.90) and Amsterdam (0.80). Enlarging the perspective, the 1719-20 bubbles overall were significantly more "AuM efficient" compared to the U.S. market booms of the 20th and 21st century. The mP/AuM ratio of the dot-com bubble was 0.48; it was 0.27 for the 1929 bubble, and only 0.21 for the current U.S. bull market (Table 4). In other words, the 1719-20 Paris bubble consumed, in proportion, five times less AuM than the dot-com bubble and almost ten times less than the 1929 bubble. [I am still not sure how to interpret all this].

2. Momentum distribution during the lifecycle of the booms

Turning to the individual asset level, the RSI sheds light on an important topic: the distribution of momentum during the lifecycle of the boom and burst. This paper only focuses on the upward phases, keeping for a next study the analysis of the crashes.

Figure 21 represents the distribution of the upward momentum during the boom of the London index A. Over the whole period, the AuM was 1,121, while the indexed price rose from 1.0 (10 Jan. 1720) to 10.73 (28 Aug. 1720). The figure breaks down the AuM for each new round number that the price reached: 280 AuM points were "consumed" as the price climbed from 1 (10 Jan.) to 2 (5 May); 290 points as the price rose from 2 to 3 (29 May); 76 points as it rose from 3 to 4 (1st June); etc. Obviously, the distribution reflects the underlying arithmetic progression of the price: the price doubled from 1 to 2; it only increased by 50% from 2 to 3; etc. Yet, it is clear that the distribution of momentum was not linear. In particular, there was a peak in momentum as the price jumped from 4 (1st June) to 5 (10 June).

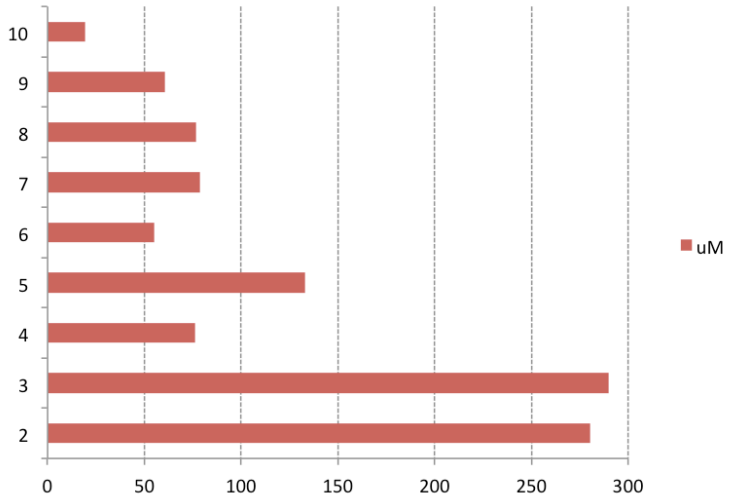

Figure 21. Price-based distribution of the AuM during the boom of the London index A

Figure 22 highlights the non-linear character of the AuM distribution during the London index boom. The AuM graph represents the daily RSI readings above 70. For example, the 3 June (23 May Julian) the RSI was 97.62: it reads on the graph as a 27.62 value; the 8 June the RSI was 84.12: it reads as 14.12, etc. The figure shows different things: a) there were several clusters of AuM distributed all along the boom; b) there was an AuM peak in the early phase (Feb.-Mar.) and another one in the last stage (August) of the boom; c) the bulk of the AuM took place in the middle stage (May-June), at a time when the price was rising extremely fast.

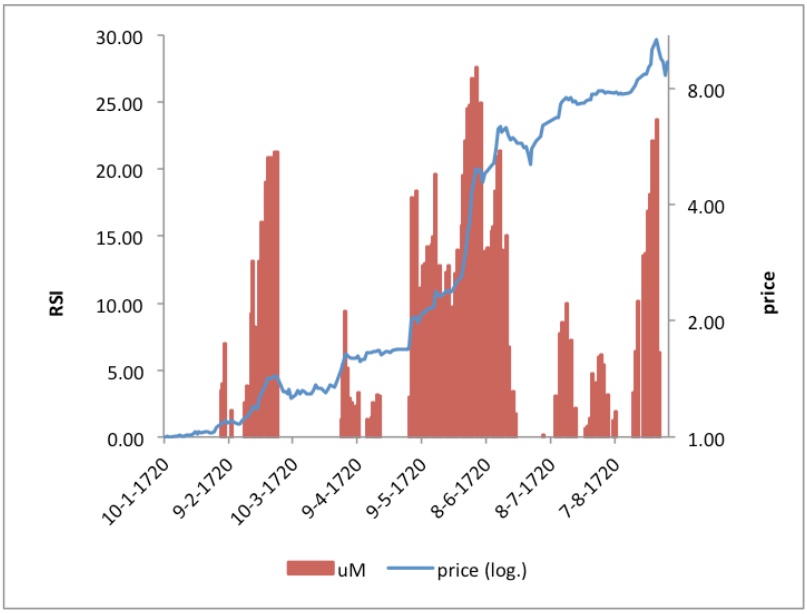

Figure 22. Chronological AuM distribution: boom of the London index A

The marine insurance firms (Figure 23) had a chronological AuM distribution remarkably similar to the London index. The Mississippi Company (Figure 24) presented a comparable picture for the middle and late stage of the boom, but it did not have an analogous AuM cluster in the early phase. By contrast, the South Sea Company (Figure 25) and the BoE (Figure 26) displayed a succession of relatively thinner peaks (rather than massive AuM clusters), with the weight of the AuM located in the penultimate stage of the boom. Yet, in spite of these differences, all these assets followed a comparable pattern: a) several AuM peaks (broad or thin) distributed all along the upward cycle; b) the bulk of the AuM concentrated *before* – and this is the key part – the last leg of the boom. That is to say, all these assets had "consumed" the largest part of their AuM in the months, or at least the weeks preceding the peak in the price. We could multiply the examples: almost all the assets studied in this paper repeated that same distribution. Including the DJIA during the 1920s bubble and the Nasdaq in the dot-com bubble (see below Figure 28 and Figure 29). In fact, there was only one exception to that general pattern: the WIC, which had its AuM heavily clustered towards the last part of the boom (Figure 27).

Interestingly, the sequence displayed by the WIC is approximately what one might have expected according to the well-known Minsky bubble model. The finding that this sequence

appears to be the exception, rather than the norm, opens the way to a reexamination of the Minsky model (see below section 4).

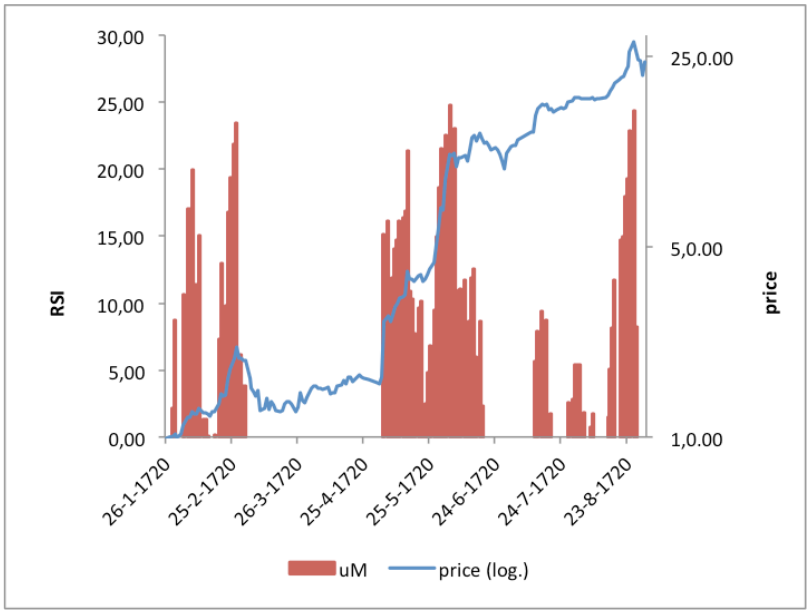

Figure 23. AuM distribution: boom of the two English marine insurance firms

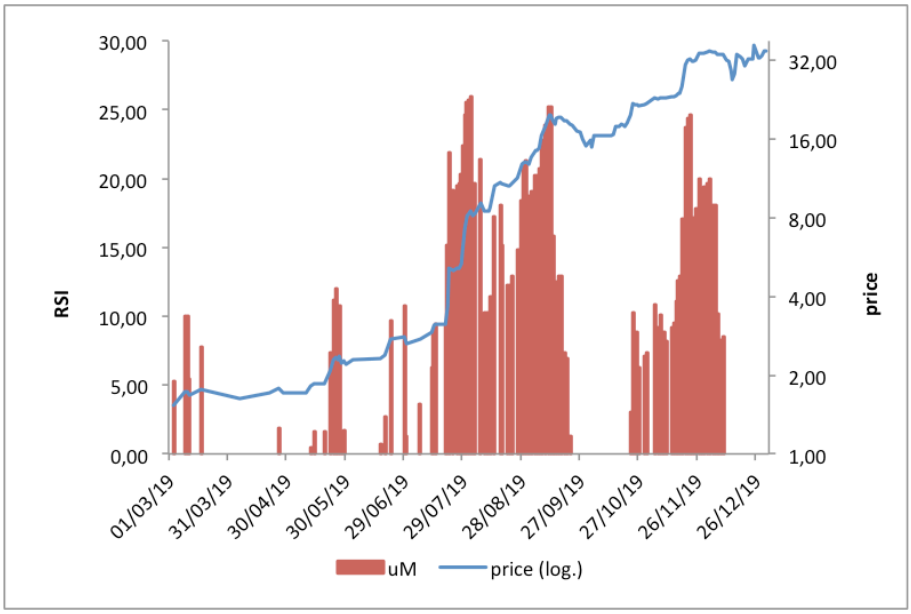

Figure 24. AuM distribution: boom of the Mississippi Company[71]

[71] The central AuM cluster (late Jun.-late Sep. 1719) represents a unique block. The interruptions, visible on the figure, correspond to days without a price quotation (mainly because of religious holydays).

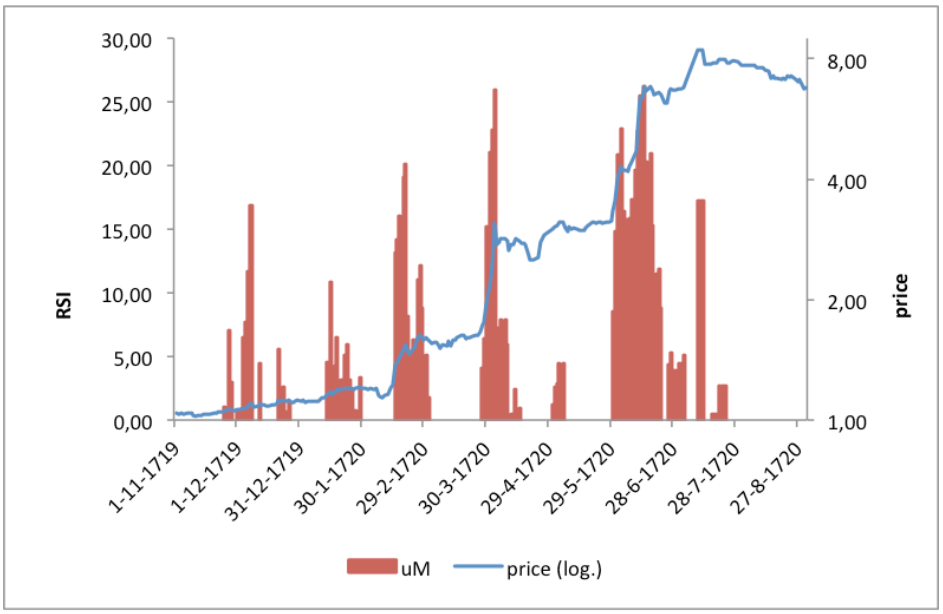

Figure 25. AuM distribution: boom of the South Sea Company

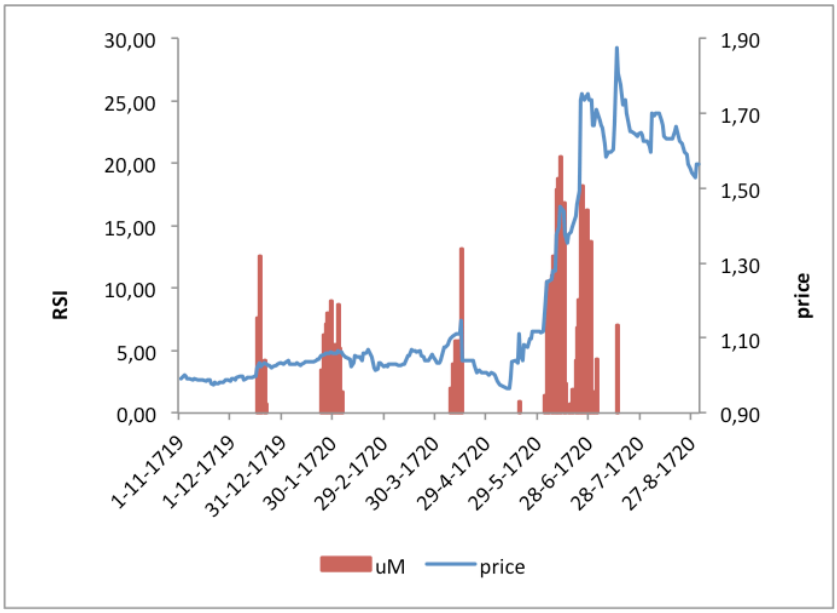

Figure 26. AuM distribution: boom of the BoE

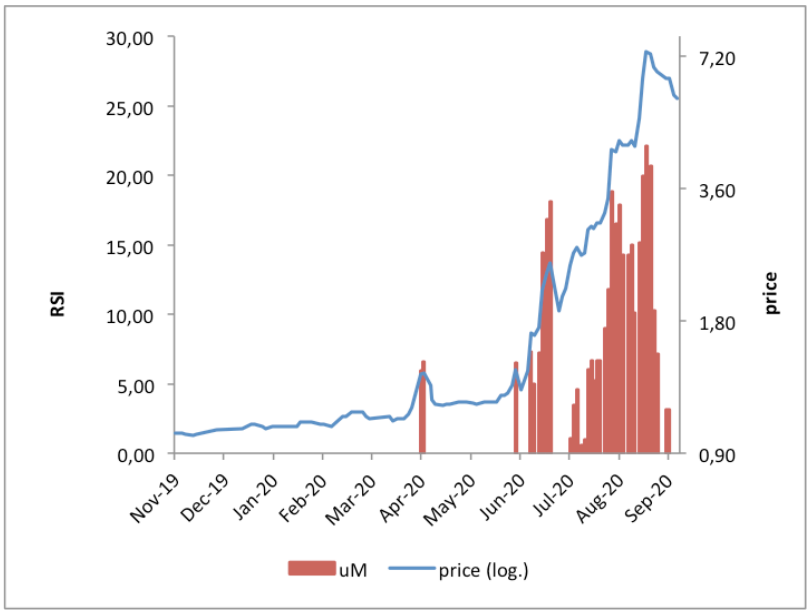

Figure 27. AuM distribution: boom of the WIC

3. Divergence between price and RSI

Bullish and bearish divergences constitute other useful elements to analyze individual assets or to compare them. For technical analysts, a divergence signals a potential market turn; for scholars trying to understand the dynamic of the underlying asset, the divergence represents a question mark. Why did the RSI decline (in the case of a bearish divergence) when the price was rising to all time heights? A possible explanation would be that the divergence resulted from a double movement: 1) "naïve" investors – lured by the booming price – entering the market en masse; 2) well-informed arbitrageurs – having decided to stop riding the boom – taking advantage of the situation to liquidate their positions.[72] The difficulty with this explanation is that bearish divergences did not happen systematically: the Mississippi and South Sea stocks experienced it, for example, but not the WIC or the marine insurance firms.

[72] The role of heterogeneous beliefs and diverse actors in financial bubbles has been investigated by a large literature. See for instance Shleifer, A., *Inefficient markets: An introduction to behavioural finance* (Oxford, 2000); Abreu, D. & Brunnermeier, M. K., "Bubbles and crashes" *Econometrica*, 71, 1 (2003); Xiong, W., "Bubbles, crises, and heterogeneous beliefs", *NBER working paper* (2013).

Table 5. Bearish divergence

Mississippi Company (Paris index)	yes	
South Sea Company	yes	
BoE	yes	
EIC	yes	
Million Bank	yes	
RAC		no
Marine insurance firms		no
London index	yes	
VOC	yes	
WIC		no
Amsterdam index		no
Lisbon on London exch. rate		no
Cadiz on London exch. rate	yes	

Table 6. Bullish divergence

Mississippi Company (Paris index)		no
South Sea Company	yes	
BoE	yes	
EIC	yes	
Million Bank	yes	
RAC	yes	
Marine insurance firms	yes	
London index	yes	
VOC	yes	
WIC	yes	
Amsterdam index	yes	
Lisbon on London exch. rate		no
Cadiz on London exch. rate		no

So, a new question arises: considering that skilled/well-informed traders were roughly the same in all the major 1720 stocks, how come that, in some cases (bearish divergence) they apparently managed to successfully ride the market boom, whereas in other cases the crash apparently took them by surprise? Abreu and Brunnermeier suggests a potential explanation. [73] According to their model, bubbles burst in two different ways: a) for some exogenous reason; b) because of the endogenous selling pressure of arbitrageurs. The second situation requires coordination among a sufficient number of arbitrageurs, a coordination that will not happen if there is no "synchronizing event". The key, therefore, would have been the presence or absence of such an event. When there was none, arbitrageurs could not coordinate their attack; the crash took them by surprise: there was no bearish divergence. By contrast, in those cases where there was

[73] Abreu, D. & Brunnermeier, M. K., "Bubbles", cit.

a synchronizing event, arbitrageurs managed to exert a coordinated selling pressure, which first generated the bearish divergence, and then precipitated the crash. The interesting part would be to understand, for each case, what might have been the triggering event. In the case of the Mississippi Bubble, there was probably a conjunction between two events, both taking place late November 1719: the run on the Royal Bank and the acceleration in the decline of the French currency.[74]

	Bearish divergence
Synchronizing event	yes
No synchronizing event	no

Is there historical evidence supporting the thesis that the double event spurred a coordinated attack on the Mississippi Bubble by rational arbitrageurs? Yes and no. Forbonnais and Du Hautchamp mention that a group of investors (the so-called "réalisateurs") sold their positions around that time.[75] According to other reports, foreigners – and in particular Englishmen – represented a significant percentage of the early "réalisateurs".[76] The sharp decline of the French exchange rate, around that period, is further evidence of capital leaving France. Yet, on the other hand, there is not much archival evidence of English traders actually selling his Mississippi shares in late November or December 1719. Lord Londonderry and sir John Lambert, for instance, were among the first English actors exiting the Parisian market, and they only did that in January 1720, after the price had peaked.[77] By contrast, the duke of Chandos kept most of his Mississippi shares throughout the French crash. This is noteworthy not only because Chandos was a well-informed and seasoned investor, but also because, in the months preceding the burst, he was increasingly sceptical about the sustainability of the Mississippi boom.[78] More generally, if there is some evidence of actors managing to successfully ride the 1719-20 bubbles, there is also plenty of evidence of informed investors unable (or unwilling) to do so.[79]

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[74] About the run on the bank: Faure, E., *La Banqueroute*, cit., pp. 275-276.

[75] Quoted in *ibid*, p. 276.

[76] Among others sources, National Archives, SP 101/120, Paris, 27 November 1719, 18 December 1719; [Pâris-Duverney, J.], *Examen du livre intitulé Reflexions politiques sur les finances et le commerce* (The Hague, 1740), I, p. 314.

[77] British Library, Add ms. 31140, f. 18, February 1720; Neal, L., *"I am not master of events": the speculations of John Law and Lord Londonderry in the Mississippi and South Sea Bubbles* (New Haven, 2012), p. 94.

[78] See, for instance, note 20 above; or Huntington Library, Stowe 57, 16, f. 367, letter to Drummond, 8 November 1719.

[79] See for instance Temin, P. & Voth, H. J., "Riding the South Sea Bubble", *American Economic Review*, 94, 5 (2004); Frehen, R. G .P., *et al*, "New evidence", cit.; Kleer, R. A., "Riding a wave: the Company's role in the South Sea Bubble", *The Economic History Review*, 68, 1 (2015); Yamamoto, K., "Beyond Rational vs Irrational Bubbles: James Brydges the First Duke of Chandos during the South Sea Bubble", in G. Nigro (ed.), *Le crisi finanziarie: gestione, implicazioni sociali e conseguenze nell'età preindustriale* (Firenze, 2016).

It makes sense to consider that bullish divergence resulted from an opposite dynamic compared to bearish divergence: 1) "naïve" investors capitulating and selling their positions; 2) arbitrageurs selectively "bottom fishing" stocks that appeared to have become cheap. For example, early November 1720, the duke of Chandos purchased EIC stock, declaring that he felt it had reached a low and that, with its 10 per cent "constant dividend", it was a good buy.[80]

From a comparative perspective, it is interesting to see which were, among the English stocks analyzed here, those that first experienced a reversal in their downward momentum. Their prices bottomed out around the same time (13-17 Dec. 1720 Julian),[81] but not their respective RSIs. One might have expected that, in the aftermath of the great crash, investors shunned the most speculative stocks, and that they "bottom fished" the two great moneyed companies, the BoE and the EIC, which seemed to have the most stable business prospects. Yet, the opposite was true: the stocks that had risen the most during the boom – the marine insurance firms and the RAC – were the first to see their RSI find a bottom (19 and 21 Sep. 1720 respectively). The EIC was next (22 Sep.), followed by the beleaguered South Sea Company (28 Sep.), while the BoE bottomed out more than two weeks later (15 Oct.) What is more, the RSI of the BoE reached a lower low (6.17 vs. 11.98) compared to the South Sea.

There is a plausible explanation to this paradox. The government was then trying to broker a deal between the BoE and the South Sea (the famous "Bank contract") that should have helped rescue the latter.[82] The divergence in momentum suggests that investors viewed the contract as more beneficial to the South Sea than to the Bank. Indeed, investors disliked the "contract" so much, that the Bank entered a downward SMLV the day after it opened its books (24 Sep.) to raise £3 million in new equities in order to finance the rescue operation.[83] It is noteworthy that the Bank's RSI bottomed out the very day when the subscriptions books were closed (15 Oct.) Evidently, investors were relieved by the fact that the capital call was not fully subscribed (only £2,281,000 were raised), which meant that the BoE would not be able to rescue the company as promised in the contract. By contrast, this was not good news for the South Sea, and its RSI fell accordingly. Yet – for reasons that would need to be better understood – the South Sea's RSI did not collapse below the September lows and the upward momentum trend was thus not broken.

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[80] Letter to Richard Cantillon. Quoted in Murphy, A. E., *Richard Cantillon: Entrepreneur and Economist* (Oxford, 1986), p. 183. Yet, "bottom fishers" were possibly also driven by motives more complex than simply a cheap price. See in particular L. Neal, *The rise of financial capitalism*, cit. pp. 114-115 convincing hypothesis about Dutch investments in BoE stock in autumn 1720.

[81] With the exception of the RAC (whose price bottomed out already the 17 Nov. 1720) and the Million Bank (whose price and RSI were still falling at the end of Dec. 1720).

[82] On the "Bank contract": Dickson, P. G. M., *The financial revolution*, cit.; Clapham, J. H., *The Bank of England*, cit.

[83] Another ominous event happened the 24 September: the Sword Blade Company (the South Sea Company's banking affiliate) ceased payments. The directors of the Bank of England immediately interpreted this as the beginning of a general liquidity crisis. See Neal, L. *The rise of financial capitalism*, cit. p. 115.

4. A critique of Minsky-Kindleberger notion of "euphoria"

[This section is also very incomplete]

Does the presence of a SMLV constitute a clear indicator that a market boom or crash is underway?[84] Yes in the case of 1719-20 equity markets, and probably yes in many other markets as well. This hypothesis, however, would need to be tested systematically, across markets and centuries, to see whether: a) there may be examples of booms or crashes without a SMLV; or b) SMLVs without a boom or crash. The latter seems particularly implausible. A SMLV is by definition the result of an extremely strong trend, and it is difficult to imagine that such a trend would fail to generate a boom on the upside, or a crash on the downside. In particular, because SMLVs often do not come alone, but tend to be followed (in the next weeks or months) by other SMLVs.[85] Anyhow, a SMLV is certainly consistent with a market boom or a market bust.

Table 7. SMLV

Mississippi Company (Paris index)	yes	
South Sea Company	yes	
BoE	yes	
EIC	yes	
Million Bank	yes	
Marine insurance firms	yes	
London index	yes	
VOC	yes	
WIC	yes	
Amsterdam index	yes	
Lisbon on London exch. rate	yes	
Cadiz on London exch. rate		no

To what extent an upward SMLV corresponds to the "euphoria" stage described in the Minsky-Kindleberger model? As it is well know, that famed model posits that financial crisis – in particular, market bubbles – follow a general pattern in several stages: they are set in motion by some "displacement" (an exogenous shock); they morph into a boom, and eventually into a period of euphoria; and they end with a crash, or at least a period of "financial distress".[86]

[84] The answer depends, of course, on the definition of those two terms. One of the most commonly-used definitions – considering boom and crash synonyms of "bull" and "bear" markets – is the price surging (or declining) more than 20%. See for instance Pagan, A. R. & Sossounov, K. A. "A simple framework for analysing bull and bear markets", *Journal of Applied Econometrics*, 18, 1 (2003); Ritholtz, B., "How to Spot a Bull or Bear Market", *Bloomberg* (August 14, 2017).

[85] See examples above.

[86] Minsky, H. P., "The Financial Instability Hypothesis: Capitalistic Processes and the Behavior of the Economy" (Cambridge, 1982); Id., *Can "It" Happen Again? Essays on Instability and Finance* (London, 2016) [1982]; Kindleberger, C. P. & Aliber, R. Z., *Manias, Panics and Crashes* (Basingstoke, 2015) [1978].

Kindleberger explicitly connected the notion of euphoria to the "speculative overtrading" concept used by classical economists. He underlined that "speculative overtrading" was in fact the last phase of the euphoria sequence, that is to say the very last leg of the boom, before it turned into what he called "convulsion" and "revulsion".[87] The "overtrading" concept came from Adam Smith. Kindleberger noted that it was "less than precise" and that it included speculation, overestimation of prospective returns, and excessive leverage.[88] I would personally argue that, for the classical economists, "overtrading" meant fundamentally a temporary "excess" of demand: not so much too much *trading*, but rather too many *traders*, in the sense of too many *buyers*.[89] It would be perhaps clearer, therefore, to talk about "overbuying" instead of "overtrading". Be as it may, this leads us back to our question. Indeed, "overbuying" bears many obvious similarities with the RSI concept of "overbought", and even more so with the notion of an extended period of "overboughtness". So, to some extent, there is a parallel between upward SMLV and the Minsky-Kindleberger's concept of euphoria.

There is, however, a crucial difference. According to the Minsky-Kindleberger model, euphoria is the last stage of the boom.[90] By contrast, empirical evidence shows that upward SMLV does not necessarily take place at the end. On the contrary, the evidence underlines that uSMLVs happen in different moments of the boom, including its early stage. The Mississippi stock went through its first uSMLV (Mar. 1719) while the price was still under par, and nine months before it peaked. The South Sea Company's first uSMLV (Jan. 1720) occurred five months before the peak.

Moreover, we have underlined above (section III.3) the non-linear character of AuM distributions. The bulk of the upward momentum of the London index, the marine insurance firms, and the Mississippi Company occurred in the middle stage of the boom (Figure 22, Figure 23, Figure 24). The South Sea Company and BoE displayed several AuM peaks distributed all along the cycle (Figure 25 and Figure 26). And it is noteworthy that the two most famous bubbles of the 20th century – the 1929 and dot-com bubbles – also exhibited that same pattern (Figure 28 and Figure 29).

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[87] Kindleberger, C. P. & Aliber, R. Z., *Manias, Panics and Crashes* (Basingstoke, 2015) [1978], p. 90 quoting the XIXth-century banker lord Overstone.

[88] Kindleberger, *Manias,* cit., p. 28.

[89] See for instance Smith A., *An Inquiry into the Nature and Causes of the Wealth of Nations*, The Glasgow Edition, 1979, (reprint Indianapolis, 1981) [1776], vol. I, pp. 438, 442. See also Mill, J. S., *Principles of Political Economy, with some of their Application to Social Philosophy* (Toronto, 1965) [1848] vol. III, p. 645 about the notion of "excess" demand, and p. 657 about "undue extension of credit".

[90] Kindleberger, *Manias,* cit., pp. 94-98, describes a phase called "distress", characterized by a loss of confidence when the market is at the top. For him, distress takes place after the euphoria phase, but also *after* the peak in the price. He writes: "The end of a period of rising prices for assets leads to distress whenever a significant number of investors have based their purchases of these assets on the anticipation that their prices will continue to increase." (p. 97). Distress appears thus different from the divergence between price and RSI that we analyze here.

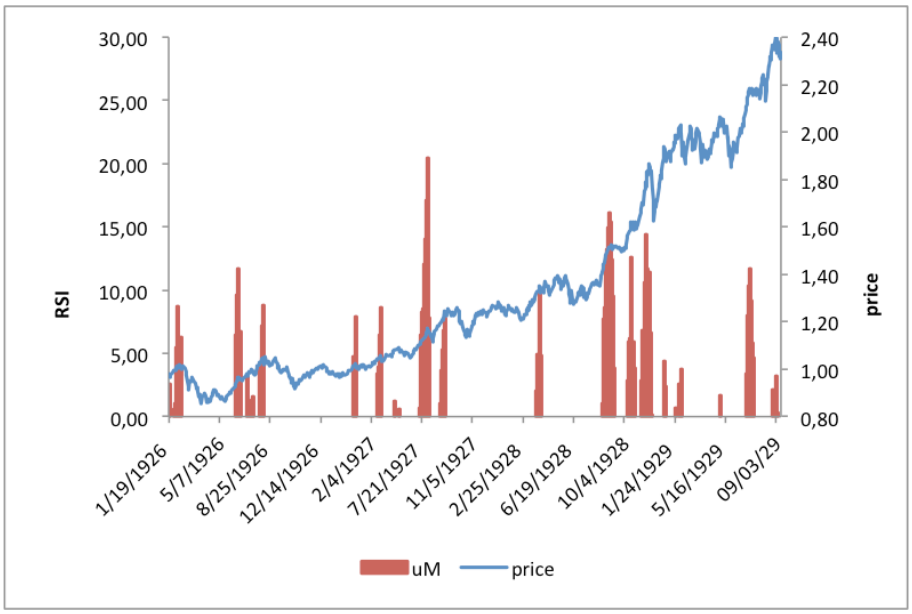

Figure 28. AuM distribution: the 1929 bubble

Dow Jones Industrial Average (Jan. 1926-Sep. 1929)

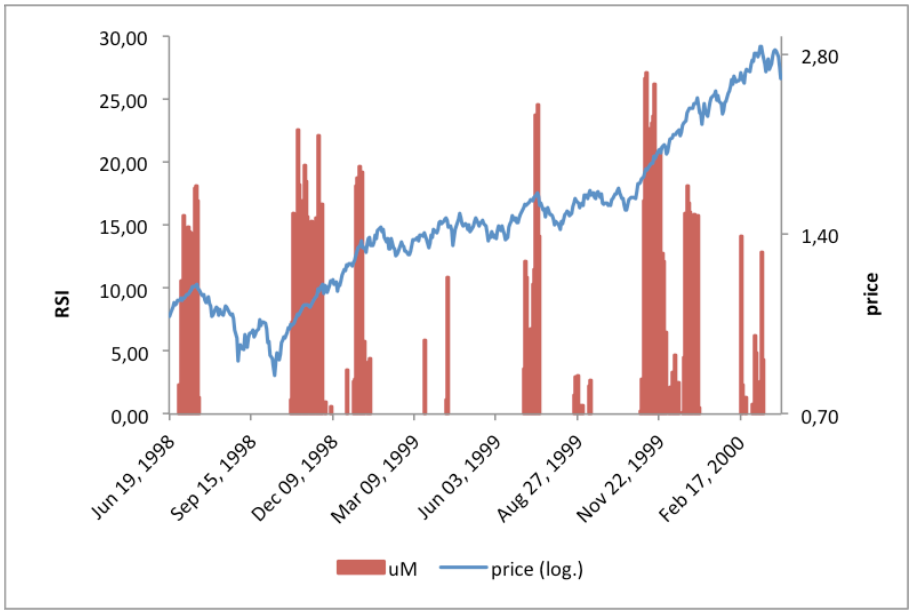

Figure 29. AuM distribution: dot-com bubble

Nasdaq Composite (June 1998- March 2000)

I have found only one case where the upward momentum distribution seems consistent (at least to some extent) with the Minsky-Kindleberger model: the WIC with its AuM predominantly concentrated in the last stage of the boom (Figure 27). A hypothetical AuM distribution graph entirely consistent with that model would presumably evoke some sort of rock of Gibraltar. That is to say, a graph displaying price and AuM increasing in parallel, at first progressively, then

possibly exponentially, until their synchronous apex, and synchronous downfall. It is not excluded that some assets might have followed the said distribution. Yet, overwhelming evidence suggests that the said "Gibraltar pattern" is not the general rule, and that it would be at best an exception.

The general tendency (that needs to be confirmed with further research) appears to be what we may call the "medieval town" or "forest" pattern. Namely, several AuM peaks – distributed all along the upward cycle – reminding the skyline of a towered settlement, or a small forest with trees tall and tiny, large and thin. This town/forest pattern has two main variants. In the first one, the bulk of the AuM is predominantly situated in the middle stage of the boom. See for example the London index, the marine insurance firms, the Mississippi Company, or the 1929 bubble (Figure 22, Figure 23, Figure 24, Figure 28). In the second variant, the mass of the AuM mostly happens in the penultimate stage of the boom (i.e. some weeks, or months before the apex in the price). See for example the South Sea Company, the BoE, or the dot-com bubble (Figure 25, Figure 26, Figure 29). The difference between these two distributions, however, is not always clear-cut. What is unequivocal, though, is that the "medieval town" pattern, whatever its variant, does not support the Minsky-Kindleberger concept of euphoria.

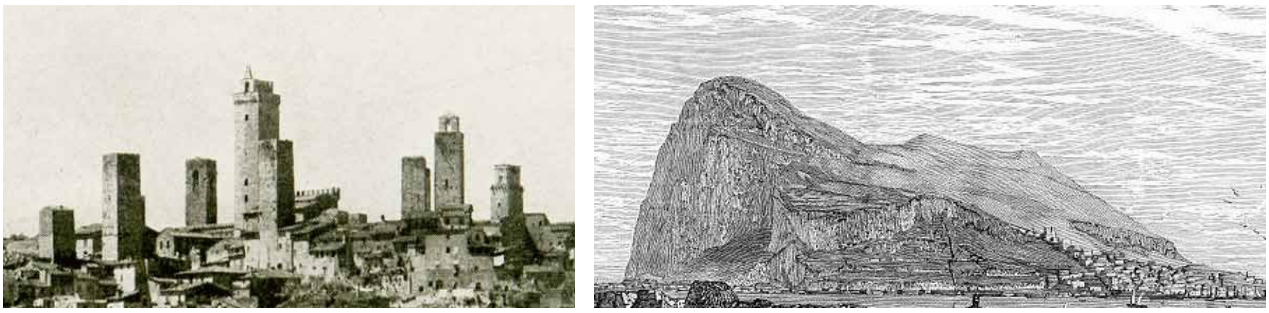

Figure 30. Two quite different patterns/skylines: medieval town[91] vs. Gibraltar

Furthermore, the very notion of divergence between price and RSI (see above) highlights that there is a tendency for "overbuying" to abate before the price reaches the summit. In other words, the very last leg of the boom does not always coincide with an upward SMLV. Sometimes it does coincide, such as in the case of the Amsterdam index in August 1720. Quite often, it does not. The last uSMLV of the Mississippi ended the 9 December 1719, whereas the price peaked the 25 December, more than two weeks later. The last uSMLV of the dot-com bubble (i.e. the Nasdaq) ended the 3 January 2000, more than two months before the top in the price (10 March). In fact, discrepancy between price and RSI appears to be much more common than coincidence between uSMLV and price peak.

[91] The town represented in the image is San Gimignano (Italy).

Divergence between price and RSI is counterintuitive and thus especially interesting. It would make sense to think that euphoria is the "force" that propels a stock towards its apex. Momentum analysis, however, shows that in reality markets often do not work like that. We have even seen that some stocks – in particular the Mississippi Company – reached the top in their price with a RSI below 70. In other words, not only the Mississippi share was not in an upward SMLV, but it had also entered a period of weak momentum: something certainly not consistent with Minsky's notion of euphoria. Weak momentum may have reflected circumspection or indecision among market participants; it was probably also the consequence of foreign speculators leaving Paris; yet it is noteworthy that it did not prevent the stock to jump to its all-time high.

In sum, Minsky's thesis about euphoria is not supported by empirical evidence, and it is even fundamentally contradicted by it.

5. A uSMLV-based definition of "euphoria"

The problem is not the notion of euphoria itself – it is a fundamental concept in bubble studies – but rather its problematic definition in the Minsky-Kindleberger model. A useful definition of euphoria needs: a) to be consistent with empirical evidence; and b) to be quantifiable, in order to allow precise comparisons between different asset bubbles. Our study offers a possible definition along these lines. Considering that euphoria is an uncommon phenomenon that manifests itself as a sustained upward pressure on the price – and therefore as a prolonged period of upward momentum – we may posit that an uSMLV would be, indeed, a good indicator of euphoria. That is to say, we may rule out that euphoria is happening unless the RSI has spent more than 15 consecutive trading days in "overbought" territory.

Tt is important to note that the choice of the number of days defining a SMLV is subjective, at least to some extent. As detailed above (section I-2), the 15 days threshold seems a good compromise: it corresponds to a relatively infrequent situation (only 42 occurrences for the Dow Jones Industrial Average from 1896 to 2018), but not so rare as to become irrelevant. Needless to say, there is nothing dogmatic about the number 15, and 14 or 16 days would probably work just as fine. The fundamental element is the notion that euphoria is characterised by an extended period of strong momentum with low volatility, and the fact that SMLVs appear to be relatively rare events.

According to our definition, euphoria – as we have shown – can take place in different moments of a boom. The South Sea Company, for instance, went through five so-defined periods of "euphoria" in 1720, the longest period taking place in May-June (Figure 31).[92] The graph simply labels "euphoria" the five uSMLV. The process is so straightforward that there is probably no need to add further examples.

[92] The fifth period of euphoria, in July, appears discontinuous on the chart. This is because there was no quotation for some days (13-16 July).

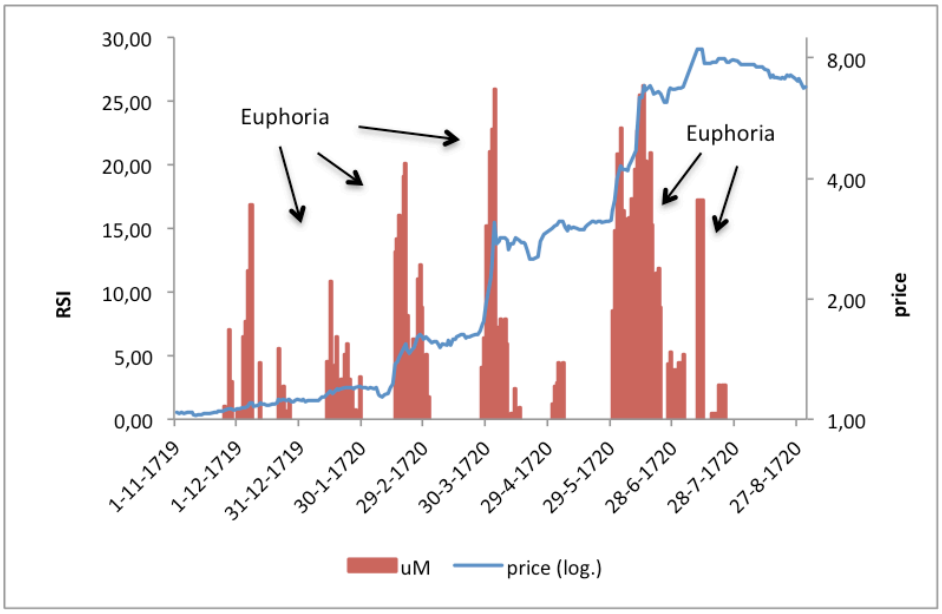

Figure 31. Five phases of "euphoria" (uSMLV-based definition) of the South Sea Company

5. Momentum and the spreading of the 1720 equity booms

[This section is also very incomplete]

The last consideration of the paper relates to the mechanism that would explain why equity booms spread from one country to the other in 1719-20. My hypothesis, drawn from the theory developed by Caginalp *et al.*, is that undervaluation played a role in this diffusion mechanism. The idea is that the RSI is a better tool than price to investigate this hypothesis.

Caginalp *et al.* have shown, with experimental asset markets, that a large initial undervaluation, in the context of excess cash, motivates traders to buy due to fundamental considerations; the new trend becomes robust as trending traders are drawn in, and this sets in motion an asset bubble.[93] According to the authors, the size of the bubble is an increasing function of the extent of undervaluation at the outset.

Initial undervaluation (compared to the market capitalization of the South Sea Company or the EIC) and excess cash were definitely two elements present at the onset of the Mississippi Bubble. As the price of the Mississippi Company skyrocketed, the English companies became undervalued in relative terms. Contemporaries considered the stream of revenues or dividends

[93] Caginalp, G., Porter, D., & Smith, V., "Momentum and overreaction in experimental asset markets", *International Journal of industrial Organization*, 18, 1 (2000); Id. "Overreaction, momentum, liquidity, and price bubbles in laboratory and field asset markets", *SSRN papers* (2000); Id. "Financial bubbles: Excess cash, momentum, and incomplete information", *The Journal of Psychology and Financial Markets*, 2, 2 (2001).

(what they called "intrinsick value") to estimate the valuation of a company.[94] Yet, there is plenty of evidence that, in practice, they also considered relative valuation (i.e. valuation versus a peer group).[95] Even today, this is the type of valuation most used by practitioners.[96] Following Caginalp's model, the undervaluation, in relative terms, of the English companies would have become the cause of the following English bubble. Figure 32 shows that the RSI of the South Sea Company entered overbought territory at a time when it was indeed highly undervalued relative to the Mississippi Company: the market capitalization (converted in £) of the latter was more than ten times larger.

It seems plausible that, around 1720, London was particularly attentive to what was happening in Paris (mainly because France and Britain were then the two major powers in Europe), whereas Amsterdam was probably more attentive to what happened in London (mainly because it appears that the Dutch considered that the EIC represented a more serious threat for the East India trade, compared to the French East India company). Thus, it is possible that investors perceived that the VOC was undervalued only once the EIC started to boom. Interestingly, Figure 33 seems to confirm this hypothesis: the RSI of the VOC spiked very rapidly after the change in market capitalization (converted in £) relative to the EIC. Likewise, once the WIC started to be involved with marine insurance (from April 1720), its RSI closely trailed the boom of the English marine insurance firms (Figure 34). The other Dutch marine insurance companies (such as Stad Rotterdam) and their Hamburg peers presumably followed the same trajectory.

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[94] E.g. *An estimate of the intrinsick value of the South Sea stock* (London? 1720). About equity valuation in 1720, see Harrison, P, "Rational Equity Valuation at the Time of the South Sea Bubble", *History of Political Economy*, 33, 2 (2001); Deringer, W., "For What It's Worth: Historical Financial Bubbles and the Boundaries of Economic Rationality", *Isis*, 106, 3 (2015).

[95] See for instance, National Archives, SP 101/68, f. 103; SP 78/164, f. 415; Savary, J., *Le parfait negociant* (Paris, 1721), vol. I, partie II, pp. 225-226.

[96] Pinto, J.E. *et al.*, "Equity valuation: a survey of professional practice", SSRN papers (2015); Rossi, E. & Forte, G., *Assessing Relative Valuation in Equity Markets: Bridging Research and Practice.* (London, 2016).

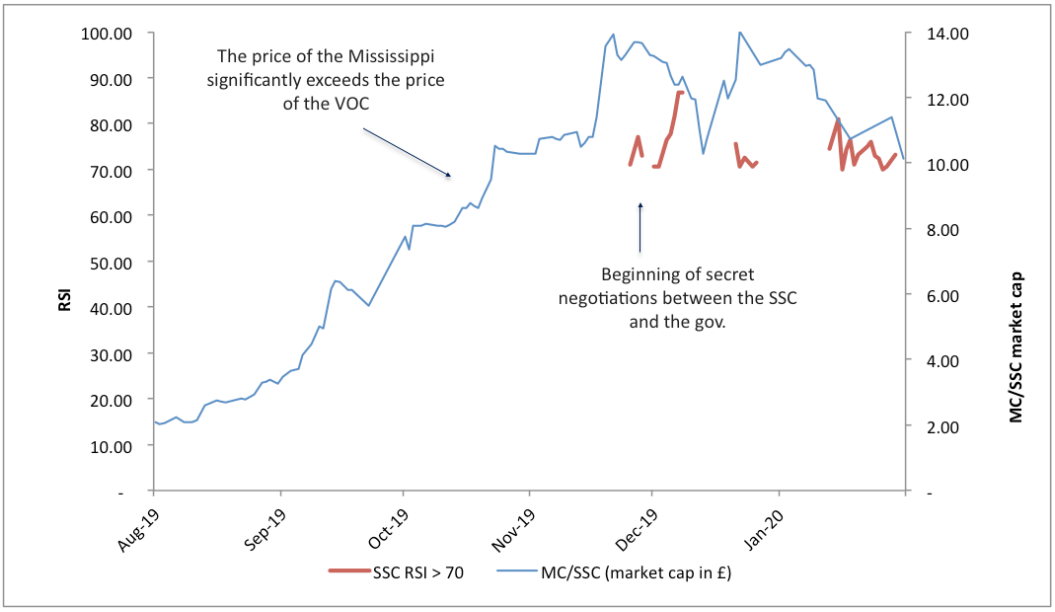

Figure 32. Was the spike in the South Sea's RSI related to the undervaluation of the firm?

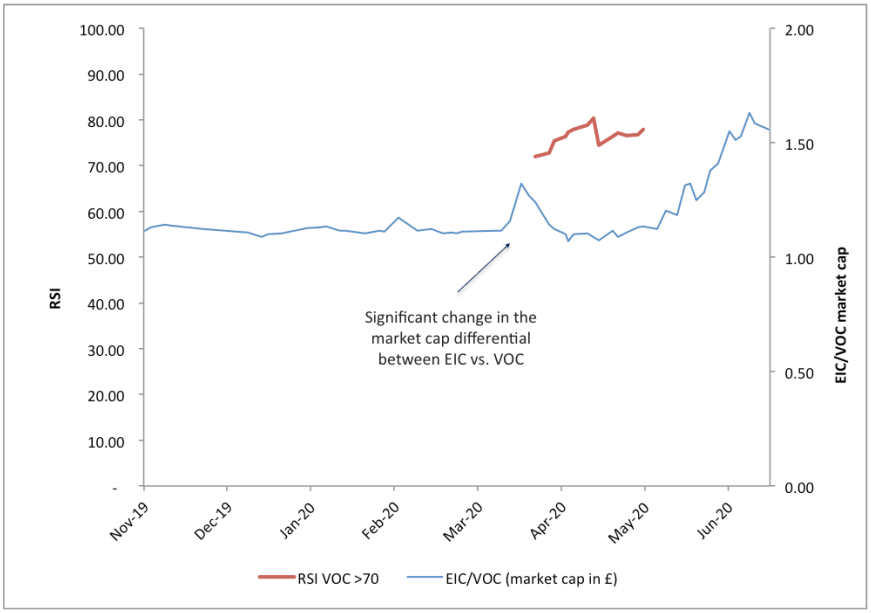

Figure 33. Did the VOC's RSI respond to the spike in the market cap differential vs. the EIC?

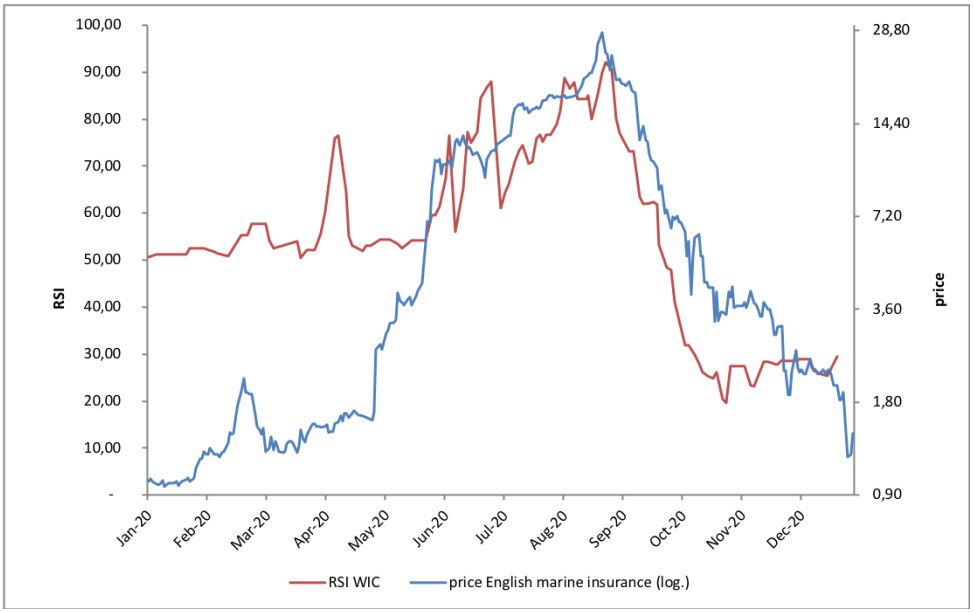

Figure 34. The WIC's RSI trailing the boom of the English marine firms (after April 1720)

Conclusion:

The model presented in these pages is still a work in progress, but it already enables us to achieve some tangible results. We have analysed around twenty assets, from different asset classes (equities, foreign exchange), countries (France, Britain, United States, etc.) and centuries (18th and 20th century), and we have consistently generated fully comparable results. We have applied the model in two directions: a) comparison and b) thorough investigation of the behaviour of single assets. Both directions have generated interesting insights. To give just one example of each approach: we saw that the comparison of the VOC and WIC's upward and downward momentum does not support the traditional thesis that the price of the latter had been manipulated; we also saw that the spike in the RSI of the South Sea indicates that the market instantly and enthusiastically reacted to the beginning of the secret talks between the firm and the British government (14 November 1719). The third direction that we explored was to combine momentum analysis with other theoretical works: Abreu and Brunnermeier's model about "synchronizing events" helped us understand why some stocks had gone through a "bearish divergence"; Caginalp *et al.*'s studies about experimental markets gave us a key to formulate a hypothesis about the sequence of the 1719-20 equity booms.

Overall, the paper yields two main outcomes. On the one hand, it sheds new light on the 1719-20 bubbles. On the other hand, it demonstrates that the overwhelming empirical evidence does not support – and even fundamentally contradicts – Minsky-Kindleberger's notion of "euphoria". The paper thus proposes a different definition of euphoria – quantifiable and consistent with empirical evidence – that is based on the notion of uSMLV.

References

ARCHIVES

Britain: British Library, Coutts Archives, National Archives.
United States: Huntington Library.

CONTEMPORARY NEWSPAPERS

Austria: *Corriere di Vienna.*
Britain: *Course of the Exchange*, *Daily Post.*
France: *La Gazette, Nouveau Mercure.*
Netherlands: *Courrier politique, Gazette d'Amsterdam, Gazette de Leyde, Lettres historiques, Leydse courant.*

PUBLISHED PRIMARY SOURCES

An estimate of the intrinsick value of the South Sea stock (London?, 1720).

[Blunt, J.], *A true state of the South Sea Scheme* (London, 1720).

Buvat, J., *Journal de la régence*, ed. Campardon (Paris, 1865).

Dangeau, P. de Courcillon, marquis de, *Journal du marquis de Dangeau*, ed. Soulié-Dussieux (Paris, 1860).

[Pâris-Duverney, J.], *Examen du livre intitulé Reflexions politiques sur les finances et le commerce* (The Hague, 1740).

Forbonnais, F. V. Duverger de, *Recherches et considérations sur les finances de France* (Bâle, 1758).

Hautchamp, B. Marmont du, *Histoire du système des finances, sous la minorité de Louis XV* (La Haye, 1739).

Savary, J., *Le parfait negociant* (Paris, 1721).

SECONDARY SOURCES

FGR 1720 price database: compiled by Frehen, R. G. P., W. N. Goetzmann & K. G. Rouwenhorst, 'New evidence on the first financial bubble', *NBER working paper* (2011).

Abreu, D. & Brunnermeier, M. K., "Bubbles and crashes", *Econometrica,* 71, 1 (2003).

Anderson, B. & Li, S., "An investigation of the relative strength index", *Banks and Bank Systems*, 10, 1 (2015).

Balvers, R. J. & Wu, Y., "Momentum and mean reversion across national equity markets", *Journal of Empirical Finance*, 13, 1 (2006).

Barberis, N., Shleifer, A. & Vishny, R, "A model of investor sentiment", *Journal of financial economics*, 49, 3 (1998).

Biondo, A. E., Pluchino, A., Rapisarda, A. & Helbing, D., "Are random trading strategies more successful than technical ones?", *PloS one*, 8, 1 (2013).

Brown, C., *Technical analysis for the trading professional: Strategies and techniques for today's turbulent global financial markets* (New York, 2011).

Caginalp, G., Porter, D., & Smith, V., "Momentum and overreaction in experimental asset markets", International Journal of industrial Organization, 18, 1 (2000).

– "Overreaction, momentum, liquidity, and price bubbles in laboratory and field asset markets", *SSRN papers* (2000).

– "Financial bubbles: Excess cash, momentum, and incomplete information", The Journal of Psychology and Financial Markets, 2, 2 (2001).

Carswell, J., *The South Sea Bubble* (London, 1960).

Chen, H, Chong T.T.L. & Duan X, "A principal-component approach to measuring investor sentiment", *Quantitative Finance*, 10, 4, (2010).

Clapham, J. H., *The Bank of England: a history (1694-1797)* (Cambridge, 1958).

Condorelli, S., "The 1719-20 stock euphoria: a pan-European perspective", *MPRA Paper* (2016).

Cootner, P. H., *The random character of stock market prices* (Cambridge MA, 1964).

Crombez, J., "Momentum, rational agents and efficient markets", *The Journal of Psychology and Financial Markets*, 2, 4 (2001).

Deringer, W., "For What It's Worth: Historical Financial Bubbles and the Boundaries of Economic Rationality", *Isis*, 106, 3 (2015).

Dickson, P. G. M., *The financial revolution in England: a study in the development of public credit 1688–1756* (London, 1967).

Di Lorenzo, R., *Basic Technical Analysis of Financial Markets* (New York, 2013).

Fama, E. F., "Two pillars of asset pricing", *American Economic Review*, 104, 6 (2014).

FGR 1720 price database: compiled by Frehen, R. G. P., Goetzmann, W. N. & Rouwenhorst, K. G., "New evidence on the first financial bubble", working paper (2011).

Faure, E., *La banqueroute de Law : 17 juillet 1720* (Paris, 1977).

Frehen, R. G. P., Goetzmann, W. N. & Rouwenhorst, K. G., "New evidence on the first financial bubble", *Journal of Financial Economics*, 108 (2013).

Gelderblom, O. & Jonker, J., "Mirroring different follies. The character of the 1720 Bubble in the Dutch Republic", in C. Labio, W. N. Goetzmann, K. G. Rouwenhorst & T. Young (eds), *The "Great Mirror of Folly": Finance, Culture, and the Crash of 1720* (New Haven, 2013).

Goetzmann, W. N., "Bubble Investing: Learning from History", in Chambers, D. & Dimson, E. (eds.), *Financial Market History: Reflections on the Past for Investors Today* (Charlottesville, 2016).

Harrison, P, "Rational Equity Valuation at the Time of the South Sea Bubble", *History of Political Economy*, 33, 2 (2001).

Hudson, R., McGroarty, F. & Urquhart, A., "Sampling frequency and the performance of different types of technical trading rules", *Finance Research Letters* (2017).

Jegadeesh, N. & Titman, S., "Returns to buying winners and selling losers: Implications for stock market efficiency", *The Journal of finance*, 48, 1 (1993).

Kim, T. & Ha, N., "Investor sentiment and market anomalies", SSRN Working Paper, (2010).

Kindleberger, C. P. & Aliber, R. Z., *Manias, Panics and Crashes. A History of Financial Crises* (Basingstoke, 2015) [1978].

Kleer, R. A., "Riding a wave: The Company's role in the South Sea Bubble", *The Economic History Review*, 68, 1 (2015).

Koudjis, P., "The boats that did not sail: Asset price volatility in a natural experiment", *The Journal of Finance*, 71, 3 (2016).

Lan, Y. W., Lin, D. & Lin, L., "The Stock Investment Strategy at Company Acquisition", *International Journal of Management Science and Business Administration*, 2 (3), (2016).

Levasseur, E., *Recherches historiques sur le système de Law* (Paris, 1854).

Malkiel, B. G., *A random walk down Wall Street* (New York, 1973).

Mill, J. S., *Principles of Political Economy, with some of their Application to Social Philosophy* (Toronto, 1965) [1848]

Minsky, H. P., "The Financial Instability Hypothesis: Capitalistic Processes and the Behavior of the Economy", in C. P. Kindleberger & J.-P. Laffargue (eds.), *Financial Crises: Theory, History, and Policy* (Cambridge, 1982).

– *Can "It" Happen Again? Essays on Instability and Finance* (London, 2016) [1982].

Murphy, A. E., *Richard Cantillon: Entrepreneur and Economist* (Oxford, 1986).

Murphy, J. J., *Technical Analysis of the Financial Markets* (New York, 1999).

Neal, L., *The rise of financial capitalism: international capital markets in the age of reason* (Cambridge, 1990).

– *"I am not master of events". The speculations of John Law and Lord Londonderry in the Mississippi and South Sea Bubbles* (New Haven, 2012).

Pagan, A. R. & Sossounov, K. A., "A simple framework for analysing bull and bear markets", *Journal of Applied Econometrics*, 18, 1 (2003).

Pinto, J.E., Robinson, T.R. & Stowe, J.D., "Equity valuation: a survey of professional practice", *SSRN papers* (2015).

Ritholtz, B., "How to Spot a Bull or Bear Market", *Bloomberg* (August 14, 2017).

Rossi, E. & Forte, G., *Assessing Relative Valuation in Equity Markets: Bridging Research and Practice*. (London, 2016).

Scott, W. R., *The constitution and finance of English, Scottish, and Irish joint-stock companies to 1720*, 3 vols. (Cambridge, 1910-12).

Shiller, R. J., "Speculative asset prices", *American Economic Review*, 104, 6 (2014).

Shleifer, A., *Inefficient markets: An introduction to behavioural finance* (Oxford, 2000).

Smith A., *An Inquiry into the Nature and Causes of the Wealth of Nations*, The Glasgow Edition 1979, (reprint Indianapolis, 1981) [1776].

Stringham, E., "The extralegal development of securities trading in seventeenth-century Amsterdam", *The Quarterly Review of Economics and Finance*, 43, 2 (2003).

Temin, P. & Voth, H. J., "Riding the south sea bubble", *American Economic Review*, 94, 5 (2004).

Tooke T., *Considerations on the State of Currency* (London, 1826).

Velde, F., "Government Equity and Money: John Law's System in 1720 France", *Federal Reserve Bank of Chicago working paper*s (2004).

White, E. N., "Bubbles and Busts: The 1990s in the Mirror of the 1920s", *NBER working papers*, 2006;

– "The Fundamental Things Apply: How to Face Up to Asset Market Bubbles", in Chambers, D. & Dimson, E. (eds.), *Financial Market History: Reflections on the Past for Investors Today* (Charlottesville, 2016).

Wilder, J. W., *New concepts in technical trading systems* (Greensboro, 1978).

Xiong, W., "Bubbles, crises, and heterogeneous beliefs", *NBER working paper* (2013).

Yang, C. & Zhou, L., "Investor trading behavior, investor sentiment and asset prices", *The North American Journal of Economics and Finance*, 34 (2015).

Yamamoto, K., "Beyond Rational vs Irrational Bubbles: James Brydges the First Duke of Chandos during the South Sea Bubble", in G. Nigro (ed.), *Le crisi finanziarie: gestione, implicazioni sociali e conseguenze nell'età preindustriale* (Firenze, 2016).

Zhang, X., Hu, Y., Xie, K., Zhang, W., Su, L. & Liu, M., "An evolutionary trend reversion model for stock trading rule discovery", *Knowledge-Based Systems*, 79, (2015).