What You Owe or Who You Know?

The Recipients of Central Bank Liquidity during the English Crisis of 1847

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November 18, 2020

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Abstract

To whom do central banks allocate their limited resources of high powered money when they face a supply constraint during financial crises? In this paper, we turn to economic history to answer this question. We draw on a large novel, hand-collected micro-level data set to study the determinants of the Bank of England's asset purchasing decisions during the crisis of 1847. We show that the Bank's policy response to its gold reserve constraint featured a combination of rules and discretion. While the Bank consistently applied the same rules regarding the quality of assets it purchased, its preferences over counterparty identity shifted in times of distress. The Bank allocated more liquidity to bankers and to firms particularly hit by the crisis, while rationing central bank money to bill brokers. Our paper thus suggests that the Bank's reserve constraint during crises shaped discount window operations in ways that could have distorted firm dynamics and generated moral hazard over the longer run even if they were able to help alleviate the short-term fallout of financial turmoils.

JEL classifications:

E44, E51, E52, E58, G21, N12, N22

Keywords:

Bank of England, bills of exchange, credit allocation, credit rationing, crisis of 1847, discount window, financial crisis, monetary policy, lender of last resort, relationship lending

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We are grateful to Olivier Accominotti, Isabel Argimón, Stefano Battilossi, Vincent Bignon, Nicholas Dimsdale, Rui Esteves, Clemens Jobst, Albrecht Ritschl, Rebecca Stuart and Stefano Ugolini for detailed comments on earlier versions of this paper. We would also like to thank seminar participants at the Economic History Society Annual Conference in Keele, LSE Economic History Seminar, CEPR Economic History Symposium at Banca d'Italia and IV Economic History Seminar at Banco de España for valuable comments. All remaining errors are our own. Any views expressed in this paper exclusively represent those of the authors and do not reflect the official viewpoint of the Bank of England, Oesterreichische Nationalbank, the ECB or the Eurosystem.

1 Introduction

In normal times, central banks have often been indifferent off whose balance sheet they purchase assets when implementing their policy decisions. Outright purchase programmes do not involve counterparty credit risk. Since purchases do not constitute a lending relationship, the central bank comes to own the asset after the purchase. From a risk management perspective, it should be the quality of the asset bought in the primary or secondary market, not the characteristics of the seller, that matters.[1] A financial or commercial crisis, however, might tip the scale, especially when legal or political constraints limit the expansion of the central bank's balance sheet. In this case, the policy effectiveness of the intervention is of particular importance and the central bank may have preferences about how it allocates its limited purchasing power.[2] This argument might apply well to a fixed exchange rate regime that experiences quickly drying up foreign reserves and frozen interbank markets, but also resonates more generally with central bank responses to crises.[3] Yet, attempts to allocate scarce central bank money to the "right" counterparties in the short run are notoriously tricky to implement[4] and may have negative macroeconomic consequences in the longer term if funds end up supporting unviable, less-productive firms to the detriment of healthy companies (Peek and Rosengren, 2005; Caballero et al., 2008) or trigger moral hazard (Carlson et al., 2015).

To whom do central banks allocate their limited resources of high powered money when they are constrained in a financial crisis? The confidentiality of modern central banks' individual purchase decisions explain why empirical evidence on this question has proven elusive so far. In this paper, we fill this gap in the literature by turning to economic history. We draw on a large novel, hand-collected purchase-level data set to study the Bank of England's operations in the crisis of 1847. The nineteenth century provides an enticing laboratory for our purpose. First, the Gold Standard meant that legal bullion reserve ratios directly constrained the Bank's balance sheet expansions during crises (Dornbusch and Frenkel, 1984). Second, central banks in the nineteenth century purchased assets via their standing facility, the discount window. The discount window endowed the holders of assets, the so called 'discounters', with the power of initiating the transaction – rather than the Bank itself. Therefore, in contrast to modern day open market purchases, we observe the universe of potential transactions, including those into which the Bank declined to enter. Third, the main asset purchased by central banks at the time was the bill of exchange. The bill of exchange represents a special type of asset because the discounter's creditworthiness was a direct determinant of the asset's quality: all owners of the bill, including the last, had to

[1] Repurchase agreements (repos) may be evoked as an exception (Gorton and Metrick, 2012). Repos, however, constitute *de facto* lending relationships. In the case of repos, the first line of defense of the creditor against losses is the creditworthiness of the counterparty, because the borrower has to be able to repurchase the assets sold to the central bank at maturity. Only once the counterparty cannot repurchase the asset, the quality of underlying assets comes into play. If the counterparty defaults, the assets need to be sold to net out the central bank's claim.

[2] Not taking any explicit decision on the procedure to follow would implicitly amount to a selection too: an allocation on the basis of a first-come, first-served principle.

[3] For example, recent central bank Quantitative Easing programmes have often aimed to make asset purchases from particular sectors for policy effectiveness reasons, e.g. targeting government bond purchases from non-banks or preferred habitat sectors such as pension funds, and focusing corporate bond purchases on companies with a significant domestic economy presence.

[4] The definition of the "right" or "correct" selection is far from trivial. As lenders of last resort during financial crises, central banks usually pledge to channel funds to illiquid, but not to insolvent counterparties. As decades-worth of research have shown, it is notoriously hard to differentiate between illiquidity and insolvency, particularly so under time pressure in a crisis (Richardson, 2007).

sign it and were jointly liable in case the underlying debtor did not pay the bill at maturity (Santarosa, 2015; Accominotti et al., 2019). This feature likely led central banks to screen and formulate (implicit) preferences for some counterparties at the discount window even in normal times. As a corollary, we can directly observe how these preferences changed after central bank money had become a scarce resource during a financial crisis.

We focus on the English crisis of 1847, rather than later or earlier ones, because of three main reasons. First, the turmoil in 1847 was the first following the important institutional innovations of the Bank Charter Act of 1844. The Act had granted the Bank an effective monopoly on the issue of new bank notes in return for a strict bullion reserve requirement (Wood, 1939). Second, the crisis of 1847 constitutes the first episode for which the Bank documented not only all effective purchases, but also those tenders at the discount window it had decided to reject. Third, during the later crises of 1857 and 1866, the British government rapidly accorded the Bank a temporary permission to breach its legal reserve requirement (Hughes, 1956; Flandreau and Ugolini, 2013). Thus, the reserve rules only briefly acted as a constraint on the Bank's balance sheet expansion during these two later episodes, as the central bank was effectively "lending freely" as propagated by Bagehot (1873).[5] While the government also indemnified the Bank for potential breaches of its reserve requirement in 1847, it only did so at the end of October 1847. Given that the crisis had been raging in the London money market since early spring 1847, the turmoil pushed the Bank very close to exhausting its note reserve and forced the central bank to ration credit on several occasions (Bignon et al., 2012).[6]

Drawing on several stratified random samples of purchase-level data, we systematically compare the econometric predictors of the Bank's purchasing decisions during normal and crisis weeks in 1847.[7] For almost 2,000 individual observations, we thus encode – by hand – a long list of counterparty features and asset characteristics as our covariates of interest. To address residual omitted variable bias and to check for the stability of our coefficients, we employ date and packet (discounter-date) fixed effects. This strategy may not fully remedy all remaining endogeneity worries. Residual omitted variable bias, however, would need to affect our estimates in a systematically different way in normal vs. crisis times even after the inclusion of fixed effects to invalidate our comparison exercise. Hence, although we are careful not to over-interpret the precise size of our coefficients, we think that the estimates are sufficiently reliable for the comparative nature of the question we seek to answer in this paper. Finally, we run our baseline models using linear probability and OLS models, but we also test the robustness of our results to non-linear model specifications (Logit and Tobit).

Our econometric analysis provides several new insights. First, pooling crisis times and normal weeks, we establish that asset quality characteristics and discounter identity both mattered for the Bank's day-to-day purchasing decisions. When choosing which bills of exchange to purchase, the Bank appears to have followed a

[5] Walter Bagehot (1873) advocated that central banks acting as LLR should lend freely, at high interest rates, and in return for good securities. These principles are generally derived from various passages in Bagehot's major work, *Lombard Street*.

[6] In a companion paper to this article (Rieder et al., 2020), we establish that the low reserve ratio in 1847 caused the Bank to quantitatively restrict its purchasing operations at the discount window.

[7] Throughout this paper, we define "crisis weeks" as those weeks where the level of notes and discounts recorded and/or the note reserve in Banking Department are more than two standard deviations from the mean over the period between 1847 to 1914. According to this definition, weeks of particularly strong financial distress thus cover the following dates in 1847: 28 March – 8 May, 26 July – 14 August, 30 August – 4 September and 13 September – 20 November.

set of internal risk management rules related to maximum maturities, purchase size and the underwriter's (i.e. the acceptor's) quality as well as location. Moreover, our pooled results indicate that the Bank generally paid attention to the solvency situation of discounters: bills submitted by seemingly weaker firms experienced higher rejection rates. We also uncover evidence for some "uncomfortable truths" suggesting a preferential treatment of bills accepted by the Bank of England's own directors and the existence of a club of favored top discounters. Second, we show that the Bank's policy response to its supply-side constraint during moments of elevated financial turmoil featured a combination of rules *and* discretion. On the one hand, the Bank consistently applied the same rules regarding the quality of assets it purchased. On the other hand, its preferences over discounter identity shifted markedly in times of distress. In crisis weeks, the Bank allocated more liquidity to bankers and to firms in particularly affected sectors of the economy. At the same time, it rationed central bank money to bill brokers. Thus, potential changes in discounters' liquidity management practices in reaction to the Bank's allocation policies during crisis windows might have triggered longer-term consequences for firm entry/exit and moral hazard.

This paper is organized as follows. In the next subsection, we discuss our contributions to the different strands of literature related to this study. Section 2 describes our primary sources and explains the new data sets compiled for this paper. Section 3 discusses the historical background of this study. Section 4 looks at descriptive evidence and discusses our empirical strategy in detail. Section 5 provides the estimation results and robustness checks. Section 6 concludes.

Contributions to the literature

Our work makes several contributions to the existing literature. First, to the best of our knowledge, this study is the first to systematically exploit purchase-level data from the Bank of England Archive using econometric techniques. We thus introduce our unique data as well as their structure and explain how we compiled our data set in detail below. Drawing on these data, we shed new light on the microeconomics of central banks' asset purchases by exploiting data from an era when discount window operations still amounted to outright sales of assets to the central bank (Bindseil, 2014).

Second, our findings relate to the economic and finance literature on relationship lending during financial crises and central bank liquidity management. In contrast to existing contributions (Bodenhorn, 2003; Jiangli et al., 2008; Puri et al., 2011; Sette and Gobbi, 2015), we do not examine relationship ties between commercial banks and their corporate customers, but rather look at whether the bank of bankers – the central bank – re-allocated scarce liquidity to particular counterparties during a crisis. Whereas studies on central bank liquidity management abound (Bindseil, 2009), the implications of supply constraints for liquidity allocation received little attention so far. El Hamiani Khatat and Veyrune (2019) discuss central bank liquidity management under fixed exchange rate regimes, but they do not directly discuss the allocation of limited central bank resources

during crises.

Third, our study also contributes to the economic history literature on relationship and insider lending in the nineteenth century, particularly in England (Lamoreaux, 1997; Fohlin, 1998; Muldrew, 1998; Valenze, 2006). In line with recent work (James, 2020), our findings reveal that the Bank of England's discounting policies in 1847 were still some way from the impartial and impersonal lending practices commonly ascribed to modern central banks. At the same time, the results reported in this paper concur with studies which argue that the Bank gradually stopped viewing commercial banks as competitors during the nineteenth century (Ziegler, 1990; Goodhart, 2018).

Fourth, our paper directly contributes to a long-standing debate in financial history. The traditional narrative links the transformation of the Bank of England into the first modern central bank, including the adoption of lender of last resort policies, to the development of an anonymous dealing with its day-to-day counterparties on the London money market. Capie (2002, p.310) suggested that the Banks's discount window was "made of frosted glass and raised just a few inches". According to Capie (2002), the central bank did not care about the identity of the discounter: it simply purchased good quality assets. Flandreau and Ugolini (2013, 2014) challenged this conventional account. In their view, the identity of all parties involved was crucial for obtaining central bank money via the discount window. The Bank would at least "raise an eyebrow" to check the identity of the discounter and record the names of all the parties involved in the underlying bill of exchange. Testing these two hypotheses requires micro data on the purchase-level and a research design that allows for a credible *ceteris paribus* analysis. A simple test for whether discounter identity or asset characteristics mattered independently does not suffice. In order to plausibly discriminate between the "frosted glass" and the "raised eyebrow" hypotheses, it is necessary to check whether the discounter identity still matters for discounting decsions after one controls for asset characteristics. Thanks to our purchase-level data set, we are the first in a position to test the two hypotheses econometrically. Although we find evidence supportive of the "raised eyebrow" metaphor, we acknowledge that the discounter's identity may matter precisely because it is a direct determinant of asset quality due to the joint liability rules governing bills of exchange at the time (Santarosa, 2015). In this sense, we argue, the boundaries between the "frosted glass" and the "raised eyebrow" metaphors necessarily blur.

Fifth, we contribute to an emerging literature on the microeconomics of central bank operations in the past (for a recent overview, see Ugolini (2017)). While Bignon and Jobst (2017) and Avaro and Bignon (2019) focus on the Banque de France's counterparty risk management and regional lending policies, we explore the intricacies and mechanics of the discount window operations of the arguably most powerful central bank throughout the nineteenth century: the Bank of England. In contrast to Jobst and Rieder (2020) who analyze the Austro-Hungarian Bank's framework to contain moral hazard involved in discount window operations, we exploit detailed micro-level information on the asset purchases themselves. We directly unravel the drivers of the Bank of England's decisions to purchase or decline specific bills of exchange.

Finally, our paper adds new insights to the economic history literature on the English crisis of 1847. Complementing the history of its origins (Campbell, 2014; Geisler Mesevage, 2020) and the available macro accounts on the crisis (Evans, 1848; Ward-Perkins, 1950; Dornbusch and Frenkel, 1984; Read, 2016), we take a Bank-internal perspective to provide novel results on its reaction to the crisis. In combination with our companion paper (Rieder et al., 2020), this article clarifies how the Bank's operational organization and its bullion reserve requirement shaped discount window policies at the micro-level.

2 Primary sources and data

Our paper exploits the wealth of detailed purchase-level information the Bank of England's London Discount Office began to record meticulously from the mid-1840s onwards.[8] To understand how the Bank kept its books, one needs a firm grasp of the nature of daily discount window interactions between the Bank and money market participants. In the large majority of cases, applications for discounts actually took the form of so called 'packets' of bills of exchange, rather than individual bills. Sale applicants, i.e. discounters, submitted a packet of bills to the Discount Office. Bank staff subsequently screened the individual bills contained in the packet and decided how many bills, if any, the Bank would purchase. The amount of central bank money[9] received from the Bank would then depend on the amount written on accepted bills minus the discount rate.[10] Usually, the Bank discounted all accepted bills from a given packet at a single rate of interest.[11] Therefore, the term 'purchase-level data' in the context of the Bank's nineteenth century operations first and foremost refers to the characteristics of a given packet submitted to the discount window.

Discount window interactions are reflected one-by-one in the Bank's ledgers which survived in the Bank of England Archive. Every single business day, the Discount Office clerks first recorded summary information on each and every submitted packet in the so called 'Daily Discount ledgers'. For each day in a given year, these ledgers contain information on the name of the discounter who applied for a sale, whether the discounter held deposit accounts with the Bank (so called Drawing Office or 'D.O.' customers), the amount applied for (i.e. the nominal value of the bill before the subtraction of the discount), the number of bills in the submitted packet and the discount rate eventually charged for the accepted bills inside the packet. The Daily Discount ledgers also document how many of the bills submitted with the packet were rejected (if any) and the ledgers even give the rejected amount in Sterling (i.e. the sum of the amounts written on rejected bills). Thus, based on the

[8] Besides the Discount Office at Head Office in London, the Bank of England's branches outside of London would have also been discounting bills. The Bank was permitted by law to establish branches outside of London from 1826 onwards. Unfortunately, micro data on the activities of branches no longer exist. We do, however, have a sense of the aggregate value of these transactions from the annual reporting of the Bank's branches' activity to Court. Reports were made to the Special Discount Committee and the annual data can also be found in Bank of England Archives, Discount Office Analyses and Summaries. During the 1847 and 1857 crises, roughly 40% of the Bank's business discounting bills by value was done through its branches. In 1866 it was 50%.

[9] We use the term 'central bank money' throughout this paper – rather than the term 'bank notes' –, because the Discount Office could pay for the bill either by handing out bank notes or by crediting a discounter's current account with the Bank.

[10] Central bank money could be paid out in notes or, for its longer-term customers, credited to an account held with the Bank.

[11] On occasion, a packet would be discounted at two rates. In 1847, around 13 percent of packets had dual rates. A glance through the ledger books after 1847 reveals that the Bank gradually decreased the number of packets which were given dual discount rates. The practice stopped in 1856. In another paper project, we are currently analysing the rationale behind these dual rates.

information in the Daily Discount ledgers, it is straightforward to compute the actual amount of central bank money received by a given discounter for any specific transaction.

The Daily Discount ledgers, however, only constituted the first step in the sophisticated documentation system maintained by the Bank. In a second step, the Discount Office staff recorded the accepted bills from a given packet in the so called 'Discounters With and Upon ledgers'. The Discounters With and Upon ledgers hold a separate section for each and every discounter who presented bills for sale at the Bank's discount window. These individual sections are organized according to the dates of sale applications put forward by the discounter. To illustrate this form of documentation, consider the following example. If *Rothschild & Sons*, a particularly prominent discounter in the London market during the 1847 crisis, had submitted a packet of 30 bills on 30 March 1847, these bills would first appear as a single entry (i.e. in packet form) in the Daily Discount ledgers. If Discount Office then decided to accept all 30 bills, these bills would be transcribed one by one into the Discounters With and Upon ledgers where they could be found under the section corresponding to *Rothschild & Son* and the entry for 30 March 1847. In other words, the Discounters With and Upon ledgers "unpack" the aggregate information from the Daily Discount ledgers. The Discounters With and Upon ledgers record the entire set of information written on each of the accepted bills. It states the location whence the bill was originally drawn, the drawer's name, acceptor's name, the date when the bill would become due for payment and the amount on the bill.

In addition, from 25 August 1847 onwards, the Bank also maintained a ledger where Discount Office staff recorded the details of rejected bills in a way almost identical to the discounter ledgers. For each date, the 'List of Bills Rejected ledger' contains information on the discounter's, the drawer's and the acceptor's name of a given rejected bill, alongside the bill's maturity date and its amount. The only difference between the Discounters With and Upon Ledger and the List of Bills Rejected ledger is that the latter does not state the location whence the bill was originally drawn but mentions the acceptor's location instead.[12] For example, had the Bank rejected three out of the 30 bills submitted by *Rothschild & Son*, the details of these three bills would have to be looked for in the List of Bills Rejected ledger, whereas the accepted 27 bills would still be recorded in the Discounters With and Upon Ledger.

We can only speculate on the reasons why the Bank started to record rejected bills on 25 August 1847 (and not before) and why the Bank documented bills it had decided to refuse in such a systematic and precise manner. Regarding the motivation to start a rejected bills ledger on 25 August 1847, this decision is likely related to the Bank's response to the crisis of 1847. The Bank had rejected large amounts of bills in the first eight months of 1847. Perhaps, one reason to start documenting rejected bills could have been the wish of the Discount Office to compile a set of undesirable bill characteristics to accelerate or streamline rejection decisions. Nevertheless, the recording of rejected bills appears to be a particularly costly exercise to undertake for securities the Bank was not going to purchase. Thus, another possibility is that the Bank used this information to keep track of

[12] We discuss this slight difference between the Discounters With and Upon Ledger and the List of Bills Rejected ledger in more detail below.

more general developments in the financial system, for example to get a sense of the overall indebtedness of highly levered acceptors (Flandreau and Ugolini, 2013).

We started our data collection by transcribing all transactions (i.e. submitted packets) recorded in the 1847 Daily Discount ledger books to get at the population of discount window applications in 1847. To minimize potential transcription errors, we validated the discounter names using the Discount Office's 'Index A – Z Discounter Ledgers 1847 - 1850' from the Bank of England Archive and we compared the daily total we recorded in the Daily Discount ledgers to aggregate statistics for each day (which are also available in the ledgers). In 1847, a total of 9,206 packets containing 97,637 bills was submitted to the Discount Office. Given that it had only 310 business days per year and opened for three hours of daily business only (Ogden, 1999)[13], Discount Office examined an astonishing average number of almost ten packets or, equivalently, more than 100 bills per hour.

In a second step and based on our data for the entire population of discount window applications in 1847, we collected two random samples. First, we drew a random sample of 1,000 packets from the underlying population. We do not unpack these 1,000 packets from our first random sample. Rather, as we explain below, we use them to obtain a first approximation of how important the applicant (discounter) identity was for the Bank's purchasing decisions. Our second random sample contains 100 packets: 50 packets from 'crisis weeks' and 50 packets from 'normal weeks'. Throughout this paper, we define 'crisis weeks' as those weeks where the level of notes and discounts recorded and/or the note reserve in Banking Department are more than two standard deviations from the mean over the period between 1847 to 1914. According to our definition, weeks of particularly strong financial distress thus cover the following dates in 1847: 28 March – 8 May, 26 July – 14 August, 30 August – 4 September and 13 September – 20 November. We sampled these 100 packets from the entire population by imposing a second condition: the submission took place between 25 August and 31 December 1847. These exact date window restrictions are necessary to enable us to unpack both the accepted and rejected bills in these sampled packets. The purpose of this second random sample is to assemble a bill-level data set. As discussed above, the List of Bills Rejected ledger only starts on 25 August 1847, with the peak of the crisis occurring at end of October (c.f. Section 3 below). We collect this bill-level sample with the aim of conducting a representative 'horse race' between discounter identity and bill characteristics in the purchasing decisions of the Bank. The 100 packets contain 863 bills whose characteristics we transcribe one by one.

We draw on the information provided directly in the various ledgers to encode a long list of covariates capturing discounter, acceptor, packet and bill characteristics.[14] To capture aggregate trends on specific days, we compute the total number of bills and the total Sterling amount submitted for discount on all the dates relevant for our samples. We also generate several packet-level variables such as a given packet's rank among

[13] Business hours were from 11am to 2pm. It is not known whether these hours were extended during financial crises.

[14] Given that the drawer had rarely any role to play in the actual payment of the bill (Accominotti et al., 2019), we disregard information regarding the drawer in our paper. The information contained in the Bank's ledgers confirms this decision: the List of Bills Rejected ledger does not list the location whence a given bill was originally drawn. This fact suggests at the very least that the quality of the bill was not dependent on the drawer's location – which could be virtually all over the world, reflecting the global trade ties of the British Empire, as shown by Xu (2020).

all the packets from a given day (in terms of value and chronologically, as they appear in the Daily Discount ledger), the packet's total number of bills and its total Sterling amount. We also encode separate dummy variables flagging whether the Daily Discount ledger contained one of three remarks next to a given packet: *withdrawn* which indicated whether the discounter eventually withdrew some or all of the bills submitted[15]; *returned* which was written next to packets the entirety or parts of which Discount Office had apparently not wanted to purchase and thus returned them to the discounter; and *maturity* likely qualifying packets containing at least one bill violating the Bank's internal maximum maturity preferences at the time.[16] Finally, based on our data for the full packet population of 1847, we compile lists of top discounters and top acceptors. We identified top discounters and top acceptors as counterparties whose total submissions (discounted or accepted, respectively) amounted to sums more than two standard deviations from the mean.

At the bill-level, we coded separate dummies for submitted bills that had been accepted by one of the Bank of England's directors (referred to as 'director' in the Discounters With and Upon Ledger or List of Bills Rejected ledger) or by HM Treasury (referred to as 'Treasury' in the Discounters With and Upon Ledger or List of Bills Rejected ledger) to capture potential 'insider' purchasing. We also added an indicator variable for bills which bore the name 'P.N.' instead of a proper acceptor's name in the Discounters With and Upon Ledger or List of Bills Rejected ledger. We hypothesize that 'P.N.' was an abbreviation used to describe promissory notes. Promissory notes constituted bills with only one other name apart from the discounter, that is, when the drawer of the bill figured simultaneously as acceptor. Finally, we also compute the remaining days to maturity for each bill. To be sure, the bill-level variable reflecting the remaining days to maturity is different from the packet-level *maturity* remark. The latter remark only appeared in crisis weeks in the Daily Discount ledgers where it was written next to an entire packet. In contrast, the remaining maturity is available for all bills, no matter whether they were ultimately transcribed into the Discounters With and Upon ledgers or the List of Bills Rejected ledger.

We draw on several other internal Bank documents and external sources to make more sense and use of the recorded data on discounter and acceptor names. We mostly use dummy variables to indicate whether a given name stands for a specific quality or type of counterparty. First, we matched the names on the packets and bills with some professions that emerge as important actors from our discussion of the London money market (see Section 3). We checked discounter and acceptor names to see whether any of these parties was a banker or bill broker. We obtained the relevant information from the *Bankers' Almanac* and the *London Post Office Directory* for 1846. Second, the *London Post Office Directory* was also helpful for coding a dummy indicating whether an acceptor was based in London or elsewhere. This information is directly available in the ledger data for rejected bills only. Since we found many of the rejected bills' acceptors to be located outside London, we suspected that the acceptor's address played a role in the Bank's purchasing decisions and checked the names on

[15]Discounters seem to have withdrawn bills if they perceived the interest rate quote they had received from the Discount Office as too high. We discuss this practice and its meaning in detail in our companion paper on the Bank's quantity rationing practices in 1847, see Rieder et al. (2020).

[16]The Bank is said to not have accepted remaining maturities greater than 95 days, with a mean remaining days to maturity of accepted bills of approximately 60 days (Anson et al., 2017).

accepted bills against the *London Post Office Directory* for 1846. We also used *London Post Office Directory* for 1846 to construct a dummy indicating whether a discounter/acceptor was involved in corn-related trades (for the significance of corn-related trades during the crisis of 1847, c.f. Section 3 below). Third, we examined our list of names against a list of companies that failed in 1847 as published by Evans (1848). Fourth, we used the Bank's so called internal rating books for discounters and acceptors to encode covariates proxying for potential relationship/club lending ties.[17] The rating books provide information on when a particular discounter/acceptor was first 'introduced'[18] to the Bank, which Bank director had introduced the name, the trade/profession of the party and the credit limit the Bank had assigned to it.[19] In fact, the majority of discounters and acceptors that appear in our data sets were *not* in the official rating books. Furthermore, the two lists were not mutually exclusive: some names appear in both books. Altogether, only 315 discounters and 103 acceptors are listed in the discounter and acceptor rating books for 1847 respectively. Our tentative conclusion is that one did not necessarily have to be part of these two 'clubs' to be allowed to discount or to be considered as a decent acceptor.[20] Still, the Bank likely collected and maintained these lists of names for a legitimate reason, perhaps because it considered them to be particularly good names or counterparties that required special monitoring. Hence, we coded dummy variables for discounters and acceptors appearing on our packets and bills indicating whether any of the names show up in the rating books.

3 Historical background

3.1 Structural and institutional context of Bank discount policy in the 1840s

Bills of exchange constituted the nineteenth century's most liquid and safe money market instruments.[21] Rather than holding bills to maturity, their owners (individuals, merchant houses and many other types of firms) often liquefied the debt owed to them before maturity. In England, they could do so through banks, who frequently passed on bills with one of the so called London 'discount houses', specialized lenders akin to modern day money market funds. Starting in 1833, London discount houses in turn gained access to re-discount facilities at the Bank of England (Fletcher, 1976). This change paved the way for the Bank to become the head of the discounting pyramid, i.e. the ultimate holder of bills. It made the Bank a natural lender of last resort during financial crises and all the more so because 1833 was a crucial turning point in yet another respect. For most of its history until then, the Bank was subject to usury laws. The latter had prohibited interest rate charges on bills of exchange and other short-dated to no higher than 6%, between 1660 and 1714, and 5% between 1714 and 1833 (Temin and Voth, 2008). The usury ceiling had introduced a credit friction inhibiting the Bank's

[17] Unfortunately, there is no descriptive archival evidence on the exact rationale behind the existence of these rating books. We suspect that these books (separate ones for discounters and acceptors) contained the names of particularly long-standing business clients of the Bank.

[18] An 'introduction' meant that one of the directors of the Bank had to present the party to the Court of Directors before it was accepted as a regular discounter at the discount window.

[19] For a discussion of the use of and the rationale behind discount window limits, see Jobst and Rieder (2020).

[20] We discuss this aspect in more detail in Section 5.

[21] For a detailed description of how bills of exchange and their underlying transactions worked, see Accominotti et al. (2019).

appropriate pricing of risk, ushering in quantity restrictions in times of high demand for central bank money.[22] After 1833, the Bank increased discount rates above 5% and changed their level more frequently (Anson et al., 2017).

The 1844 Bank Charter Act also endowed the Bank with a degree of constrained discretion in its dealings with the London money market. That Act had sought to prevent the over-issuance of private banknotes that many contemporaries felt was the source of financial crises in 1825 and 1837 (Bagshaw, 1920). To that end, the Act gave the Bank of England an effective monopoly on the issue of new bank notes. With the exception of an initial £14 million fiduciary issue, new Bank notes had to be backed one-for-one with gold. To facilitate this transition, the 1844 Act split the Bank into two departments for accounting purposes. The 'Issue Department' of the Bank was to look after the note issue and the issuance of new notes was tied to the amount of gold it held in reserve. The framers of the Act believed this would ensure monetary and price stability. Meanwhile, the rest of the Bank – the 'Banking Department' – was to operate for profit just like any other private bank.[23] The Banking Department held part of the total stock of Issue Department notes as its own reserve and the growth of its deposit liabilities were not tied to gold. This gave it some flexibility to meet demands for credit. With monetary and price stability assumed to be guaranteed by the Issue Department's backing of Bank notes with gold, the Banking Department thus started to compete more aggressively with other banks in the money market. In the two years that followed the passing of the 1844 Banking Act, the Banking Department's holdings of private securities expanded markedly.

3.2 The Bank of England's Discount Office and the crisis of 1847

The Banking Department's commercial activities were spearheaded by its Discount Office located at the Bank's London headquarters on Threadneedle Street. This office was headed by the Principal of the Discount Office who, from May 1839 to July 1878, was John Green Elsey. Mr. Elsey was in charge of, on average, seven staff throughout the period. In terms of headcount, this made the Discount Office a relatively small part of the Bank at the time. Very few archival documents remain to shed light on how the Discount Office operated on a daily basis. Whether the Discount Office operated by applying a few, simple, definitive rules well-known to market participants exercised a much greater degree of discretion remains open to debate (Capie, 2002; Flandreau and Ugolini, 2013, 2014). On the one hand, most economic historians would agree that the Bank had some general rules of eligibility for bills it discounted. One of these rules had to do with the maturity of the bill, though the exact criteria are uncertain and may have changed over time. For example, a report by the Special Committee on the Discount Department dated 8 August 1844 proclaimed that "no Bill be discounted having more than 6 months to run."[24] Others reported that the Bank preferred to discount bills at around 65 days

[22] When usury rates are binding, they can introduce a credit friction preventing lenders from adequately pricing risk: higher risk projects cannot get funding, although demand for more loans at increased rates exists. Hence, usury rates accelerate the advent of quantity rationing in credit markets as described by Stiglitz and Weiss (1981).

[23] At this time, the Bank of England was still owned by private sector shareholders.

[24] See Bank of England Archive, BoE G15/62.

and did not deal in bills of more than 95 days' tenor (Scammell, 1968). At the same time, there is anecdotal archival evidence suggesting that discretion played a role in discounting decisions. For example, the diaries of Bonamy Dobree, Deputy Governor of the Bank at the time of the 1857 financial crisis imply the exercise of a considerable amount of judgment rather than the mechanistic application of a rule: he regularly met with the Principal of the Discount Officer to discuss the quality of submitted bills (Anson et al., 2017). Even if discretion was effectively exercised in discount operations, it is an open question at what level within the organization it was wielded. While we know that senior members of the Bank's Board of Directors through the so called 'Committee of Daily Waiting' monitored the Bank's discounts each day, they seem to have done so mostly *ex post*, after the Discount Office had made operational decisions.

Financial crises, however, functioned as external constraints which certainly limited the scope of discretion the Discount Office could exercise. The crisis of 1847 here proves to be a case in point. The crisis of 1847 occurred in two phases (Evans, 1848; Ward-Perkins, 1950; Dornbusch and Frenkel, 1984; Campbell, 2014). The first phase, which peaked in April 1847, was headlined by the unwinding of a speculative boom in railway shares, in part fueled by the Bank's aggressive discount policy in the preceding years. Together with the poor harvests of 1845-6, the railway mania had left the economy and investors fragile while gold reserves drained abroad. Throughout early spring, the Bank continued to supply funds to the market as the demand for central bank liquidity gradually increased. When it became known that the government intended to take on new loans in the context of the Poor Relief Bill 1847 to fight the consequences of the Irish potatoe blight, the little remaining confidence in the financial market faded (Read, 2016). By mid-April, the Banking Department's reserve of notes had fallen dangerously low and both the Bank and the public woke up to the implications. The Bank reacted strongly by raising its discount rate, cut back on its purchases as well as its lending to the market and sold government bonds (Rieder et al., 2020). This sudden change in policy led to a temporary panic, which was partially cured when higher rates led to inflows of gold.

The second serious sting in the tail came later in the year. As the bad harvests of 1845-6 were followed by a better-than-expected harvest in 1847, the price of corn fell sharply over the summer. Many individuals and companies had speculated on prices remaining high and so began to suffer heavy losses. As a result there was a string of commercial failures with a knock-on effect to exposed lenders in the money market – several discount houses and provincial banks were forced to shut their doors (Evans, 1848; King, 1936). The renewed financial distress led to an increasing scramble for safety and rates in the money market shot up to unprecedented levels. At this point, the limits imposed on the Bank's discretion by the 1844 Charter Act began to bind again, constraining the Banking Department, and thus also the Discount Office within in. As the crisis deepened, and the demand for discounts surged, the Banking Department's note reserve started to dry up once again. The looming possibility that the Discount Office might no longer be able to purchase bills caused renewed panic in money markets.

Eventually, leading firms in the City sent a deputation to the Government to ask that the Act be suspended.

The Prime Minister and the Chancellor reacted by writing a letter to the Bank's Governor on 25 October 1847 allowing the Bank to further expand its balance sheet and indemnifying the Bank from any legal breach of the 1844 Act. In theory, this move allowed the Issue Department to print additional notes without bullion backing, which could be given to the Banking Department in exchange for some of its bills and securities. The Discount Office could then have drawn on these notes to discount additional bills. The publication of the letter, however, almost immediately abated the crisis and the Bank was never forced to actually breach the legal limit on its note issue. The panic of 1847 subsequently offered useful lessons for the crises of 1857 and 1866. During these later financial crises, the government announced the suspension of the reserve requirement rapidly after financial market turmoil had begun, quickly easing the pressure on the money market (Hughes, 1956; Flandreau and Ugolini, 2013). Arguably, suspension even became an *ex ante* expectation in those and later financial crises in the nineteenth century.

4 Descriptive evidence and empirical strategy

4.1 Patterns in purchasing decisions during the crisis year of 1847

We begin the exploration of our purchase-level data set by looking at descriptive, aggregate patterns in the Bank's decisions to accept or to refuse discount window applications. Figure 1 shows that one third of the packets submitted to the discount window in 1847 had at least one of their bills rejected (30%). Only a small fraction of all packets, however, were entirely rejected (7%), while the bulk of rejections was partial (23%). Figure 1 testifies to the fact that discounter identity alone cannot be a sufficient explanation for bill rejections. Had it been the sole driver of the Bank's purchasing decisions, packets should have always either been entirely rejected or accepted in full. It is important to emphasize, however, what *cannot* be concluded on the basis of Figure 1. First, the conclusion that discounter identity cannot be the whole story behind rejections does not necessarily mean that discounter identity does not matter at all. It is possible, and indeed plausible, to imagine that both the identity of the discounter and asset quality played a role in the Discount Office's decisions. Second, Figure 1 does not necessarily mean that decisions to (partially) reject packets were made systematically on the basis of bill characteristics. The Bank might have rejected bills or entire packets in moments of excess demand, proceeding more or less randomly in its decisions to refuse credit.

We also compare the dynamics at the discount window in crisis weeks and normal weeks. Figure 2 draws on the same data used for Figure 1 but splits the population of purchase decisions into crisis and normal times. Figure 2 illustrates that both the share of packets that get entirely rejected and the share of packets which receive partial rejections are substantially higher in crisis weeks than during times of relative calm. In the appendix, we reproduce Figures 1 and 2 by drawing on our packet-level random sample (c.f. Figures 3 and 4). We find that our random sample exhibits a virtually identical distribution of packets in terms of rejections

Figure 1: Packets submitted to the Bank of England's discount window in 1847 (N=9,206)

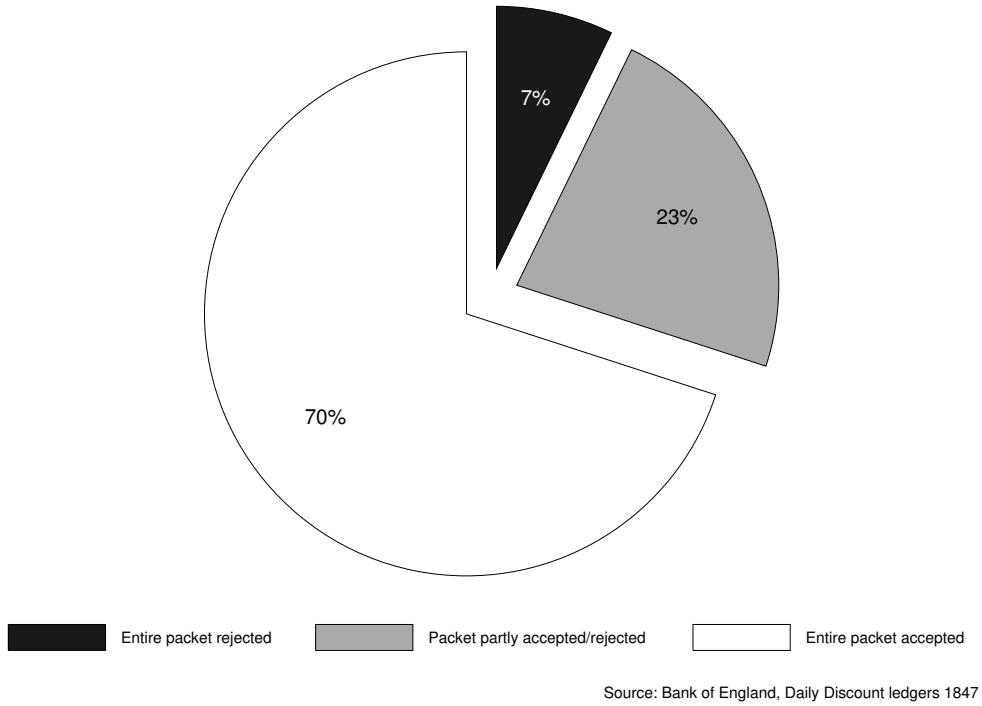
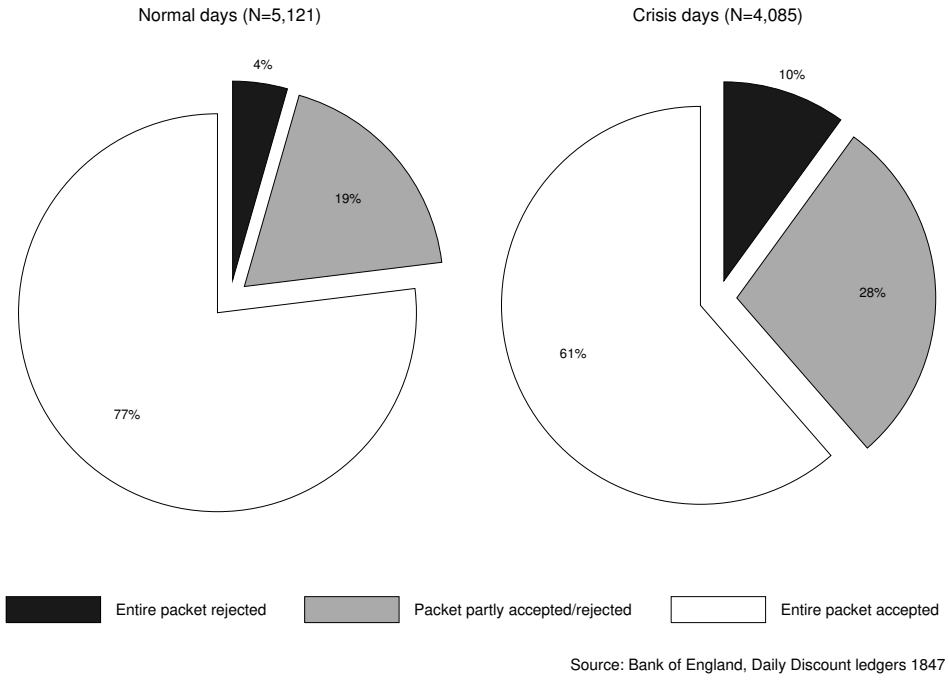


Figure 2: Packets submitted to the Bank of England's discount window in 1847 (N=9,206; 119 crisis days out of 310 days)



and accepted tenders. This observation makes us confident that our randomized sample is representative of the discount window decisions reflected in the total population of submitted packets in 1847.

Figures 5 and 6 in the appendix follow the same approach, but look at the underlying number of and amount on rejected bills from the packets. Perhaps unsurprisingly, the Bank discounted more bills and a higher total amount on average crisis days than it does on average normal days. Yet, relative to normal times, the Bank rejects more packets (Figure 2), more bills (Figure 5) and higher amounts of the total amount requested (Figure 6) during crisis days. These findings are confirmed by more formal statistical mean equality tests in Table 5 in the appendix. Finally, Figure 5 and 6 suggest that the percentage share of bills rejected is a good proxy for the percentage share of monetary value rejected by the Bank. This observation implies that the individual bills all appear to have been more or less similar in terms of size. In the appendix, we provide an additional monthly break-down of packet and bill rejections (Figures 7 to 9). The relative amount of rejections varies throughout the year but nicely follows the pattern of crisis weeks in Section 2.

4.2 Econometric approach

The preceding series of descriptive evidence leaves no doubt that crisis weeks (or days falling into crisis weeks) were special: on average, loan applications had a higher probability of being rejected in times of financial distress. This observation hints at a causal link between the Bank's supply side constraint (the Banking Department's notes reserve position) and the higher amount of rejections in crisis weeks. Corroborating earlier work by Bignon et al. (2012), our descriptive evidence suggests that the Discount Office was effectively rationing central bank money when its note reserve was in danger of drying up. This insight is crucial for our empirical modeling strategy in this paper. Under the assumption that the Bank's behavioral shift during crisis weeks directly derived from its acute supply constraint, potential changes in the drivers of asset purchasing decisions are unlikely to merely represent spurious outgrows of a differential demand structure during crisis weeks.[25] In order to address remaining spurious correlation concerns, we also employ a variety of fixed effects at different levels to test for the robustness of our findings. To invalidate our comparison exercise, residual omitted variable bias would need to affect our estimates in a systematically different way in normal vs. crisis times even after the inclusion of fixed effects.

Our two random samples constitute pooled cross sections. The first sample is at the packet-level, while the second unpacks the packets and thus contains bill-level data. For the packet-level sample, we estimate the following model by OLS:

[25] In a companion paper (Rieder et al., 2020), we establish a causal relationship between the central bank's supply constraint and credit rationing in 1847 by exploiting a regression discontinuity approach in time.

$$Y_{p,t} = \mathbf{\Psi'Day}_t + \mathbf{\Omega'P}_{p,t} + \mathbf{\Phi'D}_{p,t} + \gamma_t + u_{p,t} \tag{1}$$

where $Y_{p,t}$ is the packet-level outcome variable which takes one of three forms: 1) a dummy variable which switches on if at least one bill from the packet was rejected by the Bank (*rej*), 2) the share of rejected bills relative to total bills in the packet computed in terms of the bills' Sterling value (*rej_shareval*), or 3) the share of rejected bills relative to total bills in the packet computed in terms of the number of bills inside the packet (*rej_sharebills*); $\mathbf{Day}_t$ represents a vector of day-level covariates that is identical for packets submitted on the same day; $\mathbf{P}_{p,t}$ is a vector of packet-level independent variables; $\mathbf{D}_{p,t}$ stands for a vector of discounter characteristics; γ_t represents day fixed effects capturing call date-specific aggregate time trends and $u_{p,t}$ is the packet-specific error term.

We adapt Model 1 to suit the bill-level data in the following way:

$$Y_{b,t} = \mathbf{\Psi'Day}_t + \mathbf{\Omega'P}_{p,t} + \mathbf{\Phi'D}_{p,t} + \mathbf{\Lambda'B}_{b,t} + \gamma_{t/p} + u_{b,t} \tag{2}$$

where $Y_{b,t}$ now always represents an indicator variable taking the value of one if the bill was rejected by the Bank (*rej_bill*); $\mathbf{Day}_t$, $\mathbf{P}_{p,t}$ and $\mathbf{D}_{p,t}$ remain as defined before; $\mathbf{B}_{b,t}$ adds a vector of bill-level characteristics; $\gamma_{t/p}$ now represents date or packet (i.e. discounter-date) fixed effects and $u_{b,t}$ is the bill-specific error term.

In addition to OLS, we also estimate our Models 1 and 2 by Logit and Tobit where appropriate to test the robustness of our results to non-linear specifications.[26] To check whether coefficients differ in normal vs. crisis weeks, we proceed in two steps. First, we re-estimate Models 1 and 2 by splitting the respective samples into normal and crisis weeks. We report these results for completeness to convey a visual impression of potential changes in the estimates. Second, we again estimate Models 1 and 2 using the full sample, but we now add interaction terms of our independent variables with a dummy for crisis weeks. This second step enables us to evaluate whether potential differences in the coefficients are statistically significant when comparing normal times to crisis windows.

Tables 6 and 7 in the appendix report the summary statistics for our packet-level and bill-level samples. Throughout this paper, we cluster all standard errors for coefficients at the day-level to correct for potential intra-date serial correlation of our observations. We also normalize all continuous covariates before running the regressions to make their coefficients more comparable. Hence, the coefficients on continuous independent variables represent the marginal effect of a one standard deviation increase in the regressors.

[26] In contrast to the other estimates, we report these results in the Appendix (c.f. Tables 10 and 12).

5 Results

5.1 Packet-level regressions

In Table 1, we report our full sample packet-level OLS regressions estimates. The first three columns of Table 1 show regression results for the binary dummy (*rej*, column 1), the share of rejected bills relative to total bills in the packet computed in terms of the bills' Sterling value (*rej_shareval*, column 2) and the share of rejected bills relative to total bills in the packet computed in terms of the number of bills inside the packet (*rej_sharebills*, column 3). Columns 4-6 in Table 1 repeat the regressions from columns 1-3 with date fixed effects. In the case of negative coefficients, an increase in the corresponding covariates either reduces the probability that at least one bill from the packet gets rejected (for *rej*) or diminishes the share of bills rejected in the packet (for *rej_shareval* and *rej_sharebills*). Positive coefficients in turn have the inverse interpretation.

Our full sample regressions reveal that several covariates are highly statistical significant *ceteris paribus* predictors of packet-level outcomes. Date-specific characteristics are only available in the specifications without date fixed effects. While the total number of bills submitted on a given day displays a consistent and strongly significant positive correlation with our rejection measures, the total value of the bills submitted does not have any residual predictive power. Based on the descriptive patterns shown in Section 4, however, we suspect that the correlation between the total number of bills and higher rejection rates is spurious: on average, more bills were submitted and rejected on crisis days. Hence, our preferred packet-level specifications (columns 4-6) include date fixed effects to purge our estimates from other potential spurious correlations deriving from day-specific features.

Quantitative packet characteristics (chronological rank, value rank and total packet value) do not seem to matter for the Bank's discounting decisions, with the exception of a packet's total number of bills. The number of bills in a packet is associated with an increase in the probability of at least one rejection. Yet, the coefficient switches sign when we draw on our share outcome variables instead and becomes insignificant in the specifications with date fixed effects. This finding is intuitive: a packet with many bills will likely have a higher chance of containing at least one bill deemed unacceptable by the Bank than a very small packet. In contrast, the share of rejected bills (in terms of numbers and amounts) in a packet can be expected to be less sensitive to packet size.

Packets highlighted by a *withdrawn*, *returned* or *maturity* remark in the Daily Discount ledgers experienced an economically and statistically highly significant increase in the probability of rejection as measured by our various outcome variables. These coefficients are partly mechanical because the Daily Discount ledgers count bills that were withdrawn or returned automatically as part of the rejected bills. Although we are aware of the fact that this quasi-automatic correlation induces econometric concerns, the exclusion of the covariates from the model is equally problematic as it would likely result in omitted variable bias. An alternative option is to

Table 1: Packet-level regressions (full sample)

VARIABLES	(1) rej	(2) rej_shareval	(3) rej_sharebills	(4) rej	(5) rej_shareval	(6) rej_sharebills
Total bills on day (ln)	0.0719***	0.0500***	0.0430***			
	(0.0230)	(0.0159)	(0.0146)			
Total value on day (ln)	-0.0264	-0.0222	-0.0158			
	(0.0233)	(0.0166)	(0.0151)			
Packet's rank on day (chron.)	-0.0105	0.0037	0.0012	-0.0185	-0.0012	-0.0042
	(0.0147)	(0.0094)	(0.0087)	(0.0196)	(0.0132)	(0.0122)
Packet's rank on day (value)	-0.0091	-0.0089	-0.0147	-0.0434	-0.0492	-0.0388
	(0.0387)	(0.0267)	(0.0247)	(0.0583)	(0.0417)	(0.0403)
Packet's total value (ln)	-0.0383	-0.0171	-0.0054	-0.0124	0.0186	0.0151
	(0.0434)	(0.0317)	(0.0301)	(0.0661)	(0.0486)	(0.0478)
Packet's total number of bills (ln)	0.0633***	-0.0204*	-0.0267**	0.0730***	-0.0134	-0.0247
	(0.0186)	(0.0122)	(0.0121)	(0.0246)	(0.0176)	(0.0176)
Packet with *withdrawn* remark	0.7954***	0.7707***	0.7963***	0.6564***	0.6753***	0.6997***
	(0.0413)	(0.0990)	(0.0915)	(0.1065)	(0.1383)	(0.1245)
Packet with *returned* remark	0.7123***	0.9042***	0.9063***	0.7222***	0.9024***	0.9110***
	(0.0564)	(0.0291)	(0.0273)	(0.1105)	(0.0455)	(0.0458)
Packet with *maturity* remark	0.6813***	0.4086***	0.3857***	0.6906***	0.4078***	0.3887***
	(0.0349)	(0.0501)	(0.0529)	(0.0857)	(0.0988)	(0.1125)
Discounter has DO account	-0.0604	-0.0665**	-0.0630**	-0.0112	-0.0318	-0.0318
	(0.0444)	(0.0309)	(0.0281)	(0.0628)	(0.0456)	(0.0404)
Discounter in discounter rating book	0.0634**	0.0348*	0.0378**	0.0566	0.0211	0.0273
	(0.0310)	(0.0198)	(0.0187)	(0.0421)	(0.0276)	(0.0263)
Discounter in acceptor rating book	-0.0593	-0.0160	-0.0361	-0.0592	-0.0093	-0.0344
	(0.0460)	(0.0320)	(0.0274)	(0.0688)	(0.0449)	(0.0435)
Discounter is banker	-0.0627	-0.0163	-0.0137	-0.0374	0.0119	0.0174
	(0.0648)	(0.0258)	(0.0230)	(0.0905)	(0.0450)	(0.0387)
Discounter is bill broker	0.1764**	0.0816	0.0847*	0.2505**	0.1275*	0.1264*
	(0.0853)	(0.0543)	(0.0511)	(0.1048)	(0.0677)	(0.0704)
Discounter is top discounter	-0.1869**	-0.0754	-0.0673	-0.2401**	-0.1246*	-0.0958
	(0.0943)	(0.0485)	(0.0464)	(0.1115)	(0.0673)	(0.0677)
Discounter is top acceptor	-0.0544	0.0452	0.0329	0.1001	0.1493*	0.1308*
	(0.0924)	(0.0626)	(0.0524)	(0.1173)	(0.0851)	(0.0742)
Discounter has corn-related trade	0.3253***	0.3108***	0.2961***	0.2864*	0.2957**	0.2848**
	(0.1102)	(0.0892)	(0.0849)	(0.1520)	(0.1216)	(0.1173)
Discounter failed	0.1714***	0.0731***	0.0665**	0.1608***	0.0853**	0.0713*
	(0.0405)	(0.0259)	(0.0260)	(0.0596)	(0.0366)	(0.0384)
Observations (= number of packets)	1,000	1,000	1,000	1,000	1,000	1,000
R-squared	0.1509	0.2189	0.2355	0.4249	0.4470	0.4488
Date FE	No	No	No	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes	Yes	Yes	Yes

Clustered standard errors (date) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

exclude the corresponding packets from the estimation sample. In Table 8 in the appendix we thus re-estimate our packet-level regressions dropping packets with a *withdrawn*, *returned* or *maturity* remark. The coefficients on our other covariates remain very much stable in terms of sign, size or statistical significance.

Turning to discounter characteristics, we find that at least three identity markers are consistently significant predictors of the Bank's rejection decisions. First, the Bank generally appears to have disliked submissions by bill brokers in 1847. Packets presented by bill brokers display a 25 percentage points higher probability of getting at least one bill rejected. The corresponding coefficient is somewhat lower when we consider share-based outcomes, but both the sign and the significance hold up. Since we control for various dimensions of packet size, this result should not be spuriously driven by the fact that bill brokers turned in very large packets, both in terms of size and numbers of bills. Our findings may thus foreshadow the animosity the Bank began to display more overtly following the 1857 crisis. Accused of fueling the crisis due to their reckless lending practices, brokers were excluded from the Bank's re-discounting facilities outside crisis windows (Calomiris, 2010).

Second, in 1847 the Bank appears to have discriminated against discounters who operated a corn-related trade. This result corroborates the prominence of corn speculation in the narrative of the 1847 crisis (c.f. Section 3). The finding suggests that the Bank generally considered the solvency of discounters as important when taking asset purchasing decisions is reassuring: given the joint liability rules applicable to bills of exchange, the discounter's creditworthiness should have mattered for a packet's quality. Expected solvency concerns might also be driving the consistently high statistical significance of the third identity marker that stands out. Discounters who failed later on in 1847 or 1848 experienced higher rejection rates. Due to potential endogeneity, however, this coefficient should be taken with a pinch of salt. It might well be that the Bank's sweeping rejections during the crisis of 1847 partly caused some discounters to fail later on. We re-evaluate this reverse causality worry below when discussing our split sample packet-level regressions and our bill-level estimates.

Our packet-level estimates also provide some, albeit less unambiguous, evidence that top discounters' packets were more likely to pass the Bank's bill screening process unscathed. The reverse seems to be true for top acceptors. The former result could suggest that the Discount Office had some very large discounting clients it particularly catered to during the nineteenth century. If this preferential treatment was driven by the Bank's behavior in crisis weeks, it may be interpreted as a proto-version of a "too-big-too-fail" attitude. We will come back to this hypothesis below. The Bank's aversion to top acceptors in turn may be connected to the Bank's sophisticated monitoring system as documented by Flandreau and Ugolini (2013, 2014). Since Discount Office clerks meticulously transcribed the names of the acceptor on each submitted bill, the Bank must have had a good overview of money market participants' individual exposures. Discounters who also accepted a large amount of bills amassed an equally large amount of contingent liabilities. Hence, if the Bank cared about discounters' solvency, discounters who acted as top acceptors in the money market may have represented a less attractive counterparty, particularly so during crisis times. Finally, the insignificance of other discounter identity markers is also enticing. While the Bank may have had a special relationship to top discounters, our

Table 2: Packet-level regressions: difference crisis vs. normal times (only interacted terms displayed)

VARIABLES	(1) rej	(2) rej_shareval	(3) rej_sharebills
Δ Packet's rank on day (chron.)	-0.0077	-0.0181	-0.0213
	(0.0405)	(0.0271)	(0.0255)
Δ Packet's rank on day (value)	-0.0563	-0.0198	-0.0132
	(0.1226)	(0.0838)	(0.0780)
Δ Packet's total value (ln)	0.0839	0.0384	0.0347
	(0.1362)	(0.0940)	(0.0900)
Δ Packet's total number of bills (ln)	0.0018	-0.0070	-0.0179
	(0.0493)	(0.0343)	(0.0345)
Δ Packet with *withdrawn* remark	-0.4173***	-0.3279**	-0.2882**
	(0.1248)	(0.1543)	(0.1412)
Δ Discounter has DO account	0.0272	0.0934	0.0738
	(0.1235)	(0.0887)	(0.0787)
Δ Discounter in discounter rating book	-0.0606	0.0210	0.0123
	(0.0887)	(0.0540)	(0.0515)
Δ Discounter in acceptor rating book	0.0858	-0.0304	-0.0444
	(0.1356)	(0.0838)	(0.0816)
Δ Discounter is banker	-0.3402*	-0.1910**	-0.1593*
	(0.2001)	(0.0921)	(0.0815)
Δ Discounter is bill broker	0.2728	0.2096**	0.2354**
	(0.2239)	(0.1036)	(0.1060)
Δ Discounter is top discounter	-0.3264	-0.1368	-0.1319
	(0.2448)	(0.1134)	(0.1137)
Δ Discounter is top acceptor	0.3720*	0.2880**	0.2667**
	(0.2004)	(0.1237)	(0.1119)
Δ Discounter has corn-related trade	-0.1776	0.0584	0.0667
	(0.3120)	(0.2569)	(0.2480)
Δ Discounter failed	0.0522	0.0041	-0.0085
	(0.1208)	(0.0738)	(0.0752)
Observations (= number of packets)	1,000	1,000	1,000
R-squared	0.4330	0.4542	0.4566
Date FE	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes

Clustered standard errors (date) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

full sample packet-level estimates reveal that the Bank did not generally engage in what could be termed "club" or "relationship" lending. Once the data are purged from date-specific trends, the Discount Office does not seem to have granted preferential treatment to discounters who maintained a current account with the Bank, nor does it appear to have discriminated against or in favor of discounters who figured in the rating book or the acceptor book.

The findings in Table 1 represent full sample results at the packet-level. As such they cannot answer the question whether the determinants of the Bank's purchasing decisions changed during crises times. We approach this question by estimating an augmented version of Model 1 which includes interaction terms of our independent variables with a dummy for crisis weeks. We display the coefficients on the interaction terms in Table 2. For completeness, we also report the corresponding split sample packet-level regressions for crisis and normal weeks in Table 9 in the appendix. To check for robustness, we also re-run all split sample regressions using non-linear Logit and Tobit models to account for the binary (0 or 1) and share (between 0 and 1) form of our dependent variables. We display these results in Table 10 in the appendix.

Table 2 provides a series of insights. For one, the interaction terms on the dummy for the *returned* remark and the dummy for the *maturity* remark drop out in Table 2, because neither indicator variable ever turns on for observations from normal weeks. The Discount Office never returned a packet in normal weeks, nor did it declare any packets (partly) unsuitable for maturity reasons outside crisis windows in 1847 – at least as far as our sample is concerned. This result in itself corroborates our hypothesis that the Banking Department may have operated on different terms when the situation of its notes reserve turned dire.[27] At the same time, judging by the coefficient on the interaction term with the *withdrawn* dummy, discounters seemingly withdrew substantially fewer bills from the discount window in crisis times. Discounters normally withdrew bills if they perceived the interest rate quote they had received from the Discount Office as too high (Rieder et al., 2020). Hence, lower withdrawal rates in crisis weeks would seem to reflect a generally higher willingness to pay elevated interest rates at times when money markets were drying up.

Moreover, several coefficients on the interacted terms are economically and statistically significant. Some discounter identity markers indeed seem to have mattered differentially in crisis and normal periods. First, in crisis weeks, banks appear to have experienced significantly lower rejection probabilities and rates. For example, compared to normal weeks, a banker was 34% less likely to see at least one bill rejected when she/he submitted a packet for discount. Rather than considering commercial banks as competitors, the Bank apparently increased its liquidity supply to banks during the crisis of 1847. This result thus furnishes another piece of the historical mosaic that represents the Bank of England's gradual evolution into a lender of last resort (Ziegler, 1990; Bignon et al., 2012; Goodhart, 2018). Second, however, the Bank does not appear to have provided these emergency services to all financial institutions in the money market indiscriminately. The bill broker dummy is associated with a more than 20% increase in the rejection rates during times of distress. While bill brokers seem to have

[27] For more details on the role of returned packets/bills and the maturity remark in the context of the 1847 crisis, c.f. Rieder et al. (2020).

been generally unwelcome guests at the Discount Office in 1847, the Bank pulled down its discount window even further in crisis weeks.

Third, the coefficients on interaction terms further corroborate the hypothesis that the Bank may have regarded discounters who acted as top acceptors in the money market as more risky counterparties during crisis windows. Top acceptors' chances of seeing their packet (partly) rejected increased considerably by about 37% for the binary specification and between 27% to 28% for the two share outcomes. In fact, as is evident from Table 9 in the appendix, the full sample result for the top acceptor dummy discussed above is entirely due to higher rejection rates in crisis times. In contrast, the "too-big-too-fail" hypothesis does not seem to hold up as top discounters fared neither worse, nor better during crisis weeks. Finally, neither the interaction with the corn trade dummy, nor the interaction with the indicator variable for failure result in statistically significant coefficients. While the Bank was generally cautious about these discounter types, it does not seem to have treated them any worse in times of heightened distress. As a corollary, discounters who failed later on were unlikely to do so only because they received a complete rebuff during crisis weeks. Rather than representing a covariate that is fully endogenous to the Bank's crisis response to 1847, the failure dummy seems to constitute a proxy for generally weak counterparties.

5.2 Bill-level regressions

The packet-level results grant a first look into the "black box" of the Bank's purchasing decisions. Yet, the results discussed above do not allow for a true *ceteris paribus* interpretation as the packet-level estimates do not control for the characteristics of bills included in the packets. To integrate these characteristics into our regression framework, we take our analysis to the bill-level by unpacking a random sample of submitted packets. An alternative option would be to compute average or median bill-level characteristics for each packet. This "averaging" approach, however, is unlikely to adequately reflect the Discount Office's dealing with discount window applications. The clerks took decisions regarding individual bills, rather than entire packets, as evidenced by the detailed ledger system, in particular the List of Bills Rejected ledger.

We display our bill-level results for the full sample regressions in Table 3. The outcome variable for all our bill-level regressions is binary, flagging a rejected bill with a value of 1. Columns 1 and 2 of Table 3 summarize the full set of "horse race" results pitting discounter characteristics against bill-level variables without and with date fixed effects. Column 3 in turn displays the coefficients after the inclusion of packet fixed effects. As a corollary, all discounter and date specific covariates drop out and the corresponding coefficients are missing in column 3. Thus, the coefficients on bill-level characteristics in column 3 are purged from time-invariant observable characteristics at the discounter-date level. By fixing discounter-date covariates we can shine a direct spotlight on the question which rules/strategy the Bank of England applied when deciding whether to discount or reject a given bill of exchange.

Table 3: Bill-level regressions (full sample)

VARIABLES	(1) rej_bill	(2) rej_bill	(3) rej_bill
Total bills on day (ln)	-0.0050		
	(0.0234)		
Total value on day (ln)	0.0097		
	(0.0231)		
Packet's rank on day (chron.)	0.0170	0.0412	
	(0.0186)	(0.0258)	
Packet's rank on day (value)	0.0514	0.1347	
	(0.0547)	(0.1115)	
Packets's total value (ln)	-0.1348	-0.2130	
	(0.0831)	(0.1552)	
Packets's total number of bills (ln)	0.0185	-0.0590	
	(0.0254)	(0.0403)	
Discounter in discounter rating book	0.1315***	0.2318***	
	(0.0437)	(0.0792)	
Discounter in acceptor rating book	-0.1390**	-0.2219**	
	(0.0662)	(0.1105)	
Discounter is banker	0.0080	-0.0465	
	(0.0719)	(0.1504)	
Discounter is bill broker	0.0015	0.0420	
	(0.0284)	(0.0962)	
Discounter is top discounter	0.0684	-0.1933	
	(0.1122)	(0.1552)	
Discounter is top acceptor	-0.0765		
	(0.0517)		
Discounter has corn-related trade	0.2530***	0.2048	
	(0.0541)	(0.1330)	
Discounter failed	0.1204*	0.0203	
	(0.0651)	(0.0688)	
Acceptor in discounter rating book	-0.0246	-0.0056	0.0070
	(0.0245)	(0.0224)	(0.0216)
Acceptor in acceptor rating book	0.0155	0.0146	0.0099
	(0.0283)	(0.0324)	(0.0335)
Bill is promissory note	-0.0966***	-0.0147	-0.0149
	(0.0326)	(0.0174)	(0.0097)
Acceptor is Treasury	-0.0340	0.0144	-0.0031
	(0.0463)	(0.0579)	(0.0468)
Acceptor is Bank of England director	-0.0483*	-0.0757**	-0.0391**
	(0.0244)	(0.0302)	(0.0183)
Acceptor is banker	-0.0735***	-0.0353	-0.0493**
	(0.0230)	(0.0216)	(0.0219)
Acceptor is bill broker	-0.2069***	-0.0735	-0.0895
	(0.0602)	(0.0989)	(0.0900)
Acceptor is top discounter	-0.0025	-0.0495	-0.0074
	(0.0431)	(0.0580)	(0.0516)
Acceptor is top acceptor	0.0242	0.0216	0.0392
	(0.0268)	(0.0343)	(0.0347)
Acceptor has corn-related trade	-0.0402	-0.1513	-0.1305
	(0.0672)	(0.1389)	(0.1437)
Acceptor failed	-0.1262*	-0.0874	-0.0441
	(0.0737)	(0.0697)	(0.0572)
Acceptor based in London	-0.6473***	-0.5629***	-0.5336***
	(0.1009)	(0.1110)	(0.1158)
Amount on bill (ln)	0.0276*	0.0236	0.0257*
	(0.0140)	(0.0152)	(0.0153)
Days to maturity of bill (ln)	0.0228*	0.0301**	0.0215**
	(0.0126)	(0.0115)	(0.0099)
Observations	863	863	863
R-squared	0.3827	0.5073	0.5482
Fixed effects	No	Date	Packet
Clustered SE	Yes	Yes	Yes

Clustered standard errors (date) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

As explained in Section 2 above, we can only sample bills from 25 August 1847 onward. During our bill-level sample period from 25 August 1847 to 31 December 1847, no packets were highlighted by a *returned*, *withdrawn* or *maturity* remark. These remarks only appear in the spring phase of the crisis.[28] Hence, the corresponding indicator variables do not feature in our bill-level regressions. Also, our bill-level random sample does not contain any bills submitted by drawing account (DO) customers which explains the absence of this regressor in our bill-level result tables. Finally, due to collinearity, the top acceptor dummy drops out of our regressions with date fixed effects displayed in column 2 of Table 3, in addition to the date-specific variables.

The findings of our bill-level analysis can be summarized as follows. In contrast to our full sample packet-level results displayed in Table 1, the bill-level regressions suggest that the dummies for entries in the discounter and acceptor rating books constitute significant predictors even after we control for date fixed effects. Discounters listed in the discounter rating book appear to have experienced higher rejection probabilities at the bill-level than discounters whose names did not figure in this list. The reverse holds true for discounters listed in the acceptor rating book. Due to the lack of additional qualitative and quantitative evidence on the role of the rating books in the daily dealings of the Bank's Discount Office, we can only speculate about how to interpret these coefficients. One explanation for the higher rejection rates experienced by counterparties listed in the discounter rating book may be related to credit limits. Each discounter in the rating book had a specific credit limit assigned to his/her interactions with the Bank. Rating book discounters likely interacted with the Bank comparatively often and may have benefited from preferential treatment (i.e. less intensive screening) as long as their demand for central bank money remained within the pre-defined limits. Once credit limit allowances were reached, however, the Bank may have restricted its liquidity supply to this group of discounters.[29] Given the money market turmoil in 1847, regular discounters may have consistently operated close to their credit limits. While discounters without entries in the discounter rating book may have only engaged with the Discount Office on a more *ad hoc* basis, they might have also been granted central bank liquidity more readily in case of need. In turn, discounters whose names were listed in the acceptor rating book may have been less likely to see their bills rejected precisely because – as counterparties specialized in accepting bills rather than discounting them – they rarely exceeded discounting limits. We plan to further explore the credit limit system maintained by the Bank of England in future work to shed more light on the plausibility of this interpretation, including an investigation whether and under which circumstances discounters exceeded their credit limits and which consequences, if any, these transgressions triggered.

Unlike with our full sample packet-level regressions, we find no evidence that bill brokers or counterparties with top discounter status generally faced differential rejection rates once we control for bill-level characteristics. Similar to the packet-level results, however, the full sample bill-level regressions suggest that discounters who failed later on and who had corn-related trades were confronted with higher probabilities of rejection. Yet, an

[28] As discussed by Rieder et al. (2020), the Bank's reserve position forced it to curtail its liquidity supply in spring 1847. The Bank returned packets and discriminated against longer maturities to implement credit rationing. We hypothesize that the Bank may well have resorted to these practices again in fall 1847, had the government not provided the indemnity in late October 1847.

[29] Jobst and Rieder (2020) suggest that central banks in the past may have operated credit limit systems to enforce an early prototype of liquidity regulation.

important caveat is that neither coefficient remains precisely estimated after the inclusion of date fixed effects.

Overall, the results of our bill-level regressions in Table 3 confirm that discounter identity mattered for the Bank's purchasing decisions – even after we control for bill-level characteristics. In other words, our econometric evidence suggests that the Bank's discount window was not entirely made of "frosted glass", or alternatively, that the discount window was certainly raised more than "just a few inches". The Bank cared about the identity of the discounters it interacted with, over and beyond the other characteristics of the bills these discounters submitted. In this precise sense, the "raised eyebrow" metaphor appears to capture the Bank's strategy in purchasing decisions more adequately than the idea that the Discount Office simply looked for good quality assets. Of course, in the context of a money market dominated by bills of exchange governed according to the joint liability rule (Santarosa, 2015), the discounter's identity must matter precisely because it is a direct determinant of asset quality. In this second sense, the boundaries between the "frosted glass" and the "raised eyebrow" metaphors necessarily blur.

Taking our models to the bill-level yields a complementary value added: the possibility of disentangling the *ceteris paribus* role of bill characteristics in the Discount Office's screening process after fixing both date and discounter identity. Column 3 in Table 3 suggests that the Bank carefully reviewed some properties of each bill it discounted, no matter who presented it to the discount window, and when. For one, bill amount and days to maturity both bear a positive sign and constitute statistically significant predictors of rejections. A one standard deviation increase in the natural logarithm of the bill's amount and the days to maturity raised the rejection probability by around 3% and 2% respectively. Expressed in more tangible units, however, these marginal effects seem to be economically rather small. For example, a thousand pound Sterling increase in the amount of a submitted bill results in a 4% higher probability of rejection (only 10% of the bills in our sample bear amounts higher than a thousand pound Sterling, with an average amount of £480). At the same time, an additional 50 days to maturity increases the probability of rejection by about 2.5% (the average days to maturity were 56). Our interpretation of the time to maturity variable is that the Bank generally preferred shorter-term maturities as these would bind reserves only for a limited time (until the bill was paid). In contrast, the packet-level *maturity* remark discussed above likely flagged packets containing bills whose remaining maturity would normally not trigger concerns on behalf of the Bank but which exceeded the lower maximum threshold the Bank was prepared to accept during weeks of elevated market distress - when the note reserve was rapidly drying up. Drawing on contemporary accounts from the *The Economist*, evidence marshalled by Bignon et al. (2012) corroborates this hypothesis. The authors argue that the crisis of 1847 was coined by several episodes during which the Bank was unwilling to provide liquidity except in exchange for bills with very short (and much shorter than usual) remaining maturities. Thus, the maturity of bills likely played a dual role in the crisis year of 1847.

Our dummy variable flagging whether a bill's acceptor was based in London turns out to represent the most important bill-level determinant of rejection – both in terms of size and in terms of statistical significance.

According to our full sample estimates, bills accepted by firms/individuals located in London had a more than 50% lower chance of being refused. Although a peek into the List of Bills Rejected ledger shows that bills accepted in London could also be rejected, a large fraction of rejected bills had indeed been accepted elsewhere. In contrast, virtually all the acceptors figuring on bills eventually purchased by the Bank were located in London. This preference for London acceptors might be connected to the fact that we only rely on data from the Bank's London headquarters. The Bank of England may have preferred that discounters submit their bills accepted outside London directly to the relevant local Bank branch: local branch staff may have had a comparative advantage in gauging whether the name was of (in)sufficient quality and the transaction costs of collecting payment at maturity were likely lower.[30]

Besides London acceptors, the Bank appears to have developed a particular taste for bills accepted by bankers. The statistically significant 5% reduction in the probability of rejection indicated by the coefficient on our banker dummy suggests that the Discount Office – perhaps unsurprisingly – had a preference for bills signed by large and financially strong underwriters. A somewhat less "comfortable" finding is attached to the indicator variable for bills accepted by Bank of England directors. Although the coefficient in question is economically small (-4%), it provides econometric evidence that the Bank granted a special status to bills accepted by members of its own Court of Directors. In fact, recent work on the Bank's history in the twentieth century also points to this practice. James (2020, p.203) argues that "directors' banks were treated differently until the 1930s" based on a "decision of the Court of Directors in 1841 ordering that 'the Amount of Credit, usually affixed to Parties having Discount Accounts be omitted in the case of Bank Directors or the firms in which they are partners.'" It seems that "the Bank 'gave unconditional and unqualified reports upon all Directors' firms and took their acceptances and discounted their bills without limit."

As with our packet-level regressions, we estimate an augmented version of Model 2 including a full set of interaction terms of our independent variables with a dummy for crisis weeks. We display the coefficients on the interaction terms in Table 4, while reporting the corresponding split sample bill-level regressions for crisis and normal weeks in Table 11 in the appendix. In a robustness check analogous to the packet-level analysis, we also provide results for the non-linear Logit specifications in Table 12 of the appendix. We focus on column 2 and 3 in Table 4 which summarize the coefficients from specifications including date and packet fixed effects. Due to collinearity, several additional variables drop out in the split sample and augmented Model 2 specifications. Unfortunately, we do not obtain estimates for interaction terms on discounter dummies for bankers, top acceptors and top discounters. Hence, we cannot ascertain that our packet-level findings regarding these variables hold up once we control for bill-level characteristics. The interaction term on the dummy for bills accepted by the Treasury also drops from the model once we include date fixed effects.

Our discounter identity markers at the bill-level provide two main insights. First, our bill-level analysis confirms the packet-level result for bill brokers. Even after controlling for bill characteristics, we find that bill

[30] Existing evidence from other European central banks corroborates this interpretation (Jobst and Kernbauer, 2016; Avaro and Bignon, 2019). For more information on how the Bank of England operated its branch network, c.f. Ziegler (1990).

Table 4: Bill-level regressions: difference crisis vs. normal times (only interacted terms displayed)

VARIABLES	(1) rej_bill	(2) rej_bill	(3) rej_bill
Δ Total bills on day (ln)	0.1331***		
	(0.0436)		
Δ Total value on day (ln)	-0.1124**		
	(0.0475)		
Δ Packet's rank on day (chron.)	0.0900**	-0.0023	
	(0.0377)	(0.0689)	
Δ Packet's rank on day (value)	0.0597	0.3018	
	(0.1147)	(0.5165)	
Δ Packet's total value (ln)	-0.0645	-0.2848	
	(0.1622)	(0.7177)	
Δ Packet's total number of bills (ln)	-0.0570	0.0280	
	(0.0499)	(0.0789)	
Δ Discounter in discounter rating book	0.0213	0.2124	
	(0.0821)	(0.1462)	
Δ Discounter in acceptor rating book	-0.1390	-0.2559	
	(0.1400)	(0.2594)	
Δ Discounter is bill broker		0.3496*	
		(0.1985)	
Δ Discounter is top discounter	0.1637		
	(0.1999)		
Δ Discounter has corn-related trade	-0.1150	-0.7065***	
	(0.1050)	(0.2406)	
Δ Discounter failed	0.2076***	0.1464	
	(0.0749)	(0.1674)	
Δ Acceptor in discounter rating book	0.0611	0.0342	0.0238
	(0.0401)	(0.0337)	(0.0309)
Δ Acceptor in acceptor rating book	-0.0681	0.0072	0.0291
	(0.0494)	(0.0501)	(0.0508)
Δ Bill is promissory note	-0.0103	-0.0687	-0.0102
	(0.0555)	(0.0594)	(0.0167)
Δ Acceptor is Treasury	0.0080		
	(0.0976)		
Δ Acceptor is Bank of England director	0.0083	-0.0432	-0.0024
	(0.0591)	(0.0445)	(0.0329)
Δ Acceptor is banker	-0.0573	-0.0739*	-0.0436
	(0.0425)	(0.0392)	(0.0362)
Δ Acceptor is top discounter	0.0612	0.0385	-0.0063
	(0.0684)	(0.0768)	(0.0691)
Δ Acceptor is top acceptor	0.0752	0.0867*	0.0445
	(0.0481)	(0.0510)	(0.0497)
Δ Acceptor has corn-related trade	0.0103	-0.3026	-0.2748
	(0.2188)	(0.3784)	(0.3749)
Δ Acceptor failed	0.1814	0.2047	0.1105
	(0.1784)	(0.1733)	(0.1435)
Δ Acceptor based in London	0.2150	0.2601	0.2566
	(0.1641)	(0.1821)	(0.1917)
Δ Amount on bill (ln)	0.0199	0.0246	0.0150
	(0.0256)	(0.0280)	(0.0282)
Δ Days to maturity of bill (ln)	-0.0196	-0.0138	0.0090
	(0.0236)	(0.0245)	(0.0210)
Observations (= number of bills)	863	863	863
R-squared	0.4288	0.5259	0.5560
Fixed FE	No	Date	Packet
Clustered SE	Yes	Yes	Yes

Clustered standard errors (date) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

brokers experienced a significantly higher rejection probability in crisis weeks: the dummy is associated with a hefty 35% increase in the odds of rejection at the bill-level. Thus, the coefficient is even larger than the one we obtain from our packet-level analysis (c.f. Table 2), where it ranges from 21% to 28% depending on the specification. Second, in contrast to our augmented packet-level results, column 2 of Table 4 strongly suggests that the Bank actually rushed liquidity to firms with corn-related trades during crisis weeks. Discounters with corn-related businesses experienced a very large (-71%) and statistically highly significant reduction in the probability of rejection of the bills they submitted to the Discount Office. This finding appears to show that the Bank attempted to redirect its limited funds to ailing firms in need of liquidity in times of heightened market distress. While we cannot fully ascertain that these results reflect the benevolent behavior of a nascent lender of last resort, they are in line with our packet-level conclusion that the Bank provided emergency liquidity services to crucial, albeit selected, counterparties during the crisis of 1847.

Finally, the results for the specification with packet fixed effects (displayed in column 3 of Table 4) are striking. After fixing date and discounter identity, the coefficients on the interaction of the crisis week dummy with bill-level characteristics are all statistically insignificant. In other words, as far as bill-level characteristics are concerned, the Bank does not seem to have changed its behavior during weeks of elevated distress in the money market. This finding suggests that the Bank's purchasing strategy in crisis weeks was marked by a dichotomy. While the Discount Office consistently applied the very same rules regarding bill-level characteristics in crisis times and normal weeks, its preferences over discounter identity shifted when the Banking Department's note reserve situation turned dire. Hence, the Bank's policy response to the crisis of 1847 may be best described as a combination of rules *and* discretion.

6 Conclusion

To whom do central banks allocate their limited resources of high powered money when they face a supply constraint during financial crises? In this paper, we turned to economic history to provide an answer to this question. We draw on a large novel, hand-collected micro-level dataset to study the determinants of the Bank of England's asset purchasing decisions during the crisis of 1847. We find that the Bank's policy response to its gold reserve constraint featured a combination of rules and discretion. While the Bank consistently applied the same rules regarding the quality of assets it purchased, its preferences over counterparty identity shifted in times of distress.

The channeling of emergency liquidity to specific counterparties might trigger longer-term consequences. If counterparties' liquidity management practices change in reaction to expected support (or the absence thereof) in future crisis, the allocation of central bank liquidity can distort firm dynamics and generate moral hazard. On the one hand, firms with preferential access to central bank liquidity in times of distress may gain a competitive advantage for survival and make it more difficult for newcomers to withstand financial shocks. On

the other hand, insurance is known to invite moral hazard: anticipating central bank support in the case of a liquidity shortfall, counterparties have less reasons to hold assets that are liquid but carry lower yields. While the literature has suggested several mechanisms to limit these negative behavioral incentives (Crockett, 1996; Freixas, 2000; Naqvi, 2015), it remains subject to debate whether the Bank of England had to deal with these concerns in the nineteenth century and which, if any, strategies it employed to mitigate moral hazard (Bignon et al., 2012). Our paper suggests that the Bank's reserve constraint during crises shaped discount window operations in ways that could have distorted firm dynamics and generate moral hazard. While an analysis of these longer-run implications is beyond the scope of the present paper, our results suggest it may be worthwhile to explore them in future research.

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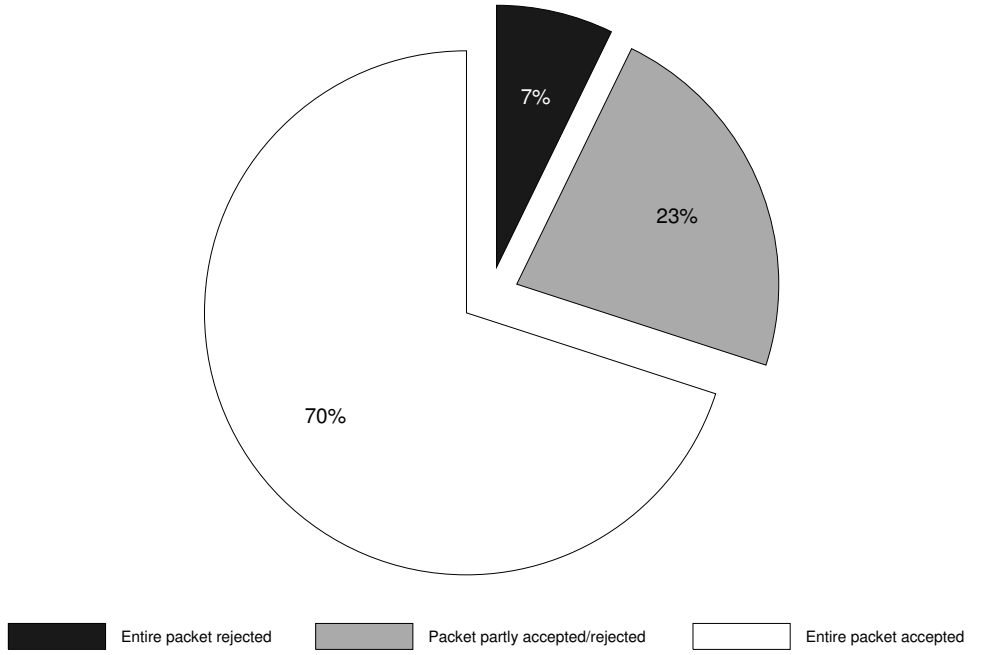
Appendix

Figure 3: Packets submitted to the Bank of England's discount window in 1847 (random sample, N=1,000)



Source: Bank of England, Daily Discount ledgers 1847

Figure 4: Packets submitted to the Bank of England's discount window in 1847 (random sample, N=1,000)

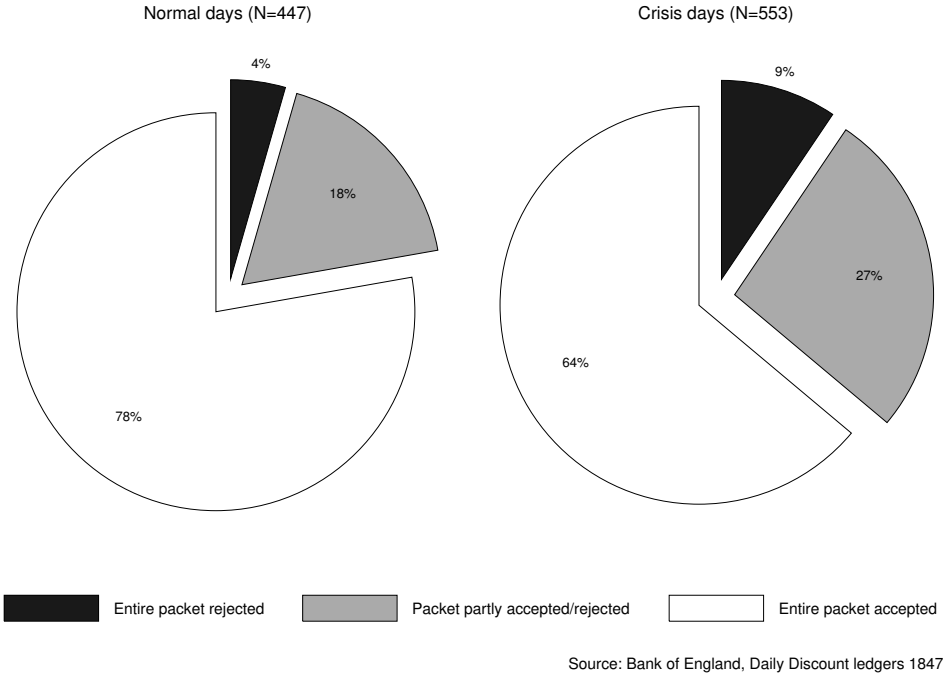


Figure 5: Number of bills submitted to the Bank of England's discount window in 1847 (N=97,637; 119 crisis days out of 310 days)

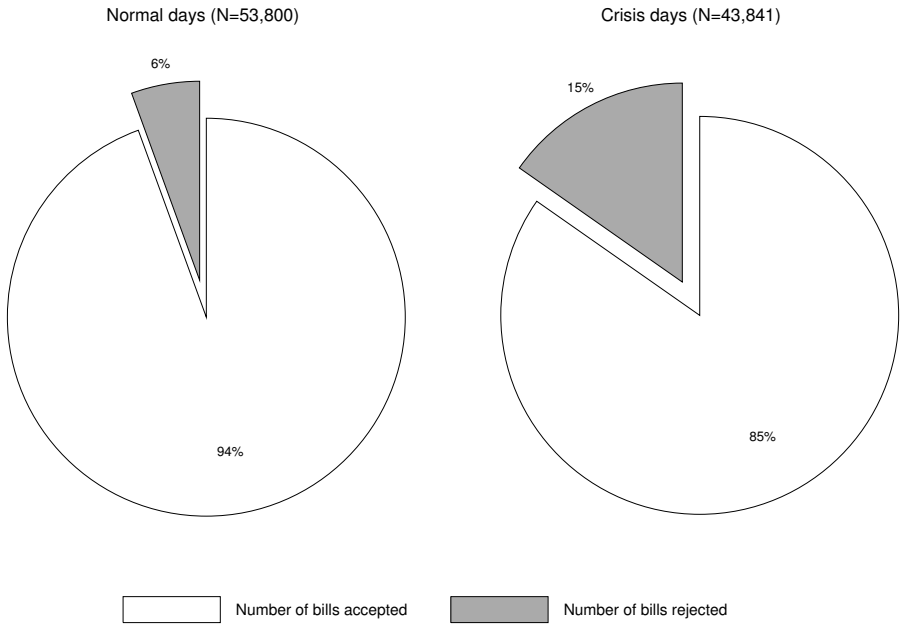
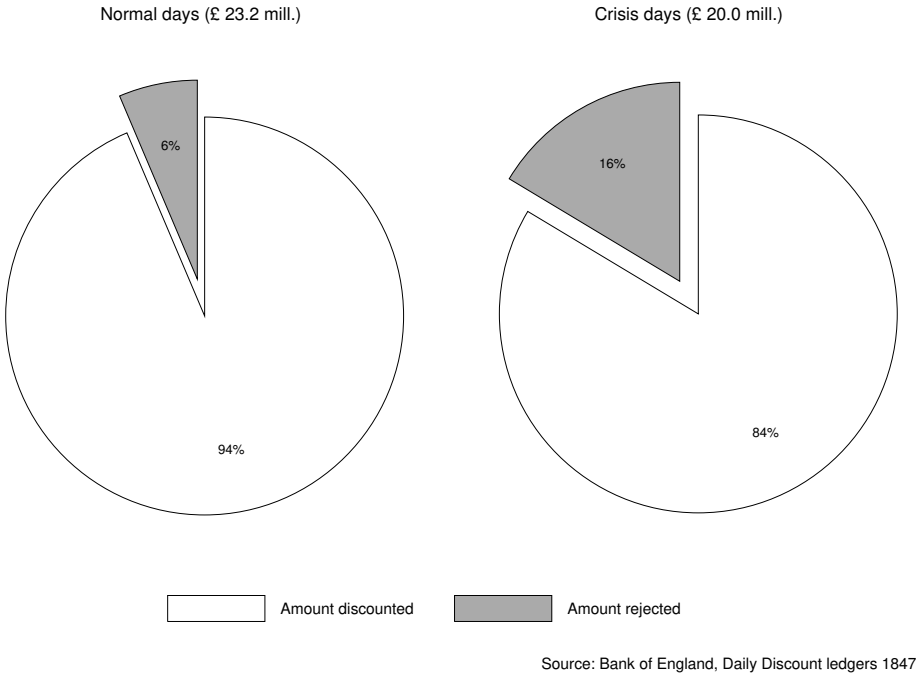
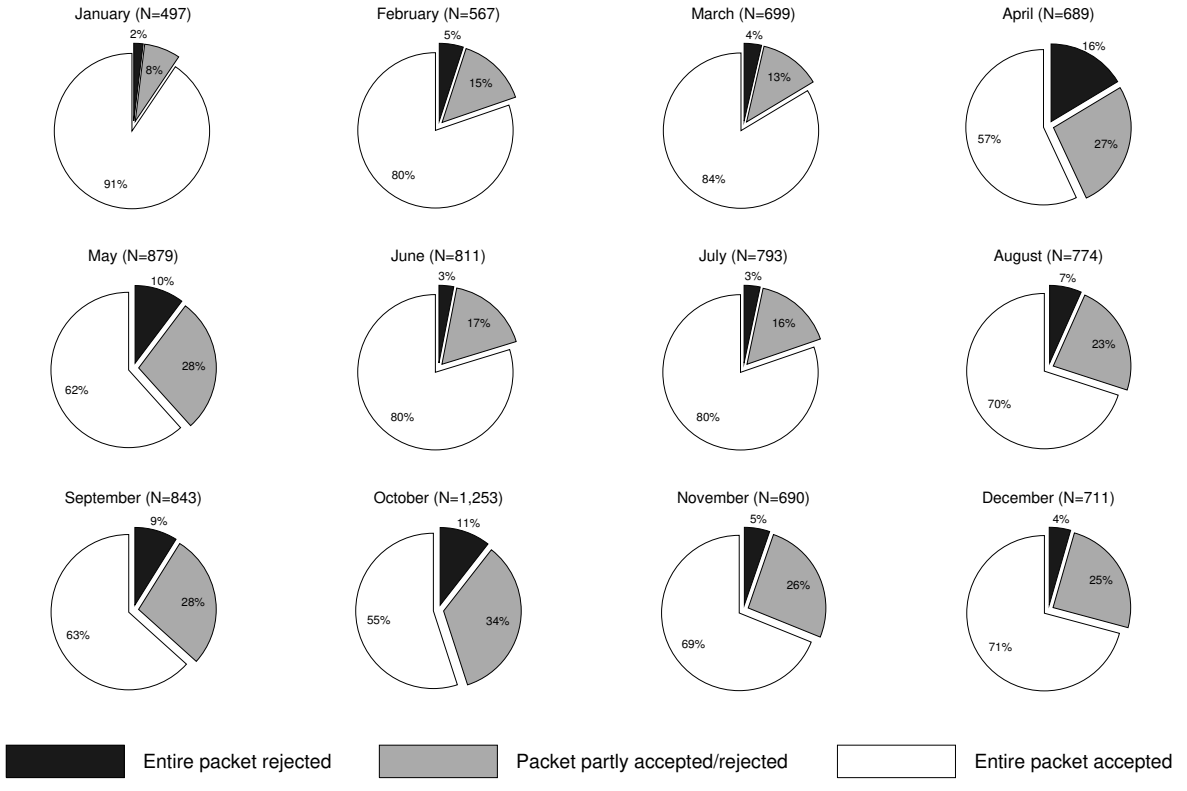


Figure 6: Value on bills submitted to the Bank of England's discount window in 1847 (total of £ 43.1 mill.; 119 crisis days out of 310 days)



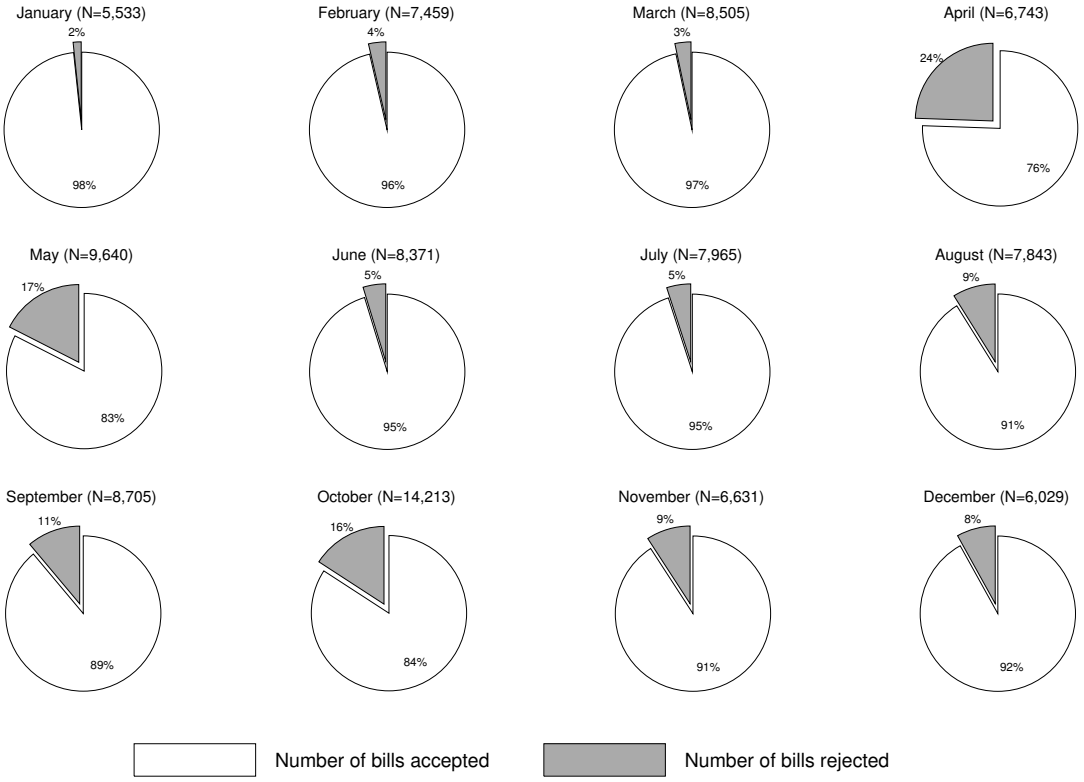
Source: Bank of England, Daily Discount ledgers 1847

Figure 7: Packets submitted to the Bank of England's discount window in 1847 (N=9,206; by month)



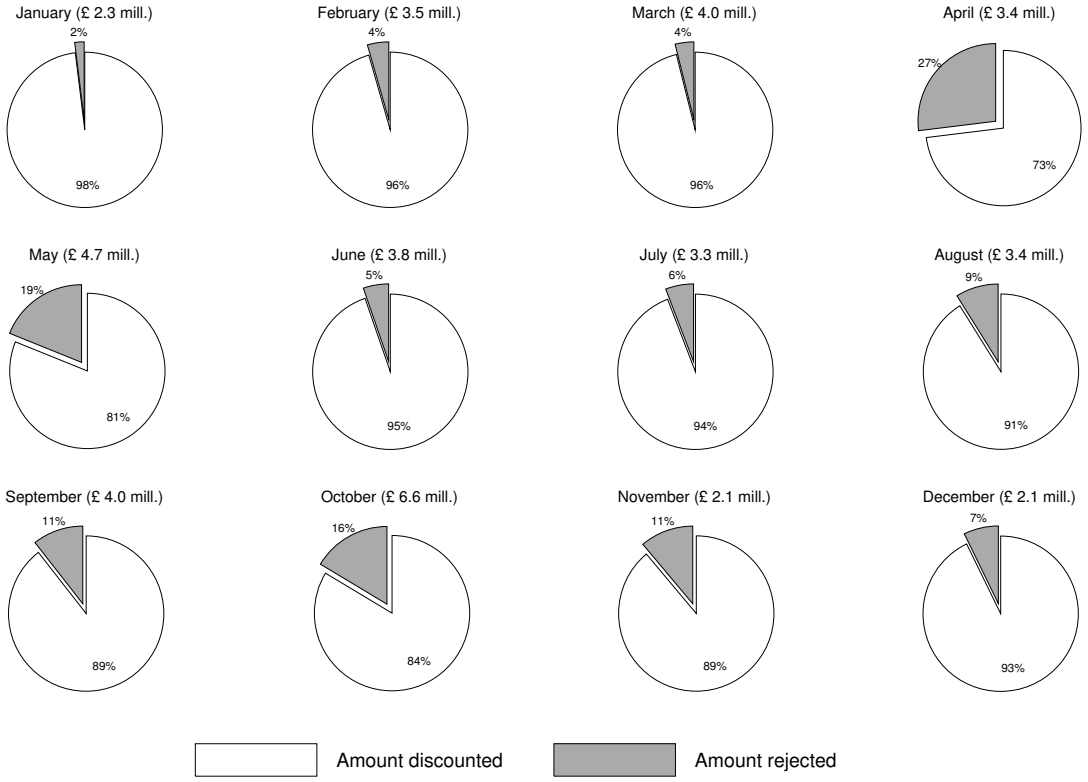
Source: Bank of England, Daily Discount ledgers 1847

Figure 8: Bills submitted to the Bank of England's discount window in 1847 (N=97,637; by month)



Source: Bank of England, Daily Discount ledgers 1847

Figure 9: Monetary value submitted to the Bank of England's discount window in 1847 (total of £ 43.1 mill.; by month)



Source: Bank of England, Daily Discount ledgers 1847

Table 5: T-tests: rejections of packets, bills and amount during crisis days vs. normal days in 1847

Period	**Total days/obs.**	**Total packet rejected**	**Part of packet rejected**	**Bills rejected**	**Amount rejected**
	Days	Count	Count	Count	Sum (in £)
Normal days	191	229	956	3,052	1,452,458
Crisis days	119	414	1,160	6,713	3,285,804
	Observations	Mean (share of total packets)	Mean (share of total packets)	Mean (rejected to total submitted)	Mean (rejected to total submitted)
Normal days	5,121	0.04	0.19	0.10	0.11
Crisis days	4,085	0.10	0.28	0.20	0.21
t-statistic		-10.65***	-11.09***	-15.74***	-15.63***

*** p<0.01, ** p<0.05, * p<0.1 (null of equal means)
Source: Bank of England daily ledger 1847

Table 6: Summary statistics for packet-level sample

Variable	Obs	Mean	Std. Dev.	Min	Max	P1	P5	P25	P50	P75	P95	P99
rej	1,000	0.2990	0.4580	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000
rej_sharebills	1,000	0.1489	0.2944	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.1334	1.0000	1.0000
rej_shareval	1,000	0.1582	0.3074	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.1376	1.0000	1.0000
Total bills on day (ln)	1,000	3.4687	0.3360	2.4849	4.2341	2.7081	2.9444	3.2189	3.434	3.7136	4.0431	4.1897
Total value on day (ln)	1,000	11.844	0.6031	10.3089	13.2592	10.6493	10.9281	11.3878	11.8317	12.3331	12.8681	13.0796
Packet's rank on day (chron.)	1,000	0.5076	0.2873	0.0159	1.0000	0.0323	0.0645	0.2500	0.5000	0.7558	0.9661	1.0000
Packet's rank on day (value)	1,000	0.5276	0.2931	0.0208	1.0000	0.0318	0.0706	0.2727	0.5263	0.7931	0.9667	1.0000
Packet's total value (ln)	1,000	7.7592	1.1537	4.7362	12.3243	5.2983	5.8215	6.9320	7.7343	8.5773	9.5496	10.8669
Packet's total number of bills (ln)	1,000	1.737	1.1193	0.0000	5.5984	0.0000	0.0000	1.0986	1.7918	2.3979	3.6636	4.7493
Packet with *withdrawn* remark	1,000	0.0009	0.0945	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Packet with *returned* remark	1,000	0.0100	0.0995	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5000
Packet with *maturity* remark	1,000	0.0170	0.1293	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Discounter with DO account	1,000	0.0930	0.2906	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000
Discounter in discounter rating book	1,000	0.3160	0.4651	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000
Discounter in acceptor rating book	1,000	0.0820	0.2745	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000
Discounter is banker	1,000	0.0530	0.2241	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000
Discounter is bill broker	1,000	0.0390	0.1937	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Discounter is top discounter	1,000	0.0300	0.1707	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Discounter is top acceptor	1,000	0.0150	0.1216	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Discounter has corn-related trade	1,000	0.0210	0.1435	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Discounter failed	1,000	0.1490	0.3563	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000

Table 7: Summary statistics for bill-level sample

Variable	Obs	Mean	Std. Dev.	Min	Max	P1	P5	P25	P50	P75	P95	P99
rej_bill	863	0.1008	0.3013	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000
Total bills on day (ln)	863	3.5429	0.3541	2.4849	4.2341	2.4849	2.9957	3.4012	3.4657	3.7842	4.1897	4.1897
Total value on day (ln)	863	11.8513	0.6571	10.2833	13.0509	10.3089	10.9132	11.3452	11.8717	12.335	12.9479	13.0509
Packet's rank on day (chron.)	863	0.5497	0.2979	0.0294	0.9825	0.0476	0.0625	0.3125	0.5667	0.8261	0.9677	0.9825
Packet's rank on day (value)	863	0.6980	0.2708	0.0263	1.0000	0.0732	0.1563	0.5172	0.7500	0.9500	1.0000	1.0000
Packet's total value (ln)	863	8.4821	1.3261	4.6052	11.3973	5.9915	6.3835	7.6079	8.3163	9.2438	11.3973	11.3973
Packet's total number of bills (ln)	863	2.6461	0.9618	0.0000	4.2047	0.0000	1.0986	2.0794	2.7081	3.5264	4.2047	4.2047
Discounter in discounter rating book	863	0.3801	0.4857	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000
Discounter in acceptor rating book	863	0.0463	0.2104	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Discounter is banker	863	0.0498	0.2177	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Discounter is bill broker	863	0.1194	0.3244	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000
Discounter is top discounter	863	0.0800	0.2714	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000
Discounter is top acceptor	863	0.0487	0.2153	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Discounter has corn-related trade	863	0.0139	0.1172	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Discounter failed	863	0.1437	0.3510	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000
Acceptor in discounter rating book	863	0.1657	0.3720	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000
Acceptor in acceptor rating book	863	0.0753	0.2641	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000
Bill is promissory note	863	0.0116	0.1071	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Acceptor is Treasury	863	0.007	0.0831	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Acceptor is Bank of England director	863	0.0151	0.1219	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Acceptor is banker	863	0.1101	0.3132	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000
Acceptor is bill broker	863	0.0023	0.0481	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Acceptor is top discounter	863	0.0116	0.1071	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Acceptor is top acceptor	863	0.0660	0.2485	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000
Acceptor has corn-related trade	863	0.0058	0.0759	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Acceptor failed	863	0.0406	0.1974	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Acceptor based in London	863	0.9421	0.2338	0.0000	1.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Amount on bill (ln)	863	5.6351	1.0328	2.7726	9.2103	3.1355	3.6889	5.0106	5.6836	6.2615	7.2363	8.294
Days to maturity of bill (ln)	863	3.8432	0.7314	1.0986	4.5643	1.3863	2.1972	3.5835	4.0775	4.382	4.5218	4.5433

Table 8: Packet-level regressions (full sample): excluding packets highlighted with *withdrawn*, *returned* or *maturity* remark

VARIABLES	(1) rej	(2) rej_shareval	(3) rej_sharebills	(4) rej	(5) rej_shareval	(6) rej_sharebills
Total bills on day (ln)	0.0736***	0.0521***	0.0448***			
	(0.0234)	(0.0162)	(0.0149)			
Total value on day (ln)	-0.0243	-0.0196	-0.0136			
	(0.0239)	(0.0169)	(0.0153)			
Packet's rank on day (chron.)	-0.0119	0.0034	0.0012	-0.0229	-0.0039	-0.0063
	(0.0153)	(0.0096)	(0.0089)	(0.0206)	(0.0139)	(0.0130)
Packet's rank on day (value)	-0.0032	-0.0007	-0.0078	-0.0468	-0.0423	-0.0321
	(0.0405)	(0.0273)	(0.0252)	(0.0628)	(0.0439)	(0.0423)
Packet's total value (ln)	-0.0462	-0.0274	-0.0142	-0.0121	0.0079	0.0046
	(0.0448)	(0.0324)	(0.0308)	(0.0701)	(0.0507)	(0.0497)
Packet's total number of bills (ln)	0.0634***	-0.0206	-0.0269**	0.0777***	-0.0103	-0.0215
	(0.0191)	(0.0125)	(0.0123)	(0.0254)	(0.0181)	(0.0180)
Discounter has DO account	-0.0633	-0.0677**	-0.0660**	-0.0059	-0.0265	-0.0297
	(0.0450)	(0.0312)	(0.0284)	(0.0647)	(0.0466)	(0.0413)
Discounter in discounter rating book	0.0639**	0.0316	0.0340*	0.0599	0.0167	0.0210
	(0.0321)	(0.0206)	(0.0194)	(0.0437)	(0.0285)	(0.0271)
Discounter in acceptor rating book	-0.0584	-0.0123	-0.0339	-0.0488	-0.0041	-0.0308
	(0.0468)	(0.0321)	(0.0273)	(0.0719)	(0.0454)	(0.0438)
Discounter is banker	-0.0676	-0.0217	-0.0184	-0.0416	0.0089	0.0169
	(0.0691)	(0.0269)	(0.0241)	(0.0973)	(0.0487)	(0.0415)
Discounter is bill broker	0.1916**	0.0893	0.0914*	0.2652**	0.1361*	0.1335*
	(0.0881)	(0.0566)	(0.0534)	(0.1097)	(0.0709)	(0.0742)
Discounter is top discounter	-0.1939**	-0.0798	-0.0721	-0.2426**	-0.1337*	-0.1059
	(0.0960)	(0.0501)	(0.0480)	(0.1177)	(0.0722)	(0.0730)
Discounter is top acceptor	-0.0605	0.0356	0.0241	0.1201	0.1443*	0.1253*
	(0.0928)	(0.0602)	(0.0500)	(0.1192)	(0.0808)	(0.0694)
Discounter has corn-related trade	0.3432***	0.2872***	0.2685***	0.2883*	0.2509*	0.2358*
	(0.1196)	(0.0961)	(0.0907)	(0.1683)	(0.1299)	(0.1243)
Discounter failed	0.1791***	0.0857***	0.0776***	0.1605**	0.1010***	0.0864**
	(0.0423)	(0.0262)	(0.0265)	(0.0635)	(0.0381)	(0.0404)
Observations (= number of packets)	964	964	964	964	964	964
R-squared	0.0724	0.0752	0.0758	0.3785	0.3544	0.3447
Date FE	No	No	No	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes	Yes	Yes	Yes

Clustered standard errors (date) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Packet-level regressions (split sample)

VARIABLES	(1) rej	(2) rej	(3) rej_shareval	(4) rej_shareval	(5) rej_sharebills	(6) rej_sharebills
Packet's rank on day (chron.)	-0.0134	-0.0211	0.0097	-0.0084	0.0084	-0.0130
	(0.0322)	(0.0260)	(0.0224)	(0.0166)	(0.0213)	(0.0153)
Packet's rank on day (value)	-0.0021	-0.0584	-0.0347	-0.0545	-0.0274	-0.0406
	(0.1042)	(0.0716)	(0.0674)	(0.0530)	(0.0589)	(0.0529)
Packet's total value (ln)	-0.0728	0.0111	-0.0074	0.0310	-0.0097	0.0250
	(0.1113)	(0.0844)	(0.0679)	(0.0663)	(0.0608)	(0.0667)
Packet's total number of bills (ln)	0.0736*	0.0755**	-0.0101	-0.0172	-0.0156	-0.0335
	(0.0391)	(0.0318)	(0.0247)	(0.0242)	(0.0249)	(0.0243)
Packet with *withdrawn* remark	1.0190***	0.6017***	0.9693***	0.6414***	0.9622***	0.6740***
	(0.0672)	(0.1028)	(0.0419)	(0.1419)	(0.0415)	(0.1292)
Packet with *returned* remark		0.7140***		0.9067***		0.9158***
		(0.1159)		(0.0529)		(0.0526)
Packet with *maturity* remark		0.7028***		0.4108***		0.3922***
		(0.0885)		(0.0958)		(0.1084)
Discounter has DO account	-0.0310	-0.0038	-0.0900	0.0034	-0.0784	-0.0047
	(0.0923)	(0.0846)	(0.0671)	(0.0600)	(0.0591)	(0.0536)
Discounter in discounter rating book	0.0996	0.0390	0.0102	0.0313	0.0219	0.0342
	(0.0759)	(0.0512)	(0.0401)	(0.0371)	(0.0383)	(0.0354)
Discounter in acceptor rating book	-0.1102	-0.0244	0.0070	-0.0234	-0.0115	-0.0559
	(0.1029)	(0.0916)	(0.0543)	(0.0637)	(0.0533)	(0.0617)
Discounter is banker	0.2279	-0.1122	0.1576*	-0.0334	0.1410*	-0.0183
	(0.1858)	(0.0965)	(0.0823)	(0.0488)	(0.0741)	(0.0415)
Discounter is bill broker	0.0562	0.3290***	-0.0167	0.1928**	-0.0311	0.2043**
	(0.1997)	(0.1194)	(0.0516)	(0.0873)	(0.0467)	(0.0920)
Discounter is top discounter	-0.0084	-0.3348***	-0.0136	-0.1505*	0.0149	-0.1171
	(0.2249)	(0.1217)	(0.0794)	(0.0819)	(0.0740)	(0.0862)
Discounter is top acceptor	-0.1922	0.1797	-0.0745	0.2136**	-0.0764	0.1904**
	(0.1652)	(0.1226)	(0.0735)	(0.0981)	(0.0679)	(0.0880)
Discounter has corn-related trade	0.3647*	0.1871	0.2819*	0.3403*	0.2689*	0.3356*
	(0.2139)	(0.2288)	(0.1612)	(0.1986)	(0.1536)	(0.1930)
Discounter failed	0.1335	0.1857**	0.0831	0.0872*	0.0757	0.0672
	(0.0996)	(0.0740)	(0.0574)	(0.0486)	(0.0519)	(0.0549)
Observations (= number of packets)	447	553	447	553	447	553
R-squared	0.4848	0.3803	0.4712	0.4274	0.4733	0.4296
Sample	Normal	Crisis	Normal	Crisis	Normal	Crisis
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes	Yes	Yes	Yes

Clustered standard errors (date) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Packet-level regressions (split sample): non-linear models

VARIABLES	(1) rej	(2) rej	(3) rej_shareval	(4) rej_shareval	(5) rej_sharebills	(6) rej_sharebills
Total bills on day (ln)	0.2253	0.3830**	0.1196	0.1986**	0.1073	0.1700**
	(0.1872)	(0.1943)	(0.0920)	(0.0830)	(0.0849)	(0.0812)
Total value on day (ln)	-0.1084	-0.1952	-0.0499	-0.1272*	-0.0444	-0.0992
	(0.2479)	(0.1722)	(0.1262)	(0.0731)	(0.1154)	(0.0716)
Packet's rank on day (chron.)	-0.1164	-0.0172	-0.0104	-0.0128	-0.0119	-0.0172
	(0.1298)	(0.1113)	(0.0630)	(0.0480)	(0.0585)	(0.0455)
Packet's rank on day (value)	0.2839	-0.1608	0.1194	-0.0956	0.0893	-0.1035
	(0.3794)	(0.3088)	(0.1813)	(0.1504)	(0.1649)	(0.1449)
Packet's total value (ln)	-0.5925	-0.0877	-0.2950	0.0070	-0.2371	0.0245
	(0.4060)	(0.3667)	(0.1956)	(0.1882)	(0.1815)	(0.1811)
Packet's total number of bills (ln)	0.4037**	0.3382**	0.0875	0.0102	0.0711	-0.0076
	(0.1614)	(0.1372)	(0.0800)	(0.0609)	(0.0751)	(0.0595)
Packet with *withdrawn* remark			7.4528	1.7900***	6.9956	1.8072***
			(0.0000)	(0.4021)	(0.0000)	(0.3789)
Packet with *returned* remark				6.9523		6.7170
				(0.0000)		(0.0000)
Packet with *maturity* remark				1.0836***		1.0256***
				(0.1207)		(0.1190)
Discounter has DO account	-0.8424	-0.1651	-0.4967*	-0.1027	-0.4609*	-0.1015
	(0.6219)	(0.3580)	(0.2841)	(0.1729)	(0.2630)	(0.1617)
Discounter in discounter rating book	0.3961	0.3691*	0.1804	0.1705*	0.1755	0.1755**
	(0.2740)	(0.2087)	(0.1306)	(0.0891)	(0.1216)	(0.0862)
Discounter in acceptor rating book	-0.7135	-0.1518	-0.3275	-0.0286	-0.3217	-0.1088
	(0.4713)	(0.3479)	(0.2272)	(0.1714)	(0.2116)	(0.1579)
Discounter is banker	-0.0338	-0.6750	-0.0075	-0.2760	-0.0101	-0.2635
	(0.8538)	(0.5553)	(0.3718)	(0.1848)	(0.3439)	(0.1795)
Discounter is bill broker	0.2260	1.7022***	-0.0281	0.7285***	-0.0259	0.6992***
	(0.7301)	(0.6263)	(0.3080)	(0.2421)	(0.2789)	(0.2310)
Discounter is top discounter	-0.5411	-2.0450**	-0.1912	-0.7065**	-0.1704	-0.6589**
	(1.3430)	(0.8258)	(0.5743)	(0.3229)	(0.5292)	(0.3129)
Discounter is top acceptor		-0.6607	-4.6066	0.1697	-4.2852	0.1275
		(1.1070)	(0.0000)	(0.4200)	(0.0000)	(0.3918)
Discounter has corn-related trade	1.9320***	1.0605	0.9618***	0.8208**	0.9016***	0.7630**
	(0.6393)	(0.8310)	(0.2537)	(0.3421)	(0.2369)	(0.3389)
Discounter failed	0.8580***	1.0026***	0.4000***	0.3883***	0.3646***	0.3504***
	(0.3036)	(0.2757)	(0.1517)	(0.1172)	(0.1404)	(0.1230)
Observations (= number of packets)	439	519	447	553	447	553
Log-pseudolikelihood	-214.03	-304.97	-253.33	-399.98	-247.32	-395.37
Sample	Normal	Crisis	Normal	Crisis	Normal	Crisis
Model	Logit	Logit	Tobit	Tobit	Tobit	Tobit
Clustered SE	Yes	Yes	Yes	Yes	Yes	Yes

Due to the non-linear specification, coefficients are not directly comparable to OLS results.
Clustered standard errors (date) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 11: Bill-level regressions (split sample)

VARIABLES	(1) rej_bill	(2) rej_bill	(3) rej_bill	(4) rej_bill	(5) rej_bill	(6) rej_bill
Total bills on day (ln)	-0.0416	0.0915**				
	(0.0263)	(0.0351)				
Total value on day (ln)	0.0687*	-0.0436				
	(0.0360)	(0.0317)				
Packet's rank on day (chron.)	-0.0382	0.0518**	0.0231	0.0207		
	(0.0313)	(0.0219)	(0.0400)	(0.0566)		
Packet's rank on day (value)	0.0684	0.1281	0.2125	0.5143		
	(0.0786)	(0.0849)	(0.1437)	(0.4954)		
Packets's total value (ln)	-0.2035	-0.2680**	-0.3648	-0.6496		
	(0.1197)	(0.1118)	(0.2461)	(0.6740)		
Packets's total number of bills (ln)	0.0619**	0.0048	-0.0385	-0.0105		
	(0.0273)	(0.0421)	(0.0311)	(0.0726)		
Discounter in discounter rating book	0.1299**	0.1513**	0.1412	0.3537***		
	(0.0588)	(0.0585)	(0.1191)	(0.0887)		
Discounter in acceptor rating book	-0.1108	-0.2498***	-0.1358	-0.3917**		
	(0.1141)	(0.0840)	(0.1959)	(0.1752)		
Discounter is banker		0.0119		-0.1620		
		(0.0843)		(0.3962)		
Discounter is bill broker	0.0882	0.1152**	-0.1052	0.2444		
	(0.0881)	(0.0534)	(0.1244)	(0.1567)		
Discounter is top discounter		0.1367				
		(0.1523)				
Discounter is top acceptor		-0.0392				
		(0.0567)				
Discounter has corn-related trade	0.3520***	0.2370***	0.5186***	-0.1879		
	(0.0866)	(0.0617)	(0.0621)	(0.2320)		
Discounter failed	-0.0027	0.2049***	0.0657	0.2121		
	(0.0442)	(0.0611)	(0.0764)	(0.1494)		
Acceptor in discounter rating book	-0.0653**	-0.0042	-0.0242	0.0100	-0.0110	0.0128
	(0.0254)	(0.0314)	(0.0188)	(0.0282)	(0.0111)	(0.0287)
Acceptor in acceptor rating book	0.0503	-0.0178	0.0087	0.0160	-0.0094	0.0197
	(0.0339)	(0.0365)	(0.0248)	(0.0437)	(0.0181)	(0.0472)
Bill is promissory note	-0.0537	-0.0640**	0.0438	-0.0249	-0.0059	-0.0161
	(0.0486)	(0.0285)	(0.0585)	(0.0168)	(0.0060)	(0.0155)
Acceptor is Treasury	0.0182	0.0262		-0.0147		0.0031
	(0.0805)	(0.0573)		(0.0469)		(0.0464)
Acceptor is Bank of England director	-0.0551	-0.0467	-0.0245	-0.0677*	-0.0312	-0.0336
	(0.0427)	(0.0417)	(0.0231)	(0.0383)	(0.0185)	(0.0274)
Acceptor is banker	-0.0179	-0.0752**	0.0153	-0.0586*	-0.0165	-0.0601*
	(0.0279)	(0.0325)	(0.0218)	(0.0329)	(0.0144)	(0.0331)
Acceptor is bill broker		-0.1199*		-0.0709		-0.0866
		(0.0665)		(0.1093)		(0.0986)
Acceptor is top discounter	-0.0864**	-0.0252	-0.0815**	-0.0430	-0.0029	-0.0093
	(0.0398)	(0.0562)	(0.0332)	(0.0694)	(0.0180)	(0.0663)
Acceptor is top acceptor	-0.0238	0.0513	-0.0325*	0.0542	0.0080	0.0525
	(0.0233)	(0.0423)	(0.0178)	(0.0478)	(0.0129)	(0.0477)
Acceptor has corn-related trade	-0.0577	-0.0475	-0.0284	-0.3309	-0.0138	-0.2885
	(0.0433)	(0.2149)	(0.0330)	(0.3756)	(0.0119)	(0.3710)
Acceptor failed	-0.2412	-0.0598	-0.2192	-0.0145	-0.1165	-0.0060
	(0.1619)	(0.0809)	(0.1654)	(0.0638)	(0.1338)	(0.0627)
Acceptor based in London	-0.7483***	-0.5334***	-0.7412***	-0.4811***	-0.7210***	-0.4644***
	(0.0956)	(0.1348)	(0.1171)	(0.1414)	(0.1315)	(0.1426)
Amount on bill (ln)	0.0178	0.0377*	0.0064	0.0311	0.0152	0.0302
	(0.0143)	(0.0215)	(0.0168)	(0.0227)	(0.0168)	(0.0228)
Days to maturity of bill (ln)	0.0382*	0.0186	0.0356	0.0218*	0.0148	0.0238*
	(0.0197)	(0.0135)	(0.0215)	(0.0127)	(0.0176)	(0.0124)
Observations (= number of bills)	315	548	315	548	315	548
R-squared	0.5057	0.3907	0.5971	0.4907	0.6519	0.5090
Sample	Normal	Crisis	Normal	Crisis	Normal	Crisis
Fixed effects	No	No	Date	Date	Packet	Packet
Clustered SE	Yes	Yes	Yes	Yes	Yes	Yes

Clustered standard errors (date) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 12: Bill-level regressions (split sample): non-linear models

VARIABLES	(1) rej_bill	(2) rej_bill
Total bills on day (ln)	-1.3210***	1.5805**
	(0.3880)	(0.7549)
Total value on day (ln)	1.9039**	-0.9530
	(0.7707)	(0.8645)
Packet's rank on day (chron.)	-0.4089	0.6581**
	(0.9113)	(0.2996)
Packet's rank on day (value)	1.0747	1.7585
	(2.1931)	(1.1811)
Packets's total value (ln)	-4.7125*	-3.0789
	(2.7831)	(1.8782)
Packets's total number of bills (ln)	1.0515	-0.3409
	(0.6605)	(0.6978)
Discounter in discounter rating book	2.8624**	2.0063***
	(1.2398)	(0.6010)
Discounter in acceptor rating book	-0.5405	
	(1.2369)	
Discounter is bill broker		-11.0423***
		(1.4236)
Discounter is top discounter		15.7154***
		(2.9243)
Discounter is top acceptor		-0.5490
		(1.0407)
Discounter has corn-related trade	2.0383	1.5200***
	(1.3321)	(0.5589)
Discounter failed		1.7378***
		(0.6541)
Acceptor in discounter rating book		0.3114
		(0.9475)
Acceptor in acceptor rating book		-0.5327
		(1.2935)
Acceptor is banker		-1.9635**
		(0.8721)
Acceptor is top acceptor		1.0828
		(1.5717)
Acceptor has corn-related trade		-0.9424
		(1.6811)
Acceptor failed		-0.2342
		(0.9025)
Acceptor based in London		-3.1758***
		(0.9582)
Amount on bill (ln)	0.6658**	0.5148
	(0.3232)	(0.3867)
Days to maturity of bill (ln)	0.8978**	0.3933
	(0.3749)	(0.2751)
Observations (= number of bills)	216	470
Log-pseudolikelihood	-34.14	-102.42
Sample	Normal	Crisis
Model	Logit	Logit
Clustered SE	Yes	Yes

Due to the non-linear specification, coefficients are not directly comparable to OLS results.
Clustered standard errors (date) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1