Leverage and Beliefs:
Personal Experience and Risk Taking in Margin Lending[*]

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Abstract:

What determines risk-bearing capacity and the amount of leverage in financial markets? This paper uses unique micro-data on collateralized lending contracts during a period of financial distress to address this question. An investor syndicate speculating in English stocks went bankrupt in 1772. Using hand-collected information from Dutch notarial archives, we examine changes in lenders' behavior following exposure to potential (but not actual) losses. Before the distress episode, financiers that lent to the ill-fated syndicate were indistinguishable from the rest. Afterwards, they behaved differently: they lent with much higher haircuts. Only lenders exposed to the failed syndicate altered their behavior. The differential change is remarkable since the distress was public knowledge, and because none of the lenders suffered actual losses – all financiers were repaid in full. Interest rates were also unaffected; the market balanced solely through changes in collateral requirements. Our findings are consistent with a heterogeneous-beliefs-interpretation of leverage. They also suggest that individual experience can modify the level of leverage in a market quickly.

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Leverage in financial markets is not constant over time. There is ample evidence that lending is pro-cyclical – high and increasing in good times, and declining when asset prices fall (Adrian and Shin 2010). For example, when the stock market crashed after Lehman's bankruptcy in 2008, "haircuts"[1] increased sharply and the volume of collateralized lending collapsed (Gorton and Metrick 2011; Krishnamurthy, Nagel, and Orlov 2012). Pro-cyclical "leverage cycles" affect the risk bearing capacity of financial intermediaries and can contribute to large changes in asset prices (He and Krishnamurty 2013). The resulting innovations to asset prices will be observationally equivalent to shocks to risk aversion, which contribute importantly to price swings in the aggregate (Campbell and Cochrane 1995; Cochrane 2011).

What causes changes in leverage and risk-bearing capacity is less clear. Both regulatory and technical constraints – such as VAR limits – and changes in behaviour can rationalize large shifts in credit provided to financial markets (Adrian and Shin 2010; Geneakoplos 2009). Several contributions to the literature on pro-cyclical leverage assume that volatility of asset prices is greater in bad states of the world (Brunnermeier and Pedersen 2009, Vayanos 2004). Fostel and Geneakoplos (2012) rationalize the positive correlation between bad news and volatility in a setting with hetereogenous agents. Higher volatility can naturally lead to a drop in leverage. Related work argues that beliefs and/or risk preferences are not constant over time, but change in response to personal experience. Krishnamurty (2009) shows theoretically how Knightian uncertainty can increase in crisis times; Malmendier and Nagel (2011) demonstrate that individuals who experienced the Great Depression invested systematically less in equities, even after controlling for age, gender, and income. Guiso, Sapienza, and Zingales (2011) demonstrate that during the recent financial crisis, investors in Italy became markedly more risk averse. Two key challenges in this literature are to demonstrate that personal experiences can lead to shifts in behaviour that alters aggregate market outcomes, and that changes in behavior are not simply a reflection of lower wealth.[2]

This paper demonstrates that personal experience can lead to pro-cyclical "haircuts" (the reciprocal of leverage) in financial markets. This is true even in the absence of any changes to personal wealth. The shifts in collateral requirements are sufficiently large to impact the market-wide level of leverage. Using hand-collected data on loan conditions from notary archives, we

[1] The difference between the market value of the asset and the loan value in the lending agreement.

[2] Guiso, Sapienza and Zingales (2011) find no correlation with wealth, consumption patterns, or other sources of risk. They also conduct an experiment where subjects watch a scary video and are then asked to participate in a trading game, and show that this is associated with a marked reduction in risk tolerance. Brunnermeier and Nagel (2008) find that wealth fluctuations only have minor effects on risk tolerance.

analyze an 18th century distress episode of a group of Amsterdam stock market investors – the Seppenwolde syndicate. It had speculated on rising prices in East India stock, using collateralized borrowing (through contracts akin to modern margin lending). Lenders to the syndicate who had funded the positions were at *risk* of significant financial losses, but escaped without losing a guilder. Aggregate leverage declined after the Seppenwolde bankruptcy. This change was driven by financiers who had previously lent to the syndicate. Before the crisis, their collateral requirements were indistinguishable from the rest of the market. Suddenly, after the Seppenwolde bankruptcy, lenders involved with the syndicate only extended loans with markedly higher haircuts (Figure 1). The average rose from 20 to almost 30% within six months. Other lenders – not at risk of personal losses – conducted business as usual.

The change in lending by financiers exposed to the stricken syndicate changed aggregate outcomes. The overall tightening of collateral requirements in Amsterdam after Christmas 1772 is fully explained by former lenders to the syndicate becoming more cautious. Interest rates on loans extended by both groups of lenders remained unchanged. The types of securities that were funded with margin loans (mainly East India Company stock) also did not change after the bankruptcy. Importantly, although haircuts of exposed and non-exposed lenders did start to converge after a year, the effect remains visible for as long as we have data – a one-off, large shock changed individual behaviour on a substantial scale and for a considerable period of time.

[Figure 1 about here]

How could the Amsterdam market feature different haircuts for the same type of collateral? In other words, why did borrowers not simply shift towards lenders that were not affected by the Seppenwolde bankruptcy? The answer lies in the decentralized market structure. Borrowers had to search for potential lenders. Who they were matched with depended to a large extent on whoever happened to have cash available for a loan at the right moment. Unaffected lenders were in short supply; this meant that borrowers had to settle for higher haircuts if their funding need happened to coincide with resource availability in the hands of an affected lender.

We interpret these findings in the light of the Geanakoplos (2003) model of collateralized lending. As in his model of repo lending, we argue that collateralized lending reflects investor heterogeneity: Investors who are optimistic about future values of a risky asset borrow, while pessimists lend.[3] In equilibrium, speculation in risky securities is financed by contracts involving

[3] In the Geneakoplos model, agents with more optimistic beliefs want to lever up to invest in the asset. Pessimistic agents are not willing to hold the asset directly, but are willing to lend to the optimists. The equilibrium contract

minimal risk to the lenders. Fluctuations in haircuts reflect changes in the level of disagreement between investors about the payoff of an asset or shifts in investor characteristics, such as the share of optimists and pessimists.[4]

The distress episode in the Amsterdam stock market in December 1772 allows us to test the implications of the Geneakoplos model directly. By only affecting one set of investors – and their lenders – it increased lender heterogeneity. We interpret the differential impact on collateral requirements as evidence in favor of the heterogeneous belief model of collateralized lending. Having only narrowly escaped from losses, affected lenders became more pessimistic; consistent with Geneakoplos (2003), they charged higher haircuts. This shift in lender behavior affected aggregate leverage. In our historical setting at least, differential experience caused a shift in beliefs that was sufficiently large to generate pro-cyclical leverage. Other factors cannot explain the pro-cyclicality of haircuts in our case. Losses amongst intermediaries, which may have played an important role in the recent crisis (Brunnermeier and Pedersen 2005; Adrian and Shin 2010), were unimportant.[5] Instead, the price fall was probably exogenous, driven by the arrival of negative news about fundamentals. Lenders at risk of losing money then reduced the riskiness of their lending by raising collateral requirements. Despite the decline in effective funding for speculators, there were no further price declines – no "loss spiral" followed the sharp shift in haircuts. Also, because lenders did not suffer any actual losses, the increase in haircuts cannot reflect an increase in (wealth-dependent) risk aversion. Finally, increases in haircuts were not driven by regulatory constraints, such as VAR limits, which can lead to cascading fire sales (Brunnermeier and Pedersen 2009).

Our research also contributes to the literature on asset prices and heterogeneous beliefs more generally. Differences in beliefs can be important for asset pricing (Miller 1977; Harrison and Kreps 1978; Jarrow 1980; Hong and Stein 2007). Where these differences come from is an area of active research interest. Agents may have access to different information sets – perhaps as a result of word-of-mouth effects (Brunnermeier 2001; Hong, Kubik, and Stein 2005a)[6] –, or different beliefs as a result of their own experiences. The latter is referred to as reinforcement learning (Erev and Roth 1998; Camerer and Ho 1999). A number of contributions look at the

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turns out to be risk free. The haircut is set such that even in the worst possible state of the world, lenders are fully repaid.

[4] Simsek (2013) uses a Geneakoplos-style model to analyse the effects of various types of disagreement between optimists and pessimists.

[5] For a historical example, cf. Schnabel and Shin (2004).

[6] Social networks can shape investor attitudes (Hong, Kubik, and Stein 2005a) and attitudes more generally (Acemoglu and Jackson 2011); social capital can boost trust in the stock market (Guiso, Sapienza, and Zingales 2008a).

impact of experience on decision making in financial markets (Choi et al. 2009; Greenwood and Nagel 2009; Kaustia and Knüpfer 2008; and Vissing-Jorgenson 2003). [7] Malmendier and Nagel (2011, 2012) argue that investors who came off age during the Great Depression under-invested in equities all their lives; those who experienced only high and rising inflation in the 1970s expected such trends to continue. Guiso, Sapienza, and Zingales (2011) argue that the 2008 financial crisis induced a big change in risk appetite, and provide experimental evidence along the same lines. In the same spirit, Heath and Tversky (1991) show that the willingness to take risks declines sharply with trust in one's own judgement. More generally, our works connects with research on the determinants of attitudes and beliefs.[8]

Our paper also contributes to the literature using historical data on haircuts as a measure of expectations. Rappoport and White (1994) argue that increasing margin requirements in the run-up to the 1929 crash on the NYSE reflected growing worries about a coming crash. Temin and Voth (2004) show how changes in haircuts in lending against stock during the South Sea bubble can be used to demonstrate that investors were "riding" the bubble. More broadly, Schnabel and Shin (2004) show how growing margin requirements created contagion through falling asset prices in the Amsterdam financial crisis of 1763 (see also Quinn and Roberds 2012).

We proceed as follows. Section I discusses the historical background and goes into the details of the 18th century secured lending contracts. In addition, we provide more information about the events in 1772. Section II lays out a simple model of secured lending. Section III describes our data. Section IV presents the main empirical results, and section V considers a variety of extensions and robustness checks. Section VI concludes.

I. Historical Background

In this section, we first summarize the main characteristics of the collateralized lending contracts in 18th century Amsterdam. We then describe how the market for these loans operated in normal times. To understand the crisis that hit the Seppenwolde syndicate in late 1772, we explain briefly the crisis that the East India Company at this time. Finally, we describe the investment syndicate's bankruptcy and how the authorities dealt with the crisis, as well as subsequent developments in the market for collateralized loans.

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[7] A formal model of experience-based belief formation is Piketty (1995).

[8] Malmendier and Tate (2005) and Graham and Narasimhan (2004) find that corporate managers who were born before the Great Depression make more conservative capital structure decisions. Malmendier, Tate, and Yann (2011) find that CEOs with a military background act systematically differently as leaders of firms. Personal experience may also be a prime determinant of differences in beliefs. For cultural change more broadly, cf. Alesina and Fuchs-Schuendeln (2007) , Nunn and Watchekon (2011), (Guiso, Sapienza, and Zingales 2008b).

I.A. Collateralized Lending in 18th century Amsterdam

The market for secured lending ("beleeningen") in 18th century Amsterdam was well developed. It can be traced back to the early days of trading in Dutch East India Company stock during the early 17th century (Gelderblom and Jonker 2004, p. 661). By the 1640s, lending against stock had developed into a mature and standardized market (Petram 2011). From the 18th century onwards, English securities were used as collateral as well, including the stock of the British East India Company (EIC).

Secured lending agreements in 18th century Amsterdam are similar to today's margin loans – the asset purchased served as collateral. Appendix A provides the transcript of a typical contract. A borrower received a sum of money from the lender and in return posted collateral, in our case English securities. In the 18th century, ownership took the form of an entry in the equity ledger of the company. For secured lending, the security in question was transferred from the account of the borrower to that of the lender. When the loan expired and the lender was repaid, the share was transferred back to the borrower. This is very similar to today's margin loan agreements. Each contract stipulated an interest rate, the size of the loan, and the amount of collateral. The haircut is defined as the margin or the fraction of the value of the collateral that was not financed with the loan. The standard period for a secured loan contract was 6 months, with a small fraction of contracts running for 3 or 12 months. Contracts were often extended beyond the maturity of the original lending contract. The data we use in this paper only refers to new contracts, not to these renewals.

If the stock price fell below a pre-established limit, the lender was entitled to additional margin. The contracts specified critical price points at which additional collateral had to be posted or part of the loan had to be repaid. For example, suppose that at the time a loan contract was signed the price of the underlying stock was 220%.[9] Further suppose that the haircut was 0.25 (i.e. the value of the loan was 165%). If the stock price fell below 200%, the borrower had to either repay 10 or post the equivalent in stock. As a result, the haircut would be restored to 0.225. With any additional price decline of at least 10, additional margin had to be posted.[10]

If the borrower defaulted and was not able to meet margin calls, or was not able to repay the loan by the end of the contract, the lender had to right to liquidate the borrower's position.

[9] In the 18th century prices were quoted as percentage of nominal (face) value.

[10] The initial haircut can be disaggregated into two components. The first element is the "distance to margin call", in this case the difference between 220 and 200%, or 0.09 of the value of the collateral. The second is "distance to loss", in this case 200% to 165% or 0.16 of the value of the collateral. If margin calls were honored, the "distance to loss" increased by 10 the moment the price fell below 200.

The collateral was already in the lender's name and he could sell it right away. Other creditors could not lay claim to this collateral.[11] The lender was only entitled to the principal value of the loan and accrued interest. Any surplus left after liquidation was to be remitted to the borrower. If the proceeds did not cover principal and interest, the borrower was personally liable for the residual.

The 18th century market for collateralized lending was highly decentralized. Direct lending between borrowers and borrowers dominated. Only around 5% of transactions featured financial intermediaries. When a borrower was looking for a loan, he or she searched for potential counterparties. Borrowers and lenders were generally not related through family ties or business connections (as far as can be ascertained from the – admittedly imperfect – documentary records).

Who were the lenders that provided funds for the market in secured loans? In general, they were rich individuals from the merchant and regent class who had largely withdrawn from active trade and had become "rentiers". Based on Elias (1903), Table 3 presents key characteristics, separated for lenders who did and did not lend to the consortium. Note that the categories of Table 3 are partially overlapping so that the percentages do not add up to 100%. Only around half of the lenders were involved in commercial activities. The other half were full time *rentiers*. Around a third of the lenders worked for the government or in the judiciary. Another third were members of the nobility – which usually indicated that an ancestor had made enough money to purchase a noble title. Around a fifth of lenders was female; these were wealthy widows or spinsters. Finally, a small fraction of lenders were specialists, i.e. individuals or firms who both lent and borrowed in this market. This group for example featured the (Portuguese Jewish) brokerage firm of David Pereira and Sons.

Lenders who financed the stricken Seppenwolde consortium were broadly similar to the rest. They were slightly more likely to be active in commerce, although the difference is not statistically significant. A lower fraction was active in government or the judiciary, but this difference is also not significant. Those who ended up exposed to the Seppenwolde syndicate lent less to specialists, and more to Jews and merchants.[12] The differences are small and mostly insignificant, except for the case of merchants (88 vs 96%).

[11] This is similar to today's automatic stay exemptions.
[12] We exclude loans to the Seppenwolde syndicate from the analysis of borrowers, to ensure comparability of lending behavior to borrowers outside the stricken investor group.

Average Loan volume per transaction was nearly identical for lenders exposed to the syndicate as compared to the rest. The interest rate charged was also nearly identical. There was a difference in the proportion of lending backed by East India stock – a factor for which we will control explicitly in the more detailed analysis below.

[Table 3 about here]

Repeated lending between the same borrower and creditor was rare. Of all lenders, a full 45% only lent once in the years 1770-75; another 26% lent 2 or 3 times. Only 3 percent of lenders engaged in more than 10 transactions. The borrower side is similar – 38% of borrowers only engaged in one transaction, and another 35% participated in 2 or 3. Only 10% of the sample borrowed ten or more times. The overwhelming majority of transactions did **not** feature repeat lending – over 80% of transactions in our data featured lenders and borrowers who had never done business with each other. Figure 2 shows the network of lenders and borrowers. The value of collateral used determines the thickness of the lines. While the Seppenwolde's act as a "spider in the web", they borrow from many financiers. As is readily apparent, there are few exclusive (or privileged) lending relationships – many borrowers have multiple lenders, and most lenders provide loans to more than borrower. The only exception is the Seppenwolde syndicate, where many lenders only lend once.

To test if random matching of lenders and borrowers can explain the nature of lending in our sample, we calculate the Herfindahl index for every lender during the pre-crisis period:

$$H_i = \sum_j s_{i,j}^2$$

where $s_{i,j}$ is the share of lending by lender i to an individual borrower j. If lenders repeatedly lent to the same borrower, to the exclusion of other investors, we would expect a high Herfindahl index. The left panel of Figure 4 presents the actual distribution of these Herfindahl indices for all lenders in ours sample. Many lenders only entered into a single transaction; these are highlighted for the observations where the Herfindahl index equals 1.[13] The distribution is discontinuous, with zero weight between 0.68 and 1. This is the result of the way a Herfindahl index is constructed and the fact that most lenders only do a few transactions.

To compare the actual distribution with a randomly-generated one, we randomly pick a lender from our set of actual lenders. We determine how many new loan contracts he or she entered into before Christmas 1772, and then randomly draw a corresponding number of

[13] The y-axes are aligned to reflect equal fractions. Grey bars reflect lenders who entered into at least 2 transactions. The white bars indicated lenders who only lent out once.

counterparties (taking into account that some borrowers are more active than others). Finally, we calculate the resulting Herfindahl index, and repeat the exercise 10,000 times. As the figure demonstrates, the two distributions are nearly identical. Both the Pearson X2 and the log likelihood test for the equality of distributions fail to reject.[14]

I.B. The EIC in 1772

The distress episode we study occurred immediately after Christmas 1772. EIC stock prices had been falling for some time (see Figure 3 for EIC stock prices between 1723 and 1794). The EIC's problems originated in Bengal where the company held large possessions. In 1757 the British had defeated the local rulers and in 1765 the EIC gained control over the *diwani*, the local taxes. This proved to be a windfall for the company. Dividends were raised and the EIC stock price increased from about 170% to 270%. However, the (military) expenses made by the Company increased substantially. In addition, eventually, revenues fell. The company started to squeeze the local population even harder than before. This contributed to the infamous Bengali famine of 1769-1773, which, apart from killing millions of people, also led to a deterioration of the Company's financial position. Nevertheless, the company refused to scale back dividends, even increasing them to the legal maximum of 12.5% per annum in March 1771. Financial shortfalls of the Company were financed through credit. Local company men in India borrowed heavily through short term bills (drawn on the Company in London) and at home the Bank of England granted the company substantial loans. Information about the worsened state of the Company was kept secret. Company directors, many of them holding large positions of EIC stock and afraid of the consequences for stock prices, were unwilling to reduce dividends. Eventually, matters came to a head. During the summer of 1772 the EIC had trouble rolling over its debt and in September 1772 the Company was finally forced to scale back its dividends. Stock prices plummeted After this, more bad news surfaced and stock prices kept falling. In the end the government intervened, placing the Company under more direct control through the Regulating Act of 1773 (Sutherland 1952). EIC stock prices stayed at a permanently lower level.

[Figure 3 about here]

I.C. Events after Christmas 1772

In 1771, a group of Dutch financiers around the brothers Van Seppenwolde took a large long position in EIC stock in 1771. At that point the EIC price had fallen from a level of 270% in

[14] P-values 0.43 and 0.505.

1768 to about 220%. Not knowing what was happening behind the scenes in London, the consortium speculated on a rebound in stock prices. It used the Amsterdam market for securitized lending to finance its positions. These were considerable, totalling almost 6% of all outstanding stock. In addition to EIC stock, the consortium also held a significant position in Bank of England stock. Table 1 gives an overview of the participants of the consortium and their holdings around Christmas 1772.[15] Backing the consortium were two old and famous merchant bankers, Clifford and Sons and Abraham ter Borch and Sons, who provided a large share of the equity necessary to finance these positions (Wilson 1966; SAA, 'Stukken betreffende'; Sautijn Kluit 1865; NA, Staal van Piershil, 386, 396; OSA 3710; GAR, 90, 56).[16]

[Table 1 about here]

The price fall of EIC stock devastated the consortium's position in the second half of 1772. Most secured loans had been contracted while the EIC price stood around 220%. The covenants stipulated that if the price fell below 200%, additional collateral had to be posted. With every additional price fall of 10%, margins had to be replenished. When, in the second half of 1772, the price of EIC fell first below 200%, 190% and 180%, the consortium managed to meet these additional margin calls (SAA, 5075, 10,593 -- 10,613; NA, Staal van Piershil, 381; GAR, 90, 52). However, when the EIC stock price finally fell below 170% after Christmas 1772, the consortium's equity had been wiped out. No further margin calls could be honored. All firms involved, including the two big players in the background, Clifford and Ter Borch, "broke" and went bankrupt.

From December 28 onwards a multitude of "insinuaties", or official payment orders were issued, requiring the borrowers to post the additional margin (Van Den Brink, 10,602, see also Wilson 1966). Since these calls could not be met, lenders had the right to sell the collateral as quickly as they could, thereby recouping the value of the loan and any interest payments that still had to be made. Any profits above the value of the loans would accrue to the consortium; losses would be the problem of the lenders. Figure 5 shows the timing of these transactions (as far as

[15] The consortium was led by Hermanus and Johannes van Seppenwolde, two brothers who had been prominent citizens in the town of Leiden. Pieter van Peene was from Leiden as well and lent out large sums of money without security to the Van Seppenwoldes (SAA, Tex en Bondt, ***). He was involved in share trading as well. Finally, Clifford en Chevalier was a small banker's firm associated with Clifford and Sons; Willem Clifford was a senior partner in Clifford and Chevalier and a junior partner at Clifford en Clifford en Zoonen, Elias (1903).

[16] It is unclear why the consortium decided to take such a large speculative position. It has been argued in the historical literature that Clifford, Clifford and Chevalier and Abraham ter Borch and sons had suffered substantial losses in the provision of credit to plantation holders in the Dutch Caribbean (Wilson ***). From this perspective, their involvement in EIC stock might be seen as a gamble for resurrection. Others have suggested that the consortium attempted to "pump and dump" the stock (Koopman ***).

they could be reconstructed). The gray bars indicate the time the official payment orders were issued; the black bars indicate actual transactions. There was a significant lag between these two, indicating that sales were delayed. Most transactions were completed by the end of January 1773.

[Figure 5 about here]

Figure 6 presents the distributions of the 'surplus' on these loans (the difference between the value of the collateral and the loan), right after the issuing of margin calls on December 29th and after the actual liquidation of the underlying collateral. Around the time of the margin calls the median surplus was around 10%. Under normal circumstances lenders would have had a comfortable margin to liquidate the collateral. Since many transactions were delayed, and prices after Christmas 1772 kept falling, the surplus at liquidation was generally lower. Nonetheless, it was always positive. In other words, lenders did not lose any money on the loans to the consortium.[17]

[Figure 6 about here]

It is unclear why lenders were waiting for a number of weeks to liquidate the collateral. At best, lenders could hope for full repayment of principal and any remaining interest payments. They had no upside from higher prices in the future, and instead would lose if prices fell even further. Figure 6 suggests that a large fraction of lenders only sold when they got close to losing money. It is possible that liquidity on the Amsterdam exchange had initially dried up. Figure 5 provides some support for this interpretation; it shows that EIC prices in Amsterdam were significantly below those in London. Since there was normally a close relationship between the two prices, driven by the possibility of arbitrage, this suggests local selling pressure. Limited liquidity may have made it difficult to sell the securities. However, most lenders could afford to sell at a discount of up to 10% without losing a penny. This would suggest that the market had come to a virtual standstill.[18]

[17] The surplus at the time of liquidation could not be reconstructed for every single loan contract. However, the finding that no single lender actually suffered any losses is corroborated by other evidence. For one of the members of the consortium (Johannes van Seppenwolde) the exact details of his (bankrupt) estate survive (SAA 30269, 347). This document lists all assets and liabilities of Van Seppenwolde after the events of Christmas 1772. The overview is complete, including everything from real estate to unpaid attorney fees, rent and even the use of a carriage. Loan transactions on the collateral of English securities all ended up on the asset side: Van Seppenwolde was owed (instead of owing) money since the collateral had been liquidated at a small profit. Two entries on the liability side were the result of losses from secured lending, but these were related to loans on the collateral of claims on plantation holders in the Dutch Caribbean, not to English securities.

[18] Alternatively, there may have been some coordination on part of the lenders to avoid a general fire sale. In response to the official margin call reminders, the consortium often asked the lender to postpone selling the

These events were extensively covered in the press. On December 29, the periodical *De Koopman* reported a scarcity of buyers on the exchange. It explicitly mentioned that margin calls had been issued and that collateral would have to be sold. In addition, secured loans were difficult to obtain, "only on additional security" (*De Koopman*, p. 295). On January 3, the *Koopman* mentioned that many more margin calls had to be met and more selling was imminent. Reflecting on developments in the market, the periodical expressed the hope that "reality will become more fashionable now people are learning these specific lessons" (*De Koopman*, p. 310). In mid-January it was reported that "bargains were to be had on the exchange" (*De Koopman*, p. 338).

The events after Christmas 1772 led to more turmoil on the Amsterdam exchange. The bankruptcy of old and renowned banks increased counterparty risk; credit in Amsterdam, often in the form of short term bills, dried up (SAA, Beleenkamer, 1; Sautijn Kluit 1865; Wilson 1966). Nonetheless, the Amsterdam market calmed down relatively quickly. On January 14, 1773 the Amsterdam city government set up a public discount facility where, on the security of domestic government bonds and non-perishable goods, anyone could borrow money. The facility was hardly used; of the total available credit of 2 to 3 million guilders only f. 335 thousand was lent out (SAA, Beleenkamer, 1 and 5). The official records mention that the gesture of setting up the facility alone had restored the 'general credit'. After the discount facility was set up, no more defaults occurred (SAA, Beleenkamer, 1)[19].

How unusual was the behavior of the EIC stock price in 1772? We measure returns as the log difference of prices over a six-month period, the standard term for secured loan contracts: $r = ln\left(\frac{p_t}{p_{t-6}}\right)$. Table 2 gives descriptive statistics for three time periods – the years from the beginning of our sample in 1723 to the first half of 1772, prior to the distress period; an event window during which the Seppenwolde episode occurred; and the full sample from 1723 to 1794.

[Table 2 about here]

On average, East India stock appreciated by half a percent over a six-month horizon during the half-century from 1723 to 1772. Returns during the Seppenwolde episode were dramatically

collateral "because of the circumstances" ("…vermits de omstandigheeden […] hij vriendelijk versogt eenige tijd stil te zitten") (SAA, Van Den Brink, 10,602). Since there was no direct upside from liquidating at a profit, this equilibrium might have been stable, as long as there were some reputation costs from deviating and the surplus remaining on the positions was big enough so the risk of loosing money was limited.

[19] "de gemoederen op de beurs aan t bedaeren zijn geraakt, na de opening van de commissie, jaselfs sodanig dat er geen ophouding van betaling meer plaats heeft gehad."

lower, with prices declining by an average of 3.4 percent over the average six month period between the beginning of 1770 and January 1773. The standard deviation is only slightly higher, but skewness is markedly more negative for the sample including the first week of 1773. The maximum loss over a six-month horizon increased from 25.6 to 35.8 percent. Figure 7 compares the distributions.

[Figure 7 about here]

The shift in distributions during the distress period markedly increased the weight in the left "tail". Prior to the second half of 1772, priced dipped by 20% or more in only 1.1 percent of all cases. Since average haircuts were 20%, this implies that in only one out of 100 lending events, the collateral values fell below the value of a loan. During the period 1770-1/1773, this frequency increased to over 7 percent.

II. Model[20]

In this section we set up a general equilibrium model of haircuts based on Geneakoplos (2003) and Simsek (2013) featuring heterogeneous beliefs. We analyse the case where borrowers' beliefs (the agents taking a position in the market) remain unchanged, but the beliefs of lenders diverge. More specifically, a fraction of lenders becomes more pessimistic than before. The aim is to analyse the impact on haircuts (and interest rates). In addition, we establish conditions under which borrowers find it optimal to accept loans from more pessimistic lenders.

II.A. Asset market and agents

The model has an infinite time horizon. Time is continuous. There are two assets in the economy. A risk-free asset is in fully elastic supply. The risk-free rate is normalized to be zero. Secondly, there is a risky asset in unit supply that has a random payout $\widetilde{r}$. The timing of the payout of the asset is unknown – for simplicity we assume that each period there is a fixed probability π that the asset pays out (conditional on not having paid out before). This captures the opportunity costs agents might face when they do not have a position in the asset. We assume that the asset has two possible payoffs, $\overline{r}$ and $\underline{r}$ with $\overline{r} > \underline{r}$. For simplicity we assume that these outcomes are equally likely. Trade in the asset takes place in a centralized market, generating a price p.

There are three types of agents in the economy indexed by $i = 1, 2, 3$. Each type of agent has mass N_i. Agents differ principally in their beliefs about the payoff of the asset. Specifically,

[20] The proofs for all propositions and lemmas are in Appendix D.

agents agree about the good payoff of the asset $\overline{r}$ but have different expectations about $\underline{r}$. Agents of type 1 are most pessimistic, agents of type 3 are most optimistic. Agents of type 2 take an intermediate position. In other words $\underline{r}_1 < \underline{r}_2 < \underline{r}_3$. The expected value of the asset for each type of agent is given by $v_i = \frac{1}{2}(\underline{r}_i + \overline{r})$. Agents have cash endowments c_i. For simplicity we assume that cash constraints are only binding for agents of type 3. Agents are risk neutral and have a zero discount rate.

II.B. Lending market and matching technology

Contracting in our economy is constrained. Agents can simply buy and hold the asset and they can sign loan contracts with each other. Shorting is not allowed.[21] The loan contracts that agents sign with each are collateralized with the asset and have limited commitment. Because of the random payoff of the asset loans can be potentially risky.

We focus on equilibria in where $v_2 < p < v_3$ such that only agents of type 3 will want to invest in the asset. Agents of type 3 can borrow money from the agents to lever up their investment. We assume that these margin loans can be obtained in a decentralized search or OTC market. More specifically, type 3 agents search counterparties from groups 1 and 2 with intensity μ. Whether they are matched to a type 1 or type 2 agents is random and depends on their relative presence in the market. At any moment in time there are M_1 matches between type 3 and type 1 agents and M_2 matches between type 3 and type 2 agents. Each loan has face value l where, for each unit of the asset pledged, the borrower receives l units of money to invest. Whenever a type 3 agent finds a counterparty they negotiate over the haircut ($h = 1 - \frac{l}{p}$) and interest rate (ρ) of the contract. For simplicity we assume that the borrower has all bargaining power and manages so extract all surplus from the match. This means that the interest rate only reflects (potential risk) and not market power. In addition, we assume that a loan contract ends randomly at a given time with probability λ (conditional on a loan still running). This captures the fact that a loan contract only run for a limited period of time.

II.C. Equilibrium

We study the steady state equilibrium of the model.

[21] This captures the feature that shorting in 18th century Amsterdam was possible but not accessible to all market participants, effectively creating short selling constraints.

Definition. Define α_1 and α_2 as the decision rules for the agent of type 3 to accept a loan from agents 2 and 3 respectively. Define M_1 and M_2 as the steady state populations of type 1 and 2 agents that are matched to a type 3 agent. A steady state equilibrium is a combination of matching rules α_1 and α_2, loan sizes l_1 and l_2, matched populations M_1 and M_2 and an asset price $v_2 < p < v_3$ such that all types maximize expected payoffs.

Decision rules α_1 and α_2 determine whether it is optimal for a borrower to accept a loan from agents of types 1 and 2. Lenders will always accept a match because there is only one type of borrower - the type 3 agent. This is not necessarily the case for the borrower. Type 1 agents are more pessimistic and being matched with them is less desirable than with type 2 agents. A borrower might be tempted to reject the match and wait for a borrower of type 2 to come along. Whether this is optimal or not depends on the following trade-off. On the one hand a match with a type 1 lender locks a borrower into a less desirable contract for a prolonged period of time (determined by λ). On the other hand, waiting and staying outside of the market has significant opportunity costs. Type 2 lenders are in fixed supply (determined by $N_2 - M_2$) and as a result a borrower might need to wait for a long time until he meets with a type 2 agent. In the mean time the asset could pay off (with probability π) and the borrower will loose out on an expected positive return. We focus on a "full matching" equilibrium where the borrower always accepts a match with type 1 lenders, i.e. $\alpha_1 = \alpha_2 = 1$. We explicitly derive the conditions under which this is optimal.

II.D. Solution

The first key element of the equilibrium can be expressed as follows.

Proposition 1. For any steady state equilibrium all loan contracts will be risk free, i.e. $l_i = \underline{r}_i$ and $\rho = 0$.

The intuition behind this result is similar to the one in Geneakoplos (2003). Suppose that the borrower and lender decided to sign a risky contract. In the bad state of the world ($\widetilde{r} = \underline{r}$), the lender expects to loose a large amount of money. In the good state of the world he will charge a high interest rate to compensate for this. In contrast, the borrower expects losses in the bad state to be limited; he believes the lender will be able to recuperate a large fraction of the loan. As a result, from his perspective, the risky interest rate is disproportionally high. This makes risky

borrowing expensive. In equilibrium, the borrower will therefore not find it optimal to borrow more than the risk free amount. This result uniquely pins down the size of a loan and, taking prices as given, the haircut.

We next establish under what conditions the full matching equilibrium ($\alpha_1 = \alpha_2 = 1$) actually exists. A steady state equilibrium with $\alpha_1 = \alpha_2 = 1$ must satisfy the following expressions

$$\mu(N_3 - M_1 - M_2) = \lambda(M_1 + M_2) \text{ and } \frac{M_1}{N_1} = \frac{M_2}{N_2} \quad (1)$$

where $V_2 > V_1$. A steady state equilibrium with $\alpha_1 = \alpha_2 = 1$ exists when $V_0 \leq V$, or in other words when it is optimal for the type 3 agent to accept a match with a type 1 agent.

Proposition 2. Define $\overline{p}$ as the threshold price for which $V_0 = V_1$, with

$$\overline{p} = \frac{\underline{r}_1 - c_3 N_3}{2} + \frac{1}{2}\sqrt{\left(\underline{r}_1 - c_3 N_3\right)^2 + \frac{4 c_3 N_3 \pi \underline{r}_1}{(\lambda+\mu)(1-\pi)}}$$

As long as $v_2 < p \leq \overline{p}$, $V_0 \leq V_1$

where p is implicitly defined by the market clearing condition

$$\frac{M_0 c_3}{p} + \frac{M_1 c_3}{p - \underline{r}_1} + \frac{M_2 c_3}{p - \underline{r}_2} = 1$$

The intuition for this result is as follows. The full matching equilibrium exists when p is lower than some upper bound $\overline{p}$. A higher price is associated with more credit availability due to more matches (a more efficient matching technology μ) and relatively more type 2 (M_2) than type 1 (M_1) loan contracts. These are exactly the conditions under which it would be optimal for a type 3 agent to reject a loan from a type 1 lender and wait for a type 2 agent to come along. When the likelihood of a future match is small, especially with a type 2 lender, a loan from a type 1 lender becomes more attractive. The upper bound $\overline{p}$ depends on the model parameters. Most importantly, $\overline{p}$ will be higher (and the constraint less binding) for larger values of $\underline{r}_1$.[22] To sum up, a borrower will decide to accept a loan from a type 1 lender when matching frictions are significant, the type 1 lender is not too pessimistic and when type 2 lenders are in short supply.

[22] For smaller values of either μ or λ the constraint will also be less binding. When it is less probable a new match will be created in the future (either due to a small probability of a match μ, or due to a small matchable population in steady state, λ, the more likely it is that a type 3 agent will accept a loan from a type 1 agent.

This final point is crucial in understanding why, after the Seppenwolde default, borrowers decided to accept loans from more pessimistic lenders. In the aftermath of the event the number of optimistic lenders was limited. Combined with the matching frictions in this market this made it optimal for borrowers to accept the more conservative terms of loans offered by the more pessimistic lenders.

II.E. Comparative statics

Next we analyze what happens to the steady state of this model after an event like the Seppenwolde default. We interpret the Seppenwolde default as a change in beliefs on the part of the lenders. We assume that before the event the differences of beliefs between type 1 and type 2 agents were arbitrarily small, i.e. $\underline{r}_2 - \underline{r}_1 \approx 0$. After the event type 1 agents, the lenders who lent to the consortium, become more pessimistic such that $\underline{r}_2 - \underline{r}_1 > 0$. For simplicity we assume that $\underline{r}_2$ remains the same.

Lemma 1. Keeping all else equal and under the assumption that $v_2 < p \leq \overline{p}$

$$\frac{\delta h_1}{\delta \underline{r}_1} < 0 \text{ and } \frac{\delta h_2}{\delta \underline{r}_1} > 0$$

The haircut on loans extended by type 1 agents increases as their beliefs about the bad state of the world become more pessimistic. Keeping the price constant, a fall in $\underline{r}_1$ will mechanically lead to a higher haircut on type 1 loans (h_1). However, as $\underline{r}_1$ falls, less credit will be extended in the aggregate and the equilibrium price will fall as well, counteracting (some of) the impact on haircut h_1. The lemma establishes that the first effect dominates. This is intuitive; keeping all else constant the price is determined by both $\underline{r}_1$ and $\underline{r}_2$. There is no change in $\underline{r}_2$ and as long as the mass of type 2 agents is non-trivial, the elasticity of the price change with respect to $\underline{r}_1$ is smaller than 1. At the same time, haircuts on type 2 loans should fall as type 1 agents become more pessimistic. This works entirely through prices. Taken together, the model predicts that haircuts charged by different type of lenders should diverge after the Seppenwolde event.

After Christmas 1772, the consortium around the Seppenwoldes effectively disappeared from the market. This means that it is likely that the event did not only lead to a change in beliefs on part of the lenders but also to a drop in the number of borrowers. The following lemma establishes what happens in response to this specific shock.

Lemma 2. Keeping all else equal and under the assumption that $v_2 < p \leq \overline{p}$

$$\frac{\delta h_i}{\delta N_3} > 0 \text{ and } \frac{\delta(h_1 - h_2)}{\delta N_3} = 0 \text{ for } i = 1, 2.$$

As the number of type 3 agents in the market falls, haircuts on both type of loans decrease. The intuition for this result is straightforward. When there are fewer borrowers, there will be less capital available to invest in the asset and the price will fall. As long as beliefs remain the same, haircuts decrease. This counteracts the predicted increase in h_1 due to a fall in $\underline{r}_1$. However, both h_1 and h_2 are predicted to fall and the (level) decrease in haircuts is identical for both type of loans. This means that the divergence of haircuts h_1 and h_2 due to a fall in $\underline{r}_1$ is not affected.

The two lemmas yield contrary predictions about what should happen with the absolute level of type 1 haircuts after the event. The first lemma predicts it should go up, the second predicts it should fall. Which of the two mechanisms dominates is ultimately an empirical question and depends on the relative size of the two shocks. There is one qualifying statement. It is likely that in reality the demand for English securities did not only depend on the demand of levered speculators but also on the demand of long term investors. In that case, a drop in N_3 would have had a smaller impact on the equilibrium price and it is more likely that the mechanism of the first lemma dominated.

II. F. Interest rates

The model has no predictions about changes in interest rates after the Seppenwolde default. By giving all bargaining power to the borrower, interest rates will always, independent of the type of match, equal the risk free rate. What pins down interest rates when we allocate (some) bargaining power to the lender? Do interest rates on loans of types 1 and 2 change differentially? It can be shown that the interest rate predictions that follow from such an extended model are ambiguous.

After being matched, agents bargain over the match-specific surplus. This is defined as $V_i - V_0$ and measures the gains to a type 3 agent from accepting a loan of type $i = 1, 2$ relative to waiting for another match in the future. Suppose that agents engage in Nash bargaining and always get a fixed fraction of the surplus. Transfers between borrowers and lenders take place through interest payments. The interest rate therefore equals the risk free rate (which is normalized to zero) plus the transfer from borrower to lender divided by the size of the loan. Let's focus on the impact of a drop in $\underline{r}_1$. In that case, type 1 lenders become less attractive and

the match specific surplus will be lower than for a type 2 lender, i.e. $V_1 - V_0 < V_2 - V_0$. Type 1 and 2 lenders will always get the same fraction of the match-specific surplus, but the absolute value of their share is smaller for type 1 agents. This would suggest that type 1 borrowers charge lower interest rates. However, the size of the loan they extend is also smaller. Both numerator and denominator decrease. The net effect is unclear and depends on the exact parameter values.

III. Data

Data on secured loan contracts comes from the archives of various Amsterdam notaries.[23] Appendix A presents a sample contract. From the same archives, we also collected additional information on official notifications of margin calls ("insinuaties") (the), and on accounts of settlement which give information about the liquidation of collateral. Finally, we assembled information from various documents in a number of private archives, offering further insight into the liquidations (see figure 3). Lender and borrower characteristics were reconstructed from a genealogical study of Amsterdam regent families (Elias 1903).

Table 4 summarizes the basic features of our data. We have information on 425 lending transactions where English stocks served as collateral. The lenders overwhelmingly came from the upper strata of Dutch society – mayors, noblemen, rich merchants and widows. The average loan value was 29,000 guilders, and the average value of collateral was 36,000 guilders. At the time, a skilled laborer could earn 1.40 guilders per day; buildings along Amsterdam's most famous canal (the *Heerengracht*) cost around 10,000 guilders (De Vries and Van der Woude, graph 12.1; Roosegaarde Bisschop, 1976).

[Table 4 about here]

For a lender to lose money in a collateralized lending transaction, two things had to happen in sequence: (1) borrowers did not respond to margin calls and (2) the collateral value fell below the size of the loan. Lenders on average imposed a 20 percent haircut – loans were typically worth 80 percent of the value of stock used as collateral. Our identification strategy crucially relies on the fact that creditors of the Seppenwolde brothers were broadly similar from other lenders, that lending behavior prior to the distress event was identical, and that only investors who were personally faced with possible losses on collateral changed their lending behavior.[24]

[23] The most important archive is the one of Daniel van den Brink; Wilson (1966) was the first scholar to use this source.

[24] Exposed lenders are defined as lenders who had to go out in the market to liquidate collateral. We drop two observations. In these two cases lenders rolled over existing margin loans at artificially low haircuts instead of liquidating the collateral. These observations belong neither to the treatment or control groups.

IV. Main Results

In this section, we present the main empirical results. We show how much haircuts changed after 1772, and how this change in behavior arose. The following section then examines the robustness of our findings. Asset returns in East India stock during the period when the Seppenwolde brothers went bankrupt had been extreme and highly unusual compared with the behavior of the stock prior to 1772. Our model predicts that the market should return to balance through changes in haircuts, and not in interest rates.

IV. A. Haircuts

Former Seppenwolde creditors tightened their standards after Christmas 1772, while other lenders continued as before. As a first pass, we calculate averages of haircuts for exposed and unexposed lenders, before and after Christmas 1772. To capture differences in loan size, averages are weighed by the size of the collateral. Table 5 summarizes the results. Those not exposed to Seppenwolde lent at virtually the same rate before Christmas 1772 as the unexposed; thereafter, the difference rises to 7 percent. Exposed lenders raise their haircuts from 20.7 to 26.1 percent; unexposed ones lower theirs (in a way that is not statistically significant) from 21.1 to 19.3 percent. The difference-in-difference is 7.3%, equivalent to approximately a one-third rise relative to the initial haircuts imposed by Seppenwolde creditors before the distress episode.

[Table 5 about here]

In Figure 8, we show the full distribution of haircuts for exposed and unexposed lenders, before and after the crisis episode. The left panel depicts the distribution of haircuts for all lenders unaffected by the distress episode, before and after Christmas 1772. The modal haircut for both periods is 20%. In the right panel, we plot the distributions for those affected by the Seppenwolde episode. Here, a distinct shift to the right is clearly visible, with the mode increasing from 20% to 25%. After December 1772, many lenders insisted on 30% or more; previously, very few had lent at a rate above 30%.

[Figure 8 about here]

In Table 6, we analyse the effect of almost losing money in the Seppenwolde transactions on haircuts econometrically. We estimate the following equation

$$Haircut_{i,t} = \beta_1 Exposed_i + \beta_2 Exposed_i * Post1772_t + \beta_3 nonEIC + \bar{\varepsilon}_{it} + \zeta_{i,t}$$

where $\overline{\varepsilon}_{it}$ includes year dummies. In a number of specifications, we use lender and borrower characteristics or lender and borrower family/firm fixed effects.[25] $\zeta_{i,t}$ is the error term.

We first pool observations from all types of collateral, and control for asset type separately in our regressions. In addition, observations are weighed by the size of the collateral. In col 1, we report pooled OLS results with standard errors clustered at the lender level (while including year dummies). Those who were exposed to the consortium initially lent with smaller haircuts on average, but the difference is small and insignificant. Lending against collateral other than the EIC took also place with markedly lower haircuts. This reflects lower risks. The variable of main interest is the interaction of being exposed with the post-1772 dummy (coefficient β_2). This shows the average change in haircuts after the default of the Seppenwolde syndicate for lenders who almost lost money. The estimated shift is upwards by 7.6 percentage points, and the coefficient is significant at the 1 percent level. Relative to the pre-crisis average of 21.9 percent, this is a dramatic change. In col 2, we add borrower and lender type dummies to account for the changing composition of the sample. The estimated coefficient is now 6.9 percent, somewhat smaller than before, but still highly significant.

In cols 3 to 5 we include lender and borrower family/firm fixed effects. The panel is unbalanced and these fixed effects should control for changes in the composition of lenders and/or borrowers in the sample. In addition they should capture unobservables on the lender/borrower level.

Table 6 reports the number of observations had we run a balanced panel. The inclusion of fixed effects implies an effective loss of observations that is quite significant. The fixed effect estimates should therefore be interpreted as robustness checks rather than benchmark estimates. In col 3, we use lender family fixed effects and borrower type dummies. This yields a coefficient of 6.1 percent, significant at the 10% level. In col 4, we use borrower family/firm fixed effects and lender type dummies; the coefficient on the interaction term falls to 4.0 percent, but is still significant at the 10% level. In the final column, we include both borrower and lender family/firm fixed effects, to capture changes in lending rates that come from compositional

[25] Lender family fixed effects are defined by lenders who are first degree relatives. Borrower family/firm fixed effects refer to lenders who either linked through participation in the same firm or are first degree relatives. We opt for using firm/family fixed effects rather than individual fixed effects to save degrees of freedom. The underlying assumption is that unobservables should be identical for first degree relatives or members of the same firm. In the latter case it is actually impossible to distinguish individual from firm transactions. When individual fixed effects are included, the coefficient estimate on the interaction term slightly increases or stays the same. However, standard errors increase as well.

change in the pool of both debtors and creditors. The coefficient of the interaction effect is now somewhat larger at 6.3 percent, again significant at the 10% level.

[Table 6 about here]

We also examine the potential role of differential pre-crisis trends. Figure 1 plots trends over time, for the exposed and unexposed lenders. It shows clearly that there is no difference in trends before Christmas 1772; it is only thereafter that haircuts diverge substantially.

IV.B. Interest rates

Next, we examine if interest rates changed in response to the Seppenwolde crisis. Did the pricing of loans shift at the same time as the size of haircuts – and in the same differential manner? In table 7, we use the same specifications as before, using interest rates on loan contracts as the dependent variable.

Table 7 shows that non-EIC stock attracted lower interest rates, but the difference is small – between 8 and 10 basis points. The model in section II predicts that the market should balance through changes in collateral requirements, not interest rates. We examine if this is true in our case. In a number of specifications we find that lenders exposed to the syndicate initially charged somewhat higher interest rates both before and after the event. In col (1), the effect is statistically significant but economically small – the estimated coefficient implies a difference of 8 basis points. When we control for lender and borrower type dummies the coefficient falls to about 5 basis points and becomes statistically insignificant.

The crucial variable for our analysis is the interaction of the post-1772 and the exposed dummy. There is no significant differential change in interest rates charged after 1772. In the benchmark estimates of columns 1 and 2 it is slightly negative, implying that exposed lenders charged lower interest rates after Christmas 1772. However, the coefficient is always economically small and never significant. This implies that interest rates were not used by exposed lenders to adjust for increases in perceived risk.

[Table 7 about here]

V. Extensions

In this section, we present a number of extensions. We demonstrate that network effects do not drive our results, that exposure to the East India Company is not responsible for the change in risk appetite, and that effects last a substantial amount of time. We also show that results are not driven by the immediate aftermath of the Seppenwolde bankruptcy.

V. A. Network effects

In this subsection, we further explore the impact of lender and borrower characteristics on haircuts. In particular, we ask if a sudden need to find new business partners after Christmas 1772 can explain the sudden increase in haircuts. Overall, there is no evidence to suggest that these factors are responsible for our findings.

Observable lender characteristics

So far, we have used lender type dummies or fixed effects to control for unobserved heterogeneity. However, the effect of characteristics may not be constant over time. Lenders who were exposed to the consortium may have been differentially affected by events after Christmas 1772. For example, if one type of lender had more exposure to the Seppenwolde brothers – say, those active in commerce – and their business was adversely affected by the turmoil of early 1773, then this could explain changes in haircuts. To control for this, we interact observable lender characteristics such as occupation, status or gender with the post-event dummy. The estimates are presented in Table 8. All estimates include lender and borrower type dummies (coefficients unreported). Estimated separately, we find that merchants lent at somewhat higher haircuts after 1772, while noblemen lent against slightly lower collateral values relative to asset prices; there is no significant interaction effect between the post-1772 dummy and the regent, gender and specialist dummies. In column 6 we estimate the impact of these interaction effects jointly.[26] Crucially, the coefficient on the interaction between exposed and the post-event dummy is virtually the same as in the benchmark estimates of Table 6 (comparable estimates are in column 2: 6.6%) and even slightly increases in the full specification of col 6.

[Table 8 about here]

[26] Because of the collinearity we cannot precisely estimate the individual contributions of these additional interaction effects.

Observable borrower characteristics

In Table 9 (cols 1 – 4), we repeat the exercise of Table 8 with observable borrower characteristics. The intuition is similar. We already controlled for borrower type dummies or fixed effects in our main estimation. The limitation of this approach is that some borrowers may have been differently affected by the events after Christmas 1772. By interacting observable borrower characteristics with the post-event dummy we can control for this factor. We distinguish between merchants, specialists – who both borrow and lend in this markets – and Jewish borrowers. Throughout we include borrower (and lender) type dummies. None of the interaction effects correlates with haircuts to a significant extent, except for Jewish borrowers. These on average saw lower haircuts after 1772. In all specifications (cols 1 – 4), the coefficient on the main variable of interest – the interaction between exposed and the post-1772 dummy is largely unaffected, ranging from 6.6% to 7.7%.

In col 5 we take the analysis one step further by including borrower-time fixed effects. This specification should fully control for changes in borrower characteristics. Effectively, we are identifying off those borrowers who borrowed from both exposed and non-exposed lenders after Christmas 1772. The estimate of the interaction effect between the exposed and post-event dummies is statistically significant at the 1% level and the economic effect (5.6%) is very similar to the benchmark estimate of Table 6 (col 2). Admittedly, we are only using a limited number of data points to arrive at this estimate. Only 3 borrowers were sufficiently active after Christmas 1772 to borrow from multiple lenders. In total, these borrowers signed 18 collateralized lending contracts after Christmas 1772, roughly equally split between exposed and non-exposed lenders (11 vs 7). This constitutes a quarter of all available observations after Christmas 1772.

[Table 9 about here]

Concentrated lending

In Table 11 we examine the interaction effect with the concentration of lending before the events of Christmas 1772. One might worry that the interaction effect between the exposed and post-event dummies is driven by the breakdown of relationship lending. If a lot of borrowing in the Amsterdam collateralized lending market took place through well-established networks, the collapse of a large group of borrowers would have led to a decline in “intermediation capital” (Bernanke 1992). In that case, lenders would have needed to screen out new borrowers, using (initially) higher haircuts as a result. In section 0, we provide evidence that relationship lending was not an important feature of the Amsterdam collateralized loan market. Here, we show that

changes in haircuts over time – for the exposed lenders – are probably not explained by the destruction of "relationship capital".

First, we look at whether lenders were less likely to be matched with borrowers after Christmas 1772 that they had lent to before (repeat borrowers). We investigate whether this differed between exposed and non-exposed agents. Results are in Table 10. They indicate that the probability of being matched with a repeat borrower indeed did decrease significantly. However, this was true for both exposed and non-exposed lenders; there is no economically or statistically important difference between the two. As new borrowers enter the market, it becomes less and less likely that a lender is matched with a repeat borrower. These results imply that the relatively high haircuts charged by exposed lenders after Christmas 1772 cannot be the result of the destruction of relationship capital. The control group faced a similar decrease in the fraction of repeat lending.

[Table 10 about here]

Second, we start from the assumption that lenders that are heavily invested in a particular client relationship will have more concentrated portfolios. We then estimate the following equation

$$Haircut_{i,t} = \beta_1 Exposed_i + \beta_2 Exposed_i * Post1772_t + \beta_3 Herfin_i + \beta_4 Herfin_i * Post1772_t + \beta_5 nonEIC + \overline{\varepsilon}_{it} + \zeta_{i,t}$$

where $\overline{\varepsilon}_{it}$ includes time effects and both borrower and lender characteristics. $\zeta_{i,t}$ is a random error. β_4 captures whether lenders exposed to the default episode increased haircuts more if they had engaged in more relationship lending before Christmas 1772 (a higher Herfindahl index). Table 11 (col 2) shows that this is not the case; if anything a higher degree of concentration before Christmas 1772 (more relationship lending) leads to lower haircuts. This effect is not statistically significant.

[Table 11 about here]

V.B. Excluding the first post-crisis month

When the Seppenwolde brothers went bankrupt, there was substantial uncertainty about the size of their position and the consequences for market prices. Several lenders had now received collateral after margin calls were not met. In addition, there is evidence of more wide-spread stress in the financial sector that was only calmed when the city government introduced a lender-of-last-resort facility in the middle of January (see historical overview). To examine if our results

simply reflect illiquidity and uncertainty during the immediate post-crisis period, we exclude the lending contracts signed in January 1773.

[Table 12 about here]

Table 12 shows that this only marginally changes the results – we still find an upward shift in the haircut charged by exposed lenders of 4-6 percent. We do loose a number of observations and the fixed effects specifications become (only borderline) statistically insignificant.

V. C. EIC factor

The EIC's stock price fall after September 1772 is the main driver behind the crisis episode we examine. It is natural to ask whether the effect that we identify is caused by the default of the Seppenwolde consortium or if it is instead related to changes in the EIC stock price. For example, it is possible that individuals who lent to the consortium overall had strong exposure to EIC stock through other portfolio holdings or to other counterparties with this exposure. Then, changes in haircuts could reflect an attempt to manage this risk, rather than the shock of the consortium's default.

To investigate this issue we estimate the following equation

$$Haircut_{i,t} = \beta_1 Exposed_i + \beta_2 Exposed_i * EICprice_t + \beta_3 Exposed_i * Post1772_t + \beta_4 EICprice_t + \overline{\varepsilon}_{it} + \zeta_{i,t}$$

where $\overline{\varepsilon}_{it}$ includes time effects and both borrower and lender characteristics. $\zeta_{i,t}$ is a random error. This equation tests whether exposed lenders in general charge higher haircuts when EIC prices are lower. Results are presented in Table 13.

Col 1 only includes the interaction between the exposed dummy and the EIC stock price. The economic size of the coefficient is relatively small and statistically insignificant. The average EIC price during 1770-1772 was 212%; for 1773-1775 it was 155%. This general fall in prices of 57% corresponds to exposed lenders increasing haircuts by 1.8% (0.57*0.033). This is less than a third of the impact of the interaction effect with the post-1772 dummy (Table 13, col 2).

Col 2 includes both interaction effects to perform a horserace: what has more explanatory power the post-1772 dummy or overall changes in the price of EIC stock? The estimates clearly show that the interaction effect with the post-1772 dummy is considerably stronger; it shows an effect

of 6.8% higher haircuts. The coefficient on the interaction between exposed and the EIC price is now wrongly signed. Overall, these results suggest that EIC stock prices have no additional predicative power above and beyond the post-event dummy.

[Table 13 about here]

V. D. Unobservables

It is possible that unobservables drive our results. While lenders exposed and unexposed to the Seppenwolde syndicate are broadly similar in many dimensions, it is generally possible to argue that an unobserved, underlying factor drove differences in risk appetite. To examine the possible empirical relevance of this issue we implement two additional tests.

First, we study the intensive margin of adjustment. If exposed and non-exposed lenders differ on unobservables in a material way, it is likely that there are also unobservable differences between lenders who lent relatively small or large amounts to the consortium. We test this in Table 14. Results indicate that lenders who, either in absolute or relative terms, lent more to the consortium did not change haircuts differentially compared to lenders who only provided relatively small loans. The interaction term with the absolute exposure measure has a positive sign, but is statistically insignificant and economically small. A one standard deviation increase in the absolute position with the consortium around Christmas 1772 only raises haircuts by 1%. The interaction term with the relative exposure measure has a negative sign and is also statistically insignificant and economically small. A one standard deviation increase in the fraction of outstanding loans that were extended to the consortium decreases haircuts by 1%.

[Table 14 about here]

Second, we use the testing approach developed by Altonji et al. (2005). The intuition is as follows. We first estimate the coefficient of the variable of interest, in our case the interaction between the Seppenwolde exposure dummy and the post-1772 dummy, without controls. Then, we re-estimate with controls, and examine how much the coefficient on the interaction term has changed. Under the assumption that unobservables will be correlated with observables, this strategy allows us to bound their possible impact on the key finding. We perform the Altonji test with haircuts as the dependent variable. If we use the EIC dummy and year fixed effects in the restricted model, and all categories of possible lenders and borrowers in the unrestricted model, we obtain an Altonji ratio of 6.7. This implies that the attenuating effect of unobservables would

have to be at least 6.7 times stronger than the effect of observable variables before our results become insignificant.[27]

V. E. Duration of effects

Is the difference in haircuts permanent? In other words, how long does it take for the differences of beliefs of exposed and non-exposed lenders to converge? In Table 14, we add time elapsed since the crisis to our regression. Specifically we run the following regression

$$Haircut_{i,t} = \beta_1 Exposed_i + \beta_2 Exposed_i * Post1772_t + \beta_3 Exposed_i * TimeSinceEvent_t + \beta_4 TimeSinceEvent_t + \beta_5 nonEIC + \bar{\varepsilon}_{it} + \zeta_{i,t}$$

where "time since event" has a value of zero before Christmas 1772 and afterwards simply counts the time that has elapsed – in fractions of the calendar year. In this specification, the interaction between the post-1772 and exposed dummies captures the instantaneous differential impact on haircuts (β_2). The interaction between the exposed dummy and "time since event" measures the degree to which haircuts converge afterwards (β_4). For example, if we are interested in how much differential impact there still is after 6 months, we can subtract $\frac{1}{2}\beta_4$ from β_2.

The estimates imply that within 2 years, the treatment's impact has largely dissipated. However, since the number of observations falls over time, the decline in haircuts is not tightly estimated and not significant at standard confidence levels.

[Table 14 about here]

V. F. Attrition

To what extent did exposed lenders exit the sample after the events of Christmas 1772? We might expect that affected lenders left the sample at a higher rate than those not affected. To test this, we compare the rates of attrition between exposed and non-exposed lenders. Results are presented in Table 15. All the estimated coefficients are positive, but they are mostly not well-estimated. If we found strong and significant coefficients, then we would know that the measured shift in haircuts is a lower bound of the change in lender behaviour. After controlling for the overall importance of individual lenders (as measured by their lending behavior before Christmas

[27] If we estimate the restricted model without the EIC and year dummies, we actually obtain a negative result – implying that results get stronger as we add controls.

1772), we do not find a statistically significant difference between both rates of attrition. This result is robust to different specifications (OLS, probit and logit).

[Table 15 about here]

VI. Conclusion

"One can only hope that reality will become
more fashionable now [that] people are
learning their lessons"
(*De Koopman* January 1773, p. 310)

Investor heterogeneity and disagreements about asset values can have important implications for asset pricing (Harrison and Kreps 1978; Heaton and Lucas 1995; Hong and Stein 2007). They may contribute to momentum, high volatility, and the formation of bubbles (Hong, Scheinkman, and Xiong 2006). How different beliefs among investors arise is less clear. Recent research suggests that personal experiences may be an important source of heterogeneous beliefs (Guiso, Sapienza, and Zingales 2011; Malmendier and Nagel 2011; Malmendier and Nagel 2009).

In this paper, we examine a well-identified case of large, lasting, differential changes in investor behavior. We analyze lenders who financed the equity positions of speculators in 18th century Amsterdam. When an important syndicate of investors went bankrupt, some of these lenders were at risk of losing money – margin calls went unanswered, and the lenders were assigned collateral. Therefore, this episode could have spelled heavy losses. In a difference-in-difference setting, we show that in actual fact, the "treated" lenders recovered all of the principal and interest owed. Nonetheless, those who *almost* lost money sharply increased their collateral requirements in all future transactions -- despite the fact that they actually sustained no losses. Other lenders – unaffected by the bankruptcy – continued to lend as before.

We cannot determine exactly what caused the differential change in behavior. The fact that East India stock was more volatile – and returns more often negative – after 1771 was public information. So was the ill fortune of the Seppenwolde syndicate. Nonetheless, the only investors who changed their behavior were the ones who came close to losing part of their capital. One interpretation is that lenders who were nearly "burnt" raised haircuts because the risk of losses was more salient.[28] Alternatively, those exposed to the Seppenwolde consortium could have learnt about their own ability to select good investors, i.e. those who could meet margin calls

[28] For an analysis of the effects of salience on risk-taking, cf. Gennaioli and Shleifer (2010).

when asset values declined. Both channels would in turn have lead Seppenwolde lenders to update their beliefs about the risks of collateralized lending to a much greater extent than unexposed lenders. Strikingly, the effects we document are visible in the data for as long as we have information on lending contracts after the default episode. Haircuts for exposed and non-exposed lenders do converge only slowly in the years after the Seppenwolde bankruptcy. Our findings therefore provide powerful support for the idea that individual risk taking can change substantially over time, as a result of personal experience – even without shocks to wealth, background risk, or consumption habits.

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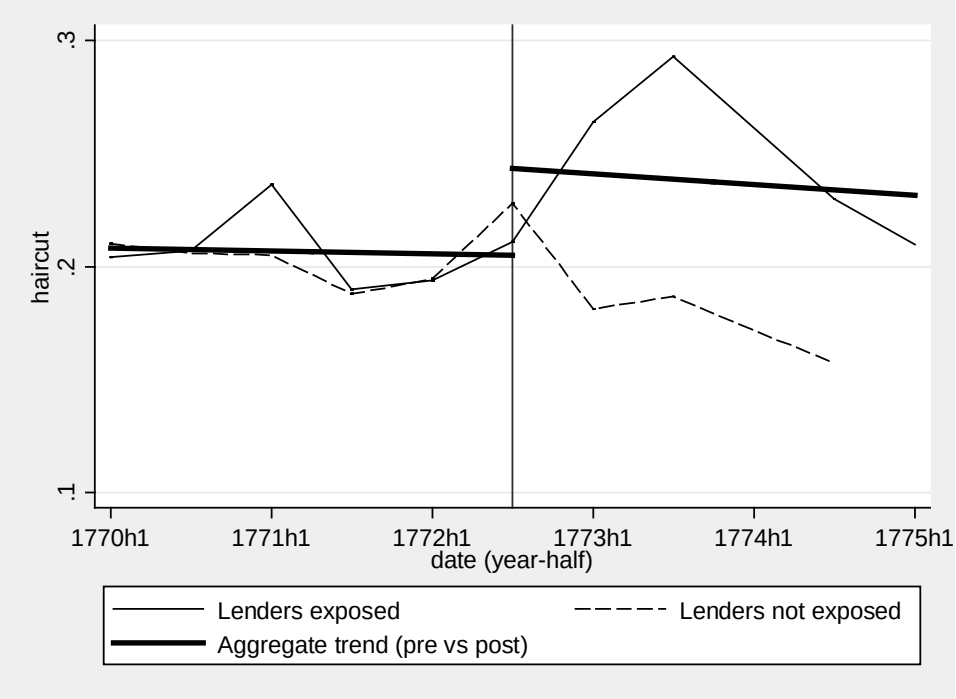
Figure 1: Haircuts over time (half-yearly averages)



This figure presents the average haircuts demanded by exposed and non-exposed lenders for every quarter between 1770h1 and 1775h1 (when our data ends). Averages are weighed by the size of the loan transactions (nominal or face value of collateral).

Figure 2: Lender and borrower network – 1770-75

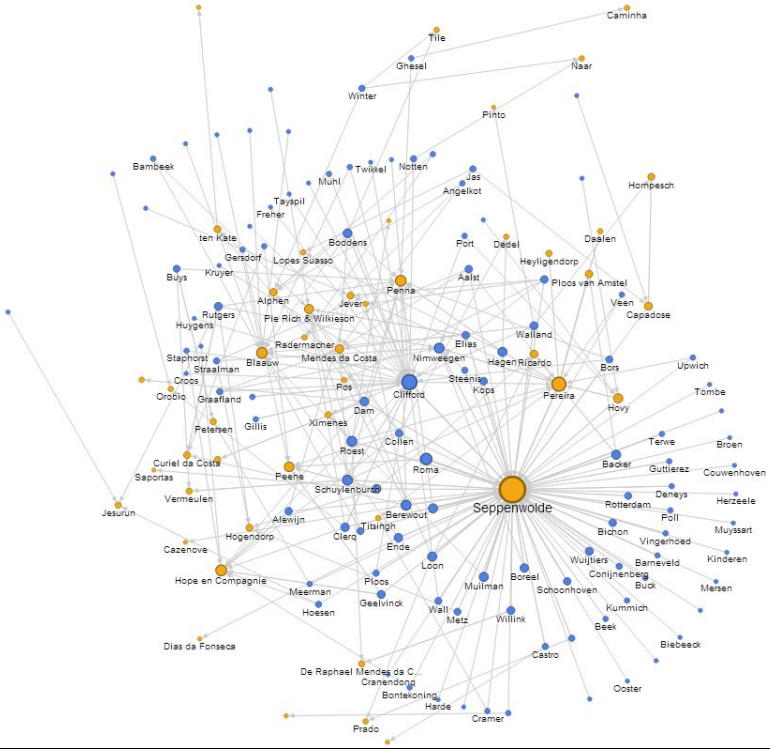
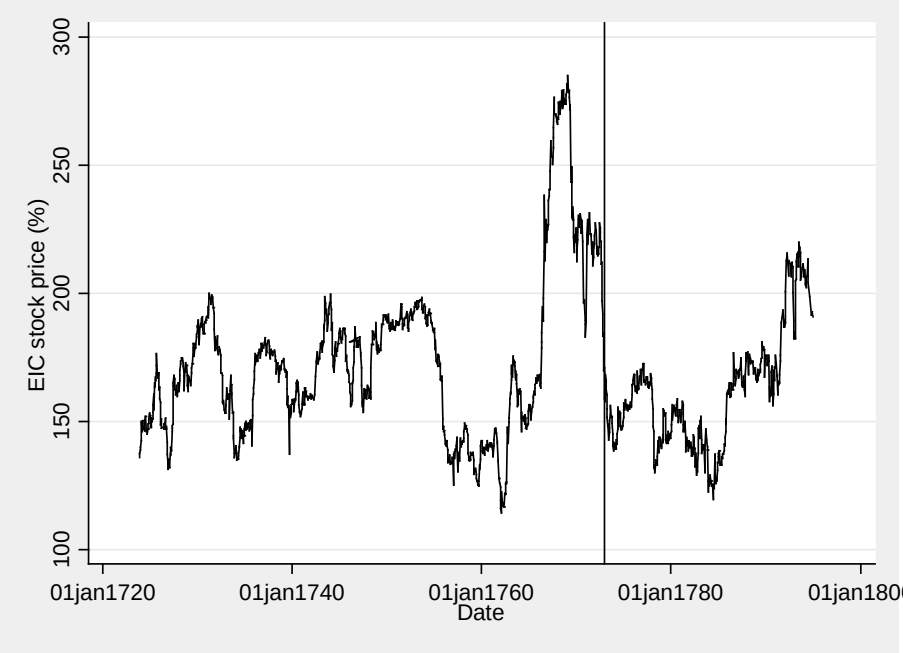


Figure 3: EIC stock price in Amsterdam between 1723 and 1793



The vertical line indicates Christmas 1772. Stock prices are recorded in percentages of the nominal (face) value.

Figure 4: Herfindahl indices – actual vs simulated

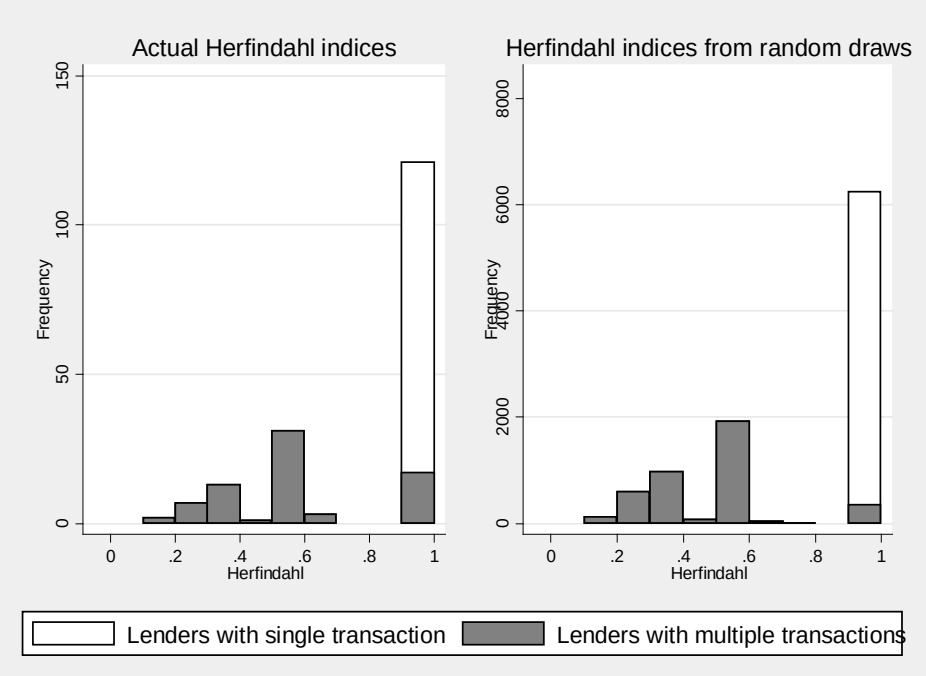
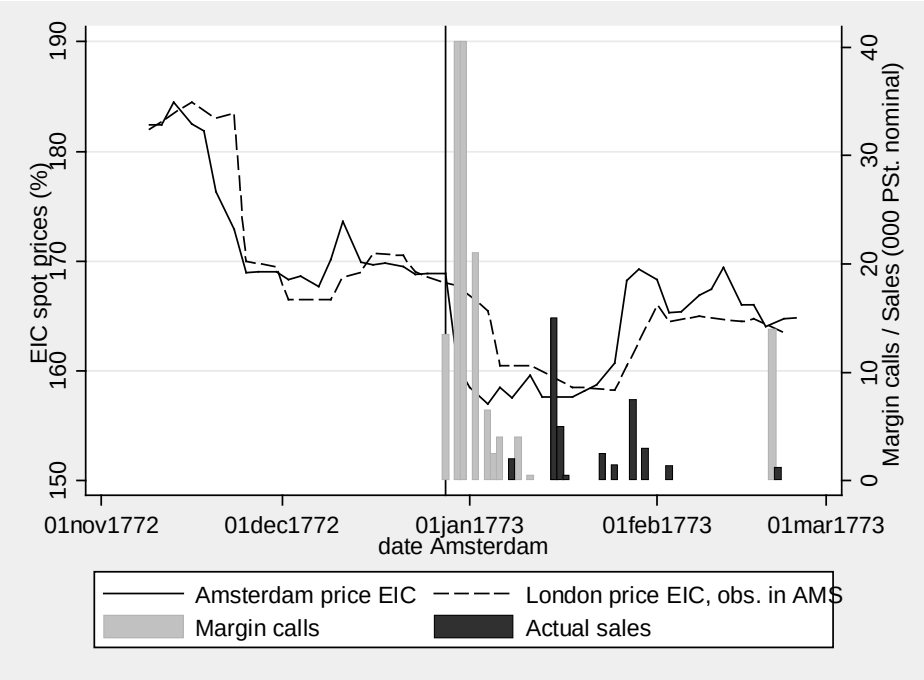
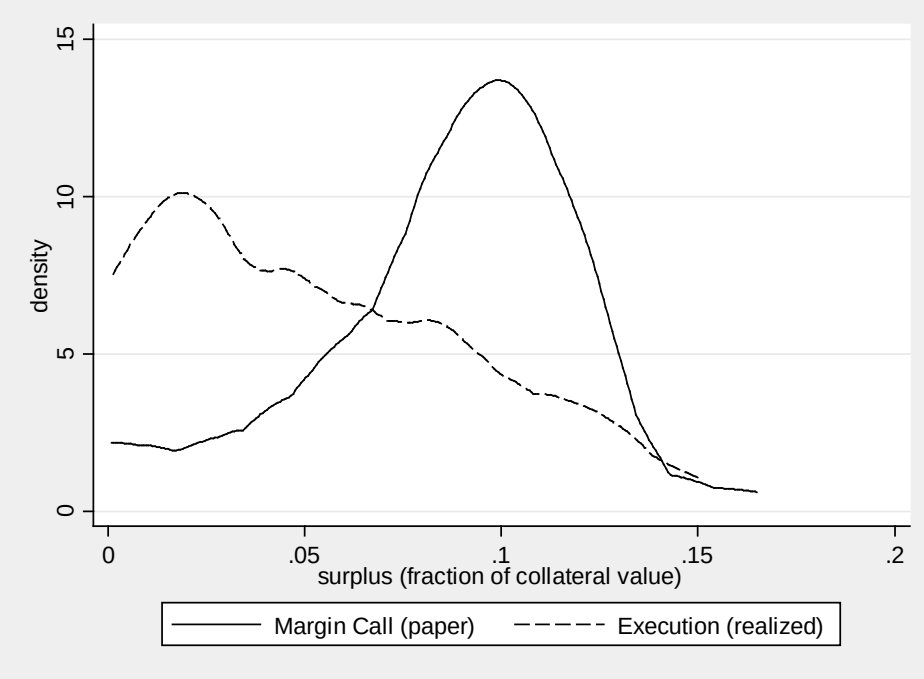


Figure 5: The Crisis after Christmas 1772



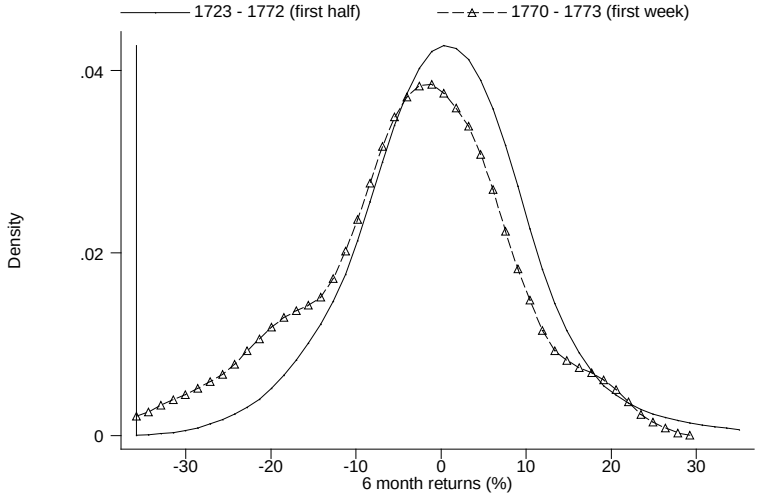
Prices EIC stock in Amsterdam and London; margin calls lenders to consortium; subsequent sell-off collateral by lenders. The black vertical line indicates Christmas 1772.

Figure 6: Surplus on loans to consortium



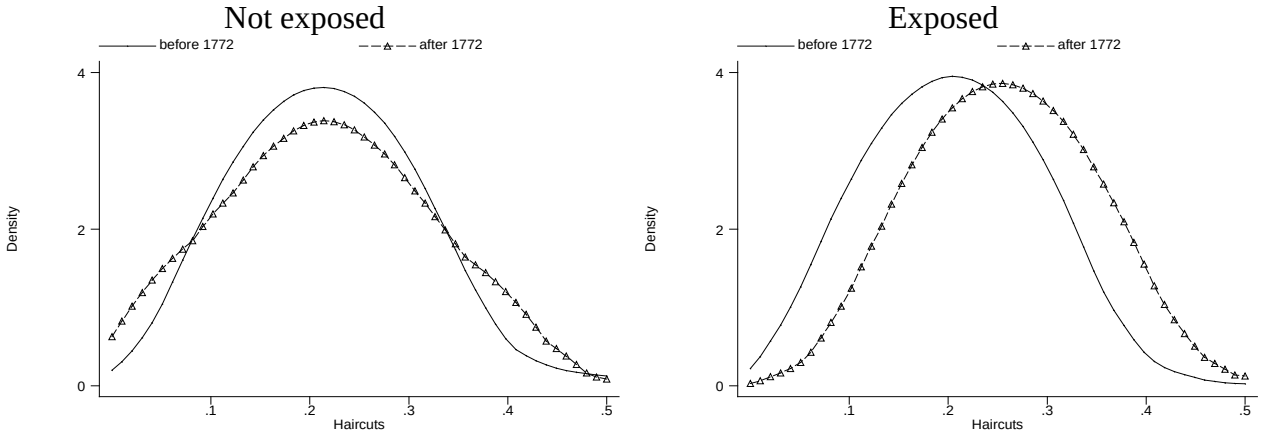
Surplus: difference between value collateral and loan, in fraction of the collateral value

Figure 7: Distribution of EIC returns



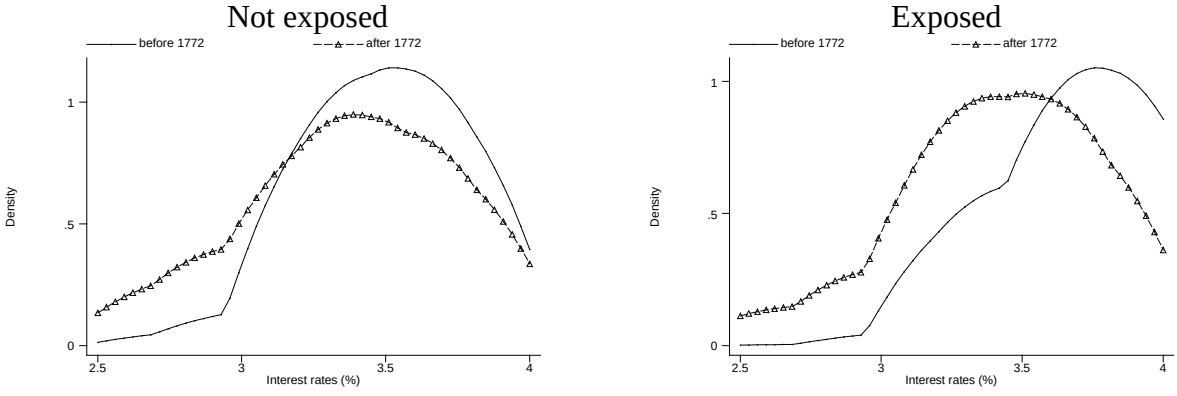
Returns calculated over 6 month periods (overlapping). Vertical line indicates the 6 month return over the second half of 1772.

Figure 8: Haircuts before and after Christmas 1772



Haircuts before and after Christmas 1772, differentiated by exposed and non-exposed lenders

Figure 9: Interest rates before and after Christmas 1772



Interest rates before and after Christmas 1772, differentiated by exposed and non-exposed lenders

Table 1: Positions of the Seppenwolde syndicate, Christmas 1772

Member of the Syndicate	Position (nominal)	
	EIC	BoE
Hermanus van Seppenwolde	£63,600	£49,500
Johannes van Seppenwolde	£69,600	£17,000
Clifford & Chevalier	£44,500	0
Pieter van Peene	£2,000	£4,000
Total	£179,700	£70,500
Total outstanding	£3,194,080	£10,780,000
% syndicate in total outstanding	5.63%	0.65%
Av. monthly turnover (1770-1772)	£196,967	?
% syndicate in av. monthly turnover	91.23%	?

Positions calculated at the end of 1772. Average monthly turnover is based on the turnover in the capital books of the respective companies. Actual market turnover would have been higher if transactions were netted out before mutations in the capital books were made.

Table 2: Descriptive statistics, EIC stock returns over 6 month periods (overlapping)

Sample	Prior to distress 1723-1772*	Distress period 1770-73**	Full 1723-1794
Mean	0.0051	-0.034	0.0028
Median	0.0068	-0.019	0.0053
σ	0.089	0.108	0.089
Skewness	0.248	-0.49	-0.07
Maximum loss	-0.256	-0.358	-0.358
% of observations with loss > 0.2	0.011	0.075	0.022

* first half

** first week of 1773

Table 3: Lender characteristics: exposed vs non-exposed

		Exposed		Non-exposed		t-stat		
		Mean	N	Mean	N	Linear	Logit	Probit
Lender characteristics	% Merchant	50.4%	119	38.2%	34	-1.25	-1.23	-1.23
	% Regent	28.0%	132	40.0%	40	1.44	1.26	1.25
	% Noble	29.4%	136	31.0%	42	0.19	0.73	0.72
	% Female	19.9%	136	21.4%	42	0.22	0.28	0.28
	% Specialist	3.7%	136	2.4%	42	-0.41	-0.66	-0.69
Borrower characteristics	% Merchant	96.4%	55	88.0%	75	1.70	1.60	1.68
	% Jew	40.0%	55	33.3%	75	0.77	0.78	0.78
	% Specialist	12.7%	55	14.7%	75	0.31	0.32	0.32
Loan characteristics	Lending volume (£ 000's)	2.909	141	2.739	110	0.35		
	EIC	0.87	141	0.58	110	5.77	4.9	5.07
	Interest rate	3.77	141	3.54	108	7.4		

Panel 1: general characteristics of lenders who did or did not lend to the Seppenwolde consortium (exposed vs non-exposed). E.g. 50.4% of lenders who lent to the consortium were merchants. Because of overlapping categories the percentages do not sum up to 100.
Merchant – active in commercial activities; regent – member of (local) government or the judiciary; specialist – lender who also borrows.
Panel 2: general characteristics of the borrowers who obtained loans from exposed or non-exposed lenders (excluding borrower from the Seppenwolde consortium). Merchant – active in commercial activities.
Panel 3: general characteristics of the loans extended by exposed and non-exposed. Lending volume – measured by the nominal value of the collateral. EIC – fraction of loans collateralized with EIC stock.
T-statistics refer to simple t-tests on the equality of means of the two different sub-samples and t-statistics calculated in a Logit and Probit setup.

Table 4: Descriptive statistics loan contracts

Variable	Obs	Mean	Std. Dev.	Min	Max
Real value of collateral (guilders)	418	36,271	27,734	4,782	238,058
Nominal (face) value of collateral (Pound Sterling)	420	1,910	1,608	300	15,000
Loan value (guilders)	422	28,969	23,244	2,200	210,000
Haircut	418	0.205	0.059	0.080	0.550
Interest rate (in %)	420	3.63	0.30	2.50	4.00
Distance to margin call					
Distance to loss	405	0.103	0.060	-0.013	0.425
non-EIC (BoE, SSC, 3% annuities)	405	0.102	0.042	-0.055	0.310

Table 5: Simple difference-in-difference estimate – EIC stock only

	Before Christmas 1772	After Christmas 1772	Δ
Not exposed	0.211	0.193	-0.018
Exposed	0.207	0.261	0.054***
Δ	-0.004	0.069***	**0.072*** **

Average haircuts on EIC stock, differentiated by exposed and non-exposed lenders, before and after Christmas 1772. Haircuts are calculated as the fraction of the collateral value that is not financed with a loan. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. Observations refer to new contracts. Averages are weighed by the nominal (face) value of the collateral. The simple diff-in-diff estimate is in bold in the lower right corner. *** indicates significance at the 1% level.

Table 6: Haircut change – benchmark estimates

	(1) Pooled OLS	(2) Pooled OLS	(3) FE	(4) FE	(5) FE
Exposed	-0.005	-0.003	0.017	-0.000	0.028
	(0.005)	(0.005)	(0.014)	(0.006)	(0.013)**
Exposed * Post 1772	0.076	0.066	0.061	0.040	0.063
	(0.022)***	(0.023)***	(0.036)*	(0.024)*	(0.036)*
non-EIC	-0.059	-0.056	-0.049	-0.052	-0.047
	(0.006)***	(0.006)***	(0.011)***	(0.008)***	(0.014)***
Lender merchant		0.007		0.004	
		(0.007)		(0.007)	
Lender regent		-0.005		-0.004	
		(0.006)		(0.006)	
Lender noble		0.003		0.004	
		(0.005)		(0.006)	
Lender female		-0.007		-0.003	
		(0.007)		(0.007)	
Lender specialist		-0.012		-0.007	
		(0.007)*		(0.009)	
Borrower merchant		-0.039	-0.042		
		(0.016)**	(0.022)*		
Borrower specialist		-0.004	-0.018		
		(0.011)	(0.017)		
Borrower Jewish		0.050	0.047		
		(0.011)***	(0.015)***		
Constant	0.219	0.245	0.235	0.211	0.174
	(0.006)***	(0.017)***	(0.026)***	(0.012)***	(0.036)***
Year dummies	Y	Y	Y	Y	Y
Lender FE	N	N	Y	N	Y
Borrower FE	N	N	N	Y	Y
N	418	387	418	387	418
N (if balanced)			166	77	33
# lenders	177	152	177	152	177
# borrowers	72	70	72	70	72
R^2	0.334	0.440	0.632	0.659	0.802

Regression estimates for all English securities. Observations refer to new contracts and are weighted by the nominal (face) value of the collateral. Haircuts are calculated as the fraction of the collateral value that is not financed with a loan. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the exposed and the post-1772 dummies captures the diff-in-diff effect. Lender and borrower fixed effects refer to fixed effects on the family/firm level. Robust standard errors (clustered at the lender level) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Interest rates – benchmark estimates

	(1) Pooled OLS	(2) Pooled OLS	(3) FE	(4) FE	(5) FE
Exposed	0.072	0.048	-0.116	0.074	-0.152
	(0.036)**	(0.034)	(0.048)**	(0.041)*	(0.057)***
Exposed * Post 1772	-0.049	-0.034	-0.077	0.035	0.073
	(0.099)	(0.099)	(0.130)	(0.113)	(0.219)
non-EIC	-0.078	-0.093	-0.084	-0.104	-0.078
	(0.036)**	(0.034)***	(0.050)*	(0.049)**	(0.053)
Lender merchant		0.126		0.090	
		(0.057)**		(0.063)	
Lender regent		-0.016		-0.017	
		(0.044)		(0.050)	
Lender noble		0.024		0.027	
		(0.045)		(0.047)	
Lender female		0.027		0.001	
		(0.049)		(0.043)	
Lender specialist		-0.023		-0.024	
		(0.032)		(0.041)	
Borrower merchant		-0.141	-0.060		
		(0.084)*	(0.088)		
Borrower specialist		-0.080	-0.096		
		(0.043)*	(0.066)		
Borrower Jewish		0.018	-0.016		
		(0.035)	(0.046)		
Constant	3.527	3.637	3.739	3.559	3.879
	(0.036)***	(0.096)***	(0.102)***	(0.071)***	(0.177)***
Year dummies	Y	Y	Y	Y	Y
Lender FE	N	N	Y	N	Y
Borrower FE	N	N	N	Y	Y
N	418	386	418	386	418
N (if balanced panel)			166	77	33
# lenders	177	152	177	152	177
# borrowers	72	70	72	70	72
R^2	0.511	0.564	0.744	0.699	0.836

Regression estimates for all English securities. Observations refer to new contracts and are weighted by the nominal (face) value of the collateral. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the exposed and the post-1772 dummies captures the diff-in-diff effect. Lender and borrower fixed effects refer to fixed effects on the family/firm level. Robust standard errors (clustered at the lender level) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Haircuts and lender characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
Exposed	-0.002	-0.003	-0.003	-0.003	-0.003	-0.003
	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)
Exposed * Post 1772	0.062	0.068	0.062	0.064	0.065	0.061
	(0.021)***	(0.023)***	(0.023)***	(0.022)***	(0.023)***	(0.021)***
non-EIC	-0.055	-0.056	-0.056	-0.056	-0.056	-0.056
	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***
Merchant * Post 1772	0.033					0.022
	(0.019)*					(0.063)
Regent * Post 1772		-0.015				0.008
		(0.017)				(0.056)
Noble * Post 1772			-0.040			-0.029
			(0.019)**			(0.023)
Female * Post 1772				-0.026		-0.002
				(0.029)		(0.053)
Specialist * Post 1772					0.005	-0.005
					(0.047)	(0.041)
Constant	0.241	0.243	0.239	0.244	0.245	0.239
	(0.018)***	(0.017)***	(0.017)***	(0.017)***	(0.017)***	(0.018)***
Year dummies	Y	Y	Y	Y	Y	Y
Lender & borrower observables	Y	Y	Y	Y	Y	Y
N	387	387	387	387	387	387
R^2	0.448	0.442	0.452	0.443	0.440	0.453
# lenders	152	152	152	152	152	152

Pooled OLS estimates for all English securities. Observations refer to new contracts and are weighted by the nominal (face) value of the collateral. Haircuts are calculated as the fraction of the collateral value that is not financed with a loan. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the exposed and the post-1772 dummies captures the diff-in-diff effect. Lender and borrower observables are as in Table 6. Merchant – active in commerce; regent – member of (local) government or judiciary; specialist – lenders also active as borrower. Robust standard errors (clustered at the lender level) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Haircuts and borrower characteristics

	(1)	(2)	(3)	(4)	(5)
Exposed	-0.003	-0.003	-0.004	-0.003	-0.001
	(0.005)	(0.005)	(0.005)	(0.004)	(0.006)
Exposed * Post 1772	0.067	0.066	0.076	0.077	0.056
	(0.023)***	(0.024)***	(0.023)***	(0.025)***	(0.024)**
non-EIC	-0.056	-0.056	-0.056	-0.057	-0.051
	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.008)***
Merchant * Post 1772	0.002			0.038	
	(0.048)			(0.050)	
Specialist * Post 1772		-0.038		-0.032	
		(0.024)		(0.022)	
Jewish * Post 1772			-0.056	-0.056	
			(0.025)**	(0.025)**	
New					
Constant	0.245	0.241	0.236	0.242	0.207
	(0.016)***	(0.018)***	(0.019)***	(0.015)***	(0.012)***
Year dummies	Y	Y	Y	Y	Y
Lender & borrower observables	Y	Y	Y	Y	
Borrower-time FE	N	N	N	N	Y
N	387	387	387	387	387
R^2	0.440	0.447	0.458	0.464	0.691
# groups (borrowers)	70	70	70	70	70

Table 10: Probability of lender matched to a repeat borrower

	(1) OLS	(2) OLS	(3) Logit	(4) Logit	(5) Probit	(6) Probit
Post 1772	-0.211	-0.196	-0.211	-0.209	-0.211	-0.207
	(0.050)***	(0.108)*	(0.050)***	(0.110)*	(0.050)***	(0.104)**
Exposed		0.026		0.020		0.021
		(0.109)		(0.086)		(0.091)
Exposed * Post 1772		-0.018		-0.002		-0.006
		(0.122)		(0.196)		(0.173)
N	224	224	224	224	224	224
R^2	0.050	0.050				

Dependent variable: is a lender matched to a repeat borrower (one (s)he has been matched to before) 0: no; 1: yes. Unit of observation: new loan contracts. To minimize measurement error of the repeat borrower variable, transactions after Jan 1, 1772 only. Post 1772 is a dummy for contracts signed after Christmas 1772. Exposed is a dummy for lenders who were exposed to the Seppenwolde bankruptcy. We report marginal effects. Estimates should be interpreted as the change in the probability of being matched with a repeat borrower in response to a change in the dummy variables from 0 to 1. Robust standard errors (clustered at the lender level) in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Haircuts and concentration lending before Christmas 1772

	(1)	(2)
Exposed	-0.002	0.022
	(0.005)	(0.012)*
Exposed * Post 1772	0.056	0.075
	(0.028)**	(0.056)
non-EIC	-0.056	-0.055
	(0.006)***	(0.006)***
Herfindahl (pre-event)	0.006	0.028
	(0.008)	(0.014)**
Herfindahl (pre-event) * Post 1772	-0.030	-0.011
	(0.036)	(0.070)
Herfindahl (pre-event) * Exposed		-0.037
		(0.017)**
Herfindahl (pre-event) * Exposed * Post 1772		-0.022
		(0.088)
Constant	0.244	0.228
	(0.017)***	(0.018)***
Year dummies	Y	Y
Lender & borrower observables	Y	Y
N	384	384
R^2	0.443	0.452
# lenders	149	149

Pooled OLS estimates for all English securities. Observations refer to new contracts and are weighted by the nominal (face) value of the collateral. Haircuts are calculated as the fraction of the collateral value that is not financed with a loan. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the exposed and the post-1772 dummies captures the diff-in-diff effect. The Herfindahl index (0-1) measures the concentration of a lender's portfolio before Christmas 1772. The double interaction between Herfindahl and Post 1772 captures whether *all* lenders with higher degrees of concentration charged higher haircuts after Christmas 1772. The triple interaction between Herfindahl, the Exposed and Post 1772 captures whether *exposed* lenders with a higher degree of concentration adjusted haircuts more. Lender and borrower observables are as in Table 6. Robust standard errors (clustered at the lender level) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Haircuts, excluding January 1773

	(1) Pooled OLS	(2) Pooled OLS	(3) FE	(4) FE	(5) FE
Exposed	-0.005	-0.002		-0.001	
	(0.005)	(0.005)		(0.006)	
Exposed * Post 1772	0.068	0.058	0.050	0.039	0.060
	(0.022)***	(0.023)**	(0.035)	(0.024)	(0.037)
non-EIC	-0.059	-0.055	-0.047	-0.053	-0.046
	(0.006)***	(0.007)***	(0.012)***	(0.008)***	(0.014)***
Constant	0.218	0.246	0.245	0.210	0.458
	(0.006)***	(0.016)***	(0.024)***	(0.012)***	(0.034)***
Year dummies	Yes	Yes	Yes	Yes	Yes
Lender FE	No	No	Yes	No	Yes
Borrower FE	No	No	No	Yes	Yes
Lender observables	No	Yes		Yes	
Borrower observables	No	Yes	Yes		
N	412	381	412	381	412
N (if balanced panel)			160	73	42
R^2	0.299	0.296	0.229	0.706	
# lenders	177	152	177	152	177
# borrowers	69	67	69	67	69

Regression estimates for all English securities. Observations refer to new contracts and are weighted by the nominal (face) value of the collateral. Observations for January 1773 are excluded. Haircuts are calculated as the fraction of the collateral value that is not financed with a loan. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the exposed and the post-1772 dummies captures the diff-in-diff effect. . Lender and borrower observables are as in table 6. Lender and borrower fixed effects are at the family/firm level. Robust standard errors (clustered at the lender level) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: EIC factor

	(1) Pooled OLS	(2) Pooled OLS
Exposed	0.003	-0.009
	(0.007)	(0.008)
Exposed * EIC price	-0.033	0.047
	(0.030)	(0.038)
EIC price	0.049	-0.015
	(0.029)*	(0.035)
Exposed * Post 1772		0.068
		(0.035)*
Constant	0.245	0.252
	(0.022)***	(0.023)***
Year dummies	Y	Y
Lender observables	Y	Y
N	288	288
R^2	0.320	0.332
# lenders	127	127

Pooled OLS regression estimates for EIC stock only. Observations refer to new contracts and are weighted by the nominal (face) value of the collateral. Haircuts are calculated as the fraction of the collateral value that is not financed with a loan. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the exposed and the post-1772 dummies captures the diff-in-diff effect. EIC prices are in fractions of the nominal (face) value. Average price before Christmas 1772 2.12, after Christmas 1772 1.55. Lender observables are as in table 6. Robust standard errors (clustered at the lender level) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14: Intensive margin

	(1) Pooled OLS	(2) Pooled OLS	(3) Pooled OLS
Exposed	-0.003 (0.005)	-0.003 (0.004)	-0.003 (0.006)
Exposed * Post 1772	0.066 (0.023)***	0.052 (0.028)*	0.077 (0.039)**
non-EIC	-0.056 (0.006)***	-0.056 (0.007)***	-0.056 (0.006)***
Absolute position with consortium (£ 000s)		-0.000 (0.000)	
* Post 1772		0.002 (0.003)	
Relative position with consortium (fraction)			-0.001 (0.011)
* Post 1772			-0.026 (0.038)
Constant	0.245 (0.017)***	0.247 (0.016)***	0.246 (0.017)***
Year dummies	Y	Y	Y
Lender observables	Y	Y	Y
Borrower observables	Y	Y	Y
N	387	387	384
R^2	0.440	0.443	0.442

Regression estimates for all English securities. Observations refer to new contracts and are weighted by the nominal (face) value of the collateral. Haircuts are calculated as the fraction of the collateral value that is not financed with a loan. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the exposed and the post-1772 dummies captures the **extensive** margin of adjustment. The "absolute position with the consortium" measures the total amount of the collateral the consortium had pledged with a specific lender around Christmas 1772 (in (£ 000s nominal or face value). The "relative position with the consortium" divides this measure by the total amount of collateral that was pledged with a specific lender before Christmas 1772. The interactions with the post 1772 dummy capture the **intensive** margin of adjustment. We do not measure this with a triple interaction because the position with the consortium for non-exposed lenders is always 0. Standard errors for the absolute and relative position measures are 5.26 and 0.39 respectively. Robust standard errors (clustered at the lender level) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 15: Haircuts and time since event

	(1) Pooled OLS	(2) Pooled OLS	(3) FE	(4) FE	(5) FE
Exposed	-0.005	-0.003		-0.000	
	(0.005)	(0.005)		(0.006)	
Exposed * Post 1772	0.097	0.086	0.086	0.054	0.101
	(0.030)***	(0.033)***	(0.046)*	(0.030)*	(0.045)**
Time since event	-0.001	0.023	0.008	-0.065	0.010
	(0.058)	(0.059)	(0.066)	(0.058)	(0.073)
Exposed * time since event	-0.051	-0.041	-0.051	-0.031	-0.058
	(0.044)	(0.044)	(0.045)	(0.042)	(0.048)
non-EIC	-0.058	-0.055	-0.047	-0.053	-0.046
	(0.006)***	(0.007)***	(0.012)***	(0.008)***	(0.014)***
Constant	0.218	0.244	0.243	0.212	0.460
	(0.007)***	(0.018)***	(0.026)***	(0.012)***	(0.032)***
Year dummies	Y	Y	Y	Y	Y
Lender FE	N	N	Y	N	Y
Borrower FE	N	N	N	Y	Y
Lender observables	N	Y		Y	
Borrower observables	N	Y	Y		
N	418	387	418	387	418
N (if balanced panel)			166	77	33
R^2	0.334	0.440	0.632	0.659	0.802
# groups (lenders)	177	152	177	152	177
# groups (borrowers)	72	70	72	70	72

Regression estimates for all English securities. Observations refer to new contracts and are weighted by the nominal (face) value of the collateral. Haircuts are calculated as the fraction of the collateral value that is not financed with a loan. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the exposed and the post-1772 dummies captures the diff-in-diff effect. 'Time since event' is measured in years. The interaction between the exposed and 'time since event' dummies captures the reversion of the treatment effect. For example, in column 3 the immediate treatment effect on haircuts is .08 and decreases by .04 every year. Lender and borrower observables are as in table 6. Lender and borrower fixed effects are at the family/firm level. Robust standard errors (clustered at the lender level) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 16: Sample attrition

	(1) OLS	(2) OLS	(3) Probit	(4) Probit	(5) Logit	(6) Logit
Exposed	0.087	0.081	0.398	0.366	0.740	0.709
	(0.052)*	(0.052)	(0.244)	(0.247)	(0.460)	(0.470)
Total lending before Christmas 1772		8.433		28.621		47.953
		(5.769)		(16.356)*		(27.806)*
Constant	0.098	0.067	-1.296	-1.411	-2.225	-2.436
	(0.033)***	(0.038)*	(0.191)***	(0.209)***	(0.373)***	(0.415)***
N	174	174	174	174	174	174
R^2	0.015	0.038				

Unit of observation: individual lenders. Sample restricted to lenders present in the repo market before Christmas 1772. Left hand side variable: 1 if lender is present after 1772, 0 if not. We relate this to whether lenders were exposed to the defaulting consortium. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. Cols (1), (3), and (5) measure the simple degree of attrition, either in fractions still present after 1772 (OLS) or in terms of the probability of returning to the sample after 1772 (probit and logit). The constant measures the degree of attrition for non-exposed lenders. The coefficient on the exposed dummy measures the difference in attrition between exposed and non-exposed. A positive number means that exposed lenders exhibit less attrition. In cols (2), (4) and (6) we condition the degree of attrition on the overall activity of lenders before Christmas 1772. Total lending is measured as £000 of nominal (face) value of collateral. Robust standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

ONLINE APPENDIX [NOT FOR PUBLICATION]

Appendix A: Sample contract – original and English translation (SAA 10,602, F. 1309)

Heden den 2e November 1772 compareerde voor mij Daniel van den Brink Openbaar Notaris binnen Amsterdam de heer Raphael de Abraham Mendes da Costa, voor en in de naam van zijn Compagnie luidende Abraham de Raphael Mendes da Costa & Co, Kooplieden binnen deeze stadt	Today, November 2, 1772 appeared before me, Daniel van den Brink, Public Notary in the City of Amsterdam, mr. Raphael de Abraham Mendes da Costa, for and in the name of his company called Abraham de Raphael Mendes da Costa & Co, merchants in this town (hereafter: "the party present").
en bekende bij deeze wel en deugdelijk schuldig te wezen aan de Heer Ananias Willink, meede Coopman alhier de somma van 24.000 guldens bankgeld spruytende uyt hoofden en ter saake van sodanige somma als de selve den 22e Oktober laatstleden aan syn comp[arants] voorn[oemde] Compagnie heeft afgeschreven, […] en welke somma van f. 24.000 Bankgeld hij Comparant in de naam van zijn voorn[oemde] compagnie aanneemt	And declared to be indebted to mr. Ananias Willink, also merchant in this city for the sum of 24,000 guilders banco, originating from and relating to a withdrawal of such sum on October 22 last in favor of the present party's said company, and the present party accepting that sum of 24,000 guilders banco in the name of said company.
en belooft aan voorn[oemde] Heer Ananias Willink of zijn Co[mpagnies] rechthebbende kosten schadeloos alhier weeder te zullen restitueren en voldoen binnen de tijdt van ses maanden te reekenen van den 6 Oktober deeses jaars met den Interest van dien tegens vier percent 't jaar en bij prolongatie gelijke interest	And promises to said mr Ananias Willink, or his company's legal representative, to return this sum (including any costs incurred), within the time of six months, counting from October 6 this year, with the interest of 4% annual, and in case of prolongation the same interest.
en zulks tot de volle en effectueele betaalinge toe tog de interessen te betaalen ieder 6 maanden des zo zal bij opeischinge of aflossinge den een den ander ses weeken voor de vervaltijd waarschouwent	And [promises] to pay the full and effective payment of the interest every six months In case that the contract is not prolonged he will be notified 6 weeks in advance.
tot nakominge deezes verbind hij comparant zijn en zijn gemelde Compagnons persoon en goederen als na rechten en specialijk sodanige vijftienhonderd ponden sterling capitaal actien in de d'Oost Indische Compagnie van Engeland als tot London voor reekening van zijn comparants	To honor this agreement, the present party pledges his own body and goods and especially 1500 Pounds Sterling capital in the stocks of the English East India Company, which have been transferred in London from the account of the present party's company to the account of said mr.

gemelde compagnie als pand ter minnen op de naam en reekening van gemelde H[eer] Ananias Willink zijn getransporteerd […]

Ananias Willink as collateral.
[…]

en zulks meede een somma van f. 1500 indien deselve actien mogten komen te daalen op 180% en zo vervolgens van 10 tot 10 % om bij aflossinge en voldoeninge van gemelde capitaale somma gerescontreerd en geluiqideerd te werden, zullende de interessen van zodaanige restitutie kon te resteeren van dien dag af dat dezelve restitutie geschied is

And he also [promises] to transfer an amount of 1500 guilders banco if the price of said stock were to fall below 180% and similarly with every additional fall of 10%. Interest payments associated with these sums of money will be calculated until the moment the money is effectively transferred.

en hy comparant belooft meede in de naam van zyn gemelde Compagnie te zullen goed doen de provisie en onkosten die by 't transporteren van dezelve Actien aan zijn compagnie zullen komen te vallen welk transport by aflossinge zal met ten geschieden door de correspondenten van zijn comparants gemelde Compagnie.

And he, the party present, promises in the name of his said Company to pay for the fees and other costs associated with transferring the stock to his Company the moment the loan is repaid, which will be arranged by the correspondents of the present party's said company

Voorts verklaarde hy Comparant dezelve Heer Anianas Willink specialijk te authoriseeren en consititueeren ommeindien zijn comparants gemelde compagnie in gebreken mogt komen te blijven de voorsz[egde] capitaale somma van f. 24000 bankgeld en interessen promptelijk te betaalen en voldoen ofte […] en meede zo wanneer bij vermindering der waarde van voornoemde Actien zijn comparants gemelde Compagnie op de eerste aanzegginge 't surplus niet kwam te voldoen dezelve actien door een makelaar alhier ofte tot London te mogen verkopen omme daar uit te vinden 't geene syn Ed[eles] uit kragte deezes zal zijn Competeerende 't geene hy Comparant in de naam van zyn voornoemde Compagnie belooft voor goed vast en van waarde te houden en zoo wanneer dezelve minder mogten renderen zoo belooft hij comparant 't mindere aan zijn Ed[elste] zullen opleggen en voldoen waar tegens gemelde Heer Ananias Willink als meerdere

Furthermore, the present party declares that, in case the present party's company defaults on the obligation to repay said sum of 24,000 guilders banco and associated interest payments in a timely fashion, or when he fails (due to the fall in value of said stocks) to provide additional surplus after a first instigation, he authorizes mr. Ananias Willink especially to have the said stock sold through an official broker, either here or in London, and to retrieve from the proceeds the amount of money he is entitled according to this agreement with the present party's company.
In case the sale yields less than the full amount, the present party promises to make up the difference. In case it yields more, mr. Ananias Willink will remit the resulting surplus.
The party present declares that he has received a counter-deed in reference to said stock.

aan zijn comparants gemelde Compagnie zal goed doen en hij Comparant bekende van syn Ed[ele] wegens voorsz[egde] actien een renvers[aal] te hebben ontvangen

Actum Amsterdam, 2 November 1772

Signed in Amsterdam, November 2, 1772

Appendix B: Additional tables

Table 17: Interest rates – Winsorized dependent variable

	(1) Pooled OLS	(2) Pooled OLS	(3) FE	(4) FE	(5) FE
Exposed	0.064	0.042	-0.111	0.060	-0.162
	(0.035)*	(0.033)	(0.045)**	(0.041)	(0.053)***
Exposed * Post 1772	-0.019	-0.008	-0.059	0.026	0.070
	(0.077)	(0.077)	(0.086)	(0.080)	(0.165)
non-EIC	-0.072	-0.087	-0.076	-0.104	-0.076
	(0.036)**	(0.033)**	(0.045)*	(0.049)**	(0.054)
Constant	3.534	3.617	3.690	3.583	3.620
	(0.033)***	(0.092)***	(0.094)***	(0.070)***	(0.145)***
R^2	0.464	0.515	0.736	0.659	0.840
Year dummies	Y	Y	Y	Y	Y
Lender FE	N	N	Y	N	Y
Borrower FE	N	N	N	Y	Y
Lender observables	N	Y		Y	
Borrower observables	N	Y	Y		
N	418	386	418	386	418
N (if balanced panel)			166	77	33
# lenders	177	152	177	152	177
# borrowers	72	70	72	70	72

Regression estimates for all English securities. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the exposed and the post-1772 dummies captures the diff-in-diff effect. Panel (A): observations are uniformly weighted. Panel (B): observations are weighted by the nominal (face) value of the collateral; the top and bottom 5% of the distribution are Winsorized. Robust standard errors (clustered at the lender level) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix C: Further robustness checks

Disaggregation of haircut components

The change in the haircut we document can be disaggregated into two parts – the difference between the price at which a contract is signed and the pre-agreed level when a margin call is triggered, and the difference between the trigger level and the value of the loan. In Table 18, we analyse the shift in the haircut for its two components separately.

In panel A, we examine the difference between market price and the trigger level for a margin call. The lenders who were exposed to the default increased the trigger level substantially, by 4-5 percent – very close to the change in the overall collateral requirements. In panel B, we analyze the distance to loss, the difference between the margin trigger and the value of the loan. Here, there are only relatively small and mostly insignificant effects – lenders adjusted the risk profile of their lending by demanding margin earlier, and keeping the value of the loan overall lower relative to the market value at the time of signing.

Table 18: Disaggregation of haircut components

	(1) Pooled OLS	(2) Pooled OLS	(3) FE	(4) FE	(5) FE
Panel (A): Distance to margin call					
Exposed	-0.009	-0.005		-0.006	
	(0.007)	(0.006)		(0.006)	
Exposed * Post 1772	0.063	0.042	0.039	0.028	0.046
	(0.023)***	(0.024)*	(0.036)	(0.028)	(0.043)
non-EIC	-0.036	-0.029	-0.029	-0.027	-0.031
	(0.006)***	(0.006)***	(0.009)***	(0.007)***	(0.011)***
Constant	0.131	0.167	0.167	0.116	0.069
	(0.006)***	(0.014)***	(0.020)***	(0.009)***	(0.026)***
R^2	0.135	0.293	0.630	0.534	0.804
Panel (B): distance to loss					
Exposed	0.004	0.002		0.007	
	(0.006)	(0.005)		(0.006)	
Exposed * Post 1772	0.012	0.022	0.025	0.010	0.027
	(0.012)	(0.012)*	(0.018)	(0.015)	(0.018)
non-EIC	-0.024	-0.027	-0.020	-0.027	-0.019
	(0.007)***	(0.006)***	(0.008)**	(0.007)***	(0.010)*
Constant	0.087	0.081	0.088	0.095	0.098
	(0.005)***	(0.017)***	(0.021)***	(0.008)***	(0.026)***
R^2	0.306	0.390	0.672	0.614	0.825
Year dummies	Yes	Yes	Yes	Yes	Yes
Lender FE	No	No	Yes	No	Yes
Borrower FE	No	No	No	Yes	Yes
Lender observables	No	Yes		Yes	
Borrower observables	No	Yes	Yes		
N	405	374	405	374	405
N (if balanced panel)			166	77	33
# lenders	177	152	177	152	178
# borrowers	72	70	72	70	72

Regression estimates for all English securities. Haircut = distance to margin call + distance to loss. Observations refer to new contracts and are weighted by the nominal (face) value of the collateral. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the exposed and the post-1772 dummies captures the diff-in-diff effect. Lender and borrower observables are as in table 6. Lender and borrower fixed effects are at the family/firm level. Robust standard errors (clustered at the lender level) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Concentration of lending

Lenders could experience losses because their counterparty failed to pay, or because collateral was insufficient. The first risk can be mitigated by lending to a wider range of counterparties. We calculate the concentration of each lender's portfolios before and after the distress period as the Herfindahl index of loan concentration. The higher the Herfindahl index, the greater the risk of a single counterparty exposing the lender to losses. About half of all lenders only lent to a single counterparty at any one point in time. The rest diversified significantly, with more than a fifth spreading risk substantially ($H \leq 0.5$).

In Table 19, we examine if lenders avoided risk concentration after the 1772 distress period. We find the opposite. The interaction of the exposed and post-event dummies suggests that lending became more concentrated for those that had been exposed to the consortium. This effect is far from statistically significant though. These results are consistent with the interpretation that collateralized loan contracts are set up in such a way that they are (perceived to be) risk free or alternatively that the only risk that matters is fluctuations in the value of the collateral. If that is the case diversification will not reduce the riskiness of a loan contract.

In line with the predictions of the Geanakoplos model, lenders did not try to reduce risks by spreading loans over an increased number of counterparties – since all contracts are ex ante risk-free, diversification yields no additional benefits. Haircuts were the only relevant margin of adjustment.

Table 19: Herfindahl index by lender

	Including Van Seppenwolde			Excluding Van Seppenwolde		
	(1)	(2)	(3)	(4)	(5)	(6)
	Pooled OLS	Pooled OLS	FE	Pooled OLS	Pooled OLS	FE
Exposed	-0.075	-0.086		-0.175	-0.210	
	(0.044)*	(0.049)*		(0.057)***	(0.063)***	
Post 1772	-0.117	-0.139	-0.158	-0.066	-0.092	-0.219
	(0.086)	(0.095)	(0.146)	(0.089)	(0.103)	(0.285)
Exposed * Post 1772	0.043	0.083	0.187	0.142	0.209	0.451
	(0.111)	(0.122)	(0.202)	(0.116)	(0.132)	(0.335)
Non-EIC	-0.024	-0.022	-0.127	-0.072	-0.046	-0.364
	(0.048)	(0.054)	(0.193)	(0.069)	(0.074)	(0.314)
Constant	0.866	0.866	0.843	0.819	0.795	0.777
	(0.036)***	(0.065)***	(0.055)***	(0.043)***	(0.086)***	(0.075)***
Year dummies	Y	Y	Y	Y	Y	Y
Lender observables	N	Y		N	Y	
Lender FE	N	N	Y	N	N	Y
N	202	175	202	128	113	128
N (if balanced panel)			50			30
R^2	0.035	0.049	0.917	0.035	0.049	0.917
# lenders	177	152	177	113	99	113

Regression estimates for Herfindahl indices on the lender level; measured before and after Christmas 1772. The Herfindahl index (0-1) measures the concentration of a lender's portfolio (loans secured on all English securities); $H = \sum_{i=1}^{N} s_i^2$ where s_i is the share of lending to an individual counterparty. Values close to 0 indicate full diversification; a value of 1 indicates full concentration. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the exposed and the post-1772 dummies captures the diff-in-diff effect. Lender observables as in table 6. Lender fixed effects on the family level. Robust standard errors (clustered at the lender level) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Total lending

Did lending volume per lender change as a result of the Seppenwolde episode? Table 20 examines total lending volume per lender. We analyze both total lending (cols 1 – 3) and lending excluding loans made to the Seppenwolde consortium (all before Christmas 1772) (cols 4 – 6). Those who were exposed lent more than the rest before the crisis, on average. Lending against assets other than the EIC was also associated with higher lending volume. There is no clear result for changes over time – average lenders lent more according to specifications 1, 2, 4 and 5, but less when we add lender fixed effects (col 3). None of these factors is significant.

The statistical results suggest that those affected by the Seppenwolde crisis reduced their lending thereafter. Especially in the fixed effect estimate of col 3, this increase seems to have been by a quantitatively considerable margin. When we exclude loans made to the Seppenwolde consortium, the treatment effect is reduced but is still negative. None of these estimates is statistically significant.

To sum up, the results suggest that lenders affected by the bankruptcy may have reduced risk by lowering their total exposure to the collateralized loan market, but we cannot be sure that the result is not driven by random variation in our data.

Table 20: Total lending

	Including Van Seppenwolde			Excluding Van Seppenwolde		
	(1)	(2)	(3)	(4)	(5)	(6)
	Pooled OLS	Pooled OLS	FE	Pooled OLS	Pooled OLS	FE
Exposed	1.911	2.144	2.489	1.433	1.783	0.188
	(0.935)**	(1.166)*	(2.054)	(0.923)	(1.212)	(2.375)
Post 1772	0.326	0.175	-0.104	0.742	0.764	0.129
	(0.487)	(0.610)	(1.713)	(0.402)*	(0.517)	(2.275)
Exposed * Post 1772	-1.186	-1.465	-3.648	-0.749	-1.232	-1.640
	(0.913)	(1.163)	(3.341)	(0.988)	(1.081)	(2.447)
non-EIC	3.337	3.499	2.782	2.243	1.832	1.720
	(1.346)**	(1.700)**	(3.612)	(0.895)**	(0.954)*	(3.345)
Constant	2.190	3.050	2.287	1.884	4.147	2.864
	(0.462)***	(1.405)**	(1.492)	(0.335)***	(1.518)***	(1.272)**
Year dummies	Y	Y	Y	Y	Y	Y
Lender observables	N	Y		N	Y	
Lender FE	N	N	Y	N	N	Y
N	202	175	202	128	113	128
N (if balanced panel)			50			30
R^2	0.040	0.080	0.880	0.050	0.150	0.955
# lenders	177	152	177	113	99	113

Regression estimates for total lending at the lender level on the collateral of all English securities. Total lending is calculated before and after Christmas 1772; in £000s of nominal (face) value. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the post-1772 and the exposed dummies captures the diff-in-diff effect. Lender observables are as in Table 6. Lender fixed effects refer to fixed effects on the family level. Robust standard errors (clustered at the lender level) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

East India Stock only

In the baseline results, we use lending against all assets in our database – East India stock (EIC), 3% annuities, and Bank of England stock. While we control for compositional change, it is interesting to examine how much of a shift we can find by focusing on EIC stock exclusively (the asset against which the Seppenwolde syndicate predominantly borrowed).

In Table 21, panel A, we show that lending requirements in EIC stock changes in very much the same fashion as in the universe of all assets. In the pooled estimation (col 2), the coefficient suggests a rise in collateral requirements by 6.8 percent. The fixed effect estimates look very similar to the benchmark numbers in Table 7. However, estimates become (borderline) insignificant. This is because with fixed effects, the effective number of observations that can be used to identify the interaction effect is constrained to those that are in the sample before and after 1772. In addition, we lose observations by constraining the sample to EIC transactions.

In panel B, we analyze lending against non-EIC assets only. Due to the limited number of observations, the fixed effect specifications cannot be estimated. The pooled OLS estimates are very similar to those for loan contracts collateralized with EIC stock. For example, the estimate of the interaction effect in col 2 is 6.6% (versus 6.8% in panel A). Overall, there is no reason to think that the estimated effects in our baseline specification only reflect changes in haircuts in one type of asset.

Table 21: Haircuts – different types of collateral

	(1) Pooled OLS	(2) Pooled OLS	(3) FE	(4) FE	(5) FE
Panel (A): EIC only					
Exposed	-0.002	0.000	0.004	-0.000	0.015
	(0.008)	(0.008)	(0.019)	(0.008)	(0.016)
Exposed * Post 1772	0.072	0.068	0.074	0.037	0.055
	(0.025)***	(0.028)**	(0.045)	(0.026)	(0.044)
Constant	0.222	0.240	0.225	0.210	0.169
	(0.006)***	(0.016)***	(0.032)***	(0.013)***	(0.046)***
N	314	288	314	288	314
N (if balanced panel)			134	65	41
# lenders	147	127	147	127	147
# borrowers	60	57	60	57	60
R^2	0.132	0.296	0.561	0.599	0.787
Panel (B): BoE, SSC and 3% Annuities					
Exposed	-0.007	-0.005			
	(0.008)	(0.007)			
Exposed * Post 1772	0.102	0.066			
	(0.016)***	(0.027)**			
Constant	0.158	0.226			
	(0.007)***	(0.019)***			
N	104	99			
# lenders	70	64			
# borrowers	27	26			
R^2	0.072	0.284			
Year dummies	Yes	Yes	Yes	Yes	Yes
Lender FE	No	No	Yes	No	Yes
Borrower FE	No	No	No	Yes	Yes
Lender observables	No	Yes		Yes	
Borrower observables	No	Yes	Yes		

Regression estimates for EIC and BoE, SSC and 3% Annuities separately. Observations refer to new contracts and are weighted by the nominal (face) value of the collateral. Haircuts are calculated as the fraction of the collateral value that is not financed with a loan. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the exposed and the post-1772 dummies captures the diff-in-diff effect. Lender and borrower observables are as in table 6. Lender and borrower fixed effects are at the family/firm level. Due to a limited number of observations the fixed effects models cannot be estimated for the non-EIC securities. Robust standard errors (clustered at the lender level) are reported in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Outliers

It is possible that a few, extreme values for the haircuts influence our results. A standard way to deal with this issue is to winsorize the data. We winsorize the top and bottom 5 percent of observations, and re-estimate (see Table 21). The results are largely unchanged. Coefficients are significant throughout, and are statistically indistinguishable from those in the baseline specification. For completeness we do the same for interest rates and reestimate our benchmark results (Table 16 in Appendix B). Again, results are virtually unchanged.

Table 22: Haircuts – Winsorized dependent variable

	(1) Pooled OLS	(2) Pooled OLS	(3) FE	(4) FE	(5) FE
Exposed	-0.005	-0.003		-0.001	
	(0.005)	(0.004)		(0.006)	
Exposed * Post 1772	0.072	0.064	0.060	0.040	0.059
	(0.020)***	(0.022)***	(0.032)*	(0.022)*	(0.031)*
Non-EIC	-0.057	-0.054	-0.047	-0.051	-0.045
	(0.006)***	(0.006)***	(0.011)***	(0.008)***	(0.014)***
Constant	0.219	0.240	0.236	0.214	0.199
	(0.006)***	(0.014)***	(0.022)***	(0.011)***	(0.033)***
R^2	0.369	0.470	0.677	0.655	0.842
Year dummies	Y	Y	Y	Y	Y
Lender FE	N	N	Y	N	Y
Borrower FE	N	N	N	Y	Y
Lender observables	N	Y		Y	
Borrower observables	N	Y	Y		
N	418	387	418	387	418
N (if balanced panel)			166	77	33
# lenders	177	152	177	152	177
# borrowers	72	70	72	70	72

Regression estimates for all English securities. Observations refer to new contracts. Haircuts are calculated as the fraction of the collateral value that is not financed with a loan. Exposed lenders are those who were forced to liquidate collateral after the events of Christmas 1772. The interaction between the exposed and the post-1772 dummies captures the diff-in-diff effect. Observations are weighted by the nominal (face) value of the collateral; the top and bottom 5% of the haircut distribution are Winsorized. Lender and borrower observables are as in table 6. Lender and borrower fixed effects are at the family/firm level. Robust standard errors (clustered at the lender level) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

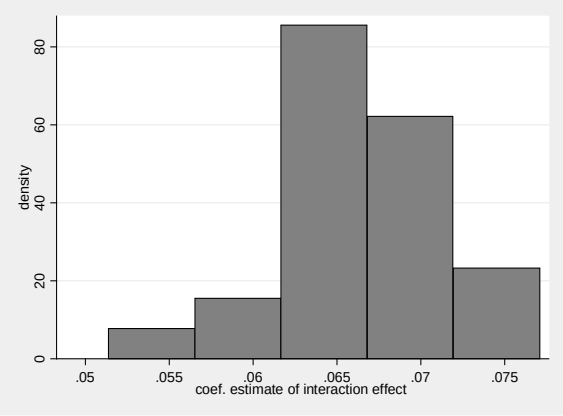
Extreme observations

The final step is to examine the sensitivity of our results to the influence of a single lender or borrower. To this end, we re-estimate the baseline specification (Table 6, col 2), dropping one lender or borrower at a time. Figure 10 panels A-D shows the distribution of coefficients (first row) and t-statistics (second row). The range of estimated coefficients is small, with results ranging from 5.5 to 7.5 percent. The t-statistics never falls below 2. This shows that our results are not driven by a single lender or borrower.

Figure 10: Outlier analysis, dropping one lender (borrower) at a time

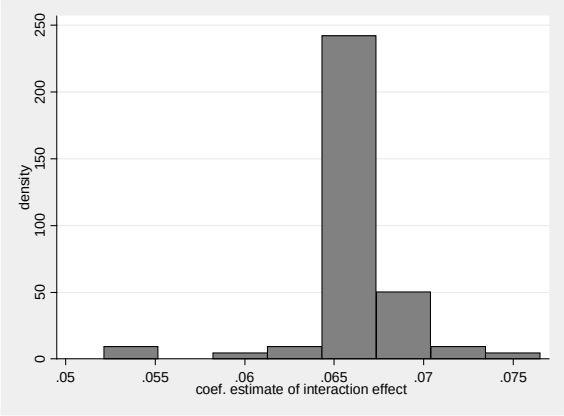
Dropping one lender at a time

(A) Coefficient estimate

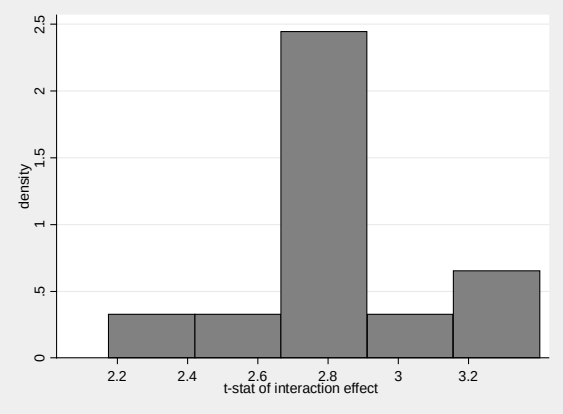


Dropping one borrower at a time

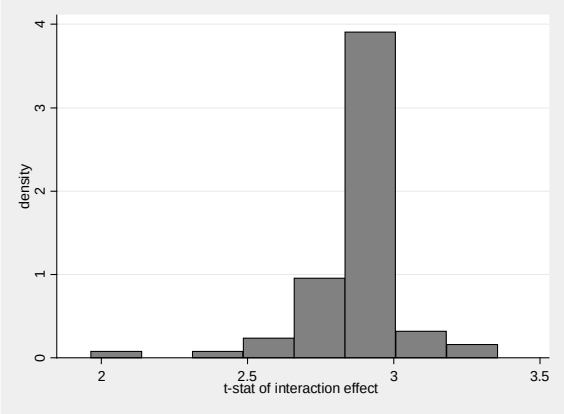
(B) Coefficient estimate



(C) t-statistic



(D) t-statistic



Estimates and t-statistics of coefficient β_2

$$Haircut_{i,t} = \beta_1 Exposed_i + \beta_2 Exposed_i * Post1772_t + \beta_3 Herfin_i + \beta_4 Herfin_i * Post1772_t + \beta_5 nonEIC + X_i + \overline{\varepsilon}_t + \zeta_{i,t}$$

Where X_i includes lender and borrower observables and $\overline{\varepsilon}_t$ includes time fixed effects. Coefficients and t-statistics are generated dropping one lender (or borrower) at a time. All estimates include lender fixed effects; lenders that are dropped out of the sample therefore have to be present both before and after Christmas 1772.

Appendix D: Mathematical proofs

To be added