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RIDING THE SOUTH SEA BUBBLE

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Riding the South Sea Bubble*

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ABSTRACT: This paper presents a case study of a well-informed investor in the South Sea bubble. We argue that Hoare's Bank, a fledgling West End London banker, knew that a bubble was in progress and that it invested knowingly in the bubble; it was profitable to "ride the bubble." Using a unique dataset on daily trades, we show that this sophisticated investor was not constrained by institutional factors such as restrictions on short sales or agency problems. Instead, this study demonstrates that predictable investor sentiment can prevent attacks on a bubble; rational investors may only attack when some coordinating event promotes joint action.

KEYWORDS: Bubbles, Crashes, Synchronization Risk, Predictability, Investor Sentiment, South Sea Bubble, Market Timing, Limits to Arbitrage, Efficient Market Hypothesis.

JEL CODE: G14, G12, N23

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I. Introduction

What allows asset price bubbles to inflate? The recent rise and fall of technology stocks has led many to argue that wide swings in asset prices are largely driven by herd behavior among investors. Shiller (2000) emphasized that “irrational exuberance”, driven by the media, investment banks and technology analysts, combined with substantial uncertainty about fundamental values to raise stock prices above their fundamental values. Others have pointed to structural features of the stock market, such as lock-up provisions for IPOs, hedge fund involvement, analysts’ advice, and the uncertainties surrounding internet technology as causes of the recent bubble [Ofek and Richardson, 2003, Brunnermeier and Nagel (2003)]. We use an historical example to ask which of these explanations is more general, with the potential to shed light on other important episodes of market overvaluation.

We examine one of the most famous and dramatic episodes in the history of speculation, the South Sea Bubble. Based on the trading behavior of a sophisticated investor, we document the kind of investment strategies that proved profitable, and relate them to predictions from the theoretical literature on asset bubbles. Data on the daily trading behavior of a goldsmith bank – Hoare’s – allows us to examine competing explanations for how bubbles can inflate. The records kept by the bank are unusually rich, providing information on trade size, frequency – often more than one per day – execution price, profits and loss, as well as customers’ orders executed. The bank was unusually successful in its trading. While many investors – including, famously, Isaac Newton – lost substantially in 1720, Hoare’s made a profit of £28,000 – about 5.5 million US-$ in today’s money [Carswell (1960)]. We demonstrate that the bank's successful dealings in South Sea stock and other shares were not simply driven by luck. Instead the bank recognized that a bubble was in progress. Investing simultaneously was nonetheless rational since investor sentiment was partly predictable. This is compatible with interpretations that emphasize "noise traders" and "synchronization risk".

We argue that this episode and the behavior of a single, well-connected and knowledgeable investor can tell us much about the nature of bubbles and the behavior of investors during periods of substantial mispricing. Three insights are important. First, the bank was not betting against the extremely rapid rise in South Sea stock, but was riding the bubble for a substantial period. It did so while at the same time giving numerous indications that it believed the stock to be overvalued. The fact that a highly sophisticated investor chose to hold large amounts of an overpriced asset, rather than attacking the bubble (or standing on the sidelines) is itself interesting in the context of recent theoretical work on the structure of incentives during bubble episodes. Second, short-selling constraints and the difficulties of arbitrage that have been emphasized in recent work on the dotcom mania cannot explain the South Sea bubble. While have every reason to suspect that the market for short-sales was underdeveloped compared to modern times, this was not decisive. It was highly profitable for well-informed market participants to "ride the bubble" for an extended period before it collapsed, instead of just exiting the market. A zero-investment constraint, if it existed, did not bind market participants like Hoare's. Third, perverse incentive effects arising from delegated investment management also highlighted in recent work on mutual funds and hedge funds were not at work. Hoare's did not have to fear that customers would withdraw their deposits if the bank underperformed the market. There is also no evidence that the bank was betting enough money to threaten the solvency of the bank; partners' equity always exceeded the value of the bank's speculative positions. It appears that the need for coordination in attacking the South Sea bubble was key for allowing it to inflate to such an extreme extent, in line with recent theoretical work by Abreu and Brunnermeier (2003). Also, the fact that rational traders failed to prevent a bubble was actually profitable for them, as is reflected in the very high returns earned by Hoare's in 1720.

This paper presents a case study of one investor in the South Sea bubble. It cannot hope to answer all questions about the bubble, but it can shed light on a variety of questions. In particular, the experience of Hoare's Bank can provide a counter-example to several theories of bubbles. If consistent with a story, such as the need for coordination if rational investors are to oppose it, it can only suggest that other investors acted similarly. Against these limitations, however, we pose the advantages of following in detail the actions of a single, sophisticated investor in the South Sea bubble. We can see into the operation of this famous bubble much more clearly than any previous study.

There is a rich body of earlier research on the emergence of bubbles. The efficient markets hypothesis rules out substantial mispricing [Fama (1965)]. If all investors are rational at all times, boom and bust cycles must be driven by perceived changes in fundamentals, and cannot occur because of cognitive biases, herding, and widespread euphoria. The same conclusion emerges from no-trade theorems under asymmetric information, as well as from backward induction in finite horizon models [Santos and Woodford (1997); Tirole (1982)]. Also, the presence of boundedly rational traders does not necessarily lead to bubbles, since rational arbitrageurs should reduce any substantial mispricing – and would profit from doing so. Even without risk-free arbitrage – as a result of limits on short-selling etc. – sophisticated investors should be able to benefit from attacking a bubble. Famous historical episodes like the South Sea bubble, the tulipmania and the Mississippi speculation have been claimed as examples of markets functioning reasonably well under uncertainty [Garber (2000)].

In contrast, recent theoretical and empirical work suggests that bubbles can inflate even if there are large numbers of highly capitalized, rational investors. In the rational bubbles literature, the prospect of "greater fools" entering the market makes it optimal for investors to hold stock that they know to be overvalued [Blanchard and Watson (1982)]. Bulow and Klemperer (1994) show that crashes and frenzies may occur if rational investors have the option to time their purchases and sales. Noise traders can affect prices in these models because rational arbitrageurs are assumed to have relatively short time horizons. Therefore, any risk of a bubble inflating further in the immediate future will encourage sophisticated investors to stand by the sidelines and not attack a bubble [DeLong, Shleifer et al. (1990), Dow and Gorton (1994)]. The role of investor sentiment in explaining wide swings in asset prices has recently been emphasized by Baker and Wurgler (2003). Some degree of myopia is often rationalized as a result of financial incentives in delegated portfolio management. Shleifer and Vishny (1997) emphasize that portfolio managers will suffer fund outflows if they underperform as a result of exiting the market for an overpriced asset – a result confirmed by Chevalier and Ellison (1997) for mutual funds, and by Agarwal, Naveen and Naik (2002) for hedge funds. Arbitrageurs' appetite to attack bubbles may also be low as a result of risk aversion. Wurgler and Zhuravskaya (2002) highlight the importance of fundamental risk in the absence of close substitutes, which makes it harder for arbitrageurs to flatten demand curves for stock.

A related argument says that arbitrageurs lack the power to offset irrational exuberance unless they can coordinate their actions. Abreu and Brunnermeier (2003) show that synchronization risk may prevent aggressive attacks on the bubble because individual investors are not large enough to bring down the market on their own; only coordinated attacks will succeed. In the absence of coordination or an exogenous event that helps individual investors to predict that others will sell, too, mispricing may persist. In this class of models, individually rational investors may find it optimal to not sell assets that they believe to be overpriced – either because they know that feedback traders will drive prices up further [DeLong, Shleifer et al. (1990)], or because they will incur an opportunity cost from standing aside [Abreu and Brunnermeier (2003)]. This approach has been used recently to interpret the rise and fall of NASDAQ. Brunnermeier and Nagel (2003) show that hedge funds used a successful strategy of market timing, and only reduced their holdings of technology stocks when they believed an attack was imminent.

An alternative approach to the analysis of bubbles highlights particular institutional features that allow bubbles to inflate. Lintner (1969) showed that substantial overpricing can occur in a model with heterogeneous agents and short-sale constraints.[1] Ofek and Richardson (2003) argue that short-sale constraints were crucial for the rise of dotcom stocks. They show that while the supply of shares to the market was kept artificially low during the

[1] There are numerous other papers in this tradition: Jarrow 1981; Detemple and Murthy 1997; Chen, Hong and Stein 2000; Jones and Lamont 2001.

"lock-up" period following IPOs, retail investors succeeded in storming the market, overwhelming institutional investors in the process.

We test the usefulness of these competing explanations using the detailed historical records of Hoare's bank. Throughout, we put the South Sea bubble and the bank's performance in context through systematic comparisons with the recent technology bubble. We proceed as follows. In Section I, we describe some of the historical background and context, compare the events of 1720 with the dotcom mania of recent years, and give an overview of our data. Section II presents evidence of Hoare's trading record, both in South Sea shares and in other securities. We derive measures of profitability, and compare them with recent evidence on the record of hedge funds during the dotcom boom. Section III discusses the causes of success, and examines the hypothesis of insider trading. Section IV argues that contemporary commentary makes it highly likely that sophisticated investors understood shares to be overvalued, and that expectations of "greater fools" buying later (and smart investors not attacking) were key for the success of firms like Hoare's. The final section concludes.

II. Historical background

A. The South Sea Company in 1720

The history of the South Sea Company has been recounted numerous times.[2] Only a few key aspects need to be highlighted here. Founded in 1711, its official purpose was to trade with Spanish America. Despite the occasional slave ship and consignment of textiles that sailed under the Company's flag, its trading activity always remained limited. From its very

[2] Carswell 1960; Scott 1912; Sperling 1962; Neal 1990; Chancellor 1999.

beginning, it was more involved in handling government debt than foreign trade. The English government's debt in the early eighteenth century had been issued in a variety of forms. Many of them were not easily transferable, and some irredeemable. Consequently, while the cost of servicing the national debt was substantial, most annuities traded at large discounts.

The company's first major venture was the debt conversion of 1719. It exchanged £1,048,111 for newly issued stock, and received annual interest payments from the government. As a result, the government's debt payments fell substantially, former debtholders saw the market value of their securities rise – and the company netted a considerable profit. By increasing liquidity, the South Sea Company made a Pareto improvement. The success of the 1719 operation inspired a much grander scheme. The South Sea Company proposed to exchange almost all of the remaining national debt for its own shares, and to add a "gift" to the Treasury for the privilege. In exchange, the Company obtained the right to issue new shares with which the conversion was to be financed. As a result of a competitive bid from the Bank of England, the South Sea Company finally had to offer much more generous terms to the government than it had proposed initially.

The bubble's growth was facilitated by the fact that the conversion price was not fixed. The higher its share price, the more cheaply the Company could obtain the government debt from its former owners – and the more cash would remain for other purposes. During the bidding war with the Bank of England, the share price already rose substantially. The South Sea Company paid generous bribes at this time. It granted "incentives" similar to stock options to 27 Members of the House of Commons, six Members of the House of Lords, plus numerous Ministers of the Crown. There is also a good chance that the King and the Prince of Wales were paid off [Carswell (1960): 103]. After the passage of the bill authorizing the conversion in the House of Commons and the Lords, King George I gave his assent in early April. Since the beginning of the year, the stock had more than doubled. The company issued fresh equity in four subscriptions, at higher and higher prices. It also announced the terms under which it would convert government debt, exchanging annuities and redeemable bonds for cash, bonds and stock. As its market price rose, the Company could buy out debtholders for ever smaller amounts of stock. In a bid to raise its stock price, it lent generously against its own shares – thus reducing supply and increasing demand at the same time. With the same intention, the Company pushed the government to outlaw all joint stock companies without a royal charter. Discussed since April, the Bubble Act was passed in June, making much of the competition for funds by new ventures illegal.[3]

From April, the broader market began to rise in parallel with South Sea stock. Also, numerous smaller ventures were being sold to investors. These schemes, known as "bubbles", raised finance based on little more than some vague ideas set forth in the prospectus. Solid businesses such as insurance companies were offered in parallel with simple frauds, such as the classic "scheme of great benefit, but no-one to know what it is" [Mackay (1841): 55-56].[4] The increasing volume of trades put pressure on the settlement of stock trades [Carswell (1960): 124]:

[3] Harris 1994.
[4] Some of the most outlandish – and most frequently cited – examples may well have been satires of actual practice; Carswell 1960.

> The offices of the South Sea Company "very soon found it impossible to keep abreast of the transfers of stock reported to them on the three days a week appointed for settlements. This sheer physical inability to register changes of ownership in the stock naturally encouraged credit trading and speculative forward sales, particularly when, as happened from time to time, the transfer office had to close in order to catch up with the existing arrears, and bargains could only be made 'for the opening of the books.'"

The company had to close its books in July and August to catch up with an ever-growing backlog of trades that had not been settled, and to prepare for the fourth money subscription. By the middle of August, with the South Sea stock's share price declining, the company induced parliament to stamp out unwelcome competition for investors' funds. The day the account books were opened, selling was massive. The Company also found itself short of cash when it needed to pay the debtholders who had converted in May. Desperate to prop up the sagging stock price, the directors promised dividends of 50 percent of the stock's face value – or approximately 6 percent relative to market value. At the same time, according to some accounts, a general credit crunch was developing in the City, as subscribers of South Sea stock sought to make their payments for the fourth money subscription.[5]

Since many of the companies being floated in exchange alley did not have charters, or changed their main business, they were technically operating outside the law. For example, the Sword Blade Company, which had been founded to produce sword blades and was used as the financial arm of the South Sea Company. As a result of the government's pressure and because of its massive lending to the South Sea Company, the Sword Blade Company became insolvent in September. Quickly, the stock tumbled to little more than its value at the beginning of the year. With growing clamor from investors in the third and fourth

[5] The claim is contentious; Dale 2004 (forthcoming)

subscription (who had paid £1,000 per £100 in stock), the South Sea Company hatched plans to be taken over by its old rival, the Bank of England. The subscription terms were modified to take account of the fall in the stock price, further reducing receivables for the Company. The year ended in scandal, with a committee of the House of Commons investigating and the Company's cashier fleeing the country [Carswell (1960)].

B. South Sea stock and the internet bubble

How does the rise and fall of stock prices during the South Sea bubble compare with the internet mania during the late 1990s? Table 1 provides a comparison with select "high profile" cases. During the South Sea bubble, daily data is only available for three companies – the Bank of England, the East India Company, and the South Sea Company. Most of the smaller bubble schemes, akin to many of the IPOs floated later during the dotcom mania, did not leave a continuous record of recorded prices.

From the NASDAQ, we selected three well-known firms whose rise and fall has often been seen as paradigmatic for the technology bubble as a whole. If we focus on the 6 months immediately before and after the peak, some striking similarities and differences emerge. The runup in prices in South Sea stock was much sharper than the one seen in the technology "bellwether" stocks – from the pre-peak low to the maximum on July 1st, 1720, prices of South Sea equity rose more than ninefold. Amazon and Cisco recorded much smaller gains. For larger, more stable corporations, the pattern was reversed. The Bank of England and the East India Company saw relatively mild increases in their share prices in 1720, compared to the rise of dotcom stocks. Compared to all-time lows before the bubble's high point, however, the technology rally in the late 1990s generated much greater increases than even South Sea stock.

Table 1: Comparison of stock price increases and declines, 1719-21 and 1998-2001

	Stock	Price increase*	Peak-to-trough**	St.dev. of daily returns
South Sea bubble	South Sea Company	843.0%	-88.0%	6.3%
	East India Company	45.0%	-68.0%	12.8%
	Bank of England	51.0%	-54.0%	15.8%
Dotcom mania	Amazon	188.0%	-79.9%	5.9%
	Cisco	220.0%	-76.5%	3.4%
	Microsoft	86.0%	-65.0%	3.0%

Note: * from minimum during 12 months prior to peak
** 12 months subsequent to peak

If the gains on the way up looked very different, the same cannot be said for the losses after the bubble burst. While share prices fell by an average of 70% from their 1720 peak, the decline was equivalent to 74% for the internet bellwether stocks. Also, volatility during the technology bubble was markedly lower than 280 years earlier – the standard deviation of daily price changes in South Sea stock was higher than for either of the three internet stocks, and relatively safe investments such as the Bank of England recorded even greater price instability.[6]

For a sophisticated investor, the sharp swings in asset prices during the South Sea bubble offered significant profit opportunities. It is possible to argue that skilled operators should have been able to reap greater profits (per month) during the South Sea bubble than during the dotcom mania. The run-up in prices was markedly sharper than in the late 1990s. Also, it the downside risk after the market's peak was broadly comparable, so that a successful strategy of "riding the bubble" three centuries ago could have presented an attractive combination of risk and return.

C. Data

Hoare's was – and still is – a private bank owned by the Hoare family, operating from its office in Fleet Street. Having started out as a goldsmith, Richard Hoare moved to the present location in 1690, and soon thereafter began to concentrate on banking. The bank boasted a long list of blue-blooded customers [Temin and Voth (2003)]. It offered payment services, loans and brokerage to its clients. It also traded actively on its own account. It had done so since the earliest entries in the account ledgers, dating from 1702. Since the inception of the South Sea Company, it had invested in its shares, together with those of the Royal African Company, the East India Company, and the Bank of England, as well as various forms of government debt.

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[6] Note that there is an unusually high number of days when share prices did not move in 1720, according to Castaing's. If we recalculate the standard deviation for the sample excluding non-trading days (defined as days with no price, or no price change), our results are almost identical.

Table 2: Trading activity on Hoare's own account in 1720, by security

	Number of transactions in 1720	Average value	Average number of shares traded	Total value traded	Maximum investment*
Bank of England	20	2,357	1,450	47,155	22,623
Ram's Insurance	4	250	2,250	1,000	265
East India Company	7	3,423	1,071	23,960	14,990**
South Sea Company	54	2,593	1,157	140,029	37,520
Royal African Company	5	672	804	3,360	900

Note: * measured on a cost basis.
** missing data on initial investment; lower bound.

In 1720, the bank traded actively in South Sea stock – it bought and sold 54 times in 1720 alone, often on the same day. In addition, Hoare's executed trades for customers, a total of 19 in 1720, and dealt extensively in other securities. Yet it was most active in trading South Sea stock. The bank followed the conventions of double book-keeping, and kept track of its transactions in the same way that it dealt with clients' loan transactions. Amounts spent on purchases of stock were entered as credits, and the proceeds of sales as debits. In the margin, the clerks entered the quantity traded, as well as miscellaneous observations. Transfer fees were also recorded to capture the full cost of trading. Customers' transactions contain the values lent against the security of stock, the quantity of shares offered as collateral, the repayment date and the interest received.[7]

Contemporary publications such as Freke's and Castaing's *Course of the Exchange* provide daily prices. They have been computerized by Neal (1990).[8] Castaing's in particular is generally accepted as a reliable guide to transaction prices. Without officially appointed market makers or specialists, Castaing and his successors had to rely on what they heard in

[7] All the archival material is held at Hoare's bank. The data used in this paper comes from the first and second loan ledgers.
[8] The data are available through ICPSR (Study No. 1008).

the crowded passages known as Exchange Alley, the small area between Lombard Street and Cornhill in the City [Carswell (1960): 13; Neal (1990): 17]. Our data, by contrast, consist of actual trades. They allow us to assess Castaing's accuracy. Trading took place in the two great coffee-houses as well as on the street and in taverns. Transactions normally were entered in the transfer books kept by the firm itself; sales and purchases were registered by the clerks, who entered the nominal quantity exchanged upon payment of a fee. In contrast to the Dutch system, transfers in England were normally neither particularly time-consuming nor costly; consequently, most trading took place in the spot market, not in the form of forward contracts.

As noted earlier, trading in South Sea stock was encumbered by unusually slow and cumbersome transfer procedures. Consequently, some of the transactions were not registered in the transfer books, but took place in the form of subscription receipts ("scrip") and forwards. This was particularly true during the two-month period in the summer when the transfer books were closed. For those in possession of shares or documents proving ownership, the seemingly chaotic arrangements in Exchange Alley did not prevent relatively efficient trading most of the time, as we are able to show based on Hoare's transactions data. Yet investors who needed to obtain their shares from the company often had to struggle with cumbersome bureaucratic procedures designed to avoid fresh supply reaching the market. Settlement, it appears, was much less efficient and effective than trading itself.

The combination of reliable daily quotations and detailed evidence of Hoare's positions makes it possible to examine the bank's trading record, to evaluate its performance compared to the market, and to test some hypotheses about the origins of its success.

III. Hoare's Trading Performance

To distinguish between competing explanations for the rise of the South Sea bubble, we ask which of the following statements best describes the investor we track: (1) The bank was the victim of irrational impulses, and not driven by any reasonable market analysis. Like so many other investors, it made any profits by luck. (2) Trading during the bubble was constrained by administrative structures of the security market and did as well as could be expected under these constraints. (3) This trader acted rationally, but in a way that promoted the bubble. He bought and sold based on expected behavior by fellow traders, not market fundamentals – thus "riding the bubble," in Brunnermeier and Nagel (2003) phrase.

If the first explanation is correct, as the colorful descriptions such as in Mackay (1841) suggest, then we should find a handful of lucky trades that helped the firm to do well. Its other actions should betray little or no understanding of overvaluation, and may even indicate that it thought South Sea stock an attractive investment for most of the period. Under the second hypothesis, we should see the considerable friction that arose from the difficulties of settling South Sea stock standing in the way of efficient trading. The bubble's rise and fall was partly facilitated by these constraints – by, for example, making it difficult to exit the market at a time of the investor's choosing. Finally, if the third hypothesis holds and the informed speculator model is correct, we should see Hoare's investing in South Sea stock and other overvalued assets for a while. The bank ought to continue buying stock, or to hold it, even when it probably thought it was overvalued, and then sell when it became clear that the market was about to turn down. Holdings of the Company's stock should have been reduced before or immediately after the peak in prices. We argue that Hoare's trading in 1720 allows us to reject hypothesis (1), and that the weight of the evidence suggests that the third explanation is the most powerful one – with only a limited role for frictions in market microstructure.

A. South Sea Stock

Figure 1 shows the timing of trades by Hoare's bank, and the prices at which it bought and sold. These transactions took place at prices that track Castaing's prices closely. Figure 2 shows the bank's net position at each time (and repeats the price of South Sea stock for reference.) Hoare's books therefore confirm the accuracy of the published records. The bank started the year with 8,600 in South Sea stock. Throughout early 1720, the bank continued to add to its holdings. While it did not buy before the initial rise in prices from around 130 to 170, it entered the market heavily after February 18. Before the first passage of the Act of Parliament authorizing the conversion scheme on March 21, the bank acquired 14,000 shares, at an average price of £1.81, for a total investment of £25,328.[9] Immediately after it became clear that the South Sea Company, and not the Bank of England, had won the competitive bid to convert outstanding debt, its share price jumped – from £255 per 100 shares on March 21 to 275 on the following day, and to 350 the day after, stabilizing at around 320 in late March.

[9] Prices were quoted as the number of pounds sterling required to purchase £100 par value of shares.

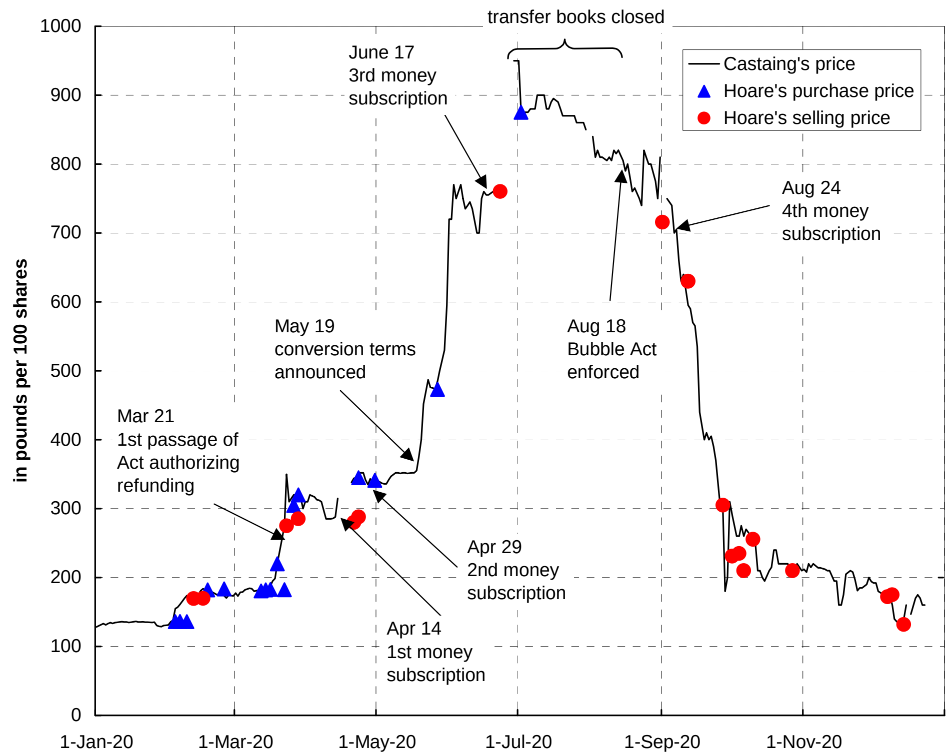

Figure 1: South Sea stock price and Hoare's trading

The bank sold 1,000 shares on March 22, immediately after the sharp run-up in prices. Then it sold 9,000 on a single day, March 28. Possibly to minimize market impact, it split the sale into eight orders, of between 500 and 3,000 shares. At the end of the day, Hoare's had taken profits of £10,313 – a gain of 57% over 38 days, equivalent to approximately 1,400,000 in current pounds sterling. After the first money subscription on April 14, the bank sold some 5,000 additional shares, at 2.84 each. Profits now exceeded £14,400, and the bank had sold just a little more than its total purchases in 1720. On April 30th, the day after the second money subscription, the bank re-entered the market, acquiring 1,000 shares at 341. Some three weeks later, after the conversion terms were announced on May 19, South Sea stock began to rise rapidly – from 375 to 473 in a week, and to 750 by early June. Hoare's bought once more, another 2,000 shares, after the first run-up in prices, on

May 27. Prices fell slightly shortly before the third money subscription. All bookkeeping operations took a long time at the South Sea Company – for example, the new shares sold through the April subscription were not entered in the transfer books (and thus, available for trading) until December. Hoare's received over 1,330 shares on 23 June in exchange for lottery tickets and bonds. On the same day, Hoare's sold 1,000 shares at 760, realizing a profit of £3,310, or 77%.[10] We do not know how many of these shares came into the company's possession as a result of lottery bond and annuity conversions.

From June 22 to August 22, the transfer books for South Sea stock remained closed. As Peter Garber and Larry Neal have emphasized, the highest prices are observed during this period, making them akin to forward transactions. After normal trading resumed, in August 1720, prices dipped below their July highs, but initially remained at levels similar to those seen in June. When the stock fell below 800, and the Bubble Act came into effect, prices began to gyrate wildly. Hoare's apparently decided to limit its exposure, and started to sell a good part of its holdings on September 1st. It sold 3,000 shares in 4 trades of 500 and 1,000. Castaing's does not record a price for this day, but for the previous day, the *Course of the Exchange* suggests a price of 810. Hoare's sold its holdings at between 745 and 773. Compared to the average buying price of the 2,000 shares from the May purchases, this represented a gain of £5,732, or 67%. Within days, the share price was falling rapidly, and Hoare's sold an additional 1,000 shares for 630 on September 12. From February to mid-September, the bank had thus earned profits of £19,355.

[10] Using the weighted purchase prices in April and May as a standard of comparison.

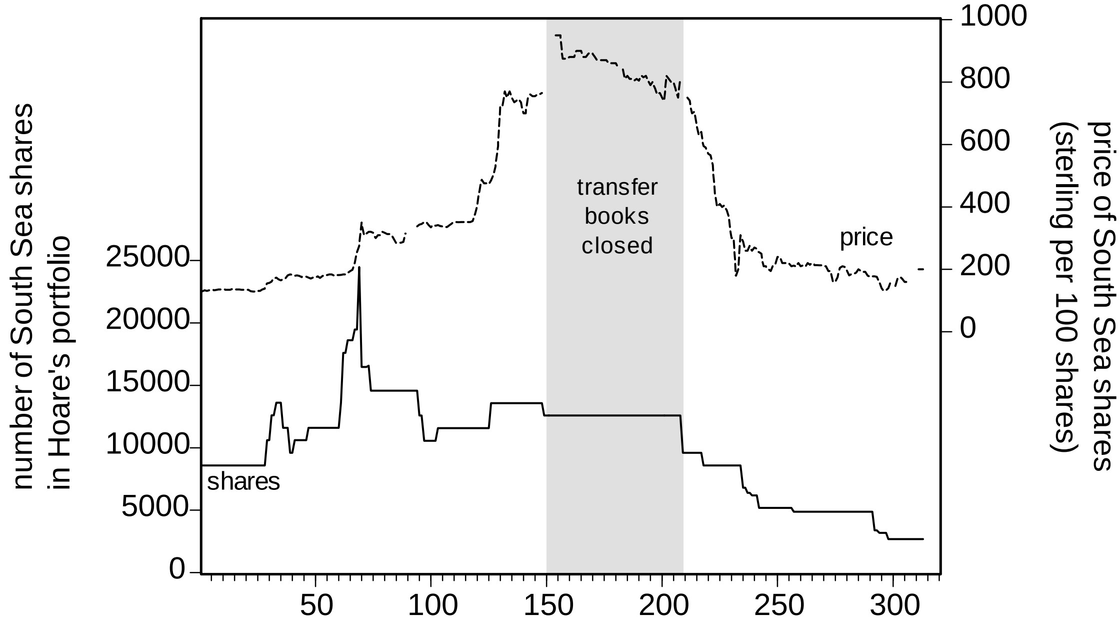

Figure 2: South Sea price and Hoare's holdings of stock

After the end of the bubble's most dramatic episode, between October and December 1720, the bank continued to reduce its position in South Sea stock. Total sales amounted to 3,700 shares, at prices ranging from 190 to 305. We cannot determine exactly how many of these were transferred as a result of conversion schemes and of the later subscriptions. Yet the frequent reference to payments for transfer fees (which are conspicuous by their absence before September) suggest that the bank mainly sold shares which it was forced to take as a result of earlier dealings in the stock.[11] We can also trace sales in December back to the third and fourth subscriptions. From late August, there was increasing outrage amongst subscribers who, having bought stock at high prices or exchanged public debt, had to wait for very considerable periods before their names and purchases were entered in the transfer books – thus making their holdings difficult to sell [Anderson (1801)]. While the company was trying to support its share price in this way, investors found themselves with illiquid

[11] In the fourth subscription, in which Hoare's participated, no receipts were issued. This made it much more difficult to sell stock before it had been entered at the transfer office, even if trading remained possible.

holdings – and Hoare's was probably one of them. Ex post, the conversion schemes and subscriptions saddled the bank with stock it had to sell at a late stage in the game; ex ante, it could probably not have had any reasonable expectation that its funds would be effectively locked up for months on end. The disappointing performance in the final quarter of the year is not necessarily a sign of the bank's strategy having failed – as Brunnermeier and Nagel (2003) show, hedge funds that successfully exploited the dotcom bubble also retained some holdings after the market's peak, and could have done even better had they sold out completely.

One simple way of examining the bank's trading performance is to ask if other investors could have earned excess returns by following Hoare's trading behavior. Did the stock drop after Hoare's sold? And did it rise after the bank bought? This is similar in spirit to – if slightly simpler than – the tests performed in Odean (1999), who examined the trading performance of clients at a direct brokerage during the technology boom. In order to implement this approach, we need to determine over which horizon we expect this information to be useful. If the market in joint stock companies in early modern London was relatively efficient, the market should incorporate the information value embedded in Hoare's trading relatively quickly – "copycat" trading within a few days of Hoare's having bought or sold should earn no profit. On the other hand, if the market adjusted slowly to the bank's speculative activity, we should find some degree of return predictability at short horizons.

As a first test, we simply calculate the probability of South Sea stock rising or falling, conditional on Hoare's buying or selling, for horizons of one day, five days and of ten days

– the day itself when the bank bought/sold, as well as four and nine subsequent days. We also report the average return over the period.

Table 3: Returns following Hoare's trading – averages and t-tests

		Horizon	1 day		5 day		10 days	
Hoare's buying			0	1	0	1	0	1
South Sea stock	down		188	4	168	25	161	31
			(63.3%)	(25%)	(65.9%)	(42.4)	(67.4%)	(41.9%)
	up		109	12	87	34	78	43
			(36.7%)	(75%)	(34.1)	(57.6)	(32.6%)	(58.1%)
	Chi(2)			9.4***		11.2***		15.46***
Hoare's selling			0	1	0	1	0	1
South Sea stock	down		182	10	144	49	111	81
			(61.7%)	(55.6%)	(59.8)	(67.1)	(57.2%)	(68.1)
	up		113	8	97	24	83	38
			(38.3%)	(44.4%)	(40.2)	(32.9)	(42.8%)	(31.9)
	Chi(2)			0.26		1.3		3.66*
Hoare's buying			0	1	0	1	0	1
		Return on South Sea stock	0.0012	0.21	-0.0025	0.021	-0.0034	0.019
		Difference		0.021		0.024***		0.022***
				(1.2)		(2.5)		(2.6)
Hoare's selling			0	1	0	1	0	1
		Return on South Sea stock	0.002	0.006	0.003	0.0007	0.007	-0.006
		Difference		0.004		-0.0023		-0.013*
				(0.25)		(0.82)		(1.7)
N			290			290		290

Note: top panel: distribution of up and down days, conditional on Hoare's trading.
lower panel: t-test in parentheses.
*, **, *** indicate significance at the 10, 5, 1 percent level.

Table 3 shows that on 63 percent of the days when Hoare's didn't buy, the value of South Sea stock declined. When Hoare's bought, negative returns were much less likely (25%), and the stock was three times more likely to have an "up-day" than a "down-day". The sample size is obviously very small, and the results should be interpreted with caution. On days when Hoare's sold, there is almost no difference in the distribution of positive/negative return days compared to the days when Hoare's didn't sell. Over a five-day horizon, only the buy decision yields strong and significant results. Following a buy decision from Hoare's, the stock rose with a probability of 57.6 percent; on an average day without Hoare's buying, it rose in one third of all cases. Over a ten-day period after Hoare's trading, significant differences in the returns following sell decisions emerge, too. The probability of the market rising after Hoare's bought was twice as high as during 10-day periods when it hadn't bought. South Sea stock also declined with slightly greater probability (68% vs. 57%) conditional on Hoare's selling.

The average return on a day when Hoare's bought was approximately seventeen times larger than on days when it did not buy: 2.1% vs. 0.12%. While this is a large difference, it is not statistically significant. There is therefore no clear evidence that information contained in the bank's trades entered the market quickly – nor is there evidence of a clear trading rule at Hoare's that would have determined buying or selling decisions based on observed returns. On days when Hoare's sold, the market actually rose three times faster than it did on days when the bank did not reduce its holdings. Again, there is no significant difference between the returns. Results at a trading horizon of 10 days are more telling. Following a buy decision by Hoare's, South Sea stock on average rose by 1.9% per day for 10 days – while it fell by 0.34% in the absence of the bank intervening. The accumulated return difference over the ten day holding period amounts to 22%. In total, there were 74 days that fell within a 10 day period after Hoare's bought into South Sea stock. An observer that had followed Hoare's trading, and replicated it exactly, could have outperformed the market substantially. We obtain a similar result for selling days, at the 10 day horizon. Following a sell decision by Hoare's, the market fell by 0.6% per day over the subsequent 10 days, whereas it tended to rise 0.7% on "normal" days. Investors who did not follow

Hoare's lead in selling underperformed by 13% over a 10-day period. We use multiple regressions for 10-day horizons to examine the success of Hoare's trading further (Table 4). Our results suggest that, using information from both sell- and buy-decisions at the bank, investors' could have gained 15.5% over a ten-day period after Hoare's bought, and avoided a loss of 24% after it sold. As is common in return regressions, our model only accounts for a small part of the variance of daily returns – between 3 and 5.9%.

If investors could have observed not simply the timing of decisions to buy and sell, but volumes also, they could have done at least as well. In eq. (2), Table 4, we show the returns following the decision to buy or sell by Hoare's, depending on trading volume. For every 1,000 shares bought, returns were 17% higher over the next 10 days; for every 1,000 sold, they were 5.6% lower. If market efficiency overall was not too high, other factors may have contributed to return predictability. Strongly positive serial correlation could bias our results if Hoare's bought simply in reaction to price increases – leading to positive returns in the subsequent period. Modeling the dynamics of returns explicitly is desirable, especially since some authors have found evidence of temporal dependence in the returns of South Sea Company stock in 1720 [Neal (1990)]. As eq. (3) in Table 4 demonstrates, there is no significant evidence of serial correlation in returns under OLS. Using alternative estimation techniques suggests that this finding is not robust. Including lagged returns underlines the significance of our results, as equations (3) and (5) show.

Since the influence of outliers is an obvious concern, we also use Huber-Biweight robust regressions. These confirm that South Sea share prices generally rose during the 10 days after Hoare's bought, and that they fell after it sold. However, the coefficients are substantially smaller – about half of their size under OLS. Also, there is some evidence of serial correlation not apparent under OLS. Similar results arise when we use median regressions, which also demonstrate a significant – if smaller – difference.[12] These findings suggest that Hoare's did have an impressive ability to sell before prices fell and to buy before they rose – and this ability was particularly pronounced in the case of large movements.

[12] Available from the authors on request.

Table 4: Returns following Hoare's trading – OLS and robust regression results

	1	2	3	4	5	6	7	8	9
		OLS			**Huber-Biweight**			**Bootstrap**	
Return$_{-1}$			0.083 (1.4)			-0.046** (2.1)			0.083 [-0.084; 0.37]
SD	-0.0155** (2.02)			-0.008*** (2.6)			-0.015** [-0.033; -0.005]		
BD	0.024*** (2.86)			0.012*** (3.85)			0.024** [0.013; 0.04]		
Svol		-0.0056* (1.8)	-0.0056* (1.77)		-0.0028** (2.4)	-0.0033*** (2.8)		-0.0056* [-0.012; 0.004]	-0.0056* [-0.014; 0.0036]
Bvol		0.017*** (4.2)	0.016*** (3.9)		0.009*** (5.7)	0.009*** (5.9)		0.017** [0.009; 0.026]	0.016** [0.003; 0.03]
Adj. R^2	0.03	0.053	0.059						
F	5.57	9.04	6.9	9.8	16.55	11.96			
N	290	290	283	290	290	283	290	290	283

Note: *, **, *** denote significance at the 10, 5 and 1 percent level, respectively. T-statistics in parentheses. Brackets below the bootstrap estimates indicate 95% bias-corrected confidence interval (estimated with 100 draws). SD is a dummy variable for days on which Hoare's sold, set to 1 for the day itself and nine subsequent days; BD does the same for days when Hoare's bought. Svol is the volume (number of shares) sold by Hoare's, in thousands; Bvol is the volume of shares purchased (in thousands).

Use of standard asymptotic theory in comparing the returns following Hoare's trading may not be appropriate – outliers can exaggerate trading performance. Also, since stock returns are rarely normally distributed, the results in Table 3 may be seriously biased.[13] To address these concerns, we bootstrap the distributions of the coefficients, using bias-corrected estimates. We find broadly unchanged results, with the statistical significance of the trading dummies and volume variables unaffected.

Another way of evaluating Hoare's trading record is to apply a variation of Jensen's alpha. We construct an artificial "mutual fund" that mirrors the bank's trading record, and examine if the timing of purchases and sales reliably earned the bank excess profits. Figure 3 provides a simple graphical representation.[14] We plot the returns on Hoare's portfolio on the y-axis against the returns on South Sea stock on the x-axis – effectively comparing the value of a portfolio fully invested in the Company to one that uses market timing as practiced by the bank. The diagonal illustrates the returns we would have expected from a buy-and-hold strategy. All points above and to the left of the diagonal indicate positive excess returns from Hoare's trading strategy – all the points below the diagonal are days of "failure". The bank did not avoid all of the sharp declines. Nor did it always reap the full benefit of large price increases. Yet on balance, the bank managed to time the market with considerable skill.

[13] Using the Kolmogorov-Smirnov test, we strongly reject the null of normality for South Sea stock returns in 1720.
[14] The results shown are for the leveraged portfolio described below.

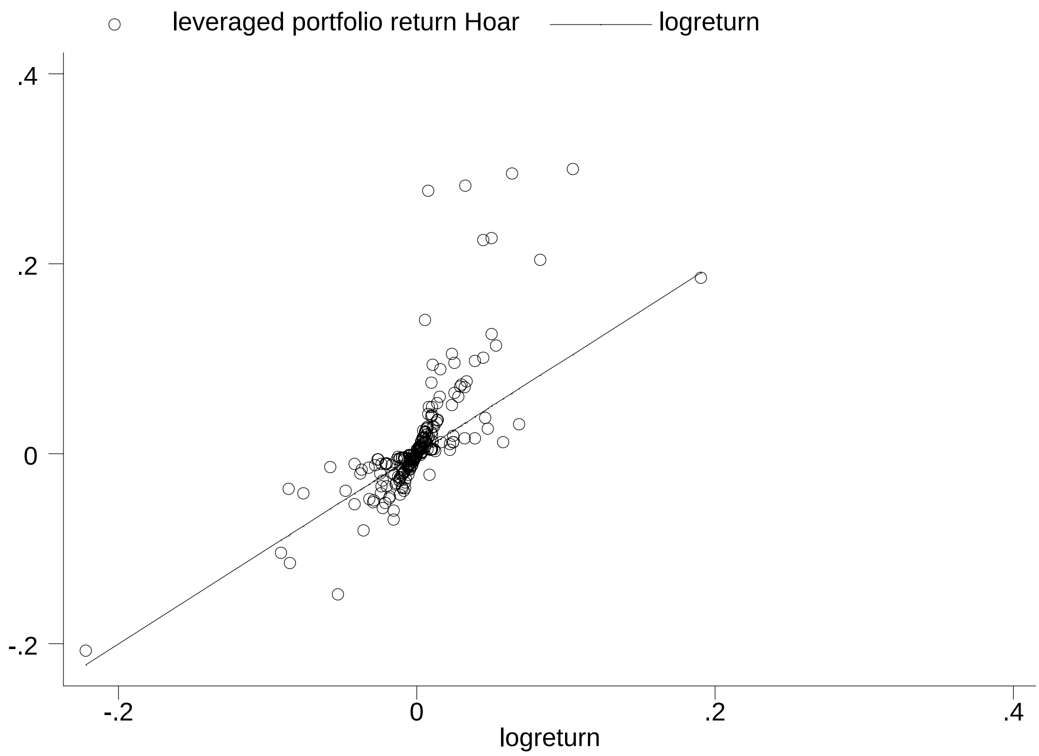

Figure 3: Hoare's trading performance, relative to returns on South Sea stock

More formally, we can test for excess returns by estimating:

$$R_{H,t} = \alpha + \beta R_{F,t} + \varepsilon_t$$

where $R_{H,t}$ is the return on Hoare's portfolio at time t, $R_{f,t}$ is the return on South Sea stock, α is the intercept, and ε is the error term. This is a simplified version of Jensen's alpha – instead of using the market portfolio as a reference for evaluating trading performance in a portfolio, we simply investigate how well Hoare's invested in a single stock. If Hoare's managed to be more fully invested at times when R_f was positive then when it was negative, we will obtain a positive and significant coefficient. We construct two trading accounts – one that assumes that the bank kept its maximum cash investment (some £35,000 in all) in South Sea stock ready for investment purposes during all of 1720. The other takes into account that the partners leveraged their investments. Hoare was a deposit-taking bank, and it did not separate its trading account from the general banking business. In 1720, the partners' maintained an equity/asset ratio of 0.15, borrowing £6.66 for every pound they invested themselves. We use the same leverage ratio for their trading account. In both cases, Jensen's alpha is positive, large, and significantly different from zero. Hoare's trading success was not determined by getting lucky with a few trades; it managed to "long" South Sea stock when it went up, and to be much less "long" when it came down or.

Table 5: Jensen's alpha – Hoare's portfolio and momentum strategy

	No leverage	Leveraged	Leveraged, share price above 200	Momentum strategy
α	0.0019**	0.0078***	0.0057**	-0.0026***
	(2.1)	(3.58)	(2.08)	(3.92)
β	0.81***	1.45***	1.71***	1.3***
	(24.0)	(18.3)	(16.43)	(53.2)
Adj. R^2	0.67	0.54	0.59	0.91
N	285	285	185	289

A direct way of examining if the result in Figure 3 is statistically significant is to test if β is larger on days with positive returns than on days with negative returns. We do so for both the leveraged and the cash portfolio. In each case, the difference is large and statistically significant – for the unleveraged portfolio, β+ is 0.94, and β- is 0.57. For the leveraged portfolio, we find β+ of 1.67 and a β- of 0.87.[15]

One obvious question to ask if Hoare's trading record relied on having some stock at the beginning of the year – which may have been rational in a balanced portfolio. To test this further, we estimate Jensen's alpha for the period when the price of South Sea share is above 200. We find an alpha that is positive and significantly larger than zero. Given the smaller sample size, the reduction in statistical significance is hardly surprising. Hoare's did well in its trading, when the stock entered the "bubble zone" and during the period as a whole.

[15] The difference between the estimates is strongly significant. This is also true if we bootstrap the distribution of the regression coefficients, using 1,000 draws.

Given that there is some evidence that Hoare's used a "feedback trading rule" (buying when South Sea stock rose, and selling when it fell), we should also worry about the possibility that its success had more to do with a simple momentum strategy rather than any investment acumen or insight.[16] We therefore constructed a momentum portfolio – buying a share on every day when the stock price rose, and selling when it fell. The final column of Table 5 gives the results for such a strategy. Jensen's alpha is strongly and significantly negative. By the end of the year, investors using price momentum as an indicator would have lost 36 percent of their capital. Buy-and-hold investors who had put all their money in South Sea stock on the first trading day of the year would still have earned a return of 56 percent. Whatever explains Hoare's trading record in 1720 – following a naïve momentum rule cannot have been key for the profitability of its trading. Nor was taking greater risks crucial for its profits. As the Sharpe ratios show, Hoare's outperformed on a risk-adjusted basis, too.[17] While the Sharpe ratio of the unleveraged portfolio does not beat a simple buy-and-hold strategy, the leveraged portfolio shows a very high risk-adjusted return.

Table 6: Profit/Loss, from 6 months before market peak to 6 months thereafter[18]

Asset	Strategy		Return	Sharpe ratio
South Sea Stock	Momentum		-36%	-2.0
	Buy-and-hold		56%	0.46
	Hoare's	unleveraged	103%	0.43
		leveraged	681%	2.39
Technology stocks	Hedge funds		136%	0.3*
	All high P/S stocks		33%	

Note: Returns are calculated as P_t/P_{t-1}-1.
P/S refers to the price-to-sales ratio, and the performance figure is for a buy-and-hold strategy.
Returns for tech stocks are from Brunnermeier and Nagel (2003).
* Average for non-directional hedge funds for 1994-98, from Agarwal and Naik (2000).[19]

[16] The bank did buy on days when the stock mainly rose – but it was not much more likely to buy in line with price movements.
[17] Calculated assuming a risk-free rate of 5%, in line with the usury limit. Cf. Sharpe 1998.
[18] 1.1.1720 to 31.12.1720 for the South Sea bubble, and September 1999 to September 2000 for the Nasdaq. Data was for the latter was kindly provided by Stefan Nagel and Markus Brunnermeier.
[19] The average for directional hedge funds was 0.1.

The bank's trading record is also impressive compared to the returns achieved by hedge funds during the recent technology bubble. Returns on for the average firms with a high price/sales ratio in the late 1990s are broadly comparable to South Sea stock. Hoare's unleveraged trading performance is also broadly speaking similar to that of hedge funds. The latter however use leveraging to a large extent; if we construct a similar portfolio for Hoare's, it easily outperforms. We do not have Sharpe ratios for hedge funds during the NASDAQ bubble. Yet returns for hedge funds during most periods tended to be markedly lower.

B. Portfolio Performance

South Sea stock was not the only investment available on the London market. If Hoare's had special skill in timing the market, it ought to have achieved superior returns on its total trading portfolio than if it had simply invested in the market at large. We reconstruct the bank's holdings as comprehensively as the historical record allows, and demonstrate that Hoare's did indeed earn large, abnormal returns – and not just on shares of the South Sea Company, but on most of the securities it invested in.

The bank bought 2,000 shares of the Royal African Company in late May 1720, at £40 per 100, for a total cost of £800. By June, the bank decided to close out its position – and did so on the 24th of June, as well as on July 21st and 26th. It sold at prices ranging from 108 to 128, with total proceeds of £2,460. The bank thus made a profit of £1,660 over the course of two months. Its timing was not perfect – according to Scott (1912), the highest price recorded in 1720 was 185, and the lowest was 23.5. Yet instead of the £161.5 in profit per 100 of nominal value of shares held, the bank earned £83, or broadly half of the maximum possible. Yet we also need to consider the length of time for which it committed its capital. Given the very brief investment period, Hoare's realized a simple return equivalent to 75% per month.

In late April, Hoare's invested in Ram's Insurance, buying 2,000 shares at 13.25. It sold on May 16th, when the stock had risen to 19 – a profit of 43% in 17 days. Again, even higher profits could have been had by investors with perfect foresight. London Assurance, as the firm became known, traded as low as high as 175.[20] But given that it only invested for 17 days, it did spectacularly well.

In the case of Bank of England stock, Hoare's had built up substantial holdings even before the bubble began to affect the stock market at large. It bought stock at various times in 1719, and in early 1720 – while both the Bank of England and the South Sea Company were bidding for the government contract to convert old loan contracts. The initial scheme, offered by the South Sea company, elicited a counter bid by the Bank of England on 27 January. Interestingly, Hoare's had purchased 3,000 shares on January 21. As soon as the news of the counter-offer became public knowledge, the bank's shares rose in value, only to fall when Parliament accepted the South Sea Company's (much improved) offer. Hoare's had reduced its exposure to the stock on January 27th already, obviously predicting that the Bank of England would not be able to sway Parliament. For most of February, the shares traded at a discount to their January value. However, by April, the general speculative fever in South Sea stock began to affect the broader market. Hoare's realized some profits in April, when it sold 3,000 shares at 167. Thereafter, it watched the stock gain another 35 percent, and then sold 3,500 shares in August, at an average price of 226. The average buying price for Hoare's dealings in Bank of England stock during 1720 was 151.6, compared to a minimum price on the exchange of 139 before the run-up in prices. The average selling price amounted to 178

[20] Scott 1912, vol. 1: 419.

for the year as a whole (including the trading in January/February), and 199 during the bubble episode from April onwards – compared to a maximum recorded price of 270. The internal rate of return was equivalent to 51% p.a.

There is one stock in which Hoare's trading record is mixed – the East India Company. Initially, the company timed its investments quite well. On May 20th, it bought 1,000 shares at 239, and sold three weeks later at 301 – a handy return of 26%. Yet the company failed to call the top of the market. It bought heavily in late July, purchasing 2,000 shares at a price of 430. It was forced to sell them at prices ranging from 230 to 139.5, leading to an average loss of 58%.

The firm did best out of the most extreme bubbles – small firms subject to extreme price movements such as Ram's Assurance and the Royal African Company. It also did very well in South Sea stock and with Bank of England shares, and it broadly speaking failed to beat the market in trading East India stock. The fact that the bank's trading was most successful in the most volatile assets – and that the bank had less spectacular success investing in the equity of firms with a sound business model that easily withstood the wave of speculation – strongly suggests that bubbles can be an important business opportunity for sophisticated investors. This is in line with the performance of hedge funds during the technology bubble. Brunnermeier and Nagel (2003), find large excess returns in shares with high price/sales ratios, but not for ordinary stocks. This is precisely what we would expect if professional firms such as Hoare's managed to predict investor sentiment in the most overpriced assets to some extent.

Ideally, we would like to analyze the trading performance of a whole group of sophisticated 18th century investors – and compare it with the returns earned by hedge funds and other investors during the internet bubble. Unfortunately, the account ledgers at Hoare's bank are among the few surviving records that show how individual investors fared in 1720. Yet it seems clear that few fund managers beat the goldsmith bank's trading record.

IV. Causes of Success

Hoare's trading record was impressive by almost any standard. This was not the result of getting lucky with a limited number of trades. Yet what accounted for the healthy returns earned by the bank? If we are to argue that Hoare's "rode the bubble" with considerable skill, we need to demonstrate that the bank did not exploit an unfair advantage – and that it was aware of the fact that South Sea stock was overvalued. The bank's long list of well-connected clients could have easily provided it with important information. Anyone following the fortunes of the company in February was waiting for information on which of the two bidders for the debt conversion contract would win. After the South Sea company's first offer, the counter bid of the Bank of England had created uncertainty. When the South Sea company had responded with a scheme offering a much more generous pay-off, the decision was up to Parliament and the government. Both bidders used bribery, but considerable uncertainty about the outcome remained. Then, one day before the competing offers would be debated in Parliament, Lord Carlton borrowed £9,000 from Hoare's, offering 6,000 shares of the South Sea company as collateral. We do not know if he had bought the shares through the bank, or obtained the loan to buy the shares. The latter is likely based on information we have from other, similar transactions on behalf of Hoare's customers, but there no definitive proof. We do however know that Hoare's had bought 1,000 shares on the day before, and had bought another 1,000 a week earlier. In early March, a little over a week after Lord Carlton's transaction, the bank bought another 7,000 shares. The exact timing does not suggest that the bank was using "front running" – positioning itself ahead of big order that would have moved the market. Lord Carlton's order was probably not large enough to single-handedly change the price of South Sea stock.

Inside information would be more likely, yet the bank only bought a few shares after his order, and took a week to do so. Yet the possibility cannot be discounted altogether. Lord Carlton was a member of Parliament, and a former Chancellor of the Exchequer, a Lord Treasurer and Privy Counsellor. We cannot be certain that he had inside information, but his trading in the company's stock certainly appears to be fortuitous. It appears that he was not one of the members that the South Sea Company had bribed.[21]

We do not find strong links between Hoare's customers and the small group of insiders that ran the South Sea company (or was bribed by them). Yet since we only observe a subset of information available to traders at the time, it may still be the case that Hoare's success derived from its customers. This need not be at variance with our claim that predictable investor sentiment was an important part of the bank's success – and that it contributed to the extreme overvaluation. Hoare's customers and the bank itself may have been trading based on the same information.[22] We can examine the origins of the bank's profits further by asking if customers' trades helped it to time its own buying and selling, and by gauging how important this information was. We model the buying and selling decisions at Hoare's as a Poisson process, with the clients' transactions as the exogenous variable.[23] If the bank profited from the value of "seeing the flow" and other, more indirect information, we should be able to predict the volume and direction of its trading based on the behavior of its clients. We again use ten-day horizons to

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[21] Only a subsample of "beneficiaries" have been reconstructed. Lord Carleton's name does not appear. Cf. Carswell 1960.
[22] We thank Jeff Wurgler for pointing out this point.
[23] Using negative binomial regressions yields virtually identical results.

examine this question.[24] The underlying assumption is that, even in relatively inefficient markets, information revealed to the bank ten days earlier will have become public knowledge. Overall, we find that the bank timed some of its purchases and sales in accordance with the transactions of its customers – it was more likely to sell, and sell large amounts of stock, when its customers sold, too (or redeem their loans against South Sea shares with the bank). The Pseudo-R^2 suggests that the bank followed the lead of its customers to some extent. The same is true of sales, even if the finding is not as strong. The basic relationship is unaffected if we include the return on the day before. In the case of purchases, positive returns increased the likelihood of the bank buying more stock; when South Sea stock was plummeting, it would sell. There is therefore some evidence that the bank was following a "momentum strategy" to some extent during 1720. Yet the increase in predictive power is relatively modest. We learn more about the timing and volume of the bank's trades based on its customers behavior than from price changes.[25]

The bank acted as a broker for its clients, and consequently saw some of the order flow for South Sea stock. It had privileged information on some of the volume about to enter the market; it may also have benefited indirectly from the knowledge that its customers had of events and decisions that were about to affect the stock's value.

Gennotte and Leland (1990) show that, under fairly general conditions, market participants who "see the flow" will tend to act like uninformed investors – buying when prices fall, and selling when they rise (leading to a positive spread on average).

[24] We use a dummy variable equal to 1 for the day of the client's sale and the nine subsequent days.
[25] It is possible that the official price series is only an imperfect guide to the prices that the partners' at Hoare's considered when making their decisions – different series certainly disagree, and descriptions of the trading in Exchange Alley suggest that both the intraday variation and the price differences at any one point in time could be very substantial. Thus, our estimate of the coefficients on return and return_{-1} may suffer from attenuation bias.

Once they receive accurate information (by observing price-informed investors, for example, or by having access to other information), they will begin to take the other side of liquidity trades. If they know that trades arising from liquidity shocks are relatively rare, they will aggressively follow price-informed traders – buying when prices rise, and sell when they fall. This is what we observe in general at Hoare's. Table 7 shows in columns 5 and 6 that Hoare's did generally buy on and before days when prices rose, and sold when they fell. In columns 7 and 8, we examine this effect for the period following customers' trades. In general, momentum trading appears markedly weaker on the buying side – the bank's trading pattern was not more "informed" when its customers were buying. The reverse appears to be true when its customers were selling – Hoare's appears to have had some information that these trades were indicative of price-relevant information. This is broadly in line with recent work on "predatory trading".[26]

[26] Brunnermeier and Pedersen 2003.

Table 7: Predicting the trading behavior of Hoare's – information from customers

	1	2	3	4	5	6	7	8
	Bvol	Svol	Bvol	Svol	Bvol	Svol	Bvol	Svol
Return					3.2***	-3.16***	4.9	-9.1*
					(0.0009)	(0.002)	(0.103)	(0.057)
$Return_{-1}$			4.92***	-1.98*	4.02***	-1.5	-7.0**	-4.9*
			(0.001)	(0.08)	(0.0005)	(0.17)	(0.02)	(0.08)
Csell		0.96***		1.05***				
		(0.001)		(0.001)				
Cbuy	1.91***		1.9***					
	(0.001)		(0.001)					
Pseudo-R^2	0.17	0.07	0.20	0.06	0.048	0.0127	0.025	0.012

Note: Constant included but not reported.
*, **, *** denote significance at the 10, 5 and 1 percent level, respectively. Probability level in parentheses.
Bvol and Svol are the volume of shares bought and sold by Hoare's, in 1,000s, and Csell and Cbuy are the volume of shares sold and bought by customers.
Equations 5 and 6 use data from all trading days in 1720; 7 and 8 are estimated for the time periods when customers bought or sold only.

We can try to gauge the financial importance of information that Hoare's might have extracted from customers' trading. If the markedly higher positive returns following Hoare's decision to buy (as documented in Table 4) largely occurred when customers bought, then information derived from these trades is a likely explanation of the bank's success. Table 8 examines the returns following Hoare's trading decisions, conditional on the behavior of its customers. During the periods when Hoare's customers were active in the market, Hoare's decisions do not predict returns, with the exception of large price declines when Hoare's sold and customers bought. This suggests that the bank may have had some insight into the investment acumen of its clients, and interpreted certain buy decisions as a sign of noise traders entering the market. Yet according to Table 8, the conclusion has to be that Hoare's trading cannot be explained by the information inherent in its customers' trading.[27] We also re-estimated Jensen's alpha for periods when the bank's customers did not trade; results were virtually unchanged.[28]

[27] The bank may, of course, have received information that was not directly connected with the buying and selling of its customers. Since we have no evidence of this, we cannot pursue the issue further.
[28] For the leveraged portfolio, we found an alpha of 0.0079, with a t-statistic of 3.04, and an adj. R^2 of 0.55. We cannot reject the hypothesis that alpha is the same during the restricted period (when customers traded) and the entire period. For periods of customers sales and buys, we estimate a positive Jensen's alpha, but it is not significantly different from zero.

Table 8: Returns following Hoare's trading, conditional on customer trades

	Customers buy		**Customers sell**	
	0	**1**	**0**	**1**
SD	-0.012	-0.029**	-0.017*	-0.006
	(1.4)	(2.2)	(1.9)	(0.9)
BD	0.025**	0.021	0.034***	0.0026
	(2.2)	(1.6)	(3.1)	(0.4)
Adj. R^2	0.0196	0.0694	0.04	0.014
F	3.4	2.8	6.0	0.42
N	240	50	231	59

Note: *, **, *** denote significance at the 10, 5 and 1 percent level, respectively. T-statistics in parentheses. SD is a dummy variable for days on which Hoares sold, set to 1 for the day itself and nine subsequent days; BD does the same for days when Hoare's bought.

Overall, there is not sufficient evidence to suggest that insider knowledge or simple front-running, facilitated by the bank's brokerage operations, were key to its success.

All trading strategies that rely on market timing require access to a relatively liquid market. The official transactions at the South Sea Company's transfer house were clearly cumbersome and slow. At the same time, the bank's dealings in Exchange Alley suggest access to a relatively efficient and liquid market. Few transactions occurred at prices that deviated significantly from published ones. While some orders had to be executed in lots of 500 or 1,000 shares, the majority of transactions occurred without much indication that larger sales (buys) depressed (drove up) prices. Given that the market lacked designated market makers, a central order book, efficient clearing and settlement as well official prices, this is quite remarkable. At the same time, there may well have been scope for prices to gyrate more wildly if trading takes place in parallel, and without prices being published quickly [Harris and et al. (1995)].

V. Detecting Overvaluation

A. Assessments in the public at large

Did contemporaries understand that South Sea stock was grossly overvalued? At first sight, the numerous accounts of frenzy and mania, of deluded maids and pensioners investing their hard-earned pennies, suggests otherwise. Nor did the eighteenth-century lack equivalent of modern-day analysts, working hard to convince investors that there was only one direction for shares – up. Fly-sheets and pamphlets trumpeted the South Sea stock's inherent value and prospects. A newspaper article, published in the *Flying Post* from the April 9th, 1720 argued that, with the share price of South Sea stock at £300, its intrinsic value would be £448; and at £600, it would be worth £880. The higher the price, the more cheaply bondholders could be bought out, and the higher the value of shares. The residual amount of stock that the Company was entitled to issue was frequently counted as profit, when in fact it constituted a liability.[29] The details of the conversion scheme, and the exact implications of subscriptions at various prices must have been difficult to understand even for relatively sophisticated investors.

Yet the historical literature on the South Sea bubble has rarely argued that a large number of investors fully believed in the value of the company's schemes. Indeed, some of the earliest retrospective accounts already mention behavior that is very much in line with the predictions of the informed speculator model [Anderson (1801)].[30] This is further confirmed by the writings of contemporary observers. There was no shortage of doomsayers – including those in high office. Archebald Hutcheson, Member of Parliament for Hasting and a lawyer at the Middle Temple, published a series of

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[29] This misunderstanding can be also be found in twentieth-century accounts of the bubble. Cf. Carswell 1960, Scott 1912.

[30] Anderson 1801: "Yet many of those very subscribers were far from believing those projects feasible: it was enough for their purpose that there would very soon be a premium on the receipts for those subscriptions; when they generally got rid of them in the crowded alley to others more credulous than themselves."

pamphlets arguing that the South Sea scheme was fundamentally flawed. As early as March 1720, in his *Collection of Calculations and Remarks Relating to the South Sea Scheme*, he warned subscribers that only immense profits could justify the current high prices of stock [Hutcheson (1720)]:

> "I verily believe … that there is no real foundation for the present, much less for the further expected, high price of South-Sea stock; and that the frenzy which now reigns can be of no long continuance in so cool a climate… It seems to be the universal opinion within and without doors [of Parliament] that the present price of South Sea Stock is much too high."

Some looked forward with glee to the fall that was to come. The Archbishop of Dublin wrote in May 1720:[31]

> "… I think, if the debts of the nation may be paid by the folly of particulars… it will be very well for the publick, and I know no obligation on me to hinder it. Perhaps what would be spent this way would be spent on gaming or luxury [otherwise], and I am of the opinion that most that go into the matter are well aware it will not [succeed], but hope to sell before the price fall."

Indeed, even relatively modest investors such as the Duchess of Rutland expressed a similar sentiment. In March 1720, she wrote to her stockbroker:[32]

> "This comes to good Mr. Warner, to lett him know that I am allmost sure, I can mack an advantage by bying in the South Seas with the hundred and four score pounds is still in your hands… so I would bye as much as theat will bye today, and sell it out agane next week, for tho I have no oppinion of the South Sea to contineue in it I am almost certine thus to mack sum litell advantage to her that is good Mr. Warner's reaell friend…"

In detailed tables, Hutcheson set out the stock's overvaluation at various purchase prices. His warnings were republished in April, July, September, and October. It was

[31] Cit. acc. to Scott 1912, vol. 1: 424.
[32] Cit. acc. to Carswell 1960: 100. The total amount invested was probably 104x20=2080, if "score" was used in the sense of 20. The Oxford English dictionary also suggests the usage of "score" for a credit line in shops and the like; we can therefore not be certain of the amount invested by the Countess.

only after the stock had dropped some 80 percent from its peak, to less than £200, that Hutcheson's calculations were no longer republished. What is remarkable is the clear understanding that only future profits and dividends can underpin permanently high stock prices – as well as the detailed demonstration that these were very unlikely to be forthcoming. While the method of calculation and presentation are unfamiliar to the modern eye, the basic principles are very similar to those used by any modern observer of financial markets. For the maximum share price of £1,000 to be justified, Hutcheson argued, dividends of no less than £40 would have had to be paid on stock with a par value of £100. The assumption is that investors would have demanded no risk premium, which would have required an even higher dividend. In a calculation designed to derive a lower bound, the absurdity of the maximum prices is thus easily demonstrated. Hutcheson also shows that skilled observers could easily abstract from the intricate technical detail of the conversion schemes and issuance terms, and that widely circulating publications contained perfectly adequate analysis of the true value of South Sea stock. Finally, his appeal to common knowledge is striking. Even in late March, 1720, when South Sea stock was trading at 300, Hutcheson argues that everyone agreed that prices were too high – yet that many expected them to rise even further.[33]

B. Hoare's Concerns about Overvaluation

Did the bank (and other sophisticated market participants) believe South Sea stock to be overvalued? There is some evidence in favor of this hypothesis – even if it is more suggestive than compelling. The bank lent against securities, and did so at varying ratios to market value of the assets it held. Under relatively general conditions, banks and brokers will lend at a discount to current market value of they expect that a large price

[33] This seems very much in line with the "greater fools" theory of rational bubbles [Blanchard and Watson 1982], even if other aspects are not compatible with the rational bubbles literature.

fall is likely. Applying options pricing to the case of stocks in 1929, for example, Rappoport and White (1994) demonstrate that brokers increasingly tightened lending criteria for margin loans as the market neared its peak. While most brokers demanded margin of 25 percent in the 1920s, they raised it to as much as 100 percent in some cases in the run-up to the crash. White and Rappoport argue that the crash was therefore expected – that key players in the market were becoming worried about overvaluation, and reduced their exposure accordingly. They also priced brokers' loans at a higher rate as the value of stocks increased, to protect against possible losses.

Securities lending at Hoare's is not directly comparable to the data from the NYSE in 1929. We do not know with certainty that customers purchased stock with the loans they received – even if some incidental information makes this very likely. Second, the term of the loan was probably not fixed, and we do not have any information on contracted duration. Nonetheless, the same incentives that led brokers to raise their lending rates in 1929 should have applied to Hoare's in 1720 if it was becoming worried about a substantial overvaluation of South Sea shares. We have two types of information, one specific to Hoare's, the other for the market in general. Contemporary papers such as Hutcheson's *Collection of Calculations and Remarks Relating to the South Sea Scheme* detail the rise in interest rates on stock exchange loans. These increased from 5% p.a. at the beginning of the year to 10% per month in April, and to 1% per day thereafter. By September, they had fallen to approximately 5% per month, thus providing a mirror image of changes in the stock price [Hutcheson (1720): 25, 90]. These are not market rates in a modern sense. First, they breached the usury limit of 5%, and may have been difficult to enforce, thereby possibly giving an upward bias to the rate demanded. Second, they were probably not available to anyone willing to pay this rate; credit rationing was common [Temin and Voth (2003)]. Yet changes over time and the very high absolute values strongly suggest that market participants were bracing for a collapse, and used the same methods to protect themselves as did New York brokers in 1929.

As the boom wore on, Hoare's bank curtailed the ratio of lending to market value of collateral. If it lent at the full market value, and prices collapsed, it may not have been able to recover its loans unless the debtor had other assets or income. Table 9 summarizes the premiums and discounts to market value at which Hoare's lent. Before the first major leap in prices in 1720, the bank lent at a premium and at a very slight discount. In late February and early march 1720, when the bank was actively purchasing shares, it lent at a discount of 12-15.5%. By early March, when prices had risen by close to 70% year-on-year, the discount widened to 57%. Some two weeks later, when prices had almost doubled again, the discount was still substantial, if somewhat smaller – 42%.

Table 9: Lending against South Sea stock at Hoare's – 1719 to 1720

Date	number of shares offered as security	loan value	£ lent per 100 par value	market price	discount
17.3.1719	1,300	1,400	107.7	109.5	-1.7%
2.4.1719	6,000	7,860	131.0	110.25	18.8%
26.2.1720	6,000	9,000	150.0	170.5	-12.0%
1.3.1720*	600	900	150.0	177.5	-15.5%
7.3.1720	2,000	1,580	79.0	184.5	-57.2%
24.3.1720	1,500	2,700	180.0	310	-41.9%
27.10.1720	300	631	210.3	212	-0.8%
23/24.12.1720	3,000	1,400	146.0	160	-8.4%

Note: * unclear if the transaction is for South Sea bonds or stock.

After the collapse in share prices, in October, the bank returned to its earlier practice of lending at the current market value, or prices close to this level, with discounts of 1 to 8%. We find no obvious differences in borrower characteristics or the amounts lent during the height of the bubble. We cannot rule out unobserved heterogeneity explaining some of the variation the ratio of loan values to market values, yet Hoare's had never lent against stocks or bonds at similar discounts outside the bubble period – making it unlikely that some unobserved, undesirable borrower characteristic was to blame.

While the discount to market value did not move one-to-one with the price of South Sea stock, it is apparent that the bank did not believe the market's rise to be permanent – customers borrowing against stock had to accept a substantial haircut, and one that that became much larger as the bubble inflated.[34] We do not have a contracted duration of loans (possibly because the bank and its clients did not agree to one), but the average duration of lending against securities at Hoare's was 497 days. The bank therefore must have expected to hold South Sea stock as collateral over a similar period [Temin and Voth (2003)]. This makes it unlikely that South Sea episode is an example of a rational bubble. The bank's lending betrays the expectation that the bubble will collapse not just with probability one, but over a finite horizon, which means that the expected value of the bubble component (as $t \rightarrow \infty$) must be less than infinity.[35]

The fact that the bank did well on its trades itself is not remarkable. Nor is the discount to market price in its collateralized lending operations with clients. The combination of the two, however, imply that Hoare's trading strategy relied on predicting investors' sentiment during the bubble – betting that prices would rise for a while, even when its lending decisions strongly suggested that it was bracing for an eventual decline. In our context, it is difficult to distinguish between noise trader risk and synchronization risk.

[34] The correlation coefficient is –0.62, significant at the 10% level.
[35] It therefore does not satisfy condition (5) in Blanchard and Watson 1982.

We cannot say for certain whether the bank decided not to attack because it did not expect other sophisticated investors to sell massively, or because it anticipated future demand from unsophisticated market participants. Yet since it was privately held, and had no reason to act with a relatively short time horizon – the classic assumption in noise trader models – synchronization risk seems a more likely cause of Hoare's actions.

VI. Conclusions

On November 27, 1721, it was time for the partners at Hoare's bank to take profits. Henry Hoare, the senior partner, had £21,000 transferred to his private account; Benjamin, the junior partner, £7,000. These were not the normal distributions to the owners at the bank at the end of the annual accounting period; the partners were reducing their involvement in trading stock, and distributing profits. Proprietary trading during the South Sea bubble had been phenomenally successful – the partners probably earned as much in 1720-21 by buying and selling stock as they had during the twenty years previous. Possibly no other single economic activity contributed as much to the partners' prosperity during the bank's early years.

The case of a single investor cannot provide general insight into the nature of bubbles. Yet the detailed, micro-level evidence provides insight into profitable trading strategies that allowed the South Sea bubble to inflate. Five key findings emerge. First, sensationalist accounts of mass folly and behavioral explanations for the bubble tell only part of the story. Hoare's differed substantially from the inexperienced investors that are said to have dominated speculation. Yet it found it profitable to participate, at least for a while, before getting out in time – it was "riding the bubble." Second, short-sale constraints – a leading explanation for the dotcom mania in recent years – probably were not crucial. Even at the height of the bubble, the bank stayed invested to a substantial extent. Given that its preferred exposure was larger than zero, this is incompatible with explanations that stress the limited ability to short shares as a key factor in the inflation of bubbles. Since the bank was owned exclusively by the partners, there was also no incentive problem arising from principal-agent relationships. Third, the bank's trading record was probably not driven by insider knowledge. While it followed some of the trades of its customers, the timing and size of these investments, as well as their connections with the South Sea Company do not suggest that the bank was privy to privileged information. Fourth, we document the extent to which investors could have known – and in many cases clearly did know – that South Sea stock was overvalued. Contemporary writings show a clear appreciation of the impossibility for the company's future earnings to underpin its elevated share price. Finally, we conclude that sentiment predictability – compatible with "synchronization risk" and noise trader interpretations – was crucial for the overvaluation that reached dramatic heights in the summer of 1720. The collapse of share prices after September 1720 was brought about by a coordinating event that made it clear that trading opportunities based on "greater fools" were coming to an end.

We do not argue that synchronization risk was the only cause for the enormous rise and fall of South Sea prices. Hoare's rode the bubble, while acting in other ways that betray a belief that the stock was overpriced; it helped intensify the boom without providing the stimulus for it. Artificial shortages of stock, partly engineered by the company itself through its loan transactions, might have contributed to the bubble, along the line of arguments offered for the dotcom mania [Ofek and Richardson (2003)], but the evidence is not compelling. There was substantial free float, and on average, the subscriptions and lending operations probably increased the supply of South Sea stock in 1720.

Once the writing was on the wall – in the form of an scramble for liquidity after the fourth subscription, and with prices beginning to decline – the bank sharply reduced its positions. Much of the literature emphasized the collapse of the Sword Blade Company on September 24th, 1720. Yet knowledgeable speculators such as Hoare's sold a good part of their holdings weeks earlier. The "coordinating event" for knowledgeable speculators to get out may well have been the decision by the Company to announce a dividend of £30 for 1720, and £50 thereafter – equivalent to a dividend yield of 4-6 per cent at prevailing prices.[36] Once investors were faced with the reality of how low the yield was (while still amounting to the enormous sum of £15 million), coordinating an attack was suddenly easy, and the bubble collapsed. It is noteworthy that Hoare's continued to hold some stock, even after its massive sales in early September. Just as in the case of hedge funds during the NASDAQ bubble of the late 1990s, "riding the bubble" – and accepting the danger of selling a little late in the game – proved superior to a strategy of early attack.

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[36] Carswell 1960, p. 147.

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