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Article

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Liquidity transformation, collateral assets and counterparties[☆]

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ABSTRACT

We investigate if the Bank of England's liquidity facilities encourage some counterparties to participate more than others and if the use of some collateral assets is promoted more than others. Between 2010 and 2016, there was regular usage of two facilities: Indexed Long-Term Repos (ILTR) and the Funding for Lending Scheme (FLS). We show that participation in ILTR is consistent with safe counterparties using the facilities to meet their liquidity needs. Collateral assets used for FLS are less liquid. Riskier and larger institutions are more likely to pre-position collateral in the FLS, but these counterparties do not subsequently draw upon FLS more than others do.

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1. Introduction

In the aftermath of the Global Financial Crisis, central banks have increased the size and scope of their lending activity to safeguard financial stability and support the real economy. Central bank lending operations are typically secured (repo) transactions in which the central bank sets the interest rate and the eligible collateral assets. Counterparties draw liquidity according to these conditions. Hence, the increase in central bank lending has led to a greater focus on counterparties' characteristics and their collateral assets. In this article, we investigate the incentives of central bank liquidity facilities. If the design of liquidity facilities creates

incentives for some counterparties to participate more than others or use some collateral more than others, the central bank could take undue risks into its balance sheet. The scope of this study is to understand whether these facilities provided incentives beyond the ones set by the policy objectives. Understanding the incentives behind liquidity facilities is crucial for the design of lending operations to avoid unintentional effects and manage the risks associated with liquidity provision.

In the United Kingdom, the Bank of England (BoE) offers liquidity insurance through a number of facilities, aimed to enhance financial stability and facilitate the transmission of monetary policy by safeguarding market liquidity. The most frequently used is the Index Long-term Repo (ILTR) facility. In addition, in 2012, in response to broadly flat output for over two years despite the already extremely accommodative monetary policy, the BoE together with HM Treasury designed a facility, called the Funding for Lending Scheme (FLS), which provides term funding for banks at rates below the market, in order to boost credit provision to the real economy. In all of these facilities, BoE lending is collateralised. The BoE attaches a risk-based haircut to each collateral asset, and

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banks can borrow up to the haircut adjusted value of their collateral. Therefore, the BoE's risk management function includes reviewing the creditworthiness of counterparties, valuing collateral assets, and setting appropriate haircuts on these assets.^{1,2} If the facilities' terms are too generous, the central bank could create undue incentives and biasing banks' asset allocation. To understand if the incentives derived from the facilities' design are aligned with the policy intention or with a more opportunistic behavior, we create hypotheses and investigate them empirically. To do this, we relate counterparties' liquidity demand to their balance sheet and collateral characteristics. Our study focuses on the first-order effects of these liquidity facilities. We are unable to track second-order adjustments that banks undertake in response to the BoE's policies.

We investigate two hypotheses. The first hypothesis is that counterparties follow policy-derived incentives. In ILTR, the policy objectives are for counterparties with liquidity shortages to participate more and use high-quality collateral. In FLS, the policy incentive is for all counterparties to participate and use less liquid collateral. The second hypothesis is that counterparties follow risk-taking incentives. In ILTR and FLS, the risk-taking incentive would encourage riskier counterparties to participate more and use riskier collateral more frequently. Both incentives are not mutually exclusive, and they could be taking place at the same time.

For ILTR, we find support to the view that the policy-derived incentives take place but no support for the risk-taking incentives. For FLS, the result is not clear cut. Although counterparties follow the policy-derived incentives, these incentives could not be distinguished from risk-taking incentives. FLS is directed at economic recovery and to create incentives for banks to lend more. To achieve that, the facility offers borrowing at a rate below market rates and no surcharge for the use of riskier collateral. Thus, most counterparties use the least expensive collateral, loan portfolios. We find that riskier counterparties do not participate more often than others, but less liquid collateral is often used.

For each liquidity facility, we examine two layers of liquidity demand. The first layer is the amount of collateral deposited in the collateral pool, adjusted by the haircut. This captures a firm's action *before* their need for liquidity is identified. This haircut-adjusted value represents the maximum amount of liquidity a counterparty can subsequently draw from the BoE if required. The BoE does not charge a fee for pledging collateral, but the act of pledging collateral is not costless from a counterparty's perspective. Marketable collateral assets have the opportunity cost of not being able to be pledged elsewhere or traded. Non-marketable collateral (i.e. loan pools) assets have maintenance costs similar to those of securitisation.³ Thus, counterparties incurring this cost do so as a form of insurance in case of a future liquidity shock and need to access BoE facilities. In other words, the size of the collateral pool reflects counterparties' expected liquidity needs and their risk aversion. We define the second layer as the actual liquidity demand, which arises *after* a liquidity need is identified, i.e. it is the amount of liquidity a counterparty subsequently draws from the facility. Both layers are economically relevant because they represent different aspects of liquidity demand. The first layer reflects an evaluation of liquidity need *ex-ante* and the second is an evaluation *ex-post* of actual liquidity needs.

Analysing the two layers of liquidity insurance demand, we find that relatively healthier counterparties (with more equity and lower loan write-off rates) are more likely to have non-zero collateral pools for use in the Bank's regular liquidity facilities such as the ILTR. Amongst those, counterparties who experienced larger deposit outflows during the quarter are more likely to draw upon the ILTR. Turning to the assets used as collateral in these operations, we find counterparties prefer to use liquid collateral assets initially. However, greater larger liquidity demands are associated with less liquid collateral pools. This result is consistent with the view that counterparties use higher quality collateral assets first and then turn to less liquid assets only if they need to expand their collateral usage. That is what we would expect, given the higher fee charged on less liquid collateral. The fact that counterparties with liquidity shortage are more likely to participate in ILTR and that more liquid collateral is used first support the hypothesis that ILTR incentives are consistent with the policy objectives.

Analysing the demand for FLS, we find that all banks that deposit collateral in the FLS pool subsequently draw upon them, i.e., the first and second layers of liquidity demand are the same in this case. On the counterparty dimension, we find that riskier counterparties (less profitable banks with higher loan write-off rates, albeit with more equity) are more likely to participate in the FLS. However, when looking into their drawing sizes, we find that riskier counterparties do not borrow substantially more than other counterparties. On the collateral dimension, we find no evidence that the demand for FLS liquidity increases on collateral risk. In part, this result is related to the fact that about 90% of the FLS collateral pool consists of collateral type C, which is already the collateral type with the highest haircut. In this sense, a further increase in collateral risk is not possible.

Because FLS provides funds below the market rate, all banks have an incentive to participate and draw their full allowance. This is reflected in our results. Most eligible counterparties in the sample participate in the facility. Because our sample includes a larger number of riskier banks, they participate more frequently. Also, most participants used their initial allowance but not subsequent ones. For this reason, we do not observe riskier counterparties drawing larger amounts. Thus, we conclude that counterparties follow policy-derived incentives even if these are consistent with risk-taking.

Even though collateral frameworks are a long-established aspect of central banks' lending operations, relatively little research has been done in this area. Without addressing collateral frameworks specifically, Nyborg and Östberg, 2014 show that loosening conditions in the money market affect stock market returns, order imbalances, and market liquidity. To the extent central bank liquidity lines improve money market conditions, this implies that changes in a central bank's framework (e.g. changes in eligibility or haircuts) could have real effects. Van Bakkum et al. (2017) show that lowering the eligibility threshold for RMBS in Europe led to an increase in lending activity and a reduction in interest rates in the Netherlands. Both papers highlight that central bank liquidity transformation can have real effects.

Our findings contrast with those from Fecht et al. (2016) While in our setup, we find no evidence that risk-derived incentives superpose incentives derived from the facilities design, Fecht et al. (2016) find evidence for a "Systemic Arbitrage". In the ECB context, they look into similar variables as to our study and show that riskier banks pledge riskier collateral assets. They argue that the ECB collateral framework does not price the correlation risk between counterparty and collateral, which would otherwise be priced in private markets. We find no evidence for such an arbitrage opportunity in the UK context. Thus, we contribute to the literature

¹ Valuation of assets is especially relevant for illiquid assets, for which there is no observable market value.

² In this setup, the BoE is exposed to financial risks only if *simultaneously* the counterparty defaults and the collateral asset defaults or falls in value by more than the haircut imposed.

³ Similar to securitisation, loans pools are special purpose vehicles normally set in form of trusts and incur structuring, servicing and legal costs.

by showing that central bank risk management can avoid this “Systemic Arbitrage”.

Similarly, our findings contrast with those from Drechsler et al. (2016). While they suggest a risk-shifting channel in the ECB collateral framework, our results are not consistent with such a channel. Drechsler et al. (2016) argue that because the ECB is mandated to impose similar haircuts across its member states, some member states received haircuts that were more favourable relative to market pricing. In this way, counterparties could use those assets to access ECB liquidity on more favourable terms. Hence, central bank liquidity provision may entail an unintended transfer of risk to the central bank balance sheet. Our study shows that this risk-shifting channel can be avoided with prudent risk management policies.

2. Institutional background

The BoE offers a range of liquidity facilities, each designed for different purposes. As well as the ILTR and FLS, this also includes the Contingent Term Repo Facility, Discount Window Facility, Operational Standing Facilities, and intraday liquidity for clearing banks. In this paper, we focus on the FLS and ILTR, as these were the two facilities that were used regularly between 2010 and 2016. As outlined below, these are complementary facilities since they offer different forms of liquidity transformation and have different maturities. The Contingent Term Repo Facility is an emergency liquidity facility that the BoE can activate in response to actual or prospective market-wide stress of an exceptional nature. It has been activated only once, in the summer of 2012, during the European Debt Crisis. We do not cover the Contingent Term Repo Facility in this study because we focus on facilities that have been used routinely throughout the period.

The Discount Window Facility is a bilateral on-demand facility. It is aimed at institutions experiencing a firm-specific or market-wide shock. It allows counterparties to borrow highly liquid assets in return for less liquid collateral in potentially large size and variable terms. The BoE publishes the amount drawn in this facility with a five-quarter lag. No usage of this facility has been reported to date. See Bank of England (2016) for a detailed description of the BoE's liquidity facilities.

The Bank of England's Collateral Framework. The BoE defines three sets of eligible collateral: Level A collateral comprises high-quality, highly liquid sovereign securities; Level B collateral comprises high-quality liquid collateral, including other sovereigns, supranational, mortgage and corporate bonds; and Level C comprises less liquid securitisations, own-name securities and portfolios of loans (see Appendix A1 for a list of those collateral assets).

Collateral assets used in operations with the BoE are held in collateral pools, special purpose vehicles in the form of trusts. The BoE applies a haircut, h , on the value of assets in the collateral pool, P ; the haircut adjusted value of the collateral pool, V , is the maximum amount a bank can borrow.

$$V = (1 - h)P$$

The main tools of risk management of the BoE are assessment of counterparties' creditworthiness, collateral valuation and the haircut – supplemented with stress tests of collateral adequacy. Assets that have no observable liquid market are valued internally by the BoE. Once a security is deposited at the BoE it cannot be used for other purposes in private markets (e.g. repo, security lending), even if the counterparty has no outstanding borrowing from the BoE. For this reason, counterparties incur an opportunity cost when they deposit collateral assets at the BoE. Note that for regulatory purposes, when counterparties deposit collateral assets at the BoE

but do not draw liquidity upon them, these assets normally count as part of counterparties' balance sheet, and so, for example, can be counted towards their holdings of high-quality liquid assets where appropriate.

Indexed Long-Term Repos. The market-wide Indexed Long-Term Repo (ILTR) operations are aimed at banks, building societies and broker-dealers with a predictable need for liquid assets. The ILTR facility is the only permanent BoE facility that has been regularly used since its introduction, and this is the focus of our study. It is usually offered monthly in a uniform price auction, and funds have six-month maturities.⁴ Both parameters in the auction, quantity and rate, are flexible and depend on the offers received in the auction and the Bank's supply schedule. The rate charged as spread to the Bank Rate. However, the spread remains constant throughout the length of the operation, if the Bank Rate moves so does the charged interest rate on the transaction. Banks bid by submitting a nominal amount and a spread to the policy rate, expressed in basis points against a specific collateral set (A, B or C). The minimum bid size is £5 Mn, and the minimum spread for borrowing using collateral type A is 0 bps, B is 5 bps, and C 15 bps. Therefore borrowing against less liquid collateral assets is more expensive. Borrowers receive sterling cash, and settlement is $t+2$.

The Funding for Lending Scheme. The Funding for Lending Scheme (FLS) was launched over the summer of 2012 by the Bank of England and HM Treasury. It is designed to incentivize banks and building societies to boost their lending to UK households and businesses. Specifically, banks and building societies are offered funding conditional on their lending activity. Both the maximum allowance and the interest rate depend on the amount counterparties lend to the real economy. The FLS was intended to boost the supply of credit flowing into the real economy by reducing funding costs. In November 2013, in light of improvements in market conditions for mortgages and other consumer credit, these forms of lending were no longer counted towards FLS drawing limits. Similarly, when the BoE announced in late 2014 that the FLS program would remain in place until 2016 (and then subsequently extended until January 2018), it also announced that only lending to small and medium-sized enterprises would be eligible, given the improved market borrowing conditions for large firms.

Although the total amount of funding available through the FLS is limited by counterparties' lending allowance, it is accessible every business day, and borrowers receive Treasury bills on the same day (“ $t+0$ ”). Funding is provided at rates below market rates and for an extended period (up to 4 years maturity).⁵ The fee is flat at 0.25% for all types of collateral.⁶ FLS has no minimum borrowing amount. In contrast to the liquidity insurance facilities, FLS provides Treasury bills rather than central bank reserves. Hence, if BoE counterparties need cash, they must engage in a further transaction

⁴ Around the EU Referendum vote, between June and September 2016, auctions were weekly. Weekly auctions were introduced again in 2019 as a precautionary step ahead of the UK's potential withdrawal from the EU.

⁵ In contrast to the ILTR where early repayment is not possible, for the FLS borrowers do not have to wait to maturity to unwind the transaction.

⁶ Given the different maturity of the borrowing, it is not appropriate to directly compare the cost of the ILTR and the FLS. Nonetheless, it should be noted that the FLS would be strictly more expensive for borrowing for six months than the ILTR (even if allocated at the minimum spreads). Consider a repo using T-bills as collateral where banks apply zero haircuts, and zero counterparty risk added. The interest rate of such transaction would be Bank Rate, 0.75% as of January 2017. To consider the total cost of FLS borrowing, we would add this value to the FLS fee of 0.25pp, which adds up to 1.0%. ILTR costs Bank Rate plus the collateral spread of 0.15pp, which currently totals 0.9% in the case of collateral type C.

exchanging these Treasury bills for cash.⁷

3. Empirical evaluation

In this section, we relate counterparty and collateral characteristics to central bank liquidity demand. During this period, the administrative setup of the BoE collateral pools allows us to relate different liquidity facilities (i.e. ILTR and FLS) to counterparty and collateral characteristics, enabling us to understand how different policy designs can create different incentives.

We proceed by presenting our dataset. We then introduce our hypotheses and the methodology used to evaluate them. Lastly, we present our empirical results and specifications. Robustness checks are presented in [Appendix A2](#).

3.1. Descriptive statistics

An interesting feature of the BoE collateral framework is that, for operational reasons, collateral for FLS and ILTR operations was held in two separate pools until September 2016. This differentiation was related to the fact that the FLS program was launched jointly with HM Treasury and intended to be temporary, whereas the ILTR is one of the BoE's permanent liquidity facilities. Both facilities accepted all types of eligible collateral (A, B, and C – type C of collateral was introduced in March 2012). In September 2016, both pools were merged into one.⁸ Hence, we can use this administrative setup as a quasi-natural experiment and analyse the collateral assets used for each liquidity facility separately.

ILTR Collateral Pool. To understand the usage of BoE facilities as a form of liquidity insurance, we analyse both banks' use of the ILTR collateral pool and their actual ILTR drawings in the period from 2010Q1 to 2016Q3. In the BoE, collateral assets are divided into 52 categories, which each fall within three broad classification groups: collateral type A, B or C. Haircuts are set according to the granular collateral categories. We obtained proprietary data on each counterparty's ILTR collateral pool, with the amount held of each category and the haircut applied to each one of the 52 categories. We use the haircut as an indicator of the riskiness of the collateral pool.⁹ From the 52 categories the BoE use internally, we calculate the Herfindal index. This index takes values between 0 and 100 and indicates how concentrated the collateral pool is. All eligible collateral types are described in [Appendix A1](#).

We analyse banks' demand for ILTR liquidity in two layers. First, the size of the collateral pool is measured as the haircut adjusted value of pledged collateral assets divided by total assets, $\frac{\sum (1-h_i) \text{pledged}_{ib}}{TA_b}$, where h_i is the haircut on collateral type i , pledged_{ib} is the amount of collateral pledged by bank b of collateral type i , and TA_b is bank's b total assets. Second, we analyse banks' actual drawing of ILTR liquidity as a share of total assets, $\frac{\text{drawing}_b}{TA_b}$, where drawing_b is the total liquidity amount bank b draws from the BoE.

[Table 1](#) presents the descriptive statistics for the ILTR collateral pool and ILTR liquidity uptake. The mean size of banks' ILTR collateral pool is 2.32% of their total assets, and banks draw on

average 0.81%. The ILTR pool average haircut is 11.33%, and its Herfindal index is 78.5.

FLS Collateral Pool. [Table 2](#) presents the collateral variables for the FLS pool. The mean size of the FLS pool is 6.43% of the counterparty's balance sheet and the mean drawing size is 4.24%. Counterparties seem to have a preference to overcollateralization, probably to avoid needing to provide additional collateral in the case of margin calls.¹⁰ For both layers of liquidity demand, the FLS pool is substantially larger than the ILTR pool. Also, the haircut level is very different. The average haircut is 27.87%. FLS is not only larger and riskier, it is also more concentrated in type of assets, and its Herfindal index is 89.6.

In order to formalize the comparison of the haircut level across the collateral pools, we look specifically at observations where a given bank has collateral assets deposited in both pools simultaneously (204 observations). This avoids the results being driven by banks self-selecting themselves into one of the pools for different reasons. We run a simple t -test of whether the haircut of the FLS pool and the haircut of the ILTR collateral pool are different, where $H_0: \text{mean}(\text{diff}) = 0$ and $H_1 > 0$, and $\text{diff} = \text{haircut}_{\text{FLS}} - \text{haircut}_{\text{ILTR}}$. The t -value is 14.3. In other words, the mean of the FLS pool haircut is significantly higher than the mean of the ILTR pool haircut at the 1% confidence level. Thus, we conclude that the FLS pool has higher haircuts than the ILTR pool, i.e. on average, it includes less liquid, riskier assets.

In order to narrow down the relative risk incentives of both collateral pools further, we compare the haircut of the subset of collateral assets that belong only to the collateral type C. Since most assets used as collateral in category C are unsecured loan portfolios, this comparison tests if counterparties have a preference to systematically deposit loans with certain risk characteristics in different pools. As before $H_0: \text{mean}(\text{diff}) = 0$ and $H_1 > 0$, and $\text{diff} = \text{haircut}_{\text{FLS}} - \text{haircut}_{\text{ILTR}}$. The t -value is 8.14. Thus, we conclude that not only are the assets in the FLS pool typically riskier than those in the ILTR pool, but also even within the type C collateral used, counterparties prefer to use less liquid collateral in the FLS.¹¹

Comparing both collateral pools, we find that the FLS pool is larger, riskier and less diversified than the liquidity insurance collateral pool.¹² This difference likely arises in part from the different fee and maturity structures of the operations (discussed in more detail in [Section 2](#)) – the ILTR fee increases for less liquid collateral. FLS, on the other hand, has a flat fee structure for all collateral types, which favours the use of less liquid collateral assets. Furthermore, because the maturity of the FLS is much longer than the ILTR, counterparties have an incentive to use less liquid assets in operations with longer maturity. For both reasons, FLS incentivises the use of less liquid collateral assets.

The Bank of England's Counterparties. Of the 189 Sterling Monetary Framework participants (as of January 2017), which includes participants eligible to participate in the ILTR, 136 are eligible to participate in the Discount Window Facility and thus eligible to register as counterparties in the FLS. Since the analysis uses counterparties' balance sheets, we exclude the sample CCPs and broker-dealers because their balance sheets are structured substantially differently from commercial banks. Thus, we are left with 128 counterparties. In this group, 38 building societies, 32

⁷ In fact, the BoE's sterling operations desk reported that some counterparties engaged in both the FLS and ILTR operations simultaneously to complete their liquidity transformation needs.

⁸ What we refer to throughout the study as the liquidity insurance collateral pool or ILTR collateral pool is formally called the Single Collateral Pool within the BoE. Prior to the pools being merged, collateral assets in this pool could be used in any transaction with the BoE apart from FLS. However, during the period in question, the only facilities activated were the Indexed Long-Term Repo and the Contingent Term Repo Facility. Hence, for simplicity, we refer to it as the ILTR collateral pool.

⁹ Here, we refer to default and liquidity risk.

¹⁰ This may also reflect the fact that for groups of loans within a firm's collateral pool, they are required to encumber the entire group of loans, even if borrowing only a portion of this value.

¹¹ Note that, in this context, this captures both default risk and also duration risk. Counterparties may prefer to pledge loans with longer maturity in the FLS because its maturity is longer.

¹² Even when controlling for differences in collateral liquidity, we find that FLS collateral assets are riskier.

Table 1**Descriptive statistics for ILTR collateral pool variables.**

Quarterly data by bank. Values presented in the table reflect the collateral pool values in auction settlement dates ($t+2$). *Drawing/TA* is the amount a given bank draws upon ILTR as share of its balance sheet, *Collateral/TA* is the haircut adjusted value of collaterals over total assets, *Haircut* is the haircut applied on the complete collateral pool of a given bank, *HHI* is the collateral pool Herfindal index, which gives how concentrated a collateral pool of a given bank is. Period 2010Q1–2016Q3.

	Mean	Std Error	1 pcl	25 pcl	50 pcl	75 pcl	99 pcl	Obs
Drawing/TA (%)	0.81	1.32	0.00	0.04	0.22	1.01	6.05	358
Collateral/TA (%)	2.32	5.20	0.00	0.09	0.40	2.20	20.04	703
Haircut (%)	11.33	11.01	0.49	2.58	7.59	18	45.66	703
HHI (%)	78.51	26.08	25.24	53.04	99.75	100	100	703

Source: Bank of England.

Table 2**Descriptive statistics for FLS collateral pool variables.**

Quarterly data by bank. Values presented in the table reflect the collateral pool values in auction settlement dates ($t+2$). *Drawing/TA* is the amount a given bank draws upon ILTR as share of its balance sheet, *Collateral/TA* is the haircut adjusted value of collaterals over total assets, *Haircut* is the haircut applied on the complete collateral pool of a given bank, *HHI* is the collateral pool Herfindal index, which gives how concentrated a collateral pool of a given bank is. Period 2010Q1–2016Q3.

	Mean	Std Error	1 pcl	25 pcl	50 pcl	75 pcl	99 pcl	Obs
Drawing/TA (%)	4.24	3.25	0.01	1.83	3.68	5.74	13.43	528
Collateral/TA (%)	6.43	4.26	0.05	3.05	5.99	8.91	17.64	528
Haircut (%)	27.87	10.90	4.64	20.46	26.97	35.93	51.66	528
HHI (%)	89.62	18.17	37.23	85.94	100	100	100	528

Source: Bank of England.

branches of foreign banks, and 58 UK licensed banks (including subsidiaries of foreign banks).

We obtained quarterly balance sheet data from the Prudential Regulation Authority for 88 banks (50 UK banks and 38 building societies). From the data provider SNL Financial, we obtained data for 18 banks (17 branches of foreign banks and 1 UK bank), mainly in quarterly format. 4 banks have only annual data available, which is therefore interpolated into quarterly frequency. Bank groups with more than one active UK bank license are aggregated into one entity (four cases). Thus, we obtained data on 106 banks (unbalanced panel, missing data for some quarters for some banks), and after accounting for aggregations, this leaves a sample of 102 banks.

We follow [Fecht et al. \(2011\)](#) in the use of counterparty variables. To represent counterparties' size we use total asset defined as '000 £ and used in logs in the estimations. To represent counterparties' profitability we use return on equity (profitability), $ROE_b = \frac{return_b}{equity_b}$, where the return is counterparties' earnings in a given quarter, and equity refers to counterparties' total equity capital in that same quarter.¹³ We capture counterparties' liquidity needs using customers deposit flow, $\Delta D_b = \frac{deposit_b}{TA_b}$, which is the change in deposits over total assets in a given quarter. To represent counterparties' creditworthiness we use the equity ratio, $ER_b = \frac{equity_b}{TA_b}$, which is banks' equity capital over total assets. Lastly, we estimate counterparties' riskiness using the proportion of a bank's loan portfolio they expect to write-off due to defaults, $WR_b = \frac{writeoff_b}{outstanding\ lending_b}$.¹⁴

Table 3 presents the summary statistics for the counterparty balance sheet variables. The sample is populated by several small and mid-sized counterparties and a few very large ones, which can be seen by the difference between the median and mean counterparties' size. Return on equity is on average 0.56%. The mean

bank receives inflows of deposits of about 1% of its total assets every quarter. The mean equity ratio is almost 8% and write-offs 0.33%.

3.2. Empirical methodology

As previously discussed, we examine two layers of liquidity demand for each liquidity facility. The first layer is the haircut-adjusted value of collateral deposited in the pool. The second layer is the amount of liquidity a counterparty draws from each facility. For each liquidity facility we model the first and second layers of demand separately as a binary choice.

The first choice is whether the counterparty deposits collateral in the pool or not. Empirically we estimate this choice as a logit model where the dependent variable *Nonzero* equals one when bank b has a nonzero collateral pool in quarter t and zero otherwise. Formally, we estimate:

$$Pr(Nonzero_{b,t}^i | \omega_{b,t}) = \Phi(\gamma' \omega_{b,t}) \quad (1)$$

where $i \in \{ILTR, FLS\}$ and $\omega_{b,t}$ is a vector of control variables as

$$\gamma' \omega_{b,t} = \gamma_1 \log(TA_{b,t-1}) + \gamma_2 ROE_{b,t-1} + \gamma_3 ER_{b,t-1} + \gamma_4 ER_{b,t-1}^2 + \gamma_5 WR_{b,t-1} + \gamma_6 \Delta D_{b,t-1}$$

Note that the equity ratio is included as a squared term to account for nonlinear effects from this variable. Collateral variables are not present in this equation because they are defined only for non-zero pools.

The second choice is whether the counterparty draws from the liquidity facility, conditional on the collateral pool being non-zero. Similarly, we estimate this choice as a logit model where the dependent variable *Draw* equals one when bank b draws upon the facility in quarter t and zero otherwise. Formally, we estimate:

$$Pr(Draw_{b,t}^i | Nonzero_{b,t}^i = 1, \psi_{b,t}) = \Phi(\beta' \psi_{b,t}) \quad (2)$$

where

¹³ Equity is owners' residual that is paid after all the claims have been paid and would include the paid-in capital raised through stocks, retained earnings and other equity-related adjustments. This information is reported by the companies in their balance sheet.

¹⁴ Write-offs are provisions banks need to write off their balance sheets when they expect a loan to default, normally when payments are overdue by more than 90 days.

Table 3
Descriptive Statistics Bank Variables.

Total Assets (TA) is a measure of banks' size and defined in '000 £, return on equity (ROE) is a measure of banks' profitability and defined as $ROE_b = \text{return}_b / \text{equity}_b$, equity ratio (ER) is a measure of bank's soundness and is defined as banks' equity capital over total assets, $ER_b = \text{equity}_b / \text{TA}_b$, write-offs (WR) is a measure of bank's risk and is defined as provisions banks need to write off their balance sheets when they expect a loan to default, normally when payments are overdue by more than 90 days, $WR_b = \text{writeoff}_b / \text{outstanding lending}_b$, $\Delta\text{Deposit}$ (ΔD_b) is a measure of counterparties' liquidity defined as the change in customer's deposits over total assets, $\Delta D_b = \text{deposit}_b / \text{TA}_b$. Period 2010Q1–2016Q3.

	Mean	Std. Error	1pcl	25pcl	50pcl	75pcl	99pcl	Obs
Total Assets ('000 £)	1.88×10^8	4.07×10^9	120,574	556,977	3.06×10^6	9.36×10^7	1.68×10^9	2711
ROE (%)	0.56	8.54	−22.73	0.24	1.14	2.44	10.36	2706
Eq. Ratio (%)	7.66	5.12	1.50	4.92	6.84	8.86	22.47	2711
Write-off (%)	0.33	0.79	−0.12	0.007	0.06	0.27	4.40	2697
$\Delta\text{Deposit}$ (%)	0.96	8.68	−8.81	−0.55	0.48	2.04	17.11	2606

Sources: PRA and SNL.

$$\beta' \psi_{b,t} = \beta_1 \text{Haircut}_{b,t}^i + \beta_2 \text{HHI}_{b,t}^i + \beta_3 \log(\text{TA}_{b,t-1}) + \beta_4 \text{ROE}_{b,t-1} \\ + \beta_5 \text{ER}_{b,t-1} + \beta_6 \text{ER}_{b,t-1}^2 + \beta_7 \text{WR}_{b,t-1} + \beta_8 \Delta D_{b,t-1}$$

The declared ILTR policy desire is to provide liquidity insurance. Thus, banks experiencing a liquidity shortage would be expected to participate more. Also, the incentives derived from the ILTR design are for counterparties to use liquid collateral because they are cheaper. To test if counterparties follow the policy incentives, we formulate the following hypotheses:

Hypothesis 1. ILTR demand is negatively related to counterparties's balance sheet liquidity. We test: $\gamma_6 < 0$, and $\beta_8 < 0$.

Hypothesis 2. ILTR demand is negatively related to the risk of the collateral used. We test: $\beta_1 < 0$.

Another possible incentive is the risk-taking incentive. This incentive happens when the risk of counterparties and/or the collateral is too generously priced compared to private markets. If the risk-taking incentive is present, riskier counterparties participate more and/or riskier collateral is used proportionally more. Thus, we formulate the following hypotheses:

Hypothesis 3. ILTR demand is positively related to counterparty risk. We test: $\gamma_5 > 0$, and $\beta_7 > 0$.

Hypothesis 4. ILTR demand is positively related to collateral risk. We test: $\beta_1 > 0$.

FLS objective is to increase lending to the real economy by providing funding at rates below market rates. For this reason, we expect that all eligible counterparties would participate, and no specific counterparty's characteristic relates to FLS demand. FLS provides an incentive to use less liquid collateral assets as the rate charged does not change depending on the collateral. We create the following hypotheses that are consistent with the policy objectives:

Hypothesis 5. FLS demand does not correlate with counterparties' characteristics. We test: $\gamma' \omega_{b,t} = 0$.

Hypothesis 6. FLS demand is positively related to the risk of the collateral used. We test: $\beta_1 > 0$.

The hypotheses around the risk-taking incentive are the same for FLS as for ILTR:

Hypothesis 7. FLS demand is positively related to counterparty risk. We test: $\gamma_5 > 0$, and $\beta_7 > 0$

Hypothesis 8. FLS demand is positively related to collateral risk. We test: $\beta_1 > 0$.

Our set of regressions is divided into three parts. First, we estimate the probability that a counterparty has a non-zero collateral pool, Equation (1). Second, we investigate the probability that a

counterparty draws liquidity from the BoE given that it has a non-zero collateral pool, Equation (2). Third, we condition the sample on counterparties participating in the collateral framework and analyse what incentivises counterparties to increase the size of their collateral pool and the amount of liquidity subsequently drawn. The estimations are performed twice, for ILTR and FLS. Note that although we compare the results for ILTR and FLS, we expect there to be differences due to their different policy objectives.

We estimate Equations (1) and (2) using logit model two specifications with and without fixed effects. Fixed effects are created using jack-knife correction as proposed by Fernandez-Val and Weidner (2016) in the time and bank dimensions. The third part investigates how much liquidity banks demand as a share of their balance sheet — using a panel data model, estimated with OLS. In all estimations, standard errors are clustered by counterparty.

3.3. The choice to deposit collateral

ILTR Collateral Pool. Our left-hand-side variable, $\text{Nonzero}_{b,t}^{\text{ILTR}}$, is a dummy variable that takes the value one if banks deposit collateral assets in their BoE account and zero otherwise. To put the magnitude of our results in context, the unconditional probability of participation, i.e. the average value of our dummy, is 22%. Table 4 presents the result for the probability model related to whether counterparties deposit collateral in the ILTR pool (first four columns). Each estimation is presented in two forms: with and without fixed effects. We focus on the results with fixed effects because they control for all other time-invariant banks' characteristics. The results without fixed effects are presented to demonstrate the robustness of the key findings.

In Table 4, the fourth column (AME) gives the average marginal effect for our preferred specification: an estimation using fixed effects in the counterparty and time dimensions. Log total assets are positively related to the size of the collateral pool with significance at the 1% level: an increase in size of one standard error (SE) would result in a 2.6% increase in the probability of depositing collateral assets in the ILTR pool. An increase in return on equity by one SE relates to a decrease in the probability of participation −0.04%. A one SE increase in the equity ratio relates to a 0.5% higher probability of having a non-zero collateral pool. Write-off is our measure of banks' riskiness. A one SE increase in loan book write-offs is related to a 0.1% lower chance of participation. This result remains significant if we substitute write-offs with other measures of risk, such as the leverage ratio or implied CDS.¹⁵ Lastly, high deposit inflow is associated with a greater

¹⁵ As an alternative specification, we estimated all regressions provided in this study using both the leverage ratio and implied 5 year CDS provided by Bloomberg. In both cases our main results remain unchanged.

Table 4**Probability that the Collateral Pool is Non-zero.**

This table relates banks characteristics to the decision to deposit collateral assets at the BoE. Left-hand variable, $Nonzero_{b,t}^i$ is a dummy that takes the value one if a bank has a non-zero collateral pool and zero otherwise. TA: log total assets, ROE: return on equity, ER: equity ratio, WR: write-off, and ΔD change in deposits. Estimation is a logit model and fixed effects refer to jackknife correction as proposed by Fernandez-Val and Weidner (2016). Standard errors are clustered at the bank dimension, Coef. represents the estimated coefficients, AME represents the average marginal effect. Standard in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	ILTR Collateral Pool				FLS Collateral Pool			
	Coef.	AME	Coef.	AME	Coef.	AME	Coef.	AME
$\log(TA_{b,t-1})$	0.93*** (0.11)	0.93*** (0.11)	4.12*** (0.58)	0.27*** (0.04)	0.53*** (0.21)	0.53*** (0.21)	−2408*** (2.12)	0.94*** (0.32)
$ROE_{b,t-1}$	−0.00 (0.01)	−0.00 (0.01)	−0.10*** (0.01)	−0.005*** (0.00)	−0.00 (0.02)	−0.00 (0.02)	30.98*** (0.05)	−0.01*** (0.00)
$ER_{b,t-1}$	0.72*** (0.16)	0.72*** (0.16)	3.08*** (0.18)	0.15*** (0.01)	0.62*** (0.23)	0.62*** (0.23)	−1569*** (0.47)	0.03* (0.02)
$ER_{b,t-1}^2$	−0.03*** (0.01)	−0.03*** (0.01)	−0.14*** (0.00)	−0.01*** (0.00)	−0.02** (0.01)	−0.02** (0.01)	74.64*** (0.02)	−0.00 (0.00)
$WR_{b,t-1}$	−0.98*** (0.25)	−0.98*** (0.25)	−2.45*** (0.33)	−0.13*** (0.01)	−0.32 (0.42)	−0.32 (0.42)	462.42*** (0.75)	−0.00 (0.00)
$\Delta D_{b,t-1}$	0.33 (0.69)	0.33 (0.69)	3.85*** (0.60)	0.15*** (0.03)	0.007 (0.02)	0.007 (0.02)	−10.39*** (0.05)	0.007** (0.003)
Bank FE	No	No	Yes	Yes	No	No	Yes	Yes
Time FE	No	No	Yes	Yes	No	No	Yes	Yes
Pseudo R ²	0.15	0.15	0.61	0.61	0.02	0.02	0.42	0.42
Obs	2506	2506	1707	1707	1527	1527	655	655
# Banks	101	101	68	68	101	101	39	39

likelihood of participation: a one SE increase in deposits leads to a 1.3% higher probability of participation in the ILTR pool.

In summary, the results for the ILTR pool show that larger banks with more equity, lower write-offs and greater deposit inflow (albeit with lower profitability) are more likely to participate in the BoE collateral framework.

Relating our results to the hypotheses raised, we find no evidence for either incentive. That is, we find no evidence that banks with liquidity shortage or riskier banks pre-position more collateral. This is consistent with the view that banks pre-position collateral before the liquidity need. In this case, [Hypothesis 1](#) may be closely linked to the second layer of liquidity demand. Also, we find no evidence that riskier counterparties participate more. The opposite happens. Relatively safer counterparties pre-position more.

FLS Collateral Pool. The unconditional probability of participation of the FLS collateral pool, $Nonzero_{b,t}^{FLS}$, is 18%. This serves to put the following results into perspective.

[Table 4](#) suggests a different picture for FLS than for ILTR. In its last column, we show the average marginal effect for our preferred specification for FLS liquidity demand. An increase of one SE in log total assets is associated with an increase of 9% in the probability that a bank participates in the FLS pool. A decrease in the return on equity by one SE relates to a decrease in the participation probability of −0.09%. A one SE increase in equity relates to a 0.15% higher probability of having a non-zero collateral pool. A one SE increase in deposits corresponds to a 0.06% higher probability of participation in the FLS pool.

In summary, larger counterparties, which are less profitable, with more equity, and greater deposit inflow, are more likely to participate. The main difference between the results for the ILTR and the FLS is the counterparty risk variable, which is not significant for the FLS. This suggests that, in contrast to the ILTR pool, participation in the FLS pool is not negatively related to counterparties' write-off rate.

Confronting these results with the hypotheses raised, we find no evidence supporting either incentive (Hypotheses 5 and 7). There are counterparties characteristics related to FLS demand, countering the prior of the policy. Economically, bank size is a major determinant of participation. It is possible that larger banks can

better intermediate the funds received, and have a proportionally larger uptake. Also, we find no supporting evidence to the risk-taking incentive as the write-off variable is not significant.

Our results in this section suggest that the only characteristic that has a different role in determining which counterparties participate in the ILTR and FLS pools is counterparties' riskiness. Whereas in the ILTR pool, there is self-selection of relatively healthier counterparties, no self-selection of this type appears to happen in the FLS pool.

There are several differences in the design of the liquidity facilities that could lead to different incentives to deposit collateral in the pool. First, the maturity of FLS is up to 4 years, whereas the ILTR is six months. Second, the ILTR delivers central bank reserves, whereas FLS delivers T-bills, implying that an FLS counterparty needs to engage in a further repurchase agreement to transform its T-bills into cash. Third, the ILTR is allocated through an auction process, whereas the FLS can be drawn in a non-competitive manner, as long as the counterparty has not reached its FLS borrowing limit. As discussed in the next section, only a subset of counterparties actually draws liquidity in the ILTR using the collateral they have deposited. Therefore, on the margin, banks (particularly smaller entities) might prefer to avoid any perceived costs involved in developing the capability and expertise to participate in the ILTR auctions. Fourth, the ILTR auction usually takes place once a month and delivery is $t+2$, whereas FLS can be drawn upon daily with same-day delivery.

3.4. The choice to draw liquidity

In this section, we examine to what extent counterparties with a non-zero collateral pool draw upon it. In the ILTR pool, 56% of the non-zero pools observations draw liquidity in the ILTR. The large share of deposits without withdrawals reflects the primary purpose of this facility: insurance against unexpected liquidity needs. In contrast, 99% of all observations with a non-zero FLS pool do draw upon them.¹⁶ In other words, the two layers of liquidity demand are

¹⁶ This is expected since there is no reason to deposit collateral in the FLS pool unless the counterparty intends to use the scheme. The 1% difference is due to a lag between collateral deposit and funds withdrawal.

Table 5
Probability of Drawing upon ILTR, conditional on non-zero collateral pool.

Estimation conditional on $Nonzero_{b,t}^{ILTR} = 1$. Left hand variable, $Draw_{b,t}^{ILTR}$, is a dummy that takes the value one if a bank has a draws upon ILTR in the period and zero otherwise. Haircut: haircut, HHI: Herfindahl Index for collateral concentration, TA: log total assets, ROE: return on equity, ER: equity ratio, WR: write-off, and ΔD change in deposits. Estimation is a logit model and fixed effects refer to jackknife correction as proposed by Fernandez-Val and Weidner (2016). Standard errors are clustered at the bank dimension. Coef. represents the estimated coefficients, AME represents the average marginal effect. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	ILTR Collateral Pool		Coef.	AME
	Coef.	AME		
$Haircut_{b,t}$	−0.04** (0.02)	−0.04** (0.02)	−5.27*** (0.03)	−0.01*** (0.00)
$HHI_{b,t}$	−0.05*** (0.01)	−0.05*** (0.01)	25.13*** (0.02)	−0.01*** (0.00)
$\log(TA_{b,t-1})$	0.75** (0.31)	0.75** (0.31)	−3067*** (3.20)	5.54*** (0.25)
$ROE_{b,t-1}$	−0.01 (0.04)	−0.01 (0.04)	−151.8*** (0.77)	−0.00 (0.00)
$ER_{b,t-1}$	−1.53*** (0.51)	−1.53*** (0.51)	−1203*** (1.37)	0.64*** (0.05)
$ER^2_{b,t-1}$	0.11*** (0.03)	0.11*** (0.03)	37.31*** (0.09)	−0.01** (0.00)
$WR_{b,t-1}$	1.91** (0.94)	1.91** (0.94)	−2.834*** (2.73)	−0.20 (0.17)
$\Delta D_{b,t-1}$	0.13 (0.08)	0.13 (0.08)	−43.21*** (0.12)	−0.03*** (0.00)
Bank FE	No	No	Yes	Yes
Time FE	No	No	Yes	Yes
Pseudo R ²	0.41	0.41	0.64	0.64
Obs	577	577	239	239
# Banks	64	64	17	17

the same for the FLS. Since drawing from the FLS is effectively deterministic given participation in the FLS pool, we focus only on the ILTR pool in this section.

We restrict the dataset to retain only observations for which counterparties have a non-zero ILTR pool. We estimate a logit model, where the left-hand side variable is a dummy that takes the value one if, in a given month, the counterparty draws upon the ILTR and zero otherwise. In this set of estimations, we can relate liquidity demand, counterparties and collateral assets since the estimations are conditional on non-zero collateral pools.

Table 5 presents the results. The last column presents the average marginal effect for our preferred specification of the logit estimation, using fixed effects in the counterparty and time dimension. One SE higher haircut is linked to a -0.11% ($= -0.01 \times 11.01$, i.e. estimated coefficient in Table 5 multiplied by its SE presented in Table 1) lower probability of drawing on liquidity in the ILTR. Similarly, a one SE higher Herfindahl index is related to a -0.26% lower probability of drawing liquidity in the ILTR. One SE increase in log total assets is associated with an increase of 52% in the probability that a counterparty draws liquidity.¹⁷ A one SE higher equity ratio relates to a 0.26% ($= -1.53 \times 5.12 + 0.11 \times (5.12)^2$, i.e. estimated coefficients in Table 5 multiplied by its SE presented in Table 3) higher probability of drawing liquidity. A one SE increase in deposits corresponds to a -0.26% probability of drawing on the ILTR. In summary, larger counterparties with more equity and less liquidity, using less risky and more diversified collateral pools, are more likely to draw upon the ILTR.

Our results suggest the prevalence of the policy-derived incentives but not of the risk-taking incentives. The drawing of ILTR is

negatively related to the liquidity of the counterparty's balance sheet (ΔD), which confirms Hypothesis 1 and negatively related to collateral risk (haircut), which confirms Hypothesis 2 and rejects Hypothesis 4.

ILTR operations are conducted through uniform price auctions, in which all participants pay the cut-off rate. This setup should incentivize smaller and less specialized institutions to participate. The fact that we find the opposite effect, i.e., that larger institutions participate more, suggests that there are incentives beyond the control of the central bank.

These results, combined with the first layer of ILTR demand, paint a picture of healthy counterparties with reduced liquidity (coming from deposit outflows) drawing upon the liquidity insurance. The fact that collateral risk (haircut) is negatively related to the probability of drawing upon the liquidity insurance suggests that using collateral type A is preferable to types B and C, i.e. banks prefer to use safer collateral assets if possible. This result is likely to be linked to the fee structure of the ILTR operation. Using collateral assets type B, banks have to pay a 5bps higher fee than collateral type A. Using collateral assets type C; banks have to pay a 15bps higher fee than collateral type A. This fee structure appears to be steep enough to give banks incentives to use collateral type A in the first instance.

3.5. The size of the collateral pool and drawing amounts

In this section, we go beyond investigating our hypotheses and shed some light on the variables influencing the size of the liquidity demand. The dependent variables, collateral/TA and drawing/TA, are the pool size over total assets and drawing amount over total assets. The collateral pool size is calculated taking into account the haircut adjustment. In this form, we capture the actual borrowing capacity of each counterparty, scaled by its size, which is the first layer of liquidity demand. The drawing amount captures the realised liquidity need of each counterparty, and so represents the second layer of liquidity demand. The estimations are performed using ordinary least squares with fixed effects in the bank and time dimensions. Standard errors are clustered at the bank dimension.

ILTR Collateral Pool. Table 6 presents the results for the ILTR pool. The three columns on the left represent the first layer of liquidity demand, and the three on the right the second layer. As before, we focus our interpretation on the columns with time and counterparty fixed effects.

For the first layer (collateral/TA), we find that no counterparty characteristic is a statistically significant explanatory variable of liquidity demand. Conversely, when looking at collateral characteristics, we find that both variables are significant: pool size and then amount drawn is positively related to collateral risk. A one SE larger haircut is associated with a 0.44% larger collateral pool. A one SE larger haircut is related to 0.11% larger liquidity drawing. Larger collateral pools are more diversified, but larger liquidity drawings are not related to more diversified collateral pools. A one SE increase in the Herfindal index relates to a 0.01% larger collateral pool.

For the second layer (drawing/TA), the only significant variable is the haircut. A one SE larger haircut is associated with a 0.11% larger drawing. That is, larger ILTR drawings use collateral with higher haircuts.

Our results suggest that larger collateral pools (the first layer of liquidity demand) tend to be more diversified pools with higher haircuts, i.e., on average, they include less liquid collateral assets. This result is consistent with the view that banks first pledge more liquid collateral assets, and then as they increase their use of the BoE's liquidity insurance, they use less liquid assets.

FLS Collateral Pool. Table 7 shows the results for the FLS pool.

¹⁷ Due to the restricted sample size for this particular estimation, the coefficient of total assets may be somewhat overestimated. So we do not place a lot of weight on the precise magnitude of this estimate. Consistent with that, the size of the effect is much smaller for the estimation without fixed effects presented in the same table.

Table 6
Size of ILTR Liquidity Demand.

This table relates the size of liquidity demand to characteristics banks and collateral characteristics. Estimations (I)–(III) represent the first layer of liquidity demand, the size of the collateral pool. The left hand variable is Collateral/TA, as defined in Table 2. Estimations (IV)–(VI) represent the second layer of liquidity demand, the amount of liquidity draw upon. The left hand variable is Drawing/TA, as defined in Table 2. Haircut: haircut, HHI: Herfindahl Index for collateral concentration, TA: log total assets, ROE: return on equity, ER: equity ratio, WR: write-off, and ΔD change in deposits. OLS panel data estimation using fixed-effects. Standard errors are clustered at the bank dimension. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	ILTR Collateral Pool					
	(I) Collateral/TA	(II) Collateral/TA	(III) Collateral/TA	(IV) Drawing/TA	(V) Drawing/TA	(VI) Drawing/TA
$Haircut_{b,t}$	0.05*** (0.02)	0.05** (0.02)	0.04** (0.02)	0.02** (0.00)	0.02* (0.00)	0.01* (0.00)
$HHI_{b,t}$	−0.05*** (0.02)	−0.04** (0.02)	−0.04** (0.02)	−0.01* (0.00)	−0.01* (0.00)	−0.00 (0.00)
$\log(TA_{b,t-1})$	−0.49*** (0.10)	4.74* (2.39)	2.40 (1.62)	−0.02*** (0.00)	0.14 (0.09)	0.03 (0.08)
$ROE_{b,t-1}$	−0.01 (0.01)	0.01 (0.03)	0.02 (0.02)	−0.00 (0.00)	−0.00 (0.00)	0.00 (0.00)
$ER_{b,t-1}$	0.47** (0.24)	0.73 (0.44)	−0.23 (0.89)	0.21 (0.2)	0.34 (0.2)	−0.19 (0.2)
$ER^2_{b,t-1}$	−0.03*** (0.01)	−0.02 (0.02)	0.01 (0.03)	−0.01** (0.00)	−0.00 (0.00)	−0.00 (0.00)
$WR_{b,t-1}$	−0.59** (0.25)	−0.32 (0.28)	0.02 (0.25)	−0.04*** (0.00)	0.27 (0.2)	0.24 (0.2)
$\Delta D_{b,t-1}$	0.10 (0.07)	0.05 (0.07)	0.02 (0.07)	0.00 (0.00)	0.00 (0.00)	−0.00 (0.00)
Bank FE	No	Yes	Yes	No	Yes	Yes
Time FE	No	No	Yes	No	No	Yes
Adjusted R ²	0.273	0.427	0.478	0.250	0.623	0.658
Obs	633	616	616	353	352	352

Table 7
Size of FLS Liquidity Demand.

This table relates the size of liquidity demand to characteristics banks and collateral characteristics. Estimations (I)–(III) represent the first layer of liquidity demand, the size of the collateral pool. The left hand variable is Collateral/TA, as defined in Table 2. Estimations (IV)–(VI) represent the second layer of liquidity demand, the amount of liquidity draw upon. The left hand variable is Drawing/TA, as defined in Table 2. Haircut: haircut, HHI: Herfindahl Index for collateral concentration, TA: log total assets, ROE: return on equity, ER: equity ratio, WR: write-off, and ΔD change in deposits. OLS panel data estimation using fixed-effects. Standard errors are clustered at the bank dimension. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	FLS Collateral Pool					
	(I) Collateral/TA	(II) Collateral/TA	(III) Collateral/TA	(IV) Drawing/TA	(V) Drawing/TA	(VI) Drawing/TA
$Haircut_{b,t}$	0.03 (0.03)	0.04 (0.03)	0.04 (0.03)	−0.00 (0.00)	−0.00 (0.00)	0.00 (0.00)
$HHI_{b,t}$	−0.04*** (0.01)	−0.04*** (0.01)	−0.04*** (0.01)	−0.04*** (0.00)	−0.04* (0.00)	−0.02* (0.00)
$\log(TA_{b,t-1})$	−0.57** (0.23)	2.73*** (0.99)	2.71** (1.02)	−0.02* (0.01)	0.26 (0.16)	−0.02 (0.11)
$ROE_{b,t-1}$	0.01 (0.03)	−0.01 (0.03)	−0.02 (0.02)	0.00 (0.00)	0.00 (0.00)	−0.00 (0.00)
$ER_{b,t-1}$	1.22*** (0.35)	1.60*** (0.45)	1.45*** (0.51)	0.84** (0.32)	1.13** (0.41)	0.44 (0.61)
$ER^2_{b,t-1}$	−0.04*** (0.01)	−0.04*** (0.01)	−0.04** (0.01)	−0.02*** (0.00)	−0.03** (0.00)	−0.00 (0.00)
$WR_{b,t-1}$	0.38 (0.41)	1.16** (0.43)	0.93** (0.44)	−0.01 (0.04)	0.07* (0.03)	0.07 (0.05)
$\Delta D_{b,t-1}$	−0.00 (0.01)	0.00 (0.01)	−0.00 (0.01)	−0.00 (0.00)	0.00 (0.00)	−0.00 (0.00)
Bank FE	No	Yes	Yes	No	Yes	Yes
Time FE	No	No	Yes	No	No	Yes
Adjusted R ²	0.354	0.820	0.825	0.116	0.630	0.718
Obs	521	520	520	521	520	520

As before, we focus our interpretation on the columns with time and counterparty fixed effects. More diversified pools are associated with smaller collateral pools (1.1 times smaller for a one SE increase in the Herfindahl index) and fewer FLS uptake (0.55 times smaller for a one SE increase in the Herfindahl index). Counterparties with one SE larger total assets have a pool size 26 times

larger than the mean counterparty. However, drawings are not significantly larger for more sizeable counterparties. Similarly, counterparties with one SE higher equity ratio have 6.3 times larger collateral pools, but drawings are not significantly different. Counterparties with loans write-offs one SE higher also have 0.74 times larger collateral pools, although again, drawings are not

significantly larger for those counterparties. In summary, larger counterparties, with more equity and higher write-offs, using more diversified collateral portfolios, tend to have larger collateral pools. Larger FLS drawings are associated with less diversified collateral pools but are not significantly related to counterparty risk.

Linking our results to our research question, we find no evidence that banks' riskiness is interconnected with liquidity uptake; in Table 6 we find no evidence that counterparty risk is associated with ILTR demand. In Table 7, we find that write-off is significant for the first layer of FLS demand, but in column VI, we find that it is not related to the second layer of FLS demand. The haircut variable, on the other hand, is positive and significant for the ILTR pool (Table 6), which suggests that larger pools tend to include riskier collateral assets. As previously described, this result appears to be linked to the fact that banks start with a core of liquid collateral assets, and as they increase their collateral pool, they add less liquid assets. Thus, we find no evidence that liquidity uptake with the BoE is linked either to riskier banks or to riskier collateral assets.¹⁸

4. Conclusion

Liquidity transformation by central banks can take many forms. Traditionally it has involved transforming liquid collateral assets (e.g. sovereign bonds) into even more liquid assets (e.g. cash). However, it can also involve transforming less liquid collateral assets (e.g. unsecuritised loan portfolios) into more liquid assets (e.g. cash or treasury bills).

In the form of the BoE's ILTR facility, liquidity insurance acts by providing liquidity transformation from a wide range of eligible collateral assets into the most liquid asset, central bank reserves, for a term of 6 months. The Funding for Lending Scheme acts in a different part of the liquidity transformation scale. In FLS, counterparties can also use a wide range of eligible collateral assets and receive a more liquid asset in return, Treasury bills, for a term of up to 4 years. In practice, these facilities' different designs and purposes have led counterparties to typically use less liquid collateral for the FLS relative to the ILTR. In this dimension, both liquidity lines are complementary.

We find evidence that counterparties follow the policy-derived incentives. Counterparties with deposit outflows and greater liquidity make greater use of the ILTR, which is the objective of the liquidity insurance policy. Although riskier counterparties seem to pre-position more collateral for usage in FLS, they do not draw upon FLS funding significantly more than others. Thus, we find no evidence that riskier counterparties have more substantial incentives to use either of the liquidity facilities. Collateral usage in ILTR operations typically starts with more liquid collateral assets, and then as the size of the demand increases, the use of less liquid assets gradually increases. FLS operations are almost entirely collateralised by unsecuritised loan portfolios. For both facilities, the composition of collateral assets follows the relative incentives of the liquidity transformation operations.

Appendix

A1 Eligible Collateral Assets at the Bank of England

The Bank of England collateral framework is divided into three types of collateral assets according to their market liquidity. Collateral type A is the most liquid type and is composed of: Gilts;

Sterling Treasury bills; HM Government debt denominated in US dollar, Canadian dollar and Euro; Bank of England securities; sovereign and central bank debt from Canada, France, Germany, the Netherlands and the United States. Collateral type B is the intermediary liquidity category and is composed of: sovereign and central bank debt from Australia, Austria, Belgium, Denmark, Finland, Ireland, Italy, Japan, Luxembourg, New Zealand, Norway, Portugal, Slovenia, Spain, Sweden, and Switzerland in Sterling, Euro or US dollar; international organizations securities denominated in Sterling US dollar, Canadian dollar and Euro; G10 government-guaranteed agency bonds; HM Government debt in other currencies; HM Government Sukuk bonds; HM government-guaranteed bank debt; FHLMC, FNMC, and FHLB securities; UK and Dutch (AAA) RMBS; UK, French, German, and Spanish (AAA) covered bonds; UK, US, EEA (AAA) ABS, credit cards, auto and equipment leases; US (AAA) ABS, consumer and student credit; Non-UK government-guaranteed bank debt; portfolios of senior corporate bonds and commercial paper issued by non-financial companies in UK, US, and EEA. Collateral type C is the least liquid category and is composed of: UK, EEA RMBS rated A- or better; UK, US, EEA covered bonds rated A- or better; UK, US, EEA ABS rated A- or better; UK, US, EEA CMBS rated A- or better; UK, US, EEA securitised portfolios of SME loans and corporate bonds; UK, US, EEA ABCP rated A1 or better; portfolio of corporate bonds and commercial paper issued by non-financial corporates; non-UK government-guaranteed bank debt; individual loans that meet certain criteria.

A2 Robustness Checks

To check the empirical validity of our main results, we present two sets of additional estimations. First, we address possible multicollinearity between variables in Table 4. To show that variables have individual explanatory power over the decision to have a non-zero collateral pool, we introduce each variable separately into the regression. Table A1 in the Appendix shows the results for ILTR and Table A2 for FLS. With respect to ILTR, although the coefficients have slightly different magnitudes, the statistical significance remains unchanged. With respect to FLS, the only variable that remains unchanged is ROE. The fact that coefficients change their significance suggests that they are jointly valid but not individually significant. This is consistent with the view that self-selection of riskier banks does not take place in the FLS facility.

Second, we address the definition of our dependent variables in Table 4. Both in ILTR and FLS, the dependent variable is defined as one for non-zero collateral pools and zero for pools with no collateral. However, if the decision to have a non-zero collateral pool is serially correlated, our results could be biased. Self-selection is not an issue with FLS because all deposits of collateral were accompanied by a drawing. Thus, the decision to deposit is related to the drawing in the same period and not to act in the previous period. Thus, we focus on the serial correlation of ILTR.

To check that regardless of the serial correlation, the results remain unchanged, we provide an alternative specification. We define the dependent variables as taking the value one when banks increase the size of their collateral pool, i.e. when they deposit more collateral and zero otherwise. Table A3 in the Appendix shows the results. Although the coefficients have slightly different magnitudes, the statistical and economic significances remain unchanged. This suggests that serial correlation is not driving the ILTR results.

¹⁸ We also have performed estimations using the interaction term between the haircut and write-off variables. The interaction variable is insignificant in all specifications.

Table A1
Probability that the ILTR Collateral Pool is Non-zero, Variables Introduced Separately.

This table relates banks characteristics to the decision to deposit collateral assets at the BoE introducing one variable at time. Left-hand variable, $Nonzero_{b,t}^{ILTR}$, is a dummy that takes the value one if a bank has a non-zero collateral pool and zero otherwise. TA: log total assets, ROE: return on equity, ER: equity ratio, WR: write-off, and ΔD change in deposits. Estimation is a logit model and fixed effects refer to jackknife correction as proposed by Fernandez-Val and Weidner (2016). Standard errors are clustered at the bank dimension. Coef. represents the estimated coefficients, AME represents the average marginal effect. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	ILTR Collateral Pool				
	AME	AME	AME	AME	AME
$\log(TA_{b,t-1})$	0.13*** (0.05)				
$ROE_{b,t-1}$		−0.003*** (0.0006)			
$ER_{b,t-1}$			0.09*** (0.008)		
$ER_{b,t-1}^2$			−0.005*** (0.0002)		
$WR_{b,t-1}$				−0.09*** (0.02)	
$\Delta D_{b,t-1}$					0.002*** (0.0003)
Bank FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Pseudo R ²	0.55	0.54	0.54	0.55	0.53
Obs	1458	1458	1458	1458	1458
# Banks	58	58	58	58	58

Table A2
Probability that the FLS Collateral Pool is Non-zero, Variables Introduced Separately.

This table relates banks characteristics to the decision to deposit collateral assets at the BoE introducing one variable at time. Left-hand variable, $Nonzero_{b,t}^{FLS}$, is a dummy that takes the value one if a bank has a non-zero collateral pool and zero otherwise. TA: log total assets, ROE: return on equity, ER: equity ratio, WR: write-off, and ΔD change in deposits. Estimation is a logit model and fixed effects refer to jackknife correction as proposed by Fernandez-Val and Weidner (2016). Standard errors are clustered at the bank dimension. Coef. represents the estimated coefficients, AME represents the average marginal effect. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	FLS Collateral Pool				
	AME	AME	AME	AME	AME
$\log(TA_{b,t-1})$	0.35 (0.27)				
$ROE_{b,t-1}$		−0.009*** (0.003)			
$ER_{b,t-1}$			−0.04*** (0.016)		
$ER_{b,t-1}^2$			0.00 (0.00)		
$WR_{b,t-1}$				0.20*** (0.04)	
$\Delta D_{b,t-1}$					0.003 (0.002)
Bank FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Pseudo R ²	0.71	0.57	0.57	0.56	0.56
Obs	655	655	655	655	655
# Banks	39	39	39	39	39

Table A3
Alternative Specification Probability that the ILTR Collateral Pool is Non-zero.

This table relates banks characteristics to the decision to deposit collateral assets at the BoE introducing one variable at time. Left-hand variable, $deposit_{b,t}^{ILTR}$, is a dummy that takes the value one when banks increase the size of their collateral pool, i.e. when they deposit more collateral and zero otherwise. TA: log total assets, ROE: return on equity, ER: equity ratio, WR: write-off, and ΔD change in deposits. Estimation is a logit model and fixed effects refer to jackknife correction as proposed by Fernandez-Val and Weidner (2016). Standard errors are clustered at the bank dimension. Coef. represents the estimated coefficients, AME represents the average marginal effect. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	ILTR Collateral Pool			
	Coef.	AME	Coef.	AME
$\log(TA_{b,t-1})$	0.51*** (0.07)	0.51*** (0.07)	1.65*** (0.62)	0.12** (0.05)
$ROE_{b,t-1}$	−0.01 (0.01)	−0.01 (0.01)	−0.04*** (0.01)	−0.002*** (0.0007)
$ER_{b,t-1}$	0.32*** (0.12)	0.32*** (0.12)	1.27*** (0.11)	0.08*** (0.007)
$ER_{b,t-1}^2$	−0.01** (0.005)	−0.01** (0.005)	−0.06*** (0.001)	−0.004*** (0.0001)
$WR_{b,t-1}$	−0.70*** (0.19)	−0.70*** (0.19)	−0.64*** (0.23)	−0.056*** (0.015)
$\Delta D_{b,t-1}$	−0.002 (0.007)	−0.002 (0.007)	0.047*** (0.006)	0.003*** (0.0004)
Bank FE	No	No	Yes	Yes
Time FE	No	No	Yes	Yes
Pseudo R ²	0.13	0.13	0.37	0.37
Obs	2506	2506	1596	1596
# Banks	101	101	64	64

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