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Credit Provision and Stock Trading: Evidence from the South Sea Bubble

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Abstract

This article studies the relationship between credit provision and stock trading behavior. We collect every stock transaction of the three major British companies during the 1720 South Sea Bubble and link stock trading to margin loan positions with the Bank of England. We give insights in the selection of traders into the loan facility by comparing the trading behavior and realized returns of borrowers to other traders. We find that loan holders are more likely to buy following high returns and document strong underperformance of borrowers.

I. Introduction

The relationship between credit and asset price bubbles has been a topic of interest for economists for many decades (Fischer (1933), Galbraith (1955), Minsky (1992), Mian and Sufi (2009), and Adelino, Schoar, and Severino (2016)). Recent empirical work has shown that easy access to credit is at the root of many equity market booms and busts (Reinhart and Rogoff (2009), Brunnermeier and Schnabel (2016)), but the mechanism through which credit affects trading strategies, prices, and wealth transfers is still unclear. In this article, we study what type of equity

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traders take credit, how they trade, and whether they gain from their investments. Understanding these issues is important as it gives insights into what policies could be effective in addressing asset bubble formation, for instance, financial literacy programs over margin requirements (Mishkin (2008), Barsky and Bugusz (2014), and Lusardi and Mitchell (2014)).

Economic theory provides different views on the selection of traders into leverage with different implications for trading and wealth transfers during bubbles. On one extreme, naive traders could transfer wealth to rational arbitrageurs because they borrow and ride the bubble unsuccessfully (Galbraith (1955), pp. 46–50, Kindleberger (1978), Barberis, Greenwood, Jin, and Shleifer (2018), and Bordalo, Gennaioli, Kwon, and Shleifer (2021)). On the other extreme, rational investors could use credit to ride the bubble successfully and outperform other traders (Abreu and Brunnermeier (2003), Temin and Voth (2004)). To identify the mechanism that links credit provision to prices, we need to compare the characteristics, trading behavior, and realized returns of loan holders to those of non-loan holders. However, such an in-depth analysis is empirically challenging for three reasons. First, we typically do not observe trader identities and we are unable to link trader characteristics and stock transactions to loan positions. Second, it is difficult to identify trading strategies for a representative sample of leveraged investors as most contemporary data sets focus on a particular type of trader (e.g., hedge funds or nonprofessional investors). Third, it is difficult to determine whether trading behavior is explained by moral hazard or trader characteristics.

We tackle these issues by studying margin loan provisions in the London equity market during the 1720 South Sea episode, a financial boom and crash that is widely considered a classical example of a bubble. In the spring of 1720, the Bank of England opened a facility allowing its shareholders to borrow money by collateralizing their Bank of England shares. We hand-collect *every* single equity transaction with buyer and seller identities for three major British companies (Bank of England, East India Company, and Royal African Company) and link the transactions to loan positions in the Bank of England facility. The three companies represented about 50% of the market in terms of pre-bubble market capitalization. We also link our trading and loan data to the complete list of subscribers for highly overvalued new share offerings in two other companies (South Sea Company and London Assurance Company).

Our data have the scope and level of detail to address each of the three empirical challenges we outlined. First, our main data source consists of trader-specific ledger accounts that record trader and borrower identities and enable us to observe each trader's daily holdings, loan positions, and share trades. Second, we do not focus on a particular type of trader as we observe the loan positions and stock transactions of *all* shareholders and loan holders. The broad market coverage of our data allows us to make general statements about the relationship between debt and trading strategies. Moreover, it facilitates an accurate measurement of wealth transfers between loan holders and other investors. Third, bank loan holders were personally liable for all their losses, also in case of default. This implies that borrowers were not subject to moral hazard and could not strategically default on

their loans. This implies that trading behavior can only be explained by trader characteristics, a conjecture we verify in our data.[1]

In the first part of our analysis, we study what type of trader takes a loan. We find that inexperienced investors and active traders were more likely to use the loan facility. Market proximity also mattered because traders who lived closer to the market showed a higher propensity to borrow. We classify an investor as inexperienced if she held no stock in the 5 years leading up to the bubble and measure trading activity by the number of trades.

We then proceed by comparing the trading behavior and realized returns of loan holders to those of other investors. Our analysis shows that bank loan holders behaved as extrapolators, that is, they were more likely to buy stocks that recently went up in price. For instance, in the spring of 1720, bank loan holders were approximately 65% more likely to buy recent winners than other traders. Consistent with our extrapolation results, we find that borrowers were also twice as likely to subscribe to new share offerings when these stocks traded at peak prices (6 to 8 times pre-bubble quotes). Even without taking returns on these new offerings into account, borrowers incurred large trading losses. Bank of England loan holders realized 14 to 23 percentage points lower annualized returns than other investors. These findings are consistent with a selection effect because Bank of England loan holders cannot strategically default on their loans. In line with this hypothesis, we find that the effects become weaker once we control for traders' characteristics and trader × date fixed effects. More specifically, we find that margin loans relieved credit constraints on investors who had little experience and intended to ride the bubble. In additional tests, we show that our findings cannot be explained by information asymmetries between investors (Brennan and Cao (1996), (1997), Brennan, Cao, Strong, and Xu (2005)) or destabilizing short selling (Lamont and Stein (2004), Hong, Kubik, and Fishman (2012)). We also document a positive relationship between loan holder buying pressure and forward-looking stock returns, consistent with the idea that extrapolating borrowers drive up prices.

Our main specifications control for company × date fixed effects that absorb any time-varying company event that could drive both credit decisions and trading strategies. The fixed effects also control for any company-specific or macroeconomic event that explains both the creation of the loan facility and investors' trading behavior. We focus on Bank of England loans because they are the most likely to capture a selection effect. In the spring of 1720, the South Sea Company also opened a loan facility that allowed its shareholders to borrow cash using South Sea Company shares as collateral. Its terms were more generous than those of the

[1]The loan-to-value ratio of bank loans ranged between 0.5 and 0.7, implying that any trading loss was fully taken by the borrower, even if she defaulted. Anecdotal evidence confirms that also ex ante it was reasonable for investors to expect that the Bank of England loan facility did not include a strategic default option. For instance, stockbroker Peter Crellius wrote on Jan. 16, 1720: "the general opinion is that they [shares] will all continue to rise. Bank shares are not mounting as rapidly as the others, but opinion ranks them the safest of all: most of the speculation is falling on the South Seas" (Wilson (1941), p. 124) (see Appendix A.1 for more details). Notice that a necessary condition to observe strategic defaults is that borrowers are protected by limited liability. This was indeed the case in Britain. Since 1704, British bankruptcy law allows the borrower to be discharged from her debt in case of good conduct and if at least 80% of lenders agree.

bank and it implicitly offered its borrowers a strategic default option.[2] To be sure that our effects are entirely driven by Bank of England loan holders, we also re-run the regressions excluding South Sea Company loan holders and we find very similar results.

Our sample ranges from Jan. 1 to Oct. 6, 1720, which means that we do not capture the full unwinding of the bubble. We end our sample on Oct. 6 because a confounding event took place on that date. The Bank of England agreed to bail out the South Sea Company and unexpectedly called all outstanding loans on Oct. 6 to raise cash. If we extend the sample period and include this margin call, we mechanically reinforce our findings because loan holders were forced to sell when prices were already falling.[3]

Our article makes two contributions. First, it contributes to the growing literature that studies the relationships between margin lending, trading behavior, and investor performance (Bian, Da, He, Lou, Shue, and Zhou (2021), Subrahmanyam, Tang, Wang, and Yang (2024)). Most of these studies typically exploit credit *contractions* and show that margin traders, on average, realize lower returns.[4] Differently from margin calls that almost mechanically induce traders to sell, we focus on the effects of credit *provision* on trading strategies and performance, as theoretically, it is not clear who takes credit, how a borrower trades, and how she performs. We find that credit affects prices by allowing extrapolators to buy stocks that recently had high performance. Our article is also different from Heimer and Imas (2020) and Heimer and Simsek (2019). While the former shows that tighter leverage constraints reduce the disposition effect by encouraging traders to accept losses, the latter reveals that stricter leverage constraints improve retail investor performance by reducing trading frequency and brokerage fees. Again our study focuses on credit expansion and related trading strategies. Moreover, we measure performance net of fees and find that loan holders underperform other traders because they pursue unsuccessful trading strategies.

Second, we contribute to the literature on trading strategies during financial bubbles. We show that extrapolative strategies employed by margin loan holders lead to poor performance. This finding adds to the literature on trading strategies during financial bubbles (Brunnermeier and Nagel (2004), Dass, Massa, and Patgiri (2008), Greenwood and Nagel (2009), Griffin, Harris, Shu, and Topaloglu (2011), Xiong and Yu (2011), Barberis et al. (2018), and Temin and Voth (2004)). Differently from these studies, we study how credit provision is related to trading and performance during a bubble. Temin and Voth (2004) also study trading behavior during the South Sea Bubble and show that an experienced trader like the Hoare's Bank successfully rode the bubble and sold its holding right before the peak of

[2]Information on the South Sea Company loan holders are not as complete as those of the Bank of England loan holders. In particular, we only have the list of loan holders that did not repaid the loan before the bubble burst.

[3]We indeed find that extending the time period of our analysis strengthens our results.

[4]While these studies consistently find inferior performance of the average margin trader, there can be a small fraction of investors that makes substantial profits. For instance, Subrahmanyam et al. (2024) show that margin lending enhances the daily returns of skilled investors as it amplifies the profits of liquidity provision by these traders.

prices. Our analysis is very different as we analyze the entire universe of investors in three major companies rather than focusing on one trader.

II. Historical Setting

A. The South Sea Scheme

The South Sea Company was established in 1711, as a result of the Peace of Utrecht, and was granted the trade monopoly between Britain and South America. Rather than being involved in international trade, the directors geared the company's business toward finance and, in particular, sovereign lending. During the war campaigns of the early 18th century, the British government accumulated a large amount of debt. The government paid relatively high yields because its debt was illiquid.[5] The South Sea Company proposed to swap government debt with South Sea Company shares and bonds. In theory, such a scheme would have made everybody better off. The government would have profited because they received an immediate cash payment and negotiated a reduction in coupon rate with the new annuity holder (the South Sea Company);[6] the public would have held a more liquid and standard financial asset; and the South Sea Company would have earned a spread between the yield received by the government and the yield paid to its bondholders.[7] Two swaps of limited size were implemented successfully in 1711 and 1719, and the company proposed a more ambitious scheme in 1720. The new plan considered the swap of almost the entire British government debt with South Sea Company claims.

The Bank of England also bid for a similar scheme, and it is believed that the competition between the two companies lead the South Sea Company to overpay in order to be granted the swap (Dale (2004), p. 75). In the final agreement, the company paid the government a *fixed* amount of £7.6 million to receive the right to exchange government annuities for South Sea Company equity and bonds. The terms of the agreement gave strong incentives to the South Sea Company to raise share prices. The debtholder traded her annuity for shares valued at *market* prices: a higher market price implied that the company could purchase the outstanding government debt with fewer shares. The government further allowed the company to raise £31.5 million of *nominal* capital to finance the debt acquisition. If the South Sea Company needed less than £31.5 million to swap the annuities, it could use the leftover to issue new shares in the market against (high) prices. Government debtholders responded enthusiastically to the swap. The price of the South Sea

[5]The illiquidity was caused by large denominations and because annuities were assigned to a particular person and therefore difficult to transfer (see Dale (2004), p. 25).

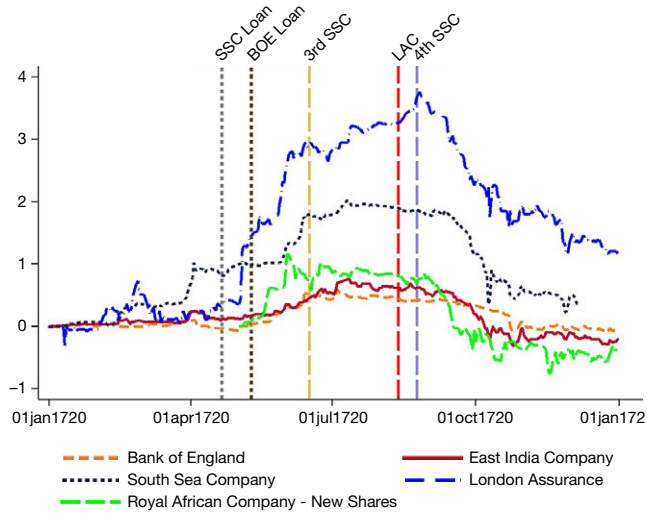
[6]The government negotiated lower coupons on both outstanding and new bond issues.

[7]It was virtually impossible for the British government to lower the coupon rate on outstanding annuities before the debt-for-equity swap because these annuities were held by a large and diverse group of investors. A reduction of the fixed coupon rate would have had to be negotiated with many different security holders. However, after the conversion, holdings of government debt were very concentrated. In particular, the South Sea Company held the vast majority of annuities, while the bank and the East India Company retained some smaller holdings. Such a concentration made it a lot easier for the British government to renegotiate the coupon rate. In particular, at the beginning of 1720, the coupon rate of the annuities held by the public was between 7% and 9%. After the debt-for-equity conversion, the coupon rate was lowered to 5% until 1727 and 4% after 1727 (Dale (2004), pp. 73–76).

FIGURE 1

Bubbles, Margin Loans, and New Subscriptions

Figure 1 displays log market prices for Bank of England, East India Company, Royal African Company, South Sea Company, and London Assurance Company for the year 1720, where prices are normalized to their Jan. 1st value. The first two vertical lines indicate the opening of the loan facilities of the South Sea Company (Apr. 21, 1720) and the Bank of England (May 10, 1720), respectively, the third vertical line represents the opening date of the South Sea Company's third share subscription (June 17, 1720), the fourth vertical line represents the opening of London Assurance Company's shareholder register (Aug. 12, 1720), and the fifth vertical line represents the opening date of the South Sea Company's fourth share subscription (Aug. 24, 1720). The figure shows that all companies in our sample exhibit a price run-up and a strong reversal which are characteristic for bubble periods. However, there is large cross-sectional dispersion in price patterns because the London Assurance Company, South Sea Company, and Royal African Company bubble more strongly than the other companies in our sample.



Company's stock rose from £200 per share in February to almost a £1,000 per share in June and the company undertook various new offerings in the summer of 1720 (see also Figure 1). The enthusiasm was based on the successful conversions arranged by South Sea companies in the previous years. Hopes in the developments of the trades with the Americas (where the South Sea Company was formally involved) and innovations of the maritime insurance business also triggered the enthusiasm of investors (Frehen, Goetzmann, and Rouwenhorst (2013)). Some contemporaries believed that these valuations were well above the fundamental value of the South Sea Company. As we discuss in Appendix A.2, Archebald Hutcheson, a member of parliament, authored a series of newspaper articles in Mar. 1720 providing arguments for the overvaluation of South Sea stock. He estimated that the fundamental value of the South Sea stock was in the range of £150–400 per share, while peak-level market prices were around £1,000.

B. Margin Loan Facilities

On May 10, 1720, the Bank of England created a margin loan facility.[8] The minutes of the bank director meetings remained elusive about the motives: "it may

[8]It is important to note that the Bank of England was a publicly traded company before it was nationalized and became Britain's central bank in 1945. In the early eighteenth century, the bank's

be for the service of this bank to lend money to the proprietors upon this bank stock." Bank shareholders could borrow cash by depositing their bank shares against a 5% interest per year, which was lowered to 4% on July 14. The loan amount was limited to £100 for each £100 nominal of bank stock, while the market price for the same amount was approximately £150 when the facility was opened. The new loan facility undercut prevailing interest rates in the market.[9] The creation of the bank loan facility followed a similar initiative by the South Sea Company on Apr. 21. Their shareholders could borrow cash by depositing South Sea shares against 5% interest per year, which was also lowered to 4% after a few weeks. The South Sea facility allowed shareholders to borrow £250 (later raised to £400) on each collateralized share of £100 nominal value. The different loan conditions imply that the loan-to-value ratio of the bank was much lower than that of the South Sea. Bank borrowers had no opportunity to lay off losses to the lender, while South Sea loan holders were subject to moral hazard (see Appendix A.1 for more details).

The bank and South Sea loan facilities were opened during an extreme credit crunch with interest rates on collateralized loans rapidly increasing.[10] Relative to other lending opportunities, both facilities were very attractive as their interest rates were much lower and the borrowed funds could be used for any purpose.

In the fall of 1720, both loan facilities were closed. The South Sea Company stopped issuing new loans after Aug. 29, 1720, but did not call any outstanding loans.[11] On Oct. 6, the bank officially announced the full annulment of the loan facility: "no loans to be made upon bank stock until further order." The annulment was due to financial difficulties the bank was experiencing as a result of the financial assistance it provided a few weeks before to the South Sea Company.[12]

C. The London Financial Market in the Early 18th Century

The basic structure of the London financial market in 1720 was very similar to the setup of contemporary financial markets (Cope (1978)). Trading was organized in a system of brokers and market markers (known as jobbers). An investor who wanted to undertake a transaction contacted a broker, who in turn inquired with

primary business activities were providing banking services to the government and commercial lending to corporations and wealthy individuals (Richards (1934)).

[9]Temin and Voth (2004) report that in Apr. 1720 interest rates on collateralized loans with other lenders were 10% per month and became 1% per day thereafter.

[10]Hutcheson's *Collection of Calculations* (1720) explains that interest rates on collateralized loans had increased from 5% per year in Jan. 1720 to 10% per month in April, while the bank and South Sea Company charged only a 4% annual interest rate on their share loans.

[11]Economic historians relate the closure to the company's growing liquidity crisis and its immediate needs for funding (see, e.g., Dale (2004), pp. 120, 140–141).

[12]Perhaps as a result of political pressure, the Bank of England decided to assist in resolving the South Sea Company's liquidity crisis by agreeing to buy subscription shares for a total of £3.75 million against a pre-determined price (Neal (1993), p. 115). Shortly after the bail out, on Sept. 24, the South Sea Company's prime bank (Sword Blade Bank) defaulted on its payments and the South Sea Company share price dived well below the Bank of England's purchase price, generating large losses for the bank. This lead to a spill-over of the financial problems to the Bank of England. The bank's directors addressed these adversities by recalling all outstanding loans and offering an interest rate discount to margin loan holders who repaid on a short notice (Neal (1993), p. 112).

various jobbers and eventually took the best deal on behalf of his client. As today, the price system was based on bid and ask prices. Investors obtained information about securities and trends in the market from newspapers usually available in the coffee houses surrounding the exchange. Both equity and bonds were traded in the Royal Stock Exchange. A derivative market was also well established, with options, futures, forwards, and naked-shorts being traded on various British securities (Dickson (1967), pp. 498–505, Cope (1978)). However, such contracts were privately negotiated and few survived. It is therefore difficult to gauge how liquid and deep these markets were. We address forward trading also in Section VI.B. In particular, we test whether our results are robust to the exclusion of forward trading.

III. Hypotheses Development

In this section, we discuss the empirical predictions of three different economic theories and our empirical strategy to differentiate between them. Before discussing the theoretical framework, we rule out an alternative reading of our findings by noting that bank loan holders were personally liable for their trading losses. Since our analysis focuses on bank loans, this implies that our findings cannot be explained by moral hazard. We support the conjecture that bank borrowers were not subject to moral hazard by computing strategic default option values for loan holders in Appendix A.1. We find low default option values, which implies that the ex-ante probability that stock prices would fall below the loan amount is very low.[13] These low default option values are also in line with the level of bank stock prices prior to the opening of the loan facility. In particular, prices had been consistently above the nominal loan amount for almost 13 years and were more than 50% above the loan amount when the facility opened. This gap widened as bank share prices rose during the bubble, making the default option even less valuable. The absence of strategic default options for bank borrowers implies that the facility simply relieved a credit constraint on its shareholders. In other words, it did not change borrowers' trading behavior because they remained personally liable for their losses. Our empirical tests in Section V will verify this conjecture.

A. Discount Rate Channel

The first theory, which we call the discount rate channel, assumes that there is no heterogeneity and disagreement among investors about share valuations. Under these conditions, the discount rate channel predicts that an increase in credit supply affects only share prices but does not affect trading behavior. This is because an increase in credit supply reduces interest rates and increases share prices mechanically. Since there is no disagreement, market participants update their valuations without the need of trading and prices do not deviate from fundamental values. An example of this mechanism is a situation where no agents borrow from the bank, but the existence of the lending facility leads every market participant to update her share valuations through lower discount rates. Another example is a merchant drawing credit for business purposes: purchasing goods, redeeming more

[13] In contrast, South Sea borrowers had valuable strategic default options and defaulted massively on their loans when the bubble burst.

TABLE 1

Theories and Empirical Predictions

Table 1 reports an overview of the three theories (in columns) and their accompanying predictions about trader types and relative gains and losses.

	Discount Rate	Rational Bubble Riding	Extrapolation
Who is the extrapolator?	–	Arbitrageur	Behavioral trader
How does the extrapolator perform?	–	Gain	Loss

expensive credit or paying employees without buying additional shares. Under the null of this theory, we also expect no differences in realized returns between borrowers and other investors. We summarize these predictions in the first column of Table 1. Notice that this theory does not assume that stocks are overvalued and it is compatible with rational bubble explanations (Garber (1990), Pastor and Veronesi (2006)).

B. Rational Bubble Riding

A second theory assumes that rational investors (arbitrageurs) become sequentially aware of a stock's overvaluation. These arbitrageurs ride the bubble counting on selling their holdings before it will burst. However, they also face coordination constraints, that is, they do not know if and how many other rational agents are aware of the mispricing (Abreu and Brunnermeier (2003)). The resolution of this uncertainty determines when they will exit the market and allows the bubble to grow. An arbitrageur will sell her holdings only when is sure that there are enough arbitrageurs that also recognize the mispricing. In this context, credit may allow arbitrageurs to pursue their strategies and ride the bubble. Therefore, if credit is obtained by this type of arbitrageur, we would observe that loan holders: i) buy stocks that recently experienced high returns and ii) realize higher trading gains than non-loan holders. We summarize these empirical predictions in the second column of Table 1.

C. Extrapolation Channel

A third theory assumes that behavioral traders act as extrapolators, that is, they consider the recent past return of a stock a reliable predictor of its future returns (Barberis et al. (2018)). As a result, extrapolators' demand for stocks is increasing with rising share prices while rational investors gradually leave the market as the stock becomes more and more overvalued. Rational investors sell their stocks to extrapolators that incur large losses when the bubble bursts. Access to credit relieves credit constraints of behavioral traders that engage in extrapolative strategies. If credit is taken by behavioral traders, we would observe loan holders to buy stocks that recently experienced high returns and then incurring trading losses vis-à-vis non-loan holders.

Notice that both the extrapolation and the rational bubble riding channel assume that prices exceed fundamental values and that some investors are aware of this mispricing. While it is always difficult to prove that stocks are overvalued (even ex post), the South Sea episode is widely regarded as a schoolbook example of a financial bubble. We believe that a significant number of contemporaries also

perceived stock prices to be higher than their fundamental values in the spring and summer of 1720. We support this conjecture in more detail in Appendix A.2.

IV. Data

We hand-collect daily stock trading, holdings, and loan position data for every individual shareholder of the Bank of England, East India Company, and Royal African Company over the course of the South Sea Bubble ranging from Jan. 1 to Oct. 6, 1720.[14] These three companies represented about 50% of the market in terms of pre-bubble market capitalization. We collect every individual transaction with buyer and seller identities and link these trading data to shareholder characteristics and daily equity holdings in the three companies. We expand our data set with daily loan positions in the bank margin loan facility (see Section II.B for more details) and also collect daily margin loan positions with the South Sea Company to make sure that our treatment and control groups are not over-represented by South Sea borrowers. We exclude South Sea borrowers to ensure that our results cannot be attributed to moral hazard since Bank of England borrowers had no opportunity to lay of losses to the lender while the South Sea borrowers did.

At the height of the South Sea boom, many companies took advantage of high valuations by issuing new shares. The South Sea Company issued four batches of new stocks and the London Assurance Company also extended its capital base. Investors who desired to purchase these new stocks, had to write down their name and desired amount on *so-called* subscription lists. We collect all names and amounts for the third and fourth South Sea stock issue and the second London Assurance offering. For a more detailed data description, archival references and examples, we refer to our Supplementary Material.

Performance Measure

We measure a trader's time-varying realized performance using a daily and stock-specific rate of return:

$$\text{RETURN}_i = \frac{\left(P_{jt} - \bar{P}_{ijt}\right) \times \text{SELLS}_{ijt} + \text{DIV}_{jt} \times \text{HOLDINGS}^N_{ijt-1}}{\overline{\text{HOLDINGS}}^M_{ij} \times \text{HOLDING\_DAYS}_{ij}} \times 170, \tag{1}$$

$$\bar{P}_{ijt} = \sum_{\tau=\tau_{0i}}^{t} \frac{P_{ij\tau} \times \text{BUYS}_{ij\tau}}{\text{HOLDINGS}^N_{ijt-1}}, \tag{2}$$

where SELLS_{ijt} is the number of stocks j sold by investor i at date t, and P_{jt} is stock j's price at t. $\bar{P}_{ijt}$ is trader i's weighted average buy price of stock j, where the weights are the number of stocks j purchased by trader i ($\text{BUYS}_{ij\tau}$), divided by the trader's number of stocks j held at time $t-1$, that is, right before the sale ($\text{HOLDINGS}^N_{ijt-1}$), τ_{0i} is the first date before the sell that the holdings of trader i change from zero to

[14] We stop our sample period on Oct. 6 to make sure that our results are not driven by the margin call made the Bank of England on that date.

positive. DIV_{jt} is the percentage dividend paid on stock j at date t.[15] $HOLDINGS^{N}_{ijt-1}$ are trader i's number of stocks j at $t-1$, whereas $\overline{HOLDINGS}^{M}_{ij}$ represents the average market value of trader i's holdings in our sample period. $HOLDING\_DAYS_{ij}$ are the number of days that trader i has positive holdings of stock j in the sample period.

We explain the main intuition behind our performance measure using a simple numerical example. Consider a trader who buys a particular stock j in three batches.[16] In particular, she buys 3 stocks on Jan. 7 for a price £120, 2 stocks on Feb. 22 for a price of £150, and 2 stocks on Mar. 13 for a price of £160. This implies that the average purchase price (P_{ijt}) for these stocks equals $£120 \times \frac{3}{7} + £150 \times \frac{2}{7} + £160 \times \frac{2}{7} = £140$. Let us further assume that she sold all 7 stocks on July 11 for a selling price (P_{jt}) of £170 and that no dividends were paid in the 100 day (Jan. 7–July 11) holding period. We also assume that the average daily market price over the 100 day period equals £150. This implies that the average market value of the trader's holdings ($\overline{HOLDINGS}^{M}_{ij}$) equals $7 \times £150 = £1,050$.

The numerator of our performance measure simply captures the trader's revenues (i.e., she sold seven shares ($SELLS_{ijt}$) for a total amount of £1,190 $(= £170 \times 7)$. These shares had been purchased for a total amount of £980 $(= £140 \times 7)$). Since no dividends were paid, total trading revenues amount to £210. To put these trading gains in perspective, we divide them by the market value of the trader's average holdings (£1,050) and interpret these scaled trading gains as a realized return. In other words, she has gained £210 on an average position of £1,050 which implies a 20% return. Ultimately, we also want to compare realized returns for traders with different holding periods. In order to achieve that goal, we annualize each trader's realized returns by dividing by the number of days that she held the position ($HOLDING\_DAYS_{ij} = 100$) and multiplying by the number of trading days in a year (170). The annualized realized return thus equals $\frac{20\%}{100} \times 170 = 34\%$.

The time variation in individual stock-level returns is important because it allows us to control for trader fixed effects, company fixed effects and company × trader fixed effects in the analysis. Hence, if the loan facility attracts poorly performing traders, we would expect the performance differential to decreases after including time-invariant trader fixed effects.

Table 2 reports that the average trader gains 4% per annum in the years leading up to the bubble. Since the summary statistics are reported at the investor level, this measure reflects the average return across the Bank of England, East India Company, and Royal African Company. Where the performance of borrowers is similar to the average investor in the period 1715–1719, loan holders underperform during 1720. As expected, 1720 also stands out in terms of volatility. The cross-sectional dispersion is thus much larger than during a non-bubble year.

[15]Companies pay dividends on the nominal holdings.

[16]We focus on only one stock for the sake of simplicity, but our line of reasoning and interpretation would not change if the trader bought and sold different stocks.

V. Results

A. Who Takes a Margin Loan?

We start our analysis by asking a simple question: what investors collateralized their shares? Specifically, we examine whether loan holders are systematically different from the average investor. This analysis gives a better understanding of what type of trader takes a loan and may provide some preliminary insights into the theories we summarized in Table 1. For instance, it seems unlikely that an inexperienced trader may consciously ride the bubble like a rational arbitrageur. In our baseline specification, we run a probit regression where the main dependent variable is a dummy variable that equals 1 if an investor takes a margin loan from the Bank of England, and 0 otherwise. We present the marginal effects of the probit regression in Table 3.

In column 1 of Table 3, we relate investors' probability of having a margin loan to their trading frequency and performance. In particular, we compute the number of trades and the realized returns in the 5 years before 1720, as specified in Section IV.A. We take this measure as an informative indicator of investors' trading skills, measured

TABLE 2

Summary Statistics

Table 2 reports summary statistics of the variables in our data. We report mean, 10th and 90th percentile for traders that borrowed from the Bank of England loan facility and for all traders. $\ln(\text{HOLDINGS})_i^{1715-19}$ is the value-weighted average trader's portfolio holdings between 1715 and 1719; $\ln(\text{TOT\_TRADES})_i^{1715-19}$ is the total number of transactions of a trader between 1715 and 1719; ACTIVE_TOP_1_i is a dummy variable that takes the value of 1 if a trader belonged to the 1st percentile in terms of number of transactions between 1715 and 1719; ACTIVE_TOP_50_i is an indicator variable for traders between the 1st and 50th percentile of the number of transactions between 1715 and 1719; BUYS_VALUE_i (SELLS_VALUE_i) is the daily market value of shares bought (sold) by a trader; $\text{RETURN}_i^{1715-19}$ is the value-weighted trader-specific realized portfolio return between 1715 and 1719, where we weight stock-specific realized returns with the trader's average nominal holdings of the stock; RETURN_i^{1720} is the value-weighted trader-specific realized portfolio return in 1720; NEW_INVESTOR_i is a dummy variable that takes the value of 1 if a trader does not appear in our sample before Jan. 1, 1720; $\text{LOAN}_i t$ is a dummy variable that takes the value of 1 if a trader held a Bank of England loan at time t; LONDON_i is a dummy variable that takes the value of 1 if a trader lived in the greater London area (City of London, Holborn, Wapping, Moorfields, Westminster, Middlesex, Bethnal Green, Sepulchre, Covent Garden, and Shadwell); FOREIGN_i is a dummy variable that takes the value of 1 if a trader was not British or Irish; ARISTOCRAT_i is a dummy variable that takes the value of 1 if a trader was an aristocrat (Lady, Dutchess, Marquess, Viscountess, Baroness, Princess, Countess, Prince, Graf, Marquis, Duke, Honorable, Earl, Baron, Count, Viscount, and Lord); BROKER_i is a dummy variable that takes the value of 1 if a trader was a broker; MALE_i is a dummy variable that takes the value of 1 if the trader was male; SSC3_i (SSC4_i) is a dummy taking the value of 1 if a trader subscribed to the South Sea Company third (fourth) subscription; and LAC_i is a dummy that takes the value of 1 if a trader subscribed to the London Assurance second subscription.

	Mean		p_{10}		p_{90}	
	Borrowers	All	Borrowers	All	Borrowers	All
$\ln(\text{HOLDINGS})_i^{1715-19}$	1,018	819	0	0	2,715	1,912
$\ln(\text{TOT\_TRADES})_i^{1715-19}$	11	6	0	0	24	11
ACTIVE_TOP_1_i	0.03	0.01	0.00	0.00	0.00	0.00
ACTIVE_TOP_50_i	0.51	0.45	0.00	0.00	1.00	1.00
BUYS_VALUE_i	8,979	3,941	0	0	20,345	6,394
SELLS_VALUE_i	6,989	3,905	0	0	18,130	6,794
$\text{RETURN}_i^{1715-19}$	0.04	0.04	0.00	0.00	0.08	0.09
RETURN_i^{1720}	−0.01	0.15	−0.83	−0.79	0.42	0.70
LOAN_{it}		0.13		0.00		1.00
NEW_INVESTOR_i	0.35	0.24	0.00	0.00	1.00	1.00
FOREIGN_i	0.01	0.06	0.00	0.00	0.00	0.00
LONDON_i	0.80	0.68	0.00	0.00	1.00	1.00
ARISTOCRAT_i	0.04	0.03	0.00	0.00	0.00	0.00
BROKER_i	0.02	0.01	0.00	0.00	0.00	0.00
MALE_i	0.91	0.81	1.00	0.00	1.00	1.00
SSC3_i	0.31	0.17	0.00	0.00	1.00	1.00
SSC4_i	0.23	0.10	0.00	0.00	1.00	0.00
LAC_i	0.11	0.04	0.00	0.00	1.00	0.00

in the pre-bubble period. We also examine a dummy variable, NEW_INVESTOR, that takes the value of 1 if an investor has never traded in any of the stocks in our sample before 1720.

Column 1 of Table 3 shows that realized returns between 1715 and 1719 are positively associated with the probability of taking a margin loan, but the coefficient is not statistically significant. Both new investors and investors who traded frequently are also more likely to take a margin loan. A 1% increase in the pre-1720 number of trades increases the probability of obtaining a loan by approximately 6 percentage points. As about 12% of the investors in the sample take a margin loan, this estimate corresponds to a 50% probability increase. A new trader is almost 17 percentage points more likely to take a margin loan.

TABLE 3

Who Takes a Margin Loan?

Table 3 reports marginal effects at the mean of a probit regression where the dependent variable is a dummy that takes the value of 1 if a trader held a margin loan with the Bank of England ($LOAN_i$) at any point in time during our sample period. $RETURN_i^{1715-19}$ is the value-weighted trader-specific realized portfolio return between 1715 and 1719, where we weight stock-specific realized returns with the trader's average nominal holdings of the stock; $ln(TOT\_TRADES)_i^{1715-19}$ is the logarithm of the total number of transactions of a trader between 1715 and 1719; $NEW\_INVESTOR_i$ is a dummy variable that takes the value of 1 if a trader does not appear in our sample before Jan. 1, 1720; $ln(HOLDINGS)_i^{1715-19}$ is the logarithm of the value-weighted average of a trader's portfolio holdings between 1715 and 1719; $LONDON_i$ is a dummy variable that takes the value of 1 if a trader lived in the greater London area (City of London, Holborn, Wapping, Moorfields, Westminster, Middlesex, Bethnal Green, Sepulchre, Covent Garden, and Shadwell); $FOREIGN_i$ is a dummy variable that takes the value of 1 if a trader was not British or Irish; $ARISTOCRAT_i$ is a dummy variable that takes the value of 1 if a trader was an aristocrat (Lady, Dutchess, Marquess, Viscountess, Baroness, Princess, Countess, Prince, Graf, Marquis, Duke, Honorable, Earl, Baron, Count, Viscount, and Lord); $BROKER_i$ is a dummy variable that takes the value of 1 if a trader was a broker; $MALE_i$ is a dummy variable that takes the value of 1 if the trader was male; $ACTIVE\_TOP\_1_i$ is a dummy variable that takes the value of 1 if a trader belonged to the 1st percentile in terms of number of transactions between 1715 and 1719; $ACTIVE\_TOP\_50_i$ is a dummy variable that takes the value of 1 if a trader was between the 1st and 50th percentile in terms of number of transactions between 1715 and 1719; Excluding SSC indicates whether we exclude South Sea loan holders from our sample; and no. of obs. indicates the number of observations. The robust standard errors are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: $LOAN_i$					
	1	2	3	4	5	6
$RETURN_i^{1715-19}$	0.011	0.002	0.002	−0.013	−0.001	0.050
	(0.078)	(0.075)	(0.074)	(0.073)	(0.071)	(0.067)
$ln(TOT\_TRADES)_i^{1715-19}$	0.060***	0.052***	0.052***	0.047***		
	(0.005)	(0.005)	(0.005)	(0.005)		
$NEW\_INVESTOR_i$	0.165***	0.158***	0.155***	0.141***	0.163***	0.138***
	(0.032)	(0.031)	(0.031)	(0.030)	(0.032)	(0.032)
$ln(HOLDINGS)_i^{1715-19}$	−0.004	−0.002	−0.002	−0.003	0.002	0.000
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$LONDON_i$		0.038***	0.040***	0.037***	0.040***	0.042***
		(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
$FOREIGN_i$		−0.105***	−0.105***	−0.103***	−0.104***	−0.089***
		(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
$ARISTOCRAT_i$			0.041	0.036	0.042	0.026
			(0.033)	(0.032)	(0.032)	(0.033)
$BROKER_i$			0.028	0.020	0.036	0.056
			(0.049)	(0.046)	(0.049)	(0.053)
$MALE_i$				0.060***	0.064***	0.056***
				(0.010)	(0.010)	(0.009)
$ACTIVE\_TOP\_1_i$					0.243***	0.138**
					(0.066)	(0.067)
$ACTIVE\_TOP\_50_i$					0.088***	0.086***
					(0.013)	(0.012)
Excluding SSC loan holders	No	No	No	No	No	Yes
No. of obs.	5,111	5,111	5,111	5,110	5,110	4,660

Column 2 of Table 3 studies other investors' characteristics, in particular we examine the role of the place of residence: whether the investor is a foreigner or lives in London. We see that investors living in London (and hence closer to the exchange) are 3.8 percentage points more likely to collateralize their shares, whereas foreign investors are about 10 percentage points less likely to have a margin loan.[17] Column 3 adds additional information about the investors, in particular whether he/she is an aristocrat or a broker: in both cases, we find no statistically significant relationship between these characteristics and the probability of taking a margin loan. Column 4 looks at the gender of the investor and reveals that male investors are 6 percentage points more likely to take a loan.

Column 5 of Table 3 explores in more detail the relationship between the number of trades for each investor before 1720 and the probability of taking a loan. Investors who trade a lot could be either market makers or individual investors who just have a high willingness to transact in financial markets. The former group is more likely to contain arbitrageurs, the latter is more likely to have behavioral traders as shown in previous work (Barber and Odean (2000), (2001)). Based on this conjecture, we divide traders into two types and generate two dummy variables. "ACTIVE_TOP_1_i" takes the value of 1 if a trader is in the top 1% of the distribution of number of trades between 1715 and 1719: likely these investors were market makers. "ACTIVE_TOP_50_i" takes the value of 1 if an investor is between the 1st and 50th percentile of the number of trades distribution prior to 1720. Most likely, these investors just displayed a high propensity to trade. Column 5 shows that both categories are more likely to take a loan: traders in the top 1% of trade's distribution are 24 percentage points more likely to have a Bank of England loan; traders between the 1st and the 50th percentile are almost 9 percentage points more likely to take a margin loan.[18] Column 6 repeats the specification of column 5, where we drop investors that during our sample period took at least once a South Sea Company loan. We remove South Sea loan holders to make sure that our control group of non-loan holders does not contain South Sea borrowers that are subject to moral hazard. The results change little compared to those in column 5.

All in all, these findings indicate that loans are not randomly assigned among investors. In particular, less experienced individuals, investors who trade actively and male investors are more likely to take margin loans.

B. Do Loan Holders Behave as Extrapolators?

In this section, we test one of the main predictions of the rational riding and extrapolation theories, namely whether the bank loan facility attracts extrapolating investors. Our test is based on an equation where we regress a buy dummy on the interaction between a bank loan dummy and the share returns of company j over the past τ days. In its simplest specification, the equation takes the following form:

[17]The reference group of the location dummies are investors living in Britain outside of London.

[18]In total, investors in the top 1% of the trades distribution obtain £106,100 in margin loans from the Bank of England; investors between the 1st and 50th percentile £903,050.

$$\text{BUY}_{ijt} = \alpha + \theta_1 \text{LOAN}_{it} \times \text{RETURN}_{jt-\tau} + \theta_2 \text{LOAN}_{it} + \theta_3 \text{RETURN}_{jt-\tau} + \theta_4 \ln(\text{HOLDINGS})_{ijt-1} + \varepsilon_{ijt}, \tag{3}$$

where BUY_{ijt} is a dummy that takes the value of 1 if investor i buys shares in company j at day t, LOAN_{it} is a dummy taking the value of 1 if investor i has a bank loan at day t, $\text{RETURN}_{jt-\tau}$ are stock j's realized return over the past τ trading days, and $\ln(\text{HOLDINGS})_{ijt-1}$ is the natural logarithm of trader i's nominal holdings in stock j at day $t-1$. Our main coefficient of interest is θ_1. A positive θ_1 indicates that loan holders are more likely to buy stock j following positive returns of stock j in the past τ days. This would be in line with both the rational bubble riding and the extrapolation channel. The discount rate channel would predict θ_1 to be 0 in every specification.

We progressively saturate equation (3) with fixed effects, largely intended to capture trader characteristics, until it takes the following form:

$$\text{BUY}_{ijt} = \alpha + \theta_1 \text{LOAN}_{it} \times \text{RETURN}_{jt-\tau} + \rho_{jt} + \kappa_{it} + \psi_{ij} + \xi_i \times \text{RETURN}_{jt-\tau} + \theta_4 \ln(\text{HOLDINGS})_{ijt-1} + \varepsilon_{ijt}, \tag{4}$$

where ρ_{jt} are company × date fixed effects, κ_{it} are trader × date fixed effects, ψ_{ij} company × trader fixed effects, and $\xi_i \times \text{RETURN}_{jt-\tau}$ are trader fixed effect interacted with past returns. Most of these fixed effects control for trader's characteristics. As we test theories based on a selection of investors into margin loans, we would expect θ_1 to approach 0 the more fixed effects we introduce in the regression.

We display the results in Table 4. Columns 1–3 consider the relationship between the probability of buying a stock and the interaction of the margin loan dummy and past returns, without controlling for any set of fixed effects as in equation (3). We vary the past returns window from a short time horizon of four trading days (column 1) to a longer time horizon of 14 trading days (column 2). Column 3 considers an intermediate time horizon of 6 trading days, corresponding to a trading week. In each of the three specifications, we find a positive coefficient on the interaction term between the margin loan dummy and past returns, indicating that margin loan holders are more likely to buy shares with high realized returns in the past trading period. The effect is statistically significant and economically sizeable. For instance, in our sample, the average share return in the past trading week is 0.75%, which implies that loan holders are 27% more likely to buy. In contrast, in the run-up phase of the bubble, between May 1 and June 15, the average return in the past trading week equals 1.9% which implies that loan holders are 67% more likely to buy vis-à-vis the average trader.

In columns 4 and 5 of Table 4, we progressively add fixed effects to the regression, while fixing the past return window to 6 trading days. In column 4, we include company × date fixed effects and thereby control for time-varying company characteristics such as company specific news. We still find that the coefficient θ_1 on the interaction term is positive and statistically significant, but 25% smaller than the coefficient in column 3. Column 5 controls for both company × date fixed effects and trader × date fixed effects. The coefficient on the interaction term is positive and statistically significant at the 10% level. Its magnitude is about

TABLE 4

Do Loan Holders Behave as Extrapolators?

Table 4 reports parameter estimates of a linear probability regression where the dependent variable is a buy dummy (BUY_{ijt}) that takes the value of 1 if trader i bought share j on date t. The main independent variable is a loan dummy ($LOAN_{it}$) interacted with realized returns of stock j over the past τ trading days ($RETURN_{jt-\tau}$) using opening prices. $LOAN_{it}$ takes the value of 1 if investor i has an outstanding margin loan with the Bank of England at date t. $\ln(HOLDINGS)_{ijt-1}$ denotes the logarithm of trader's i's nominal holdings in share j at $t-1$. Depending on the specification, we control for company × date fixed effects (company–date FE (ρ_{jt})), trader × date fixed effects (trader–date FE (κ_{it})), company × trader fixed effects (company–trader FE (ψ_{ij})) and trader fixed effects interacted with realized returns in the last week (trader FE × $RETURN_{jt-6}$ ($\xi_i \times RETURN_{jt-6}$)). Standard errors clustered by trader and date are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: BUY_{ijt}						
	1	2	3	4	5	6	7
$LOAN_{it} \times RETURN_{jt-4}$	0.053***						
	(0.016)						
$LOAN_{it} \times RETURN_{jt-14}$		0.066**					
		(0.028)					
$LOAN_{it} \times RETURN_{jt-6}$			0.070***	0.056**	0.042*	0.042	0.023
			(0.025)	(0.023)	(0.025)	(0.028)	(0.030)
$\ln(HOLDINGS)_{ijt-1}$	0.004***	0.004***	0.004***	0.004***	0.004***	−0.003***	−0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$LOAN_{it}$	0.004***	0.003***	0.004***	0.004***			
	(0.001)	(0.001)	(0.001)	(0.001)			
$RETURN_{jt-4}$	0.001						
	(0.002)						
$RETURN_{jt-14}$		0.003					
		(0.004)					
$RETURN_{jt-6}$			0.003				
			(0.003)				
INTERCEPT	0.002***	0.002***	0.002***	0.002***	0.002***	0.007***	0.007***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
R^2	0.005	0.005	0.005	0.007	0.513	0.542	0.545
No. of obs.	1,538,411	1,548,633	1,543,522	1,543,522	1,543,522	1,543,522	1,543,522
Company × date FE (ρ_{jt})	No	No	No	Yes	Yes	Yes	Yes
Trader × date FE (κ_{it})	No	No	No	No	Yes	Yes	Yes
Company × trader FE (ψ_{ij})	No	No	No	No	No	Yes	Yes
Trader FE × $RETURN_{jt-6}$ ($\xi_i \times RETURN_{jt-6}$)	No	No	No	No	No	No	Yes

30% lower than the coefficient in column 4. This result indicates that controlling for time-varying trader characteristics is important, and confirms that margin loans are not randomly distributed within the population of investors (in line with our findings in Table 3). In column 6, we add trader × company fixed effects: the coefficient on the interaction term does not change in magnitude, but it is no longer statistically significant. Column 7 documents another sharp decline in θ_1 after adding time-invariant trader fixed effects interacted with past returns. This new set of fixed effects represents the average tendency of a trader to extrapolate past returns. The drop in θ_1 from 0.042 to 0.023 suggests that the behavior of loan holders can be explained by some time-invariant traders' characteristics that affect trading strategies as a function of past returns. In the Supplementary Material, we repeat the analysis after excluding South Sea loan holders from our sample because they may be over-represented in either the treatment or control group and thus bias our coefficients. As before, this has little effect on our findings. Overall, these results show that the loan facility attracts extrapolating investors. These results are thus inconsistent with the discount rate channel and in line with the rational riding

and extrapolation channel (see Section III). Our findings are also driven by traders' characteristics and do not lend support to an explanation based on moral hazard.

C. Do Borrowers Subscribe to New Share Issues?

In this section, we study whether loan holders were also more likely to subscribe to share offerings of companies whose securities recently experienced high returns in the secondary market. This analysis is important for two reasons. First, in addition to buying past winners on the secondary market, investors could also follow extrapolative strategies by subscribing to new issues of bubbling stocks at peak prices. Second, it allows us to extend our study to two additional companies: the South Sea Company and the London Assurance Company.

The rational bubble riding and extrapolation channel predict that borrowers are more inclined to subscribe to highly valued new share issues. We test these hypotheses in Tables 5 and 6. In particular, during the summer of 1720, the South Sea and London Assurance Company took advantage of their 6- to 10-fold stock price increase by issuing new stock. Investors could subscribe to these new issues by writing down their names and desired nominal amounts on *so-called* subscription lists. We retrieve these names and create subscription dummies for two South Sea stock issues and a London Assurance issue. Each dummy takes the value of 1 if an investor subscribes to a particular issue, and 0 otherwise. We run a probit regression for the third and fourth South Sea subscriptions and present the marginal effects in Table 5, while we present the marginal effects for the London Assurance Company in Table 6.

Table 5 reports that bank borrowers are 15 percentage points more likely to subscribe for the third South Sea batch (column 1) and 14 percentage points more likely to demand stock in the fourth South Sea issue (column 4). If we control for time-invariant trader characteristics, these percentages drop to 8.3 and 9.9 percentage points, respectively (columns 2 and 4), while remaining statistically significant if we exclude South Sea loan holders from the sample (columns 3 and 6). Since 17% of the bank shareholders acquired third subscription shares, and 9.7% subscribed to the fourth, these estimates correspond to an increase of 50%–100% of the subscription probability.

When we look at other traders' characteristics, we see that active traders, new investors and Londoners are significantly more likely to demand South Sea share subscriptions. These results mimic the findings of Table 3 where we find a strong effect of the same variables on the probability of taking a loan. We also find that traders who realized high returns before 1720 are more likely to participate in the third South Sea subscription.

In addition to the new share issues of the South Sea Company, we also exploit a new share issuance of the London Issuance Company. The results of the second London Assurance subscription are very similar. Column 1 of Table 6 shows that without controlling for trader characteristics, margin loan holders are 6 percentage points more likely to subscribe to new London Assurance Company (LAC) stock. Since about 4% of the Bank of England shareholders subscribed to the LAC, our estimate implies that a margin loan holder is 1.5 times more likely to acquire newly issued London Assurance shares. The effect halves after including traders'

TABLE 5

Do Loan Holders Subscribe to the South Sea Company?

Table 5 reports marginal effects at the sample mean of a probit regression where the dependent variable equals 1 if a trader subscribed to the third (fourth) subscription of the South Sea Company, and 0 otherwise. $LOAN_i$ is a dummy variable that takes the value of 1 if a trader held a Bank of England loan in the week leading up to the third (fourth) subscription date of June 17 (Aug. 24). $RETURN_i^{1715-19}$ is the value-weighted trader-specific realized portfolio return between 1715 and 1719; $\ln(TOT\_TRADES)_i^{1715-19}$ is the logarithm of the total number of transactions of a trader between 1715 and 1719; $NEW\_INVESTOR_i$ is a dummy variable that takes the value of 1 if a trader does not appear in our sample before Jan. 1, 1720; $\ln(HOLDINGS)_i^{1715-19}$ is the logarithm of the value-weighted average of a trader's portfolio holdings between 1715 and 1719; $LONDON_i$ is a dummy variable that takes the value of 1 if a trader lived in the greater London area; $FOREIGN_i$ is a dummy variable that takes the value of 1 if a trader was not British or Irish; $ARISTOCRAT_i$ is a dummy variable that takes the value of 1 if a trader was an aristocrat; dummy variables that equal 1 for brokers ($BROKER_i$) and male investors ($MALE_i$); Excluding SSC indicates whether we exclude South Sea loan holders from our sample; and no. of obs. is the number of observations. Robust standard errors are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: $SSC3_i$			Dependent Variable: $SSC4_i$		
	1	2	3	4	5	6
$LOAN_i$	0.157***	0.083***	0.077**	0.140***	0.099***	0.099***
	(0.033)	(0.030)	(0.031)	(0.020)	(0.019)	(0.019)
$RETURN_i^{1715-19}$		0.195***	0.148**		−0.015	−0.029
		(0.070)	(0.071)		(0.058)	(0.058)
$\ln(HOLDINGS)_i^{1715-19}$		0.000	0.003		−0.006**	−0.005**
		(0.004)	(0.004)		(0.003)	(0.003)
$\ln(TOT\_TRADES)_i^{1715-19}$		0.052***	0.044***		0.039***	0.031***
		(0.006)	(0.006)		(0.004)	(0.004)
$NEW\_INVESTOR_i$		0.076***	0.080***		0.039*	0.025
		(0.029)	(0.029)		(0.021)	(0.019)
$LONDON_i$		0.058***	0.054***		0.015*	0.011
		(0.011)	(0.011)		(0.009)	(0.008)
$FOREIGN_i$		−0.122***	−0.115***		−0.060***	−0.050***
		(0.015)	(0.014)		(0.012)	(0.011)
$ARISTOCRAT_i$		0.305***	0.279***		0.082***	0.046
		(0.044)	(0.046)		(0.031)	(0.029)
$BROKER_i$		0.060	0.080		−0.012	−0.032
		(0.061)	(0.064)		(0.033)	(0.022)
$MALE_i$		0.069***	0.057***		0.036***	0.028***
		(0.012)	(0.012)		(0.009)	(0.008)
Excluding SSC loan holders	No	No	Yes	No	No	Yes
No. of obs.	5,111	5,110	4,918	5,111	5,110	4,759

characteristics as we show in column 2. We also find that trading activity and market proximity are strong predictors of LAC share subscription. Finally, in column 3, we see that none of these results change after removing South Sea borrowers from our sample. These results are in line with the trading behavior predictions of both the rational riding and extrapolation channel. However, the LAC results are only in line with the wealth transfer predictions of the extrapolation channel which predicts that the marginal borrower transfers wealth to other investors. We explain in the Supplementary Material that LAC subscribers could only lose money on their position. Table 6 reports that loan holders are more inclined to subscribe for new LAC offerings and thus underperform other investors. This finding is thus inconsistent with the wealth transfer predictions of the rational riding channel.

D. Do Borrowers Gain or Lose During the Bubble?

Our results show that loan holders were more inclined to ride the bubble, but it is unclear whether this trading strategy leads to over- or under-performance. It is

TABLE 6

Do Loan Holders Hold Positions in the London Assurance Company?

Table 6 reports marginal effects at the sample mean of a probit regression where the dependent variable is a dummy variable that takes the value of 1 if a trader subscribed to the second subscription of the London Assurance Company (LAC_i). $LOAN_i$ is a dummy variable that takes the value of 1 if an investor held a Bank of England margin loan in the week leading up to the subscription date of Aug. 12. $RETURN_i^{1715-19}$ is the value-weighted trader-specific realized portfolio return between 1715 and 1719, where we weight stock-specific realized returns with the trader's average nominal holdings of the stock; $\ln(TOT\_TRADES)_i^{1715-19}$ is the logarithm of the total number of transactions of a trader between 1715 and 1719; $NEW\_INVESTOR_i$ is a dummy variable that takes the value of 1 if a trader does not appear in our sample before Jan. 1, 1720; $\ln(HOLDINGS)_i^{1715-19}$ is the logarithm of the value-weighted average of a trader's portfolio holdings between 1715 and 1719; $LONDON_i$ is a dummy variable that takes the value of 1 if a trader lived in the greater London area (City of London, Holborn, Wapping, Moorfields, Westminster, Middlesex, Bethnal Green, Sepulchre, Covent Garden, and Shadwell); $FOREIGN_i$ is a dummy variable that takes the value of 1 if a trader was not British or Irish; $ARISTOCRAT_i$ is a dummy variable that takes the value of 1 if a trader was an aristocrat (Lady, Dutchess, Marquess, Viscountess, Baroness, Princess, Countess, Prince, Graf, Marquis, Duke, Honorable, Earl, Baron, Count, Viscount, and Lord); $BROKER_i$ is a dummy variable that takes the value of 1 if a trader was a broker; $MALE_i$ is a dummy variable that takes the value of 1 if the trader was male; Excluding SSC indicates whether we exclude South Sea loan holders from our sample; and no. of obs. is the number of observations. The robust standard errors are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: LAC_i		
	1	2	3
$LOAN_i$	0.063***	0.031***	0.032***
	(0.015)	(0.011)	(0.011)
$RETURN_i^{1715-19}$		0.023	0.025
		(0.028)	(0.026)
$\ln(HOLDINGS)_i^{1715-19}$		−0.008***	−0.006***
		(0.002)	(0.001)
$\ln(TOT\_TRADES)_i^{1715-19}$		0.018***	0.015***
		(0.003)	(0.002)
$NEW\_INVESTOR_i$		0.001	0.002
		(0.009)	(0.009)
$LONDON_i$		0.016***	0.016***
		(0.004)	(0.0044)
$ARISTOCRAT_i$		−0.007	−0.009
		(0.013)	(0.010)
$BROKER_i$		0.050	0.044
		(0.032)	(0.031)
$MALE_i$		0.025***	0.020***
		(0.004)	(0.004)
Excluding SSC loan holders	No	No	Yes
No. of obs.	5,111	4,806	4,459

important to compare the performance of loan holders to those of other traders because rational riding and extrapolation theories provide different predictions on this matter. Rational riding predicts that borrowers realize higher returns than other traders, while extrapolation predicts the opposite. In this section, we compare the realized returns of loan holders with those of other traders. We begin by studying the time-varying performance of traders, so that we can control for trader fixed effects like in the extrapolation analysis. Specifically, we regress trader *i*'s realized returns on stock *j* at day *t* (as measured by equation (1)) on a loan dummy that takes the value of 1 if trader *i* has a bank loan at day *t*. We progressively control for traders' lagged stock-specific holdings, company fixed effects and trader fixed effects.

Table 7 reports that loan holders earn 8 percentage points lower annualized returns than other traders. The performance gap shrinks to 7 percentage points after including trader fixed effects and company fixed effects, but it remains statistically significant. We document a further drop to 4 percentage points after adding trader ×

TABLE 7

Do Loan Holders Gain or Lose During the South Sea Bubble?

In Table 7, we regress investor-company specific realized returns on $LOAN_{it}$, a dummy variable that takes the value of 1 if a trader held a margin loan of the Bank of England at date t. $RETURN_{ijt}$ measures investor i's realized return in company j at date t coming from selling stock j or receiving dividends (see equation (1)). We control for the natural logarithm of each trader i's nominal holdings in share j at the beginning of the trading day ($\ln(HOLDINGS)_{ijt-1}$). Depending on the specification, we also control for company fixed effects (ν_j), trader fixed effects (ξ_i), and company × trader fixed effects (ψ_{ij}). The standard errors clustered by trader and date are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: $RETURN_{ijt}$			
$LOAN_{it}$	−0.084**	−0.083***	−0.072**	−0.041*
	(0.039)	(0.030)	(0.030)	(0.023)
$\ln(HOLDINGS)_{ijt-1}$	0.006	0.009	0.035***	0.042***
	(0.014)	(0.017)	(0.011)	(0.010)
INTERCEPT	0.047	0.040	−0.029	−0.051*
	(0.073)	(0.082)	(0.039)	(0.027)
R^2	0.004	0.007	0.537	0.776
No. of obs.	15,590	15,590	15,590	15,590
Company FE (ν_j)	No	Yes	Yes	No
Trader FE (ξ_i)	No	No	Yes	No
Company × trader FE (ψ_{ij})	No	No	No	Yes

company fixed effects. Overall, these results suggest that the average loan holder rides the bubble unsuccessfully. The margin loan dummy becomes economically smaller after introducing traders' fixed effects, a result again consistent with nonrandom selection of traders into the margin loan facility. In the Supplementary Material, we exclude South Sea loan holders from our sample and again find very similar results. These results are in line with the idea that borrowers are subject to behavioral biases (extrapolation) and inconsistent with rational riding.

In a second step, we study which trader characteristics explain the correlation between margin loan dummies and traders' performance. Differently from the analysis in Table 7, we study the time-invariant cross section of traders because that allows us to include various trader characteristics that do not vary over time (as we did in Sections V.A and V.C). We compute the total realized returns of each trader's portfolio during our sample period and we relate them to the margin loan dummy and the time invariant traders' characteristics. We present the results in Table 8. Column 1 shows that the univariate negative relationship between traders' performance and margin loans also holds in the cross section. Margin loan holders display total realized returns that are 22 percentage points lower than those of the average trader. Columns 2–8 show that the performance gap between loan holders and other traders shrinks as we add more controls. This implies that traders' observable characteristics partially explain the underperformance of loan holders. In particular, experience, trading frequency, and market proximity explain almost 50% of the performance differential. These findings are similar to those in Tables 3–5 where we also see that inexperienced traders, frequent traders, and Londoners are more likely to take a loan and to follow extrapolative trading strategies. More importantly, these results are overall similar to those in Table 7 because they are in line with the theoretical predictions of the extrapolation channel and do not lend support to the rational riding theory.

TABLE 8

What Drives Loan Holders' performance?

In Table 8, we regress individual (time-invariant) realized returns in 1720 ($RETURN_i^{1720}$) on trader characteristics. $RETURN_i^{1715-19}$ is the value-weighted trader-specific realized portfolio return between 1715 and 1719; $ln(TOT\_TRADES)_i^{1715-19}$ is the number of transactions of a trader between 1715 and 1719; $NEW\_INVESTOR_i$ takes the value of 1 if a trader does not appear in our sample before Jan. 1, 1720; $ln(HOLDINGS)_i^{1715-19}$ is the logarithm of the value-weighted average of a trader's portfolio holdings between 1715 and 1719; $LONDON_i$ is a dummy variable that takes the value of 1 if a trader lived in the greater London area; $FOREIGN_i$ is a dummy variable that takes the value of 1 if a trader was not British or Irish; $ARISTOCRAT_i$ is a dummy variable that takes the value of 1 if a trader was an aristocrat; dummy variables that equal 1 for brokers ($BROKER_i$) and male investors ($MALE_i$); Excluding SSC indicates whether we exclude South Sea loan holders from our sample; and no. of obs. is the number of observations. The robust standard errors are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: $RETURN_i^{1720}$								
	1	2	3	4	5	6	7	8	9
$LOAN_i$	−0.226***	−0.217***	−0.196***	−0.167***	−0.152***	−0.142***	−0.140***	−0.137***	−0.149***
	(0.038)	(0.038)	(0.037)	(0.040)	(0.040)	(0.040)	(0.040)	(0.041)	(0.040)
$RETURN_i^{1715-19}$		1.275***	0.800**	0.835**	0.601	0.600	0.577	0.588	0.222
		(0.334)	(0.351)	(0.351)	(0.374)	(0.372)	(0.374)	(0.374)	(0.335)
$ln(HOLDINGS)_i^{1715-19}$			0.048***	0.065***	0.034***	0.031***	0.029**	0.029**	0.026**
			(0.007)	(0.008)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
$ln(TOT\_TRADES)_i^{1715-19}$				−0.075***	−0.078***	−0.072***	−0.068***	−0.065***	−0.054***
				(0.019)	(0.019)	(0.018)	(0.019)	(0.019)	(0.019)
$NEW\_INVESTOR_i$					−0.257***	−0.264***	−0.271***	−0.264***	−0.334***
					(0.087)	(0.087)	(0.088)	(0.088)	(0.089)
$LONDON_i$						−0.075**	−0.072**	−0.070**	−0.084***
						(0.031)	(0.031)	(0.031)	(0.032)
$FOREIGN_i$						0.063	0.063	0.066	0.063
						(0.065)	(0.065)	(0.065)	(0.066)
$ARISTOCRAT_i$						0.197*	0.195*	0.198*	0.161
						(0.103)	(0.103)	(0.103)	(0.113)
$BROKER_i$							−0.403	−0.398	−0.319
							(0.290)	(0.290)	(0.326)
$MALE_i$								−0.042	−0.052
								(0.033)	(0.033)
INTERCEPT	0.117***	0.058**	−0.133***	−0.135***	0.072	0.123*	0.133*	0.158**	0.205***
	(0.018)	(0.025)	(0.043)	(0.043)	(0.072)	(0.072)	(0.073)	(0.073)	(0.074)
R^2	0.004	0.011	0.024	0.027	0.029	0.032	0.033	0.033	0.041
No. of obs.	5,098	5,098	5,098	5,098	5,098	5,098	5,098	5,097	4,649
Excluding SSC	No	No	No	No	No	No	No	No	Yes

E. Loan Holder Trading and Stock Prices

In this section, we test whether loan holders generated enough buying pressure to move stock prices. Since our dependent variable is share returns, we need to aggregate our data to company-date level. We estimate the following regression equation:

$$\text{RETURN}_{jt} = \alpha + \beta \text{BUY\_PRESS}_{jt}^{\text{LOAN}} + \Omega X_{jt} + \eta_{jt}, \tag{5}$$

where RETURN_{jt} is the end of trading day return of company j at date t.[19] $\text{BUY\_PRESS}_{jt}^{\text{LOAN}}$ is the buying pressure of margin loan holders for the shares of company j at date t. Following Lakonishok, Shleifer, and Vishny (1992), it is defined as the ratio of the volume of buys minus the volume of sells of loan holders

[19]We use end of trading day returns in order to rule out that traders are chasing daily returns, but cannot rule out intraday trend chasing.

at date t, divided by total volume traded by loan holders at date t. The precise definition of buying power is as follows:

$$\text{BUY\_PRESS}_{jt}^{\text{LOAN}} = \frac{\sum_{i \in \text{LOAN}_t} \text{BUY}_{ijt} - \text{SELL}_{ijt}}{\sum_{i \in \text{LOAN}_t} \text{BUY}_{ijt} + \text{SELL}_{ijt}}. \tag{6}$$

Similarly, we define the buying pressure of traders without a margin loan as follows:

$$\text{BUY\_PRESS}_{jt}^{\text{NON\_LOAN}} = \frac{\sum_{i \notin \text{LOAN}_t} \text{BUY}_{ijt} - \text{SELL}_{ijt}}{\sum_{i \notin \text{LOAN}_t} \text{BUY}_{ijt} + \text{SELL}_{ijt}}. \tag{7}$$

We regress end-of-the-day trading returns on buying power and present the results in Table 9. In column 1, we consider investors with Bank of England margin loans, and we control for the buying pressure of investors without margin loans. In column 2, we also control for one trading day lagged measures of buying pressure both for investors with and without margin loans. We see that loan holders' buying pressure at date t has a positive and statistically significant coefficient. The economic significance is important: multiplying the standard deviation of buying pressure (0.504) by the coefficient, we obtain $0.007 \times 0.504 = 0.3\%$. Since the average daily return is 0.84%, a standard deviation increase in loan holders' buying pressure increases daily returns by approximately 35% of the mean. Interestingly, column 1 also reveals that the buying pressure of investors without a margin loan has a positive but statistically insignificant coefficient. These results are consistent with the conjecture that loan holder stock purchases are related to price increases. This could be because loan holders generate excess demand that is not met by supply provided by non-loan holders. However, the results are also consistent with loan holders trading on days with low liquidity. Moreover, we need to treat the results in Table 9 with caution because we cannot rule out that loan holders react to intraday price movements.

In column 3 of Table 9, we add company fixed effects to the specification in column 2, and the results do not change materially. Column 4 addresses issues related to reverse causality, and also controls for the company returns in the past trading day: the results are again unchanged. Overall, the results are in line with the notion that extrapolative trading behavior is related to price movements. This is also consistent with Goetzmann and Massa (2002), who show that momentum activity correlates positively with security prices.

VI. Robustness

A. Information Asymmetry and Price Reversals

We document that loan holders buy after price increases and we interpret these results as evidence of extrapolation of past returns. However, this trading behavior is also consistent with a model of slow information revelation and information asymmetry (Brennan and Cao (1996), (1997), Brennan et al. (2005)). More precisely, these models assume that information diffuses slowly from better to poorly informed traders, while both types are rational. Under these assumptions, they make

TABLE 9

Loan Holder Trading and Stock Prices

Table 9 reports parameter estimates and corresponding standard errors (in parentheses) of a time series regression of stock j returns ($RETURN_{jt}$) on loan holder buying pressure ($BUY\_PRESS_{jt}^{LOAN}$) as defined in equation (6). We define loan holders as traders who use the Bank of England loan facility. We control for buying pressure of non-loan holders ($BUY\_PRESS_{jt}^{NON\_LOAN}$), lagged returns ($RETURN_{jt-1}$, lagged buying pressure of both loan holders and non-loan holders. We include company fixed effects in the final 2 columns.

	Dependent Variable: $RETURN_{jt}$			
	1	2	3	4
$BUY\_PRESS_{jt}^{LOAN}$	0.007*	0.007**	0.009**	0.008**
	(0.004)	(0.003)	(0.004)	(0.004)
$BUY\_PRESS_{jt}^{NON\_LOAN}$	0.017	0.017	0.016	0.016
	(0.016)	(0.016)	(0.013)	(0.013)
$BUY\_PRESS_{jt-1}^{LOAN}$		−0.001	0.000	0.000
		(0.005)	(0.004)	(0.004)
$BUY\_PRESS_{jt-1}^{NON\_LOAN}$		−0.014	−0.016	−0.016
		(0.015)	(0.014)	(0.014)
$RETURN_{jt-1}$				0.002
				(0.014)
No. of obs.	336	333	333	331
Company FE	No	No	Yes	Yes

two important predictions about investors' trading behavior and prices. First, poorly informed traders behave as trend chasers, while better informed traders follow a contrarian strategy. Second, prices slowly converge to fundamental values.[20] In this section, we test whether our findings can be explained by information asymmetries and slow diffusion of information.

First, we construct trader-specific measures that proxy for information asymmetries in the London equity market. We interact them with past returns and use them as additional controls in equations (3) and (4). We first follow Brennan and Cao (1997) and Brennan et al. (2005), and proxy for asymmetric information using a foreigner dummy. British investors should be better informed about stocks traded in London than foreigners, especially in the 18th century when information travels more slowly from one country to another. In an additional specification, we proxy for information asymmetry by including a dummy that equals 1 for investors who live in London. Londoners are probably better informed about stocks trading on the London stock exchange than traders residing elsewhere. Our last proxy for information asymmetry is a dummy that takes the value of 1 for new investors (i.e., those who have never traded Bank of England, East India Company, and Royal African Company stocks prior to 1720).

We present the results in Table 10. In every specification, our main interaction term ($LOAN_{it} \times RETURN_{jt-6}$) has a loading that is positive and very close to the loading in column 5 of Table 4. This implies that adding extra controls that proxy for information asymmetries has little effect on our main findings. In addition, we find in Tables 3, 5, and 6 that traders who are presumably better informed because they live closer to the market are more likely to take a loan and follow extrapolative strategies. These findings are in sharp contrast with the predictions laid out previously.

[20]Brennan and Cao ((1996), p. 168): "So that the precision of public information about the payoffs increases through time."

TABLE 10

Extrapolation, Margin Loans, and Investors' Characteristics

In Table 10, we report parameter estimates of a linear probability regression where the dependent variable BUY_{ijt} takes the value of 1 if investor i buys share j in date t, and 0 otherwise. Realized returns are computed over the past 6 trading days ($RETURN_{jt-6}$) using opening prices. $LOAN_{it}$ takes the value of 1 if investor i has a share loan outstanding with the Bank of England at t. $FOREIGN_i$ is a dummy variable that takes the value of 1 if the investor is foreigner (i.e., not from the UK or Ireland), and 0 otherwise. $LONDON_i$ is a dummy variable for traders living in the greater London area (City of London, Holborn, Wapping, Moorfields, Westminster, Middlesex, Bethnal Green, Sepulchre, Covent Garden, and Shadwell). $NEW\_INVESTOR_i$ is a dummy taking the value of 1 if an investor does not appear in our sample prior to Jan. 1, 1720. We also report the number of observations (no. of obs.). We control for trader × date fixed effects (κ_{it}) and company × date fixed effects (ρ_{jt}). The standard errors clustered by trader and date are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: BUY_{ijt}		
$LOAN_{it} \times RETURN_{jt-6}$	0.043*	0.042*	0.043*
	(0.024)	(0.024)	(0.024)
$FOREIGN_i \times RETURN_{jt-6}$	0.006		
	(0.005)		
$LONDON_i \times RETURN_{jt-6}$		0.004	
		(0.005)	
$NEW\_INVESTOR_i \times RETURN_{jt-6}$			−0.010*
			(0.006)
R^2	0.527	0.527	0.527
No. of obs.	1,701,963	1,701,963	1,701,963
Company × date FE (ρ_{jt})	Yes	Yes	Yes
Trader × date FE (κ_{it})	Yes	Yes	Yes

Second, we consider the prediction that prices slowly converge to their fundamental value. This implies that prices should not be subject to reversals. However, Figure 1 shows strong evidence of price reversals which are characteristic for bubble periods. The 1720 price patterns are more in line with overvaluation followed by long-term reversal to fundamental values.[21] Put differently, reversal patterns are not in line with increased informativeness of prices as in Brennan and Cao (1996).

B. Forward Contracts

Another possible concern is that our transaction data may contain settlements of future contracts that were closed on days prior to the recorded transaction date. We address this issue in two ways. First, we exclude transactions where either buyer or the seller is a broker, as brokers mostly served as counterparty on forward contracts. We then classify traders as brokers if they are either labeled as a broker in the index books (Panel A of Table 11), or if they are among the 1% most active traders (Panel B). Panels A and B of Table 11 show that our main findings do not change if we exclude brokers and frequent traders (market makers). Second, we exclude days with a higher probability of forward trading. More specifically, we take out trading days that follow immediately after the re-opening of the companies' books. Books were closed for a few weeks around dividend payment dates to allow

[21]Notice that this reversal is different and based on a longer time period than the liquidity reversal documented by Kahraman and Tookes (2017).

TABLE 11

Robustness Extrapolation Results

Table 11 reports parameter estimates of a linear probability regression of buy dummies on a loan dummy ($LOAN_{it}$), realized returns over the past 6 trading days ($RETURN_{it-6}$) using opening prices and the interaction of a loan dummy and realized returns. BUY_{ijt} takes the value of 1 if investor i buys share j on date t. $LOAN_{it}$ takes the value of 1 if investor i has a share loan outstanding with the Bank of England at t. Depending on the specification, we control for date fixed effects (υ_t), company fixed effects (ν_j), trader × date fixed effects (κ_{it}), company × date fixed effects (ρ_{jt}). The standard errors clustered by trader and date are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: BUY_{ijt}		
Panel A. Excludes All Brokers			
$LOAN_{it} \times RETURN_{it-6}$	0.066***	0.059***	0.055**
	(0.022)	(0.020)	(0.024)
No. of obs.	1,687,311	1,687,311	1,687,311
Panel B. Excludes Most Active Traders (Top Percentile)			
$LOAN_{it} \times RETURN_{it-6}$	0.061***	0.052**	0.032
	(0.023)	(0.021)	(0.022)
No. of obs.	1,680,313	1,680,313	1,680,313
Panel C. Excludes All Trades in the Week After Closure of Transfer Book			
$LOAN_{it} \times RETURN_{it-6}$	0.057***	0.053***	0.043*
	(0.021)	(0.020)	(0.024)
No. of obs.	1,630,409	1,630,409	1,630,409
Date FE (υ_t)	No	Yes	No
Company FE (ν_j)	No	Yes	No
Trader × date FE (κ_{it})	No	No	Yes
Company × date FE (ρ_{jt})	No	No	Yes

the companies' clerks to compile the list of shareholders that were entitled to receive a dividend. In these periods, forward stock transactions may take place and these transactions are usually settled right after the re-opening of the books. We collect the dates for which the Bank of England and East India Company books are closed from John Freke's "Prices of Stocks."[22] Panel C of Table 11 shows that the extrapolation results remain unchanged after taking out re-opening days.

C. Destabilizing Short Sellers

Another potential concern is that margin loan holders trade as extrapolators because we capture credit-constrained arbitrageurs that need to finance a short position with a broker and we do not observe these short positions. As it becomes more expensive to maintain a short position during the run up of the bubble, investors may reduce or wind up their positions by buying back borrowed stocks (see Lamont and Stein (2004), Hong et al. (2012)). As a result, we would observe that loan holders buy stocks following positive past returns to reduce their short position. Two important arguments contradict this alternative explanation for extrapolative trading behavior of loan holders. First, trading stocks to maintain a short position is incompatible with the finding that margin loan holders are twice as likely to subscribe to new (overvalued) share issues. Tables 5 and 6 also show that

[22]Since the books were typically only closed in order to determine the dividend payments, the Royal African Company books were open during our entire sample period as they did not pay dividends in 1720.

many loan holders subscribed to these risky new share issues. Second, Lamont and Stein (2004) and Hong et al. (2012) explain that destabilizing short positions are largely driven by open end funds that experience redemptions by investors and are therefore forced to close their short positions for lack of funds. However, our sample does not contain any open end mutual funds that are subject to redemptions.

VII. Conclusion

This article studies the characteristics, trading behavior, and performance of loan holders during the South Sea Bubble. While the relationship between credit provision and asset prices has been the subject of many studies, economic theories have produced different predictions on the characteristics, trading behavior, and performance of loan holders during bubbles. On the one hand, rational agents could use credit to ride a bubble successfully (Brunnermeier and Nagel (2004), Temin and Voth (2004)); on the other hand, credit could be used for speculative purposes and lead to losses.

We combine detailed data on stock transactions with traders' characteristics, loan positions, and subscriptions to new share offerings. We find that inexperienced investors and active traders are more likely to take a margin loan. Our results show that loan holders behave as extrapolators, subscribe to highly overvalued share offerings and incur large trading losses. These results are driven by traders' characteristics rather than moral hazard because borrowers were liable for their trading losses. In line with the characteristics-based explanation, we find that our results become weaker after controlling for various trader characteristics and trader × date fixed effects. Overall, our findings are in line with the idea that behavioral traders use leverage to expand their positions during the run-up of the bubble. They then incur large losses when the bubble bursts. Our findings are not consistent with rational agents using margin loans to ride the bubble and with theories that relate price increases exclusively to the decline in the discount rate.

We believe that our article provides useful insights for policymakers. Retail investors are assuming a more prominent role in financial markets. Recent experiences with GameStop and cryptocurrencies indicate that they trade extensively on margin, take risky positions and incur losses. Our article shows that margin traders also take large risks when they are personally liable for their losses. These findings suggest that retail investors do not fully understand the risks associated with margin lending. Financial literacy programs that explain the risks of margin trading during financial bubbles could thus be a useful tool to mitigate risk and reduce losses.

Appendix

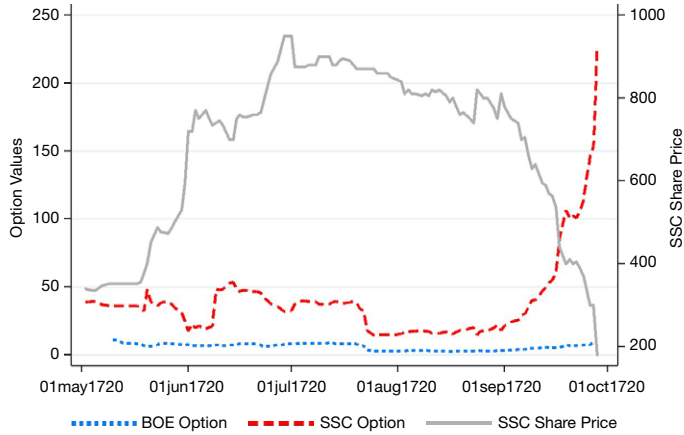
A.1. Moral Hazard and the Value of the Default Option

In this appendix, we approximate the value of a borrower's default option and explain why the South Sea loan facility is subject to moral hazard and the bank loan facility not. A borrower is subject to moral hazard if she can reap all future trading gains while being able to lay off a substantial part of the losses to a third party. Translated to our setting, this means that there are future scenarios in which the loan amount exceeds the collateral value. In such scenarios, the borrower holds a right to default on her debt

FIGURE A1

Default Option Valuations and Stock Prices

Figure A1 displays the daily value of the default option of the Bank of England (dotted line) and South Sea loan holder's (dashed line) on the left axis. Moreover, we plot the price of the South Sea stock on the right axis. The Black–Scholes formula is used to compute the value of the bank and South Sea loan holder's default option over the course of the bubble. We start our sample at the first of May, however, we can only compute the bank's option value starting from the day its loan facility opened (May 10).



and can thus transfer part of the losses to the lender. If default scenarios are ex ante sufficiently likely and lucrative, the default option becomes valuable.

A borrower's default option is effectively a put option on her collateralized stocks with an exercise price equal to the nominal loan amount. In other words, it becomes attractive for the borrower to default on her loan when the stock price (and therefore the collateral value) drops below the loan amount. We use the Black–Scholes formula to price the default option of the bank and South Sea loan facilities over the course of the bubble. More precisely, we price a 1-year default option by i) setting the risk-free rate equal to 2% and ii) approximating the option volatility by the realized 4-month rolling window volatility. Figure A1 displays the default option value for bank and South Sea loan holders.[23]

The most important take-away from Figure A1 is that bank's option value is close to 0. This expectation seems not unreasonable because the bank stock price had been consistently above £100 since July 19, 1707, and stock prices were gradually increasing. In contrast, the South Sea default option is much more valuable and even in-the-money after Sept. 19, 1720. The high South Sea option value is in line with the idea that investors deemed scenarios in which the South Sea price would drop below £400 quite likely. Also these expectations are not unreasonable as the South Sea price had been below that level as recently as May 19, 1720. In other words, bank loan holders attached low probabilities to default scenarios, while such scenarios were quite likely for South Sea borrowers.

In fact, these ex ante expectations line up nicely with the ex post evidence because Dickson (1967) notes that the South Sea Company was unable to retrieve more than

[23]Note that the exercise price for the South Sea option increases on May 20 from £250 to £300 and further increases to £400 on June 9, 1720, because the South Sea Company increases the maximum loan amount.

70% of the total sum lent of £11 million. In contrast, only two bank borrowers defaulted and the bank was able to cover their full loan amounts by selling collateralized shares in the secondary market.[24]

A.2. *Ex Ante Versus Ex Post Overvaluation*

In this section, we discuss whether a bubble dynamic was already discernable ex ante. The overvaluation assumption plays an important role in bubble theories. It is important to notice that we allow for rational bubble explanations. In fact, the discount rate channel assumes that prices do not deviate from fundamental values. In contrast, the rational riding and extrapolation channels assume that prices exceed fundamental values and that some investors are aware of this overvaluation ex ante. While the South Sea episode is widely considered as a textbook example of a bubble episode, it is not obvious whether investors during a bubble episode were also able to discern that stocks were overvalued. As we study the trading strategies of borrowers during a bubble episode, this matters for the interpretation for our findings.

We discuss a variety of contemporary sources claiming ex ante that stocks were overvalued. One example pertains to a member of parliament (Archebald Hutcheson) who published a series of newspaper articles in Mar. 1720 arguing that the South Sea stock is overvalued. These articles appeared several months before the bubble reached its peak value. He writes "It seems to be the universal Opinion … That the present Price of South-Sea Stock is much too high."[25] Hutcheson's claim was not merely based on gut feeling, but supported by a sophisticated "intrinsic value" computation based on discounting future cash flows.

He estimated that the fundamental value of the South Sea stock was in the range of £150–400 per share, while it traded around £1,000 at its peak. Based on these computations he reached the conclusion that "I verily believe … 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." His articles and computations were publicly available and thus accessible for all investors. Moreover, as a member of parliament, Hutcheson was a reputable source. Hutcheson's example also shows that some early 18th century investors were acquainted with sophisticated equity valuation techniques that bear striking similarities to today's methods (Harrison (2001)).[26] In addition to Hutcheson's publications, other public sources like newspapers and poems were also critical of the high valuations of the South Sea Company. The newspaper *The Theatre* computed the value of the South Sea stock early April to be worth around £140 while it was trading at prices above £200. Another example are the lyrics to the "South Sea Ballad" by Edward J. Ward in 1720. The text of the poem states: "Since bubbles came into fashion. Successful rake exert their pride, and count they airy millions … But should our South-Sea bubble fall, what number would be frowning…. When all the riches that we boast consists in scraps of paper."

[24]In fact, the proceeds of the share sale exceed the loan amount after transaction costs and the remaining sum is returned to the defaulting share holders.

[25]This quote is from his pamphlet titled "Collection of Calculations and Remarks Relating to the South Sea Scheme," published on Mar. 1720.

[26]Using information available to investors in 1720, Harrison (2001) estimates that even the most conservative estimate of South Sea Company income yielded a *P/E* ratio of 25 at the peak of the bubble, with some estimates even producing a ratio exceeding 100. These *P/E* ratios are not dissimilar to the roaring twenties (33) and the peak of the dotcom bubble (44) estimated by Shiller (2005).

In addition to the publicly available material, we discuss a few private sources discussing the deviations from fundamental value. The Archbishop of Dublin wrote in May 1720 that most investors in South Sea stock were "well aware it will not [succeed], but hope to sell before the prices fall" (Scott (1903)). Stockbroker Richard Cantillon writes to a client on May 19, 1720: "I esteemed every stock here extravagantly high" (Murphy (1986), p. 166). Investor John Trenchard writes in 1720: "what imaginary hopes can there be, that their stock will keep the advanced price."[27] Moreover, Temin and Voth (2004) provide evidence that the Hoare's bank was increasingly tightening the lending conditions for loans collateralized by South Sea stocks as the price reached its peak, suggesting that the bank was increasingly worried about overvaluation of the South Sea shares. In addition to perceived mispricing, an unprecedentedly high trading volume was noted by contemporary observers. Banker Richard Cantillon writes on Apr. 29, 1720: "People are madder than ever to run into the [South Sea] stock" (Murphy (1986), p. 165). Stockbroker Peter Crellius even compares the behavior of investors in Apr. 1720 to "nothing so much as if all lunatics had escaped out of the madhouse" (Chancellor (1999), p. 94).

The third piece of evidence that investors were aware of the overvaluation is the wave in new equity issues that occurred well before the peak of the bubble. Standard corporate finance theory predicts that companies issue new shares when prices are above fundamental values. In other words, the overvaluation allows them to finance new investments (too) cheaply. The prime example of this intuition is that the amount of outstanding shares in the South Sea Company more than doubled over the period of Apr. to Aug. 1720. In addition to the South Sea's new share issuances, the spring of 1720 is characterized by a wave of IPOs. Anderson ((1787), pp. 104–112) estimates around 180 new joint stock companies floated in 1720. The investor opportunism is reflected by some of the underlying business models of these new companies. One example is a company that "traded in human hair," but perhaps the most famous example is "a company for carrying on an undertaking of great advantage, but nobody to know what it is." In response to this wave of IPOs, an act was passed that prohibited the flotation of new companies without specific parliamentary authorization on June 1720. This act would become known as the "bubble act" as its purpose was defined as "restraining several extravagant and unwarrantable practices" (Harris (1994)). This goal was also clear to contemporary commentators. In a discussion on the act, the newspaper *The Original Weekly Journal* writes on June 25, 1720: "it might take off abundance of their bubbles."

Supplementary Material

To view supplementary material for this article, please visit http://doi.org/10.1017/S0022109023001163.

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[27]Quoted from "A Comparison Between the Proposals of the Bank and the South-Sea Company," published early 1720.

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