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 nonetheless invested in the stock; 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.

JEL Codes: G14, E44, N23

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

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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" raised stock prices above their fundamental values in the 1990s. Others, however, have pointed to structural features of the stock market, such as lock-up provisions for IPOs, analysts' advice, strategic interactions between investors, and the uncertainties surrounding internet technology, as causes of the recent bubble. 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. Data on the daily trading behavior of a goldsmith bank – Hoare's – allow us to examine competing explanations for how bubbles can inflate. While many investors – including Isaac Newton – lost substantially in 1720, Hoare's made a profit of over £28,000, a great deal of money at a time when £200 was a comfortable income for a middle-class family [Carswell (1993) : xvii]. The behavior of a single knowledgeable investor can tell us much about the nature of bubbles and investors during periods of substantial mispricing.

The bank did not profit simply by chance. It "rode the bubble" for a substantial period while giving numerous indications that it believed the stock to be overvalued. Short-selling constraints and the difficulties of arbitrage that have been emphasized in recent work on the dot-com mania cannot explain the South Sea bubble. A zero-investment constraint, if it existed, did not bind market participants like Hoare's. Perverse incentive

effects arising from delegated investment management highlighted in recent work on mutual funds and hedge funds were not at work. We infer that the need for coordination in attacking the South Sea bubble was the key to allowing it to inflate to such an extreme extent, in line with recent theoretical work by Abreu and Brunnermeier (2003) .

There is a rich body of earlier research on the emergence of bubbles. The efficient markets hypothesis rules out substantial mispricing [Fama (1965)]. The same conclusion emerges from no-trade theorems under asymmetric information, as well as from backward induction in finite horizon models [Santos and Woodford (1997b) ; Tirole (1982)]. Famous historical episodes like the South Sea bubble, the turnip mania and the Mississippi speculation have been claimed as examples of markets functioning reasonably well under uncertainty [Garber (2000)].

Recent theoretical and empirical work, however, suggests that bubbles can inflate even if there are large numbers of highly capitalized, rational investors. One school of thought emphasizes short-sales constraints and other technical sources of friction.[1] Ofek and Richardson (2003) argue that short-sale constraints were crucial for the rise of dot-com stocks. 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. In the rational bubbles literature, on the other hand, the prospect of "greater fools" entering the market makes it optimal for investors to hold stock that they know to be overvalued.[2] Noise traders can affect prices in these models and encourage sophisticated investors to stand by the sidelines and not attack a bubble [De Long et al.

[1] Lintner 1969, Chen, Hong and Stein 2000, Jones and Lamont 2001, Jarrow 1981, Detemple and Murthy 1997, Harrison and Kreps 1978.
[2] Blanchard and Watson 1982. Their model was later ruled out by Santos and Woodford 1997a.

(1990) , Dow and Gorton (1994)].[3] Abreu and Brunnermeier (2003) argue that arbitrageurs lack the power to offset irrational exuberance unless they can coordinate their actions; synchronization risk may prevent aggressive attacks on the bubble because individual investors are not large enough to bring down the market on their own. This approach has been used recently to interpret the rise and fall of NASDAQ.[4]

We test the usefulness of these competing explanations using the detailed historical records of Hoare's Bank, placing the South Sea bubble and the bank's performance in context through comparisons with the recent technology bubble. In Section II we describe the historical context, compare the events of 1720 with the dot-com mania, and summarize our data. In Section III we present evidence of Hoare's trading record, derive measures of profitability, and compare the bank's performance with the record of hedge funds during the dot-com boom. Section IV discusses the causes of Hoare's success and examines the hypothesis of insider trading. Section V shows that sophisticated investors understood shares to be overvalued and that expectations of "greater fools" buying later were key for the success of firms like Hoare's. A final section concludes.

II. Historical background

The South Sea Company's history is well-known; only a few key aspects need to be highlighted here.[5] 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 beginning, it

[3] Some degree of myopia often is rationalized as a result of financial incentives in delegated portfolio management [Shleifer and Vishny 1997, Chevalier and Ellison 1997, Agarwal, Naveen and Naik 2002].
[4] Brunnermeier and Nagel 2003.
[5] Carswell 1993, Neal 1990, Scott 1912, Chancellor 1999.

was more involved in handling government debt than foreign trade. The English government's debt in the early eighteenth century was 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 debt holders saw the value of their securities rise, and the company netted a considerable profit. By increasing liquidity, the South Sea Company made a Pareto improvement [Neal (1990) : 94-97].

The success of the 1719 operation inspired a much grander scheme. The South Sea Company proposed to convert almost all of the remaining national debt into its own shares, paying the Treasury for the privilege. In exchange, the Company obtained the right to issue new shares to finance the conversion. As a result of a competitive bid from the Bank of England, the South Sea Company had to improve its offer to the government substantially.

During the bidding war with the Bank of England, the share price rose quickly. The South Sea Company paid bribes to advance its case, granting "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 and, possibly, the King and the Prince of Wales [Carswell (1993) : 104]. By early April, Parliament and the King had approved the conversion; the stock had more than doubled since January. The conversion ratio was not fixed, and the Company could obtain government debt more cheaply as its share price rose, an obvious plus for its owners. The company issued fresh equity in four subscriptions, at higher and higher prices. It also lent generously against its own shares, reducing supply and

increasing demand for them. With the same intention, the Company pushed the government to pass the Bubble Act in June (outlawing unchartered joint stock companies).[6]

Massive trading put pressure on the settlement process. The company closed its books in July and August to catch up with the backlog, and to prepare for the fourth money subscription. The day the account books were opened, selling was massive. The Company found itself short of cash to pay debt holders. Desperate to prop up the sagging stock price, the directors promised dividends of 50 percent of the stock's face value, approximately 6 percent relative to market value.

The Sword Blade Company, founded to produce sword blades, was used as the financial arm of the South Sea Company. It became insolvent in September. Thereafter, the price of South Sea stock declined rapidly. With growing clamor from investors 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 year ended in scandal, with a committee of the House of Commons investigating and the Company's cashier fleeing the country.[7]

How did the rise and fall of stock prices during the South Sea bubble compare with the internet mania during the late 1990s? Table 1 summarizes key characteristics for the three companies for which daily data are available – the Bank of England, the East India Company, and the South Sea Company.[8] 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. During the five-year period before the peak, technology stocks gained more than even the South Sea Company; during the year before the height of the bubble, no

[6] It probably did not influence the share price much: Harris 1994.
[7] Carswell 1993, Dale 2004.
[8] Most of the smaller bubble schemes, akin to many of the IPOs floated later during the dot-com mania, did not leave a continuous record of recorded prices.

tech stock outpaced its shares. The South Sea bubble was largely confined to a sharp run-up in prices over about 6 months; the dotcom mania unfolded over a longer period. The decline during the year after the high point, however, is relatively similar. 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 any of the three internet stocks.

Table 1: Comparison of stock price increases and declines, 1716-21 and 1995-2001

	Stock	Log price increase, 12 months*	Log price increase, 5 years**	Log price decline, peak-to-trough***	St.dev. of daily log returns****
South Sea bubble	South Sea Company	2.13	2.30	-2.12	0.063
	East India Company	0.80	1.08	-1.15	0.033
	Bank of England	0.66	0.72	-0.77	0.026
Dotcom mania	Amazon	1.06	4.27	-1.6	0.058
	Cisco	1.16	3.74	-1.49	0.034
	Microsoft	0.62	2.78	-0.65	0.03

Note: * from minimum during 12 months prior to peak
** from minimum during 5 year period prior to peak
*** lowest value 12 months subsequent to peak
**** from 1.1.1720 to 31.12.1720 and from 1.9.1999 to 30.8.2000.

A. Data

Hoare's trading activity in 1720 is shown in Table 2. Hoare's Bank was and still is a private bank owned by the Hoare family. Richard Hoare was a goldsmith who moved to Fleet Street in 1690 and 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.

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, executed trades for customers, 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. Amounts spent on purchases of stock were entered as credits, and the proceeds of sales as debits, alongside information on quantities traded. Hoare's participated in two subscriptions in 1720, making only one payment in each case.[9] It also received shares and bonds indirectly since it owned some of the government debt being exchanged. 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.[10]

Contemporary publications such as Freke's and Castaing's *Course of the Exchange* provide daily prices [Neal (1990)].[11] Without official market makers, Castaing and his successors had to rely on what they heard in the crowded passages known as Exchange

[9] The bank doesn't appear to have dealt in scrip; instead, it traded shares and bonds received through the exchange of debt just like the other shares it had purchased. It sometimes sold them on the same day. There is no evidence of using forward bargains.
[10] All the archival material is held at Hoare's bank. The data used in this paper comes from the first and second loan ledgers.
[11] The data are available through ICPSR (Study No. 1008). We use Castaing's, since his data are accepted as a reliable guide to transaction prices.

Alley, the small area between Lombard Street and Cornhill in the City. Our data, by contrast, consist of actual trades and confirm the accuracy of Castaing's prices. Trading took place in the two great coffee-houses as well as on the street and in taverns. Transfers were registered by the South Sea Company itself. 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. The combination of reliable daily quotations and detailed evidence of Hoare's holdings makes it possible to examine the bank's trading record, evaluate its performance, and to test some hypotheses about the origins of its success.

III. Hoare's Trading Performance

A. South Sea Stock

Figure 1 shows the timing of trades in South Sea stock by Hoare's bank, and the prices at which it bought and sold. The bank's transactions track Castaing's prices closely; the ledgers therefore confirm the accuracy of the published records. 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. The bank had been buying during the run-up of prices in February and March, but then sold some of its holdings later in the month and in April. After the summer peak, Hoare's apparently decided to limit its exposure, and sold 3,000 shares on September 1st.

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 earned profits of £19,355.

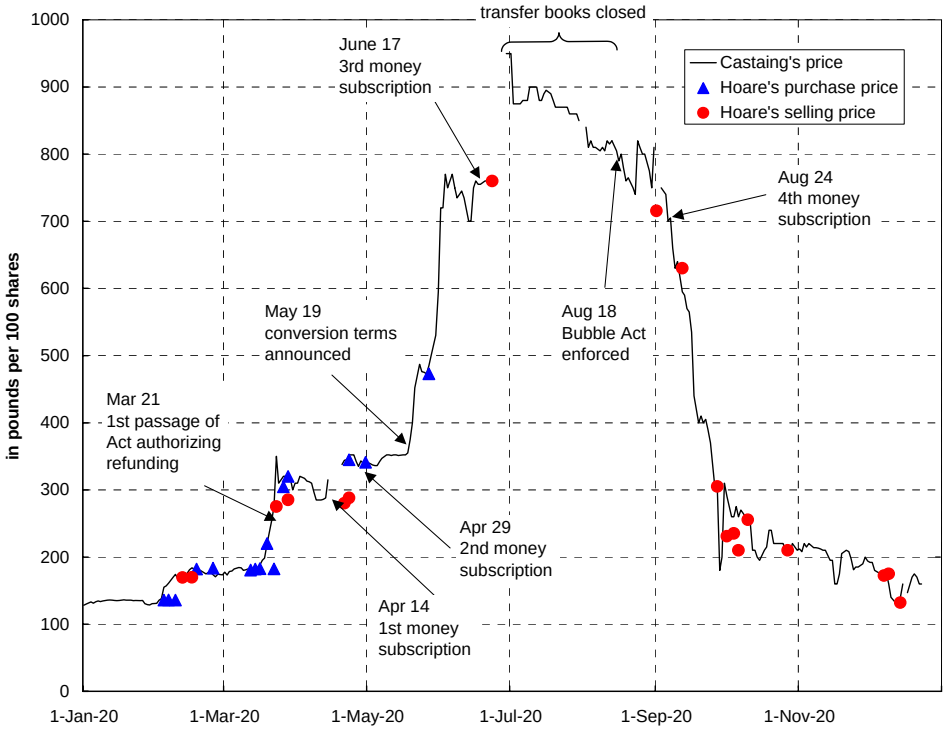

Figure 1: South Sea stock price and Hoare's trading

One way of evaluating the bank's trading performance is to ask if other investors could have earned excess returns by following Hoare's actions. Did the stock drop after Hoare's sold? And did it rise after the bank bought? This is similar in spirit to the tests performed in Odean (1999) , who examined trading performance at a direct brokerage during the 1990s. 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, it 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 longer horizons. We calculate log returns on South Sea stock over one, five, and ten day horizons. In order to avoid same-day returns influencing our results, we begin our event window with the next-day returns, calculated as $\ln(P_{t+\tau}/P_t)$, where τ=1 for one-day returns, 5 for five-day returns, and 10 for 10-day returns. This also avoids confusing our analysis with price impact. We do not have direct evidence on total volumes traded, but Hoare's average transaction was equal to 0.09% of all shares outstanding. This does not suggest that the bank alone was likely to have moved prices. However, the practice of splitting its orders (trading in multiples of 1,000 shares, with a maximum of 4,000 per trade) implies that the bank's trades were relatively large relative to turnover.[12]

[12] It could have done this to either conceal its identity or to minimize price impact.

Table 3: Returns following Hoare's trading

Return	$\ln(P_{t+1}/P_t)$		$\ln(P_{t+5}/P_t)$		$\ln(P_{t+10}/P_t)$	
Panel A:	Hoare's trading		Hoare's trading		Hoare's trading	
Performance following buys	None	Buy	None	Buy	None	Buy
Return on South Sea stock	-0.001	0.032	-0.0079	0.122	0.0002	0.1473
Difference		0.033*		0.1299**		0.1471*
		(0.091)		(0.014)		(0.047)
Panel B:	None	Sell	None	Sell	None	Sell
Performance following sales						
Return on South Sea stock	0.0006	-0.006	0.004	-0.063	0.014	-0.093
Difference		-0.006		-0.067**		-0.107**
		(0.59)		(0.05)		(0.032)
Panel C:						
Multivariate regressions, Newey-West	1	2	3	4	5	6
Bdum	0.033*		0.13**		0.149**	
	(0.08)		(0.013)		(0.043)	
Sdum	-0.0067		-0.069**		-0.11**	
	(0.59)		(0.044)		(0.029)	
Bvol		0.013**		0.058*		0.077**
		(0.044)		(0.07)		(0.027)
Svol		0.0001		-0.012		-0.025
		(0.96)		(0.20)		(0.145)
Panel D:						
Quantile regressions	1	2	3	4	5	6
Bdum	0.016***		0.044***		0.066*	
	(0.01)		(0.028)		(0.035)	
Sdum	0.00003		-0.019		-0.048*	
	(0.98)		(0.18)		(0.06)	
Bvol		0.009***		0.025***		0.056***
		(0.001)		(0.01)		(0.002)
Svol		0.001		-0.0055		-0.012
		(0.35)		(0.2)		(0.39)
Pseudo-R^2	0.003	0.0062	0.013	0.011	0.012	0.011

Note: p-values in parentheses, based on Newey-West heteroscedasticity-consistent standard errors with correction for autocorrelation (5 lags for five-day returns, 10 lags for 10-day returns) in Panels A, B, and C. Significance based on Monte Carlo simulation (as described in the text) in Panel D for regressions 3-6.
*, **, *** indicate significance at the 10, 5, 1 percent level.
Bdum is equal to unity if Hoare's bought at t=0, and zero otherwise; Sdum is equal to unity if Hoare's sold at t=0, and zero otherwise. Bvol is the number of shares bought, in thousands; Svol is the number of shares sold

In Table 3, Panels A and B give the average return on a day when Hoare's bought or sold. The following day, South Sea stock on average rose by 0.033 more than on days when the bank did not buy. Over 5 days, the outperformance amounted to 0.1299, and over ten

days, to 0.147. Since Hoare's sometimes traded more than once during a five- or ten-day interval, we use Newey-West autocorrelation-consistent standard errors. The outperformance is almost always significant. After Hoare's sold, South Sea stock registered large negative returns at 5 and 10 day horizons. In Panel C, we examine the question in a multivariate setting.[13] The size and significance of positive returns following Hoare's decision to buy is confirmed, as are the negative returns following days of sales (at horizons of five and ten days). South Sea stock rose strongly if Hoare's executed large buy orders, and the effect strengthens with the length of the return period; a similar result is not apparent for sell orders. Panel D reports quantile regressions based on minimizing the sum of absolute deviations [Koenker and Hallock (2001)]. This reduces the influence of outliers. The coefficients are markedly smaller, but remain highly significant on the buy side.[14] The procedure confirms the strong outperformance following buy decisions. Our results suggest that, using information from both sell- and buy-decisions at the bank, investors could have earned mean log returns of 0.147 over a ten-day period after Hoare's bought, and avoided a loss of 0.107 after it sold. Observing the volumes of Hoare's purchases and sales does not appear to have enhanced returns beyond the information contained in buy and sell decisions.

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[13] We estimate $\ln(P_{t+\tau}/P_t) = C + \beta Bdum_t + \gamma Sdum_t + \varepsilon_t$ in equations 1, 3, and 5, where τ is the return horizon (1 in eq. 1, 5 in eq. 3, and 10 in eq. 5). In equations 2, 4, and 6, we examine if knowledge about the number of shares traded by Hoare's could have been useful in predicting returns, using Bvol and Svol (the number of shares bought and sold, respectively, in thousands) as explanatory variables.

[14] To test the significance of our results, we ran 10,000 Monte Carlo simulations of returns, using the actual distribution of five- and ten-day returns and a set of randomly assigned dummies for trading days. Significance was established by comparing the size of the estimated coefficients based on actual trading with the distribution of simulated coefficients.

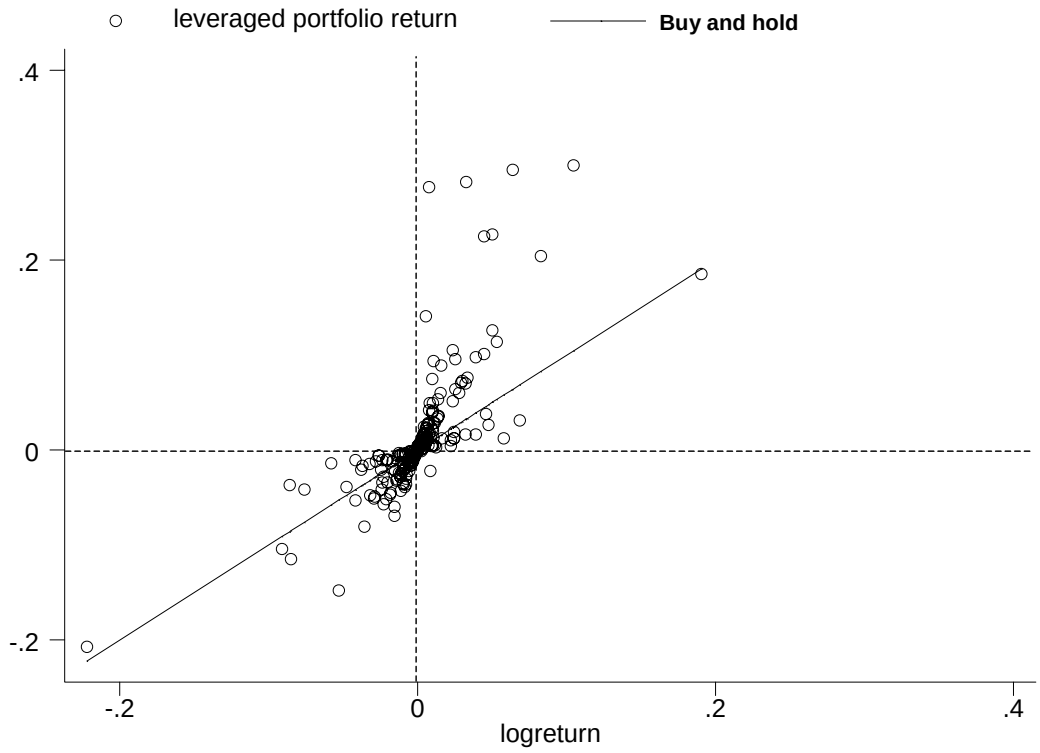

Figure 2: Hoare's trading performance, relative to returns on South Sea stock

We also can examine if the timing of purchases and sales reliably earned the bank excess profits, constructing an artificial "mutual fund" (with varying proportions of South Sea stock and cash, and the total value determined by Hoare's maximum investment).[15] Figure 2 provides a simple graphical representation. 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 therefore illustrates the returns 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

[15] The results shown are for the leveraged leveraged portfolio, constructed by using the bank's overall equity/asset ratio initially and then counting capital gains as equity (from which profit distributions to the partners were substracted).

benefit of large price increases. Yet on balance, Figure 2 suggests highly convex, options-like payoffs, with relatively high loadings on South Sea stock during periods of high returns.[16]

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), its success may have been driven by a simple momentum strategy rather than any investment acumen or insight. To examine this issue, we construct a momentum portfolio – buying a share on every day when the stock price rose, and selling when it fell. Results for this and other strategies are shown in Table 4. By the end of the year, investors using price momentum as an indicator would have lost substantially. Buy-and-hold investors who had put all their money in South Sea stock on the first trading day of the year would have earned a log return of 0.445. Hoare's did much better. A naïve momentum rule cannot have been key for the profitability of its trading, and taking greater risks also was not crucial for its profits. Hoare's unleveraged portfolio has a lower standard deviation of log returns than either the buy-and-hold or the momentum strategy, and the leveraged portfolio is less volatile than buy-and-hold.[17] The bank's trading record is impressive compared to the returns achieved by hedge funds during the recent technology bubble (which showed log returns of 0.86).[18]

[16] We thank an anonymous referee for highlighting the options-like payoffs. Standard performance measures may be less than fully reliable in such an environment. Cf. Dybvig and Ross 1985.
[17] While Sharpe ratios would provide a standard way of adjusting returns for risk, they are unreliable guides to performance measurement in the context of options-like payoffs. Cf. Goetzmann, Ingersoll, Spiegel and Welch 2001.
[18] Brunnermeier and Nagel 2003.

Table 4: Profit/Loss on South Sea stock, from 6 months before market peak to 6 months thereafter

Strategy		Log returns	Standard deviation of daily log returns
Momentum		-0.446	0.043
Buy-and-hold		0.445	0.063
Hoare's	Unleveraged	0.708	0.027
	Leveraged	2.055	0.054

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 – and especially in the case of the most speculative assets. We reconstruct the bank's holdings as comprehensively as the historical record allows, revealing that Hoare's earned large returns on most of its holdings. Hoare's realized a return of 75 percent per month in the Royal African Company in the early summer. In late April, the bank made a profit of 43 percent in 17 days in Ram's Insurance. Hoare's owned substantial holdings of Bank of England stock before the bubble began and bought more at various times in 1719 and in early 1720. The bank sold in April and again in August, earning an internal rate of return equivalent to 51 percent per annum.

In one case, Hoare's trading record is mixed: the East India Company. Initially, the company timed its investments well, netting a return of 26 percent between May and June. Yet the company failed to call the top of the market, leading to a loss of 58 percent.[19] The bank's trading was most successful in the most volatile assets, suggesting that bubbles can be an important business opportunity for sophisticated investors. Hedge funds in the late 1990s showed a similar pattern. Brunnermeier and Nagel (2003) find large excess returns

[19] East India stock was probably being manipulated [Neal 2000]; making it harder to trade successfully.

for trading 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.

IV. Causes of Success

Hoare's trading record was impressive by almost any standard, and it was not due to chance. To demonstrate that Hoare's skillfully "rode the bubble," we also have to demonstrate that the bank did not exploit an unfair advantage, and that it knew South Sea stock to be overvalued. We deal with the first question here and the second in the next section. The bank's long list of well-connected clients could have provided it with important information. Anyone following the stock market in February and March was waiting for Parliament's final decision in awarding the conversion contract.

Hoare's customers traded during this crucial period. Before the authorization of the Act on March 21, Lord Carlton borrowed £9,000 from Hoare's, offering 6,000 shares of the South Sea company as collateral. Hoare's had bought 1,000 shares on the day before, and another 1,000 a week earlier. In early March, a little over a week after Lord Carlton's transaction, the bank purchased 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, and speculative buying of South Sea stock before March 17 was very common [Carswell (1993)]. Had the bank not bought at all before March 21, and paid the price from March 22 for the 7,000 shares it bought since 1.1.1720, this would have reduced its log return for the year to 0.55 (1.77 with leverage),

instead of 0.71 (2.1). While buying before the final decision by Parliament (possibly influenced by private information) helped, it was not decisive for Hoare's performance.

There are also few direct 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 is possible that Hoare's success derived from its customers. Did information contained in customers' trades help the bank's trading record? We model Hoare's trades as a Poisson process in Table 5, with the clients' transactions as the explanatory variable, again using ten-day horizons. If this channel mattered, we should be able to predict the volume and direction of the bank's trading based on the behavior of its clients. The underlying assumption is that, even in relatively inefficient markets, information revealed to the bank ten days earlier would 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. The Pseudo-R^2 suggest that the bank followed the lead of its customers to some extent; higher sales by customers went hand-in-hand with lower purchasing volume by Hoare's, and larger number of purchases are associated with more buying by Hoare's. The same is not true of sales, when the bank was less likely to sell when its customers did – and more likely to sell when they bought. Columns 3 and 4 show how Hoare's trading decisions were affected by same-day returns. In the case of purchases, positive returns increased the likelihood of the bank buying more stock; when South Sea stock was plummeting, it sold.[20] These results however provide little evidence that the bank was following a "momentum strategy" during 1720. The predictive

[20] Price impact is one possible interpretation.

power of returns is modest, and we learn more about the timing and volume of the bank's trades based on its customers behavior than from price changes.[21]

Table 5: Predicting the trading behavior of Hoare's – information from customers

	1	2	3	4	5	6
Dependent variable	Bvol	Svol	Bvol	Svol	Bvol	Svol
Log return			13.5***	-1.73***	15.5***	-34.9***
			(0.001)	(0.001)	(0.001)	(0.001)
Csell	-0.01***	-0.06***				
	(0.001)	(0.001)				
Cbuy	0.63***	0.46***				
	(0.001)	(0.001)				
Pseudo-R^2	0.18	0.07	0.07	0.0009	0.06	0.09
N	313	313	290	290	50	59

Note: Dependent variable is the number of shares bought (Bvol) or sold (Svol). In eq. 5 and 6, we exclude all observations if customers did not buy (eq. 7) or sell (eq. 8) within a 10-day interval, starting on the day of the purchase itself. Csell and Cbuy are the volume of shares sold and bought by customers.
Constant included but not reported.
*, **, *** denote significance at the 10, 5 and 1 percent level, respectively. Probability level in parentheses.

The bank acted as a broker for its clients, and consequently saw some of the order flow for South Sea stock. 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. 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

[21] 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 log return may suffer from attenuation bias.

relatively rare, they will aggressively follow price-informed traders – buying when prices rise, and sell when they fall. In columns 5 and 6 of Table 5, we examine the interaction of stock returns and Hoare's investment decisions during periods following customers' trades. On the buying side, trading is similar – 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 may have had some information that these trades were indicative of price-relevant information.

We can try to gauge the financial importance of information that Hoare's might have extracted from customers' trading. If markedly higher positive returns followed Hoare's decision to buy when customers bought, then information derived from these trades is a likely explanation of the bank's success. Table 6 examines the returns following Hoare's trading decisions, conditional on the behavior of its customers. During the periods when customers were buying, Hoare's buy decisions do not reliably forecast positive returns – but sell decisions forecast negative ones. When customers were selling, there is some evidence that Hoare's sell decisions were followed by large price declines – but no more so than on days during periods when customers were buying. Hoare's trading success cannot be explained by the information inherent in its customers' investment behavior.[22]

[22] 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 this issue further.

Table 6: Returns following Hoare's trading, conditional on customer trades (dependent variable is $\ln(P_{t+10}/P_t)$)

	Customers' trading		Customers' trading	
	Not buying	**Buying**	**Not selling**	**Selling**
Bdum	0.068*	0.14	0.23***	-0.1
	(0.1)	(0.12)	(0.002)	(0.2)
Sdum	-0.1	-0.18***	-0.11**	-0.16***
	(0.13)	(0.02)	(0.08)	(0.004)
Adj. R^2	0.096	0.038	0.0055	0.0044
F	2.37	3.46	5.33	5.95
N	213	64	214	63

Note: *, **, *** denote significance at the 10, 5 and 1 percent level, respectively. P-values based on Newey-West heteroscedasticity and autocorrelation-corrected standard errors in parentheses. Sdum is a dummy variable for days on which Hoares sold; Bdum does the same for days when Hoare's bought.

V. Detecting Overvaluation

A. General Assessments

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, suggest otherwise. And the eighteenth-century did not lack equivalents of modern-day analysts, working hard to convince investors that there was only one direction for shares: up. 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 rarely has 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)].[23] This is further confirmed by the writings of contemporary observers. There was no shortage of doomsayers – including those in high office. Archebald Hutcheson, MP for Hasting, published a series of 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 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."

The Archbishop of Dublin wrote in May 1720 that most investors in South Sea stock "are well aware it will not [succeed], but hope to sell before the price fall."[24] Another investor instructed her broker "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."[25]

In detailed tables, Hutcheson set out the stock's overvaluation at various purchase prices. It is remarkable to see 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 calculations 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

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[23] 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."
[24] Cit. acc. to Scott 1912, vol. 1: 424.
[25] Letter of the Duchess of Rutland to her broker, cit. acc. to Carswell 1993[sic].

argued, dividends of no less than £40 needed to be paid on stock with a par value of £100. He assumed that investors would not have demanded a risk premium, which would have required an even higher dividend, deriving a lower bound on the needed dividend. The absurdity of the maximum prices thus was easily demonstrated. Hutcheson also showed that skilled observers could abstract easily 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. Even in late March, 1720, when South Sea stock was trading at 300, Hutcheson argued that everyone agreed that prices were too high – yet that many expected them to rise even further. This seems in line with the "greater fools" theory of rational bubbles [Blanchard and Watson (1982)].

B. Hoare's Concerns about Overvaluation

Did Hoare's Bank (and other sophisticated market participants) believe South Sea stock to be overvalued? The bank lent against shares as security, and it 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 a large price 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. Interest rates on brokers' loans also increased. Rappoport and White argue that the crash was therefore expected – key players in the market were becoming worried about overvaluation, and reduced their exposure accordingly.

Hoare's lending against South Sea stock as collateral is not directly comparable to 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 likely. Second, 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 for the market in general, the other specific to Hoare's. Contemporary papers such as Hutcheson's *Collection of Calculations* detail the rise in interest rates on collateralized loans. These increased from 5 percent per annum at the beginning of the year to 10 percent per month in April, and to 1 percent per day thereafter. By September, they had fallen to approximately 5 percent 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 percent, and may have been difficult to enforce. 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.

Hoare's bank curtailed the ratio of lending to market value of collateral as the boom wore on. If it had lent at the full market value and prices collapsed, it might not have been able to recover its loans unless the debtor had other assets or income. Table 7 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 or at a 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 percent. Quickly thereafter, when prices had risen by almost 70 percent year-on-year, the discount widened to 57 percent. Some two weeks later, when prices had almost doubled again, the discount was still substantial, if somewhat smaller – 42 percent. There is

also no lending against South Sea stock at all during the peak of the bubble, between April and September 1720.

Table 7: 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 percent. 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 became much larger as the bubble inflated.[26] While we do not have contracted terms of loans, the average duration of lending (with stock as collateral) 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)].[27]

That the bank was "long" during the bubble, and did well on its trades, is not remarkable. Nor is the discount to market price in its collateralized lending operations with

[26] The correlation coefficient is –0.62, significant at the 10% level.

[27] 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 $t \to \infty$) must be less than infinity. It therefore does not satisfy condition (5) in Blanchard and Watson 1982.

clients. The combination of factors, however, implies 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 expected a reasonably quick decline. In our context, it is difficult to distinguish between noise trader risk and synchronization risk. 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.

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.

Five key findings emerge from the micro-level evidence on trading behavior. First, sensationalist accounts of mass folly 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 in the bubble before getting out in time. It was "riding the bubble." Second, short-sale constraints – a leading explanation for the dot-com

mania in recent years –were not crucial to the bubble. 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 also was no incentive problem arising from principal-agent relationships. Third, the bank's trading record is unlikely to have been 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 lack of 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 dot-com 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 late August in the form of a scramble for liquidity after the fourth subscription; with prices beginning to decline, the bank liquidated its positions. The “coordinating event” for knowledgeable speculators to get out may well have been a growing credit shortage in August as a result of subscription payments becoming due [Neal (1990)], and the decision by the Company to announce a dividend of 3-5 per cent at prevailing prices.[28] Once investors were faced with the reality that additional investors were no longer pushing up prices reliably, and of how low the yield was, coordinating an attack suddenly was easy, and the bubble collapsed.

[28] The credit crunch hypothesis is controversial [Dale 2004]. Hoare's own accounts show a decline in cash holdings in late August by over one third within 10 days, a highly unusual and large drop in liquidity.

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