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## Abstract

We examine how banks' cross-border lending reacts to changes in liquidity regulation using a new dataset on Individual Liquidity Guidance (ILG), which was enacted in the UK from 2000 to 2015 and is similar to the Basel III Liquidity Coverage Ratio. A one percentage point increase in liquidity requirements to total assets reduces UK resident banks' cross-border lending growth by around 0.6 percentage points and both bank and non-bank lending are affected. But quality matters: an increase in the holdings of High Quality Liquid Asset (HQLA) qualifying sovereign debt offsets some of the reduction in total cross-border lending growth. Furthermore, the strongest reduction is driven by foreign subsidiaries from countries where sovereigns do not issue HQLA; in contrast subsidiaries from countries issuing HQLA are able to protect their lending to unrelated entities and cut their intragroup lending instead. Banks with a higher deposit share as a consequence of established retail operations, such as those headquartered in the UK, are also able to offset the effects of increases of liquidity requirement on cross-border lending.

**Key words:** Liquidity regulation, liquidity requirements, external lending, intensity of prudential regulations.

**JEL classification:** G21, G28, F36.

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# 1 Introduction

Prior to the financial crisis, bank regulation mainly focused on ensuring banks had adequate capital, despite exposure to liquidity risk and bank runs being a fundamental feature of banking models at least since Diamond and Dybvig (1983). The experiences of the 2008 crisis reignited interest in liquidity regulations. The classical prescription of a Lender of Last Resort comes with the risk of moral hazard (Bagehot, 1873; Freixas, 1999; Freixas et al., 2004; Carlson et al., 2015) and so liquidity regulation is used as a complement. The introduction of global liquidity standards - the Net Stable Funding Ratio (NSFR) and the Liquidity Coverage Ratio (LCR) - in the Basel III accord are aimed at ensuring banks are able to survive runs.

The LCR has been phased in from 2015 to 2019 to allow banks to adjust, and so there is little evidence so far on how banks react to liquidity regulation.[1] In contrast to capital regulation, few countries have recent experience with liquidity regulation,[2] and far fewer have applied it in a time varying and bank-specific manner. The UK is an exception, as banks were subject to Individual Liquidity Guidance from their microprudential supervisors from 2010-2015. Banks were required to hold liquid buffers in the form of High Quality Liquid Assets (HQLA) to minimise the risk of a potential liquidity stress.

In this paper, we examine the impact of liquidity regulation on UK banks' cross-border lending. We consider the effect of an increase in liquidity requirements on lending to both banks and non-banks, and we also examine changes to sovereign debt holdings. Sovereign debt – at least that of certain countries – is accepted as HQLA; and therefore it can be used to meet banks' liquidity requirements. The way that the liquidity regulation was applied - with only some countries' sovereign debt considered to be eligible as HQLA - means that we are able to exploit cross-country heterogeneity to analyse the unintended consequences of liquidity regulation. By using data on confidential bank-specific and time-varying liquidity requirements set by the Financial Services Authority (and later Prudential Regulatory Authority - PRA) in the UK, we are able to build an intensity measure of liquidity requirements and estimate the effect of changes in liquidity requirements on individual banks'

[1] It is important to note that - while we frequently refer to liquidity 'requirements' throughout this paper when quantifying the effect of our results - liquidity regulations cannot be seen as a binding 'requirement' in all states of the world given that 'required' liquid assets are usable to cover outflows in stress periods.

[2] As outlined in Monnet and Vari (2019), a few countries have applied cash-reserve requirements and securities-reserve requirements in the past but were generally abandoned in the 1970s and 80s due to complexity and interaction with government debt management.

lending behaviour.

The United Kingdom is a major financial centre with over 200 foreign affiliates from over 60 different countries - including from a mixture of advanced economies and emerging markets. But, rather than only lending to the UK real economy, the City of London is also an entrepôt where banks can raise funding and then lend on externally. The UK financial system thus provides an ideal environment to ask how banks meet liquidity regulation given the presence of multiple types of banks with varied financial linkages to other countries and sovereigns.

Our main result is that a 1 percentage point increase in the required HQLA/total asset ratio causes banks to decrease the growth rate of their external lending by around 0.6 percentage points (pp).. Simultaneously, banks increase their exposure to sovereign debt of countries which is considered HQLA by 0.2 pp (of their total external lending). There is important bank heterogeneity with subsidiaries from non HQLA-issuing countries cutting their lending by far more than subsidiaries from countries which issue HQLA. UK-owned banks (where the sovereign also issues HQLA) are, on average, not affected. Further analysis reveals that this is driven by the relevance of retail deposits. Specifically, banks with a higher deposit share as a consequence of established retail operations, such as most of those headquartered in the UK, are also able to offset the effects of increases of liquidity requirement on cross-border lending.

Our paper relates to several strands of the literature. First and foremost we contribute to the literature on the effects of bank liquidity requirements. Banerjee and Mio (2018) examine the introduction of Individual Liquidity Guidance in the UK, and show that banks increase their high quality liquid assets and reduce interbank loans and short-term wholesale funding. The focus on the introduction of ILG did not, however, allow the authors to take into account the changes in the intensity of liquidity regulation as well as to focus on more exogenous components of liquidity regulation (liquidity add-ons). This allows us to more precisely estimate the impact of liquidity regulation. We also focus, contrary to Banerjee and Mio (2018), on the *external* transmission of liquidity regulation in a setup that allows us to control for demand effects and thus focus on the credit supply effects of changes in liquidity regulation. Bonner and Eijffinger (2016) undertake a similar exercise to Banerjee and Mio (2018) and exploit a change in the haircuts applied to bonds in the Dutch liquidity regime. They show that banks target an institution specific liquidity

buffer. Duijm and Wierts (2016) also exploit the change in the Dutch liquidity regime and show that banks target a minimum short-term liquidity buffer and mainly adjust to the liquidity requirement via changes in their liabilities.

We go beyond these papers and exploit the full set of changes in banks' Individual Liquidity Guidance (ILG) over the full time period when ILG was in place to examine how banks respond to changes in liquidity regulation. In contrast to the papers above which focus on one individual change, we can exploit over 100 changes of different intensity in banks' ILG to examine not only the effect on banks' excess liquidity, but also the effect on banks' external lending, the role of bank heterogeneity and differential sectoral responses.

We also contribute to the literature on the external transmission of regulation. Aiyar et al. (2014) examine the international transmission of capital requirements and show that banks cut their external non-bank lending to their non-core markets following a change in capital requirements. Danisewicz et al. (2017) examine the effect of a change in capital requirements at the parent bank level and show that branches cut their interbank lending and maintain their non-bank lending following a change in requirements. Buch and Goldberg (2017) also show that macroprudential instruments - in particular capital requirements and LTV ratios - may affect banks' external lending and that bank heterogeneity is important. None of these papers examine the effect of liquidity requirements on external lending. This gap reflects the fact that very few countries have made changes in liquidity requirements, and the UK is unique in having a fully fledged microprudential liquidity regime with frequent changes; and also that liquidity requirements are largely a recent innovation.

As mentioned, the UK is a major financial centre and is used by many foreign banks, from a diverse set of countries, as a central base for acquiring funding and managing liquidity and other financial operations. This allows us to contribute to the literature on liquidity management of global banks, for example Cetorelli and Goldberg (2012), by examining how intragroup lending responds to a change in liquidity regulation. The heterogeneity in parent-bank country means we are able to explore the role of different regulatory treatments and contribute to the literature of regulatory fragmentation. In particular, we are able to examine whether banks, whose parent is located in a country whose debt is eligible to be considered as HQLA, respond differently to banks from ineligible countries.

This paper proceeds as follows. Section 2 discusses in greater detail the institutional

background and potential effects of UK liquidity regulations. Section 3 describes the data. Section 4 includes stylised facts on the ILG as well as the determinants of excess liquidity holdings. Section 5 contains the empirical strategy and results.

# 2 UK Liquidity Regulations and their potential external effects

## 2.1 Background on UK liquidity requirements

Individual Liquidity Guidance (ILG) was introduced in the UK by the Financial Services Authority in 2010.[3] It resembles the Basel III LCR in that it requires banks to be able to cover outflows in a stressed period with high quality liquid assets. It has since been updated by its successor the Prudential Regulatory Authority (see Prudential Regulation Authority, 2014, for example) until the migration to LCR (see Prudential Regulation Authority, 2015).

The 2010 version of ILG (FSA Handbook 2010) required two stresses: the first is a firm-specific stress for two weeks with active outflows of funds and the second is a system-wide stress of three months with slower withdrawals. The 2010 version consisted of ten liquidity risk drivers resulting in individual bank liquidity guidance. Important categories for most firms are wholesale funding, retail funding, intra-day, off-balance sheet and downgrade trigger. For wholesale funding, firms calculate the net cumulative wholesale funding position day on day up to 3 months.[4] The calculation is based on the contractual cash flows that take into consideration maturing assets and liabilities and the rollover ratios (also known as stress factors) provided by regulators. For the remaining risk drivers, the withdrawals are considered to happen immediately.[5] Importantly for our study, regulators can also implement add-ons to the outflows calculated above if the firm is subject to outflows not covered by the framework. Finally, regulators might also introduce scalar multipliers to the outflows calculated above.

There are no standard rules used to build the scenarios or liquidity buffers except at

[3]See FSA Consultation Paper 08/22 and FSA Policy Statement 09/16.

[4]See "Annex - required size of liquidity buffer" for more details.

[5]Retail funding is the impact of withdrawal of retail deposits. Off-balance is the expected impact of cash flows arising from off-balance sheet activities. Intra-day is the liquidity risk arising from banks' participation in a payment or settlement system (in terms of collateral and cash requirements). Downgrade trigger refers to outflows that would result from a downgrade of the bank's current long-term credit rating by 1 and 2 notches.

"simpler firms". When each of the different liquidity risk drivers are evaluated in the context of supervisory review and evaluation processes (SREP), the stress factors associated with each driver are modified and the bank's ILG as a whole is determined. These are updated at periodic meetings with supervisors and then the bank is given time to comply.

The firm must hold liquidity buffers, composed of high quality liquid assets (HQLA), to withstand liquidity shocks as calculated by the stress-test framework described above, according to the following formula (see also Banerjee and Mio, 2018):

$$\text{ILG ratio} \geq \text{ILG requirement} = \frac{\text{High quality liquid assets}}{\text{Net stressed outflows}} \tag{1}$$

where:

$$\begin{aligned}\text{Net stressed outflows} = \\ &(\text{wholesale} + \text{retail} + \text{intraday} \\ &+ \text{downgrade} + \text{off-balance} + \text{add-ons}) * \text{scalar}\end{aligned}$$

Wholesale, retail, intraday, downgrade and off-balance are components of the ILG requirement. Each of these components is a function of banks' balance sheet items and different sets of stress factors. Regulators might adjust the tightness of the liquidity regulation by moving several components of the framework above.[6]

They might alter the general ILG requirement by, for example, demanding that banks hold liquidity buffers correspondent to 60% of their potential outflows instead of 55%. By altering the stress factors, regulators might increase the size of potential outflows, increasing the required liquidity buffers for a constant ILG ratio.

Finally, regulators might alter add-ons and scalars for idiosyncratic risks not captured directly through the balance sheet items listed above. As seen in figure 3 discussed below, regulators increasingly used add-ons as a way to adjust banks' liquidity requirements. Add-ons often target considerations around operational risks and are hence less dependent on balance sheet characteristics, providing us with a more exogenous measure of liquidity regulation. That is why, in this paper, our main variable of interest is changes to liquidity add-ons. After 2015 the ILG was phased out to switch to the Liquidity Coverage Ratio

[6]Details on the calculation can be found in "LMM tool for Standard ILAS firms". The stress factors in the Liquidity Metric Monitor are standard ones.

framework. However, the PRA continued to adopt an interim Pillar 2 approach based on the add-ons in a firms' existing ILG. Where add-ons do not relate to risks captured by the LCR, the PRA continued to apply them as previously.

## 2.2 Potential effects on external lending

As noted by Allen and Gale (2017), the literature on liquidity regulation is at an early stage and there are no benchmark theoretical models to examine how banks would react. Banks can respond in many different ways to an increase in liquidity requirements. If liquidity requirements are not binding then we would expect no effect. On the other hand, if banks wish to maintain a fixed level of excess requirements (as found by Bonner and Eijffinger, 2016, and Duijm and Wierts, 2016), banks are likely to adjust their balance sheets. In particular, banks can change the structure of their funding and therefore potential outflows by switching to more stable forms of funding; or banks can make other adjustments on the asset side either by increasing the level of HQLA or by selling non-HQLA assets (thus reducing their funding needs).

The following hypotheses assume that either liquidity requirements are binding or that a bank wishes to maintain a level of excess liquidity similar to the level it maintained prior to the increase in requirements.

- H1: If a bank is faced with increased liquidity requirements then a bank will increase its holdings of liquid assets. If a bank's liquidity requirements are binding, then it will have to increase its liquid assets or adjust its liabilities to make them longer-term to meet the requirement. Given the expense and agency costs involved in terming-out a bank's funding relative to low transaction costs on acquiring liquid assets (by definition), it should be cheaper in the short-term for a bank to adjust via increasing liquid assets.

- H2 (corollary of H1): If a bank's liquidity requirements increase it will increase its holdings of HQLA, this will largely consist of sovereign bonds from countries which are acceptable as HQLA.

- H3 (corollary of H1 and H2): If banks adjust by increasing HQLA then ceteris paribus they will cut back on lending.

We test these hypotheses in section 5.

# 3 Data

Our data is regulatory as well as monetary and financial statistics data from the Bank of England at (or aggregated to) a quarterly frequency over the period 2009Q1 – 2015Q3. The appendix provides information on the data that is used for our main regression analysis. Table A.1 defines each of the variables and explains how they were constructed. Table 1 provides summary statistics.

## 3.1 Dependent variables

In our main specification, the dependent variable is the growth in cross-border lending to non-residents. To take into account the volatility of this series we adopt several data cleaning strategies (with alternatives discussed in the sensitivity analysis). For our base case, we first drop any growth rates of external lending that are greater than 100% in absolute value before winsorising the data at the 1% level. We only consider observations of bank-country pairs if the stock of lending exceeds a share of 0.2% in the current or the preceding quarter's total stock of external lending (rather than including large percent changes relative to small stocks). Keeping only significant portfolios ensures that we focus on economically meaningful changes in external lending.[7]

In further specifications, the dependent variable is the growth in external lending to banks and, separately, non-banks. We also examine the changes in lending to sovereigns (over lagged total external lending) which are considered to be issuing liquidity buffer qualifying securities. Excluding sovereign loans which are considered HQLA allows for a cleaner and more nuanced examination of the way that banks external lending responds to changes in liquidity requirements.

## 3.2 Bank balance sheet characteristics

Bank balance sheet characteristic enter as control variables to account for bank-specific variation over time not captured otherwise by the regression framework. We use the following variables:

[7]The 0.2% is chosen because it is one tenth of the average portfolio share for UK banks (which is 2%) - i.e., the average UK banks lend to 50 countries. Results are robust to choosing a higher threshold - see table 5.

- Bank size – i.e. the log of a bank's total assets in levels, deflated by CPI inflation, which we loosely interpret as 'size' (and which will also probably pick up other factors such as the risk-taking behaviour of banks, to the extent that this reflects too-big-to-fail subsidies)
- Capital Ratio – i.e. bank's non risk-based capital-to-asset ratio
- Commitment Share – i.e. ratio of total commitments divided by total assets.

### 3.3 Liquidity data

We use information on liquidity provided in the Bank of England's FSA047, FSA048 and FSA050 forms.[8] Confidential information on ILG requirements (including add-ons) is provided by the PRA. As explained, we use as our main ILG variable changes in add-ons divided by total assets, winsorising it at the 1% level. The base sample includes by firms that report on a weekly and monthly basis, which covers all large banks and banks with cross-border activity located in the UK.[9] Total assets come from the weekly FSA 047 / 048 in order to achieve a match between requirements' and balance sheet items' frequency of reporting. Data on HQLA exposure come from FSA50 forms.

## 4 Stylised facts on ILG

Each bank's ILG is confidential, but the statistics in this section have been aggregated to illustrate how ILG changes over time. Figure 1 shows the distribution of changes in liquidity requirements add-ons over the period 2010-2015. Although liquidity requirements were introduced in 2010 most of the changes in add-ons take place considerably later in 2012 and 2014. On average, when ILG add-ons were tightened, the increase in required liquid assets was 2.5% of total assets. In contrast capital requirements changes are rarely larger than 1% of risk-weighted assets (see Forbes et al., 2017).

[8] Templates can be found in https://www.fca.org.uk/firms/gabriel/liquidity-data-guide.

[9] Firms that report on a frequency higher than weekly are called a "low frequency liquidity reporting firm". Most conditions are summarised in the FCA handbook and are related to size. For firms to report at a monthly frequency, their balance sheet assets should be less than £5 billion. Other firms not included in this paper's sample follow simplified conditions and should have assets smaller than £1 billion, as well as fulfill specific requirements regarding the composition of their assets and liabilities.

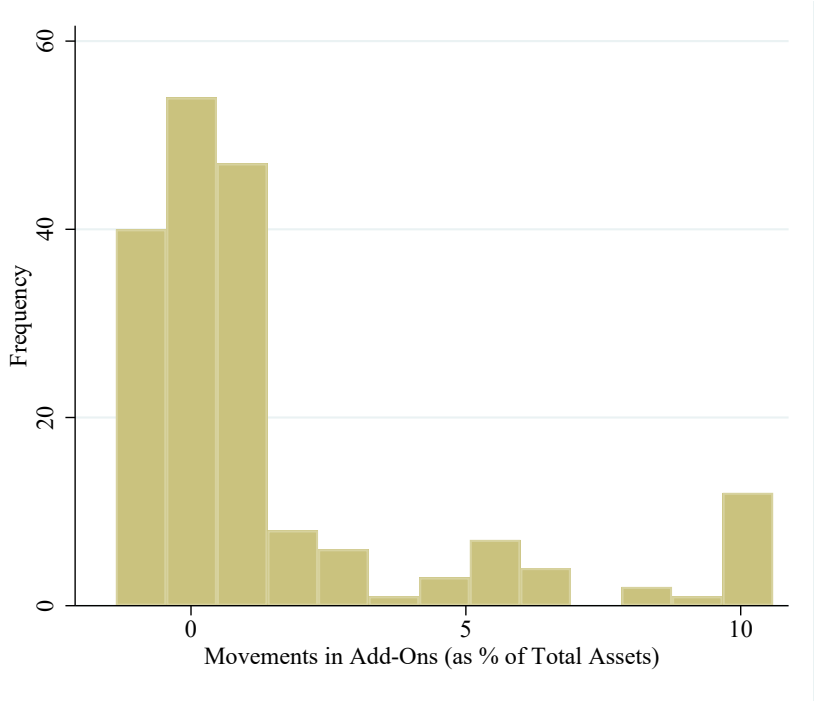


**Figure 1: Change in liquidity requirements (add-ons) as a % of total assets**
Note: the chart shows a histogram with 16 bins (width 0.75) depicting the total number of movements on add-ons as % of total assets. Add-on is a component of the calculation of liquidity guidance and the main independent variable of this paper. Source: PRA, including forms FSA 047 /048. Authors' calculations.

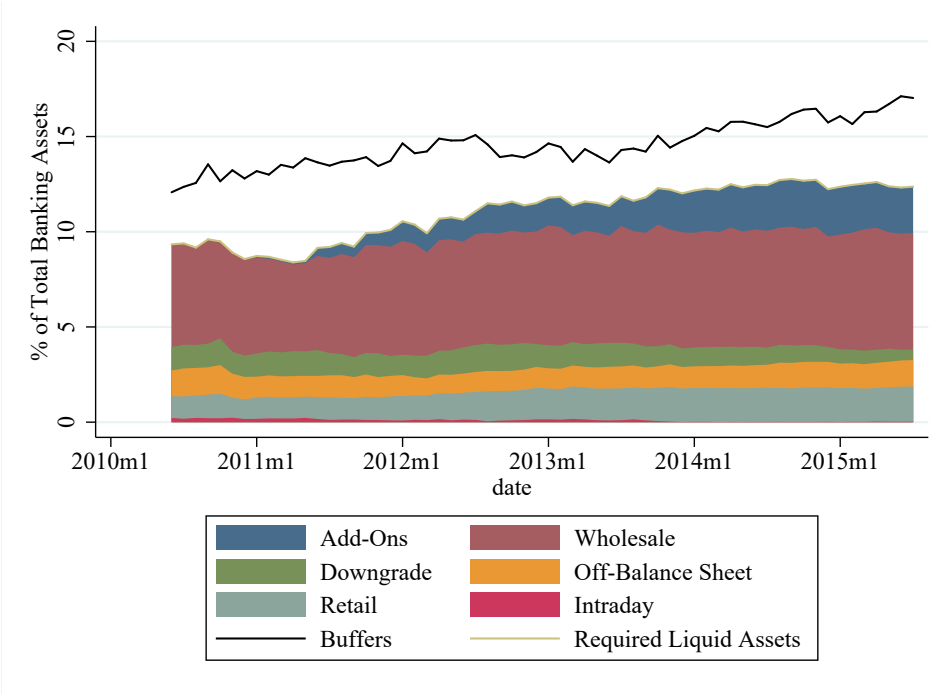


Figure 2: Banks' actual liquidity holding and requirements together with components (% of total assets)
Note: the chart shows aggregate values for banks' actual holdings of liquidity buffers and the components of liquidity requirements, as calculated by actual balance sheets items and stress factors. Source: PRA, including forms FSA 047 /048. Authors' calculations.

Figure 2 below illustrates the evolution of the various components of the ILG and the actual holdings of liquidity buffers (black line) over time for the average bank in the UK (weighted by total assets). The biggest component of the ILG is the wholesale requirements, but from 2012 onward the "add-ons" begin to be a larger and more variable part of the requirement. The increased use of add-ons is visible in figure 3, which also shows the average requirement and the average holdings of liquid assets from 2010-2015 as a percent of total assets. The trend towards increased liquidity requirements is clearly visible in the chart.

## 4.1 How quickly do banks respond to changes in liquidity guidance?

Banks take time to build their excess liquid assets following an increase in requirements. Figure 4 below plots the average excess liquidity a bank holds in the period around a change in add-ons. Banks increase their excess liquidity before the change in requirements and

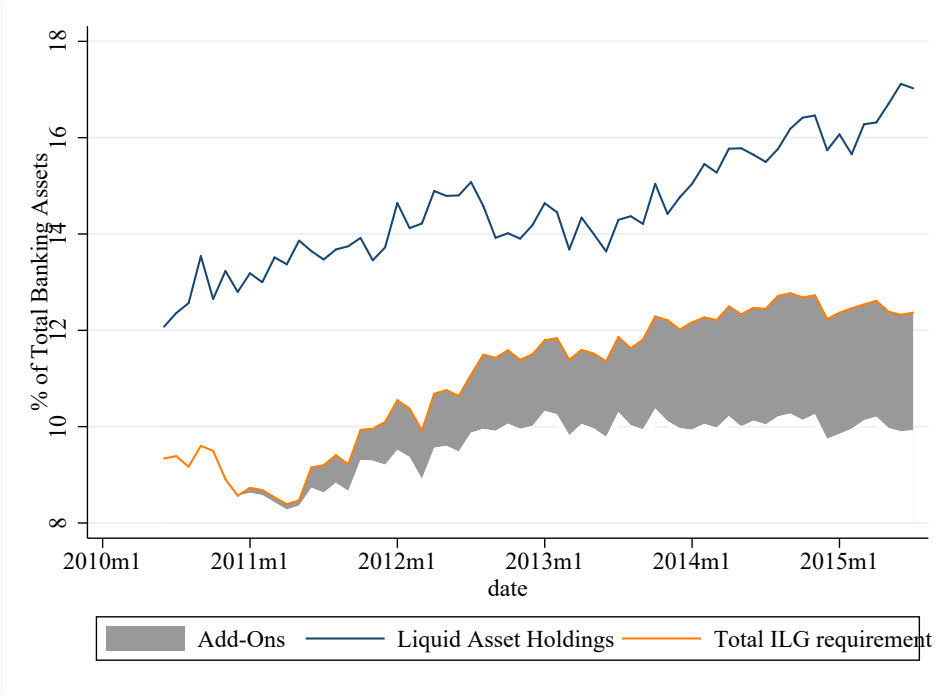


Figure 3: Banks' actual holdings and liquidity requirements with detail on add-ons (% of total assets)

then rebuild it afterwards. Banks take approximately five months to rebuild their excess liquidity, from the second week after the increase in add-ons, with a third of the rebuild undertaken within the first month. This finding that banks rebuild their liquidity is in line with Bonner and Eijffinger (2016) and Duijm and Wierts (2016), who also show that banks target a fixed level of excess liquidity. This type of balance sheet behaviour is also similar to findings on banks' levels of capital in excess of their minimum requirement, for example Francis and Osborne (2009) and de Ramon et al. (2016), who find that banks target a significant buffer above their minimum requirement and increase their capital ratios in response to an increase in capital requirements. However, the speed at which banks rebuild excess liquidity is considerably faster than the time taken to rebuild excess capital over requirements; for example, Bridges et al. (2014) estimate for a panel of UK banks from 1990 to 2007 that banks take over 3 years to rebuild their excess capital following an increase in capital requirements, and only manage to rebuild 40% of it in the first year. This is why we use a longer set of lags for capital in our empirical specification as we expect any effect from changes in capital requirements to be more persistent.

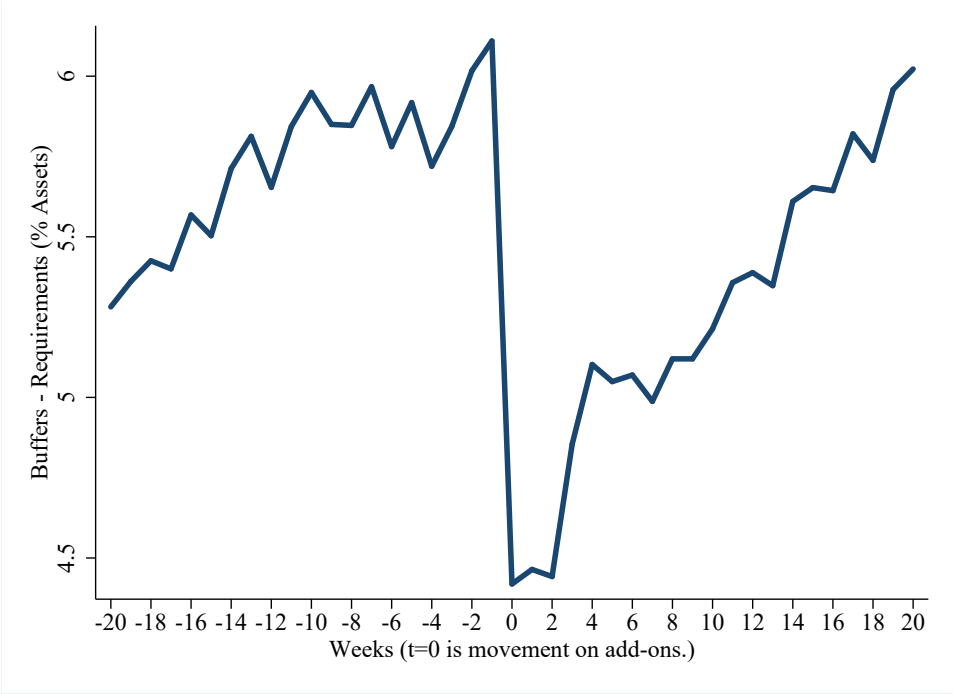


Figure 4: Banks' average excess liquidity holdings around the time of an add-on movement Note: The chart shows the behaviour of excess liquid buffers (liquid buffers minus requirements as % of total assets) around the week of when add-ons were changed. This is the average for all banks and all periods of time. Source: PRA, including forms 047/048. Authors' calculations.

## 4.2 What determines the size of excess liquidity banks choose to hold?

Table 2 shows the results of estimating the determinants of banks' weekly excess liquidity holdings while also controlling for recent changes in the ILG.

We estimate the determinants of excess liquidity scaled by total assets with a mixture of aggregate and bank specific factors:

$$\begin{aligned} excessliquidity_{it} = \alpha + \beta_1 govbondyield_t + \beta_2 capitalratio_{it} + \beta_3 banksize_{it} \\ + \beta_4 group_{it} + \beta_5 \delta ILGmovement_{it} + \zeta_i + \epsilon_{it} \end{aligned} \tag{2}$$

Government bond yield is the yield of the UK 5 years gilt bond, capital ratio is banks' capital over total assets, bank size is the natural logarithm of banks' total assets and group is the absolute net value of lines "loans and deposits with group" (from forms FSA047/048) over total assets. ILG movement is a bank-specific variable that counts the number of weeks since the last ILG tightening or introduction.

The results relating to controls are intuitive. The coefficient on bond yields is positive: higher government bond yields suggest a lower opportunity cost of holding liquid assets such as government bonds, lowering the cost of excess liquidity. The coefficient on the capital ratio is negative, but not significant.[10] Larger banks hold smaller excess liquidity, in line with Bonner and Eijffinger (2016) and DeYoung and Jang (2016), which is likely to be because larger banks have a greater access to funding sources implying that a lower excess is required. Higher cross-border group financing (loans and deposits with non-resident deposit taking corporations of the same group) is not associated with a lower liquidity cushion, given the non-significant coefficient. It is hence not clear if centralised liquidity management by international banking groups allows banks to hold less excess liquidity. Finally, the second column shows a positive and significant coefficient on the ILG variable. This confirms the impression from figure 4 that over time banks gradually increase their excess liquidity following a change in the ILG.

[10]Banks with higher capital ratios might be expected to hold less liquidity if capital and liquidity are substitutes, in line with Acosta-Smith et al. (2019) who examine the relationship between capital and liquidity holding for banks in the UK from 1988-2013, DeYoung et al. (2018) for the US and de Haan and van den End (2013) for the Netherlands.

With regard to our econometric analysis the fact that banks aim to hold a fixed level of excess liquidity and thus rebuilt their excess liquidity following ILG tightening implies that changes in liquidity requirements will affect banks even if they are already able to meet the new requirements with their existing liquid asset holdings.

# 5 Empirical methodology and results

## 5.1 Specification

The dependent variable ($\Delta Y_{ijt}$) is the exchange-rate-adjusted growth in the stock of loans by PRA-regulated bank $i$ to country $j$ at quarter $t$. We also explore how subcomponents of lending growth are affected differently. To explain variations in the dependent variable, we estimate the following model on quarterly data:

$$\Delta Y_{ijt} = \alpha_0 + \alpha_1 \Delta LR_{i,t-1} + \alpha_2 X_{it} + f_i + f_{jt} + \varepsilon_{ijt} \tag{3}$$

where $\Delta LR_{i,t-1}$ is the change in bank $i$'s add-on liquidity requirement (in percent of lagged bank's total assets). Following guidance from regulators that banks' adjustments to changes in liquidity requirements are expected to be quick (around 1 month), we did not include any other lags of this term; the dynamics of adjustment was also verified in section 4 above. X is a matrix of bank-specific characteristics such as size, commitment shares and capital ratios. $f_{jt}$ is a matrix of country-specific time fixed effects to account for demand shocks (including absorbing credit demand) in receiving countries. This follows Aiyar et al. (2014) and allows a straightforward interpretation of the coefficients on the change of liquidity requirements as a supply shock. $f_i$ is a vector of bank-specific fixed effects. Standard errors are clustered by bank and time.

## 5.2 Baseline Results

Our regressions results are presented in tables 3 – 9. The regression results for specification (3) are shown in table 3. We start with the simplest specification and gradually add further controls. In order to be able to compare between specifications, the sample of all regressions is restricted to the specification with the complete set of controls (our baseline specification). Column (1) suggests a fall of 0.43 percentage points in external lending

growth for each 1pp increase of liquidity requirements as % of total assets, significant at a level of 5%. Column (2) introduces as controls bank size (as measured by the log of total assets), commitment share and capital ratios, without any major impact on the size and significance of the coefficient for liquidity requirements.

As a further control, column (3) also adds changes in bank-specific UK capital requirements, as examined by Aiyar et al. (2014) and Forbes et al. (2017). The inclusion of a change in capital requirements in the previous year is an important addition given the finding in the literature above that a tightening in capital requirements has a negative effect on external lending (eg. Aiyar et al., 2014) and that this effect can be persistent Bridges et al. (2014). If banks de-risk following a change in capital requirements and hold more liquid assets then the impact of a change in liquidity requirements will potentially be smaller as banks will already hold higher levels of liquidity. However, the magnitude and significance of the coefficient of interest on overall lending is not significantly altered, although a change in capital requirements does decrease overall lending. The coefficient on capital requirements is larger than the coefficient on liquidity requirements, but changes in capital requirements are generally smaller than changes in liquidity requirements. For the sample of equation in column (3), the average increase in liquidity requirements is 2.5% of total assets, while the average increase in capital requirements is 0.3% of risk weighted assets (RWA). These numbers would be associated respectively with falls of -1.4 and -0.6 percentage points in external lending growth, meaning that the average increase in liquidity requirements has a stronger effect on external lending growth than the average increase in capital requirements.

As outlined in the hypotheses in subsection 2.2, the previous literature on the effect of bank capital requirements on lending, together with the different maturity of interbank vs non-bank lending, suggests that banks‘ reaction might be different between each type of lending. We therefore split total cross-border lending into two components: loans to banks and loans to non-banks and include bank level controls.

Results in columns (4) suggest a fall of 0.77 percentage points in external lending growth to banks in response to each 1 pp increase in liquidity requirements as a % of total assets. Column (5) suggests that the fall in lending growth to non banks is somewhat smaller (0.5 pp) than the fall in lending growth to banks. However, where results differ is in the effect of capital requirements: a change in capital requirements does not seem to affect interbank

lending while it does affect external non-bank lending. At first glance this appears to be in contrast to the results of Aiyar et al. (2014), but we cover a different (and post-crisis) time period, which may explain the difference. We are also examining the short-term (1 quarter ahead) effect of changes in liquidity requirements while controlling for both the current and persistent effect of changes in capital requirements: interbank lending is easy to cut and short term so much of the cut in lending may have taken place in previous quarters. Indeed, Danisewicz et al. (2017)show that cuts in interbank lending stemming from a change in capital requirements only occur in the first quarter.

### 5.2.1 Accounting for HQLA issued by sovereigns

The results for non-bank lending growth in table 3 might be influenced by the inclusion of government as one of the sectors included in the definition of non-banks. Importantly, for countries issuing liquidity buffer qualifying securities, this government debt can be used to help banks meet their increased liquidity requirements. The hypotheses in subsection 2.2 above were developed assuming that non-bank lending was real economy lending – or at the very least was lending that would not help banks to meet their liquidity requirements. Figure 5 uses information from forms F50. As seen there, most of the buffer-qualifying foreign (non-UK) securities held by British headquartered banks are those issued by European countries and the US. Columns (1) and (2) of table 4 show the results of a regression to examine the determinants of exposure to high quality sovereigns using the same specification as equation (3) but with a different LHS variable. The dependent variable is the quarterly change of the value of foreign liquidity buffer qualifying divided by lagged total cross-border lending. The results imply that when liquidity requirements are raised by 1pp, banks increase their exposure to sovereign debt of countries which are considered HQLA by 0.2 pp of their total cross-border lending.

Columns (4) and (6) take the exercise one step further and use as the dependent variable cross-border lending growth from the baseline regressions, but excluding liquidity buffer qualifying securities. Column (4) presents the result on aggregate bank and non-bank lending, while column (6) presents the result for non-bank lending. The results are unambiguous, despite the different samples. The growth rate of total external lending – excluding HQLA-qualifying government debt - falls by 0.65% when liquidity requirements are increased compared to a fall of 0.56% when government debt is included. The result

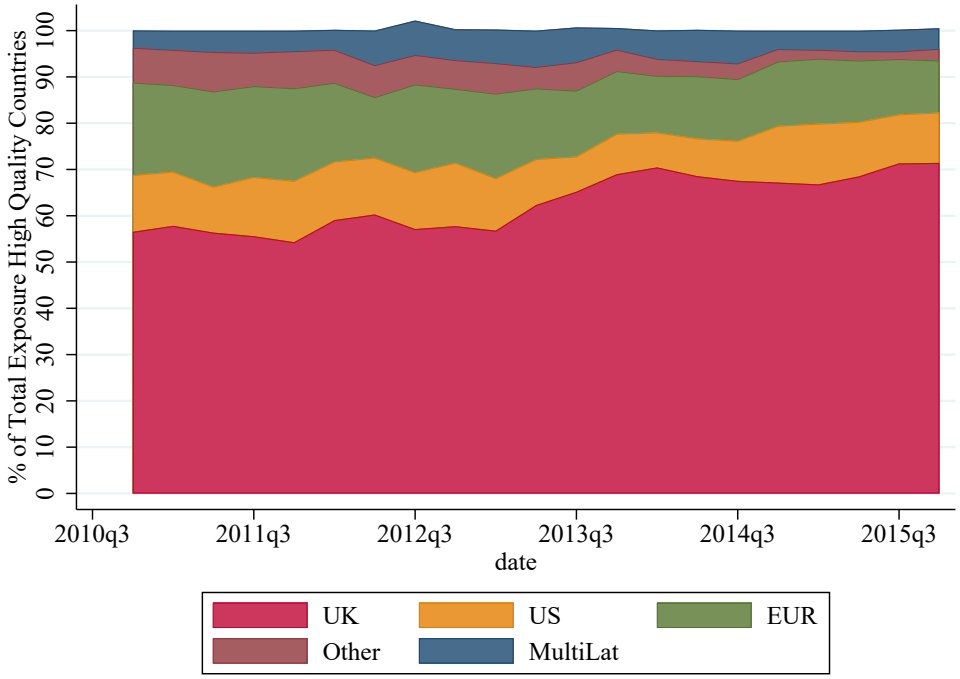


Figure 5: The composition of liquidity buffer qualifying securities held by banks

is similar for non-bank external lending excluding liquidity buffer qualifying securities – this falls by 0.68% in response to a 1pp increase in liquidity requirements, compared to 0.5% before. This is not surprising: removing a component which tends to increase when liquidity requirements are tightened (as show in in column (2)) yields a larger fall in lending growth than in our base case. The main conclusion is that movements in liquidity requirements have two cross-border effects: (i) a broad reduction in external lending and (ii) an increase in HQLA sovereign debt investment.

### 5.2.2 Robustness

Table 5 presents several robustness exercises for the basic specification. Columns (1) and (2) repeat the basic specification of column (3) of table 3, but with different cleaning strategies. Column (1) winsorises growth rates at the 10% level (without dropping data beforehand) and column (2) uses winsorisation at the 5% level after dropping any growth rates of external lending that are greater than 100% in absolute value. Column (3) applies the same strategy of column (2) to the results of column (4) of table 4. We also try specifications using one lag of capital requirements (in order to align it with the specification for liquidity requirements) in column (4), clustering only at bank level in column (5), with

different combinations of fixed effects in columns (6) and (7), considering observations of bank-lending pairs if the stock of lending exceeds a share of 0.1% and 0.5% in the current or the preceding quarter's total stock of external lending (instead of 0.2% as in the basic specification) in columns (8) and (9) respectively and finally restricting the sample to the period after the sovereign crisis in European countries in column (10). For the last check, we used the period post- 2012Q3, after the "whatever it takes" statement. The basic results survive in all specifications. The coefficient for liquidity requirement is smaller when bank fixed effects and country fixed effects are separately dropped. This last result might suggest that it is relevant to control for demand shocks. On the other hand, the coefficient is larger and more significant for the period post 2012Q3.

### 5.2.3 The role of excess liquidity

Although liquidity guidance is not a minimum requirement, we have shown that banks aim to maintain a constant distance to the guidance level. Figure 4 shows that even though banks hold considerable liquidity in excess of requirements they do nonetheless try to rebuild this excess after a change in requirements. This suggests that banks likely react to the ILG even if they maintain a sizable excess liquid asset buffer. However, banks which did not have yet time to completely rebuild their buffers might still react more strongly to an increase in liquidity requirements. To examine whether this is a feature of the data, we interact the change in liquidity requirement with the change in the ILG and augment equation (3) with

$$\begin{aligned} \Delta Y_{ijt} = \alpha_0 + \alpha_1 \Delta LR_{i,t-1} + \beta \Delta LR_{i,t-1}.Excessliq_{i,t-1} \\ + \alpha_2 X_{it} + f_i + f_{jt} + \varepsilon_{ijt} \end{aligned} \tag{4}$$

where $Excessliq_{i,t-1}$ is defined as actual holdings of liquidity buffers minus requirements (the same concept of equation 2).

Our results are shown in table 6. Banks with higher excess liquidity have a lower growth rate of cross-border lending. This is a liquidity analogy to Francis and Osborne (2009) and Berrospide and Edge (2010): both find that the level of capital above a bank's minimum (or target ratio) affects loan growth. And is to be expected in the sense that

a higher proportion of liquid assets over total assets necessarily means lower long-term lending. The table also shows the interaction between excess liquidity and a change in liquidity requirements. We find that the interaction does not turn out to be significant, albeit with a positive point estimate. This provides at best only inconclusive evidence that banks with higher levels of excess liquidity cut lending by less, in line with the hypothesis that banks react to the ILG even if they maintain a sizable excess liquid asset buffer.

## 5.3 The role of head office location and intragroup transfers

Banks manage liquidity across their entire organisation and funds flow between parent banks and their affiliates (Cetorelli and Goldberg, 2012). The City of London is also a major wholesale - which is somewhat short-term and unstable - funding source for foreign banks. We might expect a bank which is headquartered in the UK to react differently to those which are headquartered elsewhere. A major reason for this is that the UK-owned banks have access to retail funding and so may be less affected by changes in liquidity requirements; foreign subsidiaries do not generally have such easy access to retail funding but may be able to rely on transfers of liquidity from their parents.

We repeat our baseline regressions (excluding HQLA sovereign lending) but explore the effect of the parent country. Table 7 illustrates the results. In column (1), we test whether UK-owned banks show a different cross-border lending reaction than foreign subsidiaries by including an interaction term between changes in liquidity requirements and a dummy which is 1 if a bank is UK-owned and zero otherwise. The dummy turns out to be significant and positive indicating that UK banks are less affected in their cross-border lending growth than subsidiaries. These results are also confirmed when splitting the sample: columns (2) and (3) illustrate the growth rate in cross-border lending for UK owned and foreign subsidiaries respectively. The effect of a change in liquidity requirements is not significant for UK owned banks; however it is highly significant and negative for foreign subsidiaries located in the UK. A 1pp increase in liquidity requirements leads to a 1.5 pp fall in the growth rate of cross-border lending.[11]

We then explore whether the parent country makes a difference. Our hypothesis is that

[11]When the dependent variable is the change in HQLA sovereign lending growth over total external lending (the same specification of column (2) of table 4) the results are similar as well. The coefficient for foreign subsidiaries is highly significant and larger than for the whole sample, while the coefficient for UK owned banks is non-significant.

foreign subsidiaries where the parent is from a country with HQLA eligible assets might cut lending by less as it will find it easier to raise the necessary liquid assets in a short time frame. This could be because the parent transfers HQLA from head office to its sub or because the subsidiary upstreams fewer liquid assets from the UK to its parent. Columns (4) and (5) show the results from these separate regressions. Banks from countries whose sovereign debt is eligible for inclusion as HQLA cut their lending by less than banks from countries which are not eligible for inclusion as HQLA.

Ideally, we would like to directly explore the consequences of liquidity regulations for intragroup funding. But at this point, we reach the limit of our data. The monetary and financial statistics from the Bank of England include information on intragroup assets and liabilities, but in aggregated form (to the rest of the world).[12] We attempt to investigate the transfer of funds hypothesis more fully in table 8 using these much restricted data. As it is not possible to control for country-specific demand shocks, the regressions of table 8 are not as well specified as those of our baseline. Column (1) shows that our basic result survives in aggregate terms: the growth rate of cross-border lending growth falls in response to an increase in liquidity requirements. Banks which are from countries whose sovereign debt is eligible to be included in HQLA requirements cut their intragroup lending growth, while there is no effect on cross-border lending growth excluding intragroup lending (column (3) and column (5)). In contrast, banks from countries which are ineligible for HQLA cut their non-intragroup external lending (column 4). In addition, we do not find any effect on cross-border intragroup lending for this group from movements in liquidity requirements (column 2). This seems to suggest considerable heterogeneity in the way that banks respond to increases in liquidity requirements and that the home country and therefore easier access to HLQA is an important driver of the response.

## 5.4 The role of retail deposits as a funding source

An important result from subsection 5.3 is that UK banks' external lending is less affected by changes in liquidity requirements than the lending by foreign subsidiaries based in the UK. We find that adding external lending as a share of total assets to the analysis does not explain the different patterns. This is unsurprising given there is no discernible difference between UK and non-UK banks in terms of their exposure to cross-border lending. But one

[12]Data on intragroup assets and liabilities by country started to be collected from 2014.

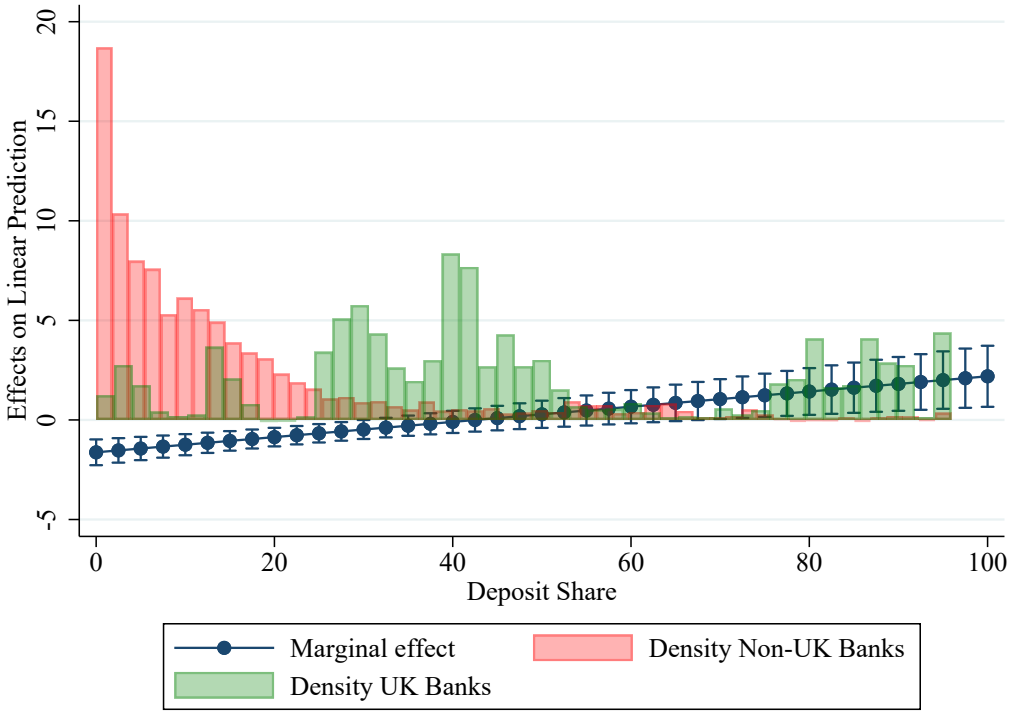


Figure 6: Banks' distribution of deposit shares (% of total assets), nationality (UK and non-UK) and marginal effect of increases in liquidity requirements

important difference comes from the funding side, since many UK-owned banks provide retail services in the UK. It might be that non-retail banks are more affected by liquidity requirements, since banks with established retail operations find it easier to shift to more stable funding sources. We explore this possibility by looking at how the effect of ILG changes varies with reliance on retail deposits.

Table 9 adds the variable deposit share to the main specification. [13] Adding a term for deposit share does not increase the explanatory power of the regression (column 1). The variable is non-significant, and the coefficient for liquidity requirements is marginally more negative. The results from columns (2) - (4) confirm that banks with a large deposits share cut lending by less following a tightening of the ILG. The coefficients for UK and non-UK banks are similar indicating that a greater retail presence lowers the impact of liquidity requirement tightening on external lending for both groups. But only for the UK-only sample, the level effect of liquidity requirements and the interaction with deposit share offset each other for the bulk of the distribution. This means that deposit shares are much

[13]The definition used for deposit share is retail deposits as a share of total assets excluding capital. Given that equity has undefined maturity, the denominator is a proxy for runnable liabilities.

larger for UK banks, as expected, as shown in figure 6. UK banks are clustered in two groups in terms of deposit shares: the main one between 22% and 50% and a tail between 80% and almost 100%. This means that most UK banks are in the segment where the effects of liquidity requirements increases are ambiguous. On the other hand for non-UK banks' deposit shares are typically below 20%. This confirms the hypothesis that banks with established retail operations might find it easier to shift to more stable funding sources when facing changes in liquidity requirements. UK banks seem to take full advantage of their retail positions.

# 6 Conclusion

By using a new dataset on UK bank liquidity regulation and its intensity, we are able to document the effect of changes in bank liquidity requirements on external lending. We observe that banks hold liquidity in excess of the requirements and aim to keep this excess relatively constant as evidenced by the fact they build up their excess following an increase in requirements. Part of this increase comes from banks increasing their sovereign debt holdings – which are considered high quality liquid assets - in response to an increase in liquidity requirements. We also find that banks cut their external lending in response to an increase in liquidity requirements, both to banks and to non-banks. Bank nationality is important: whether a bank is from a country whose sovereign debt qualifies as HQLA materially alters the effect on lending. Banks whose parent is from an eligible country do not cut their external lending but upstream fewer funds. Finally, banks with higher deposit shares seem to be able to offset increases in liquidity requirements more easily. UK banks seem to take full advantage of their position as retail banks in the country to shift to more stable funding sources. The Bank of England's Individual Liquidity Guidance is similar to, but not exactly the same, as the Basel III Liquidity Coverage Ratio. As such, some of the ways in which banks react to ILG may not be exactly the same as their reaction to the LCR. But given the broad similarities between the two types of regulations, our results provide useful quantitative insight as to how banks might respond to changes in the LCR, in particular with regard to the potential effects on external lending.

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| Variable | mean | median | std. dev. | min | max | obs. |
|---|---|---|---|---|---|---|
| **Dependent variables** | | | | | | |
| External Lending growth | | | | | | |
| *Total* | -4.83 | -1.27 | 32.07 | -98.91 | 88.31 | 10016 |
| *Banks* | -14.72 | -6.12 | 43.77 | -100.00 | 92.28 | 10016 |
| *Non-Banks* | -4.53 | -1.16 | 31.00 | -100.00 | 87.32 | 6577 |
| *Total adjusted High Quality Sovereign* | -4.42 | -1.24 | 32.37 | -98.89 | 88.57 | 9346 |
| *Non-banks adjusted high quality sovereign* | -4.32 | -1.14 | 31.52 | -100.00 | 87.82 | 9693 |
| *Total adjusted from UK-owned banks* | -2.30 | -0.97 | 28.16 | -98.89 | 88.57 | 4873 |
| *Total adjusted from foreign subs* | -6.56 | -1.68 | 36.01 | -98.89 | 88.57 | 4820 |
| *Total adjusted from foreign subs HQLA countries* | -6.57 | -1.84 | 36.66 | -98.89 | 88.57 | 2736 |
| *Total adjusted from foreign subs non-HQLA countries* | -6.54 | -1.46 | 35.16 | -98.89 | 88.57 | 2084 |
| Change high quality sovereign exposure (% total external lending) | 0.00 | 0.00 | 10.97 | -48.94 | 53.09 | 4512 |
| **Δ Liquidity requirement (add-on % total assets)** | 0.37 | 0.00 | 1.69 | -1.44 | 10.74 | 10016 |
| **Control variables + interaction terms** | | | | | | |
| Bank size (log) | 17.63 | 17.21 | 2.06 | 13.07 | 21.18 | 10016 |
| Commitment share | 0.54 | 0.54 | 0.19 | 0.00 | 1.37 | 10016 |
| Capital ratio | 0.15 | 0.13 | 0.10 | 0.01 | 0.55 | 10016 |
| Deposit share | 35.75 | 31.49 | 29.41 | 0.00 | 95.92 | 9512 |
| Δ Capital requirements | -0.09 | 0.00 | 1.30 | -15.14 | 8.31 | 10016 |
| Excess Liquidity | 7.31 | 5.89 | 5.29 | 1.17 | 28.14 | 8957 |

Table 1: Summary Statistics

| | Excess Liquidity | |
|---|---|---|
| ILG Movement | | *0.0203**** |
| | | *(0.00346)* |
| Gov Bond 5Y yield | *1.201*** | *1.204*** |
| | *(0.459)* | *(0.497)* |
| Cap. Ratio | *-0.00240* | *-0.0577* |
| | *(0.0883)* | *(0.0816)* |
| Size | *-3.330** | *-3.883*** |
| | *(1.746)* | *(1.613)* |
| Group Financing | *0.000364* | *-0.0339* |
| | *(0.0456)* | *(0.0368)* |
| Constant | Yes | Yes |
| Bank Fixed Effects | Yes | Yes |
| Observations | *7,141* | *5,878* |
| R-squared | *0.644* | *0.728* |
| Adj. R-squared | *0.641* | *0.725* |

Table 2: The determinants of excess liquidity

Notes: The dependent variable is actual liquidity holdings - required liquidity. The variable 'ILG movement' is the number of weeks since a bank's liquidity requirement was last increased. Standard errors are clustered at the bank level. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. The sample period is 2010Q1 to 2015Q3.

| | External Lending | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| | All | All | All | Banks | Non-Banks |
| ΔLiquidity Requirements (t-1) | *-0.432*** | *-0.417*** | *-0.561*** | *-0.773*** | *-0.503*** |
| | *(0.191)* | *(0.201)* | *(0.229)* | *(0.306)* | *(0.245)* |
| Bank Size | | *6.331*** | *6.987*** | *3.344* | *10.86**** |
| | | *(3.083)* | *(3.015)* | *(4.225)* | *(2.995)* |
| Commitment Share | | *-2.148* | *-1.264* | *5.728* | *0.662* |
| | | *(5.231)* | *(5.127)* | *(9.389)* | *(4.459)* |
| Capital Ratio | | *13.50* | *11.10* | *-22.21* | *26.39*** |
| | | *(14.15)* | *(14.01)* | *(23.03)* | *(13.38)* |
| Δ Capital Requirements (sum t to t-3) | | | -1.754* | -0.705 | -2.291*** |
| | | | *(0.952)* | *(1.097)* | *(0.810)* |
| Constant | Yes | Yes | Yes | Yes | Yes |
| Time-Country Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Bank Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 10,016 | 10,016 | 10,016 | 6,577 | 9,346 |
| R-squared | 0.209 | 0.209 | 0.210 | 0.267 | 0.236 |
| Adj. R-squared | 0.0325 | 0.0330 | 0.0337 | 0.0699 | 0.0567 |
| Banks X Quarter | 455 | 455 | 455 | 446 | 441 |

Table 3: Dependent variable is growth in external lending

Note: The table presents the estimated parameter values from fixed effects panel regressions. The dependent variable is the quarterly percentage change in cross-border bank lending. The data and variables are discussed in Section 3 and Appendix A. Standard errors are clustered at the bank-time level. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. The sample period is 2010Q1 to 2015Q3.

| | HQLA lending / Total external lending | | External Lending Adjusted for High Quality Sovereign Exposure | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Total | | Total | | Non-Banks | |
| ΔLiquidity Requirements (t-1) | *0.305*** | *0.209*** | *-0.535*** | *-0.654*** | *-0.632*** | *-0.681*** |
| | *(0.153)* | *(0.105)* | *(0.234)* | *(0.280)* | *(0.279)* | *(0.285)* |
| Bank Size | | *0.936* | | *7.543*** | | *8.429**** |
| | | *(0.965)* | | *(3.162)* | | *(3.174)* |
| Commitment Share | | *1.056* | | *-1.579* | | *5.051* |
| | | *(1.969)* | | *(5.871)* | | *(4.783)* |
| Capital Ratio | | *3.489* | | *14.14* | | *16.15* |
| | | *(5.380)* | | *(16.34)* | | *(15.37)* |
| Δ Capital Requirements (sum t to t-3) | | *-0.649*** | | *-2.028** | | *-2.341*** |
| | | *(0.328)* | | *(1.073)* | | *(0.971)* |
| Constant | Yes | Yes | Yes | Yes | Yes | Yes |
| Time-Country Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 4,512 | 4,512 | 9,693 | 9,693 | 8,927 | 8,927 |
| R-squared | 0.096 | 0.102 | 0.211 | 0.213 | 0.232 | 0.235 |
| Adj. R-squared | 0.0101 | 0.0150 | 0.0288 | 0.0304 | 0.0416 | 0.0446 |
| Banks-quarters | 434 | 434 | 455 | 455 | 440 | 440 |

Table 4: Banks change in their external lending adjusting for HQLA exposure

Note: The table presents the estimated parameter values from fixed effects panel regressions. The dependent variable is the quarterly change in HQLA divided by lagged total cross-border lending (Columns 1 and 2), total cross-border lending growth (columns 3 and 4), or external lending growth to non-banks (columns 5 and 6) adjusted for high qualty sovereign exposures. The data and variables are discussed in Section 3 and Appendix A. Standard errors are clustered at the bank-time level. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. The sample period is 2010Q1 to 2015Q3.

| | External lending (all) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| | Non Adj. Winsor. 10% | Non-Adj. Winsor. 5% after dropping larger than \|100%\| | Adj. Winsor. 5% after dropping larger than \|100%\| | One lag of capital req. | Clustered at the bank level only | Time-country fixed effects only | Time and bank fixed effects only | Share 0.1% total stock external lending | Share 0.5% total stock external lending | Post "whatever it takes" |
| ΔLiquidity Requirements (t-1) | *-0.636*** | *-0.533**** | *-0.636**** | *-0.465*** | *-0.654*** | *-0.483*** | *-0.454** | *-0.557*** | *-0.603*** | *-1.030**** |
| | *(0.305)* | *(0.203)* | *(0.245)* | *(0.227)* | *(0.312)* | *(0.239)* | *(0.257)* | *(0.261)* | *(0.301)* | *(0.348)* |
| Bank Size | *9.056*** | *6.241*** | *6.719*** | *5.775*** | *7.543** | *0.891**** | *7.564**** | *7.167*** | *11.71**** | *7.258** |
| | *(3.684)* | *(2.656)* | *(2.750)* | *(2.820)* | *(3.991)* | *(0.224)* | *(2.712)* | *(2.859)* | *(3.542)* | *(4.324)* |
| Commitment Share | *-1.544* | *-1.538* | *-1.263* | *-0.667* | *-1.579* | *5.838*** | *-2.857* | *-0.304* | *-1.519* | *-6.447* |
| | *(6.420)* | *(4.455)* | *(5.030)* | *(4.912)* | *(6.979)* | *(2.443)* | *(5.102)* | *(5.284)* | *(6.418)* | *(7.416)* |
| Capital Ratio | *13.32* | *12.15* | *14.22* | *11.16* | *14.14* | *0.858* | *14.33* | *7.056* | *15.70* | *4.406* |
| | *(17.69)* | *(12.43)* | *(14.33)* | *(13.81)* | *(18.50)* | *(6.132)* | *(14.45)* | *(14.77)* | *(17.03)* | *(18.80)* |
| Δ Capital Requirements (sum t to t-3) | *-1.031* | *-1.533** | *-1.796** | *0.257* | *-2.028*** | *-0.734* | *-1.708** | *-1.819** | *-2.745*** | *-2.039** |
| *[Column (4): (t-1)]* | *(1.236)* | *(0.857)* | *(0.975)* | *(0.158)* | *(0.780)* | *(0.872)* | *(0.891)* | *(0.988)* | *(1.201)* | *(1.100)* |
| Constant | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Time-Country Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes |
| *[Time Fixed Effects Only]* | | | | | | | Yes | | | |
| Bank Fixed Effects | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes |
| Observations | 10,842 | 10,016 | 9,693 | 11,086 | 9,693 | 9,693 | 9,693 | 11,392 | 7,278 | 7,149 |
| R-squared | 0.183 | 0.211 | 0.215 | 0.194 | 0.213 | 0.198 | 0.027 | 0.205 | 0.236 | 0.193 |
| Adj. R-squared | 0.0132 | 0.0346 | 0.0326 | 0.0228 | 0.0304 | 0.0169 | 0.0197 | 0.0346 | 0.0382 | 0.0343 |
| Banks-quarters | 455 | 455 | 455 | 522 | 455 | 455 | 455 | 455 | 455 | 336 |

Table 5: Robustness for basic specification

Note: The table presents the estimated parameter values from fixed effects panel regressions. The dependent variable is the quarterly percentage change in total external lending. The data and variables are discussed in Section 3 and Appendix A. Standard errors are clustered at the bank-time level (with exception of column (5)). *** is significant at the 1% level, ** at the 5% level and * at the 10% level. The sample period is 2010Q1 to 2015Q3 (with exception of column (10)).

| | External Lending | Adjusted External Lending |
|---|---|---|
| | (1) | (2) |
| | All | All |
| Δ Liquidity Requirements (t-1) | *-0.890**** | *-1.024*** |
| | *(0.340)* | *(0.403)* |
| ΔLiquidity Requirements (t-1) * Excess Liquidity | *0.0374* | *0.0390* |
| | *(0.0254)* | *(0.0279)* |
| Excess Liquidity | *-0.309*** | *-0.212* |
| | *(0.156)* | *(0.162)* |
| Bank Size | *6.153*** | *6.464*** |
| | *(2.909)* | *(3.004)* |
| Commitment Share | *-2.237* | *-1.763* |
| | *(5.402)* | *(6.051)* |
| Capital Ratio | *6.024* | *5.560* |
| | *(14.10)* | *(16.06)* |
| Δ Capital Requirements (sum t to t-3) | *-2.302*** | *-2.209*** |
| | *(0.905)* | *(0.958)* |
| Δ Liquidity Requirements (t-1) - total effect | *-0.618*** | *-0.739*** |
| | *(0.238)* | *(0.282)* |
| Constant | Yes | Yes |
| Time-Country Fixed Effects | Yes | Yes |
| Bank Fixed Effects | Yes | Yes |
| Observations | 9,304 | 8,957 |
| R-squared | 0.212 | 0.216 |
| Adj. R-squared | 0.0387 | 0.0352 |
| Banks-quarters | 430 | 430 |

Table 6: The effect of excess liquidity

Note: The table presents the estimated parameter values from fixed effects panel regressions. The dependent variable is the quarterly percentage change in total external lending (columns 1 and 4), external bank lending (column 2) and external non-banks lending(columns 3 and 5). The data and variables are discussed in Section 3 and Appendix A. Standard errors are clustered at the bank-time level. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. The sample period is 2010Q1 to 2015Q3.

| | Adjusted External Lending | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| | All banks | UK-owned banks | Foreign Subsidiaries | Foreign subsidiaries from high quality countries | Foreign subsidiaries from non high quality countries |
| ΔLiquidity Requirements (t-1) | *-1.061**** | *0.403* | *-1.486**** | *-1.778**** | *-2.845** |
| | *(0.344)* | *(0.411)* | *(0.344)* | *(0.497)* | *(1.441)* |
| ΔLiquidity Requirements (t-1) * Dummy UK-owned banks | *1.225*** | | | | |
| | *(0.498)* | | | | |
| Dummy UK-owned banks | *-24.48*** | | | | |
| | *(10.42)* | | | | |
| Bank Size | *7.444*** | *14.81**** | *4.092* | *6.681* | *-9.327* |
| | *(3.125)* | *(5.629)* | *(4.943)* | *(7.042)* | *(13.39)* |
| Commitment Share | *-1.105* | *-4.775* | *6.860* | *10.01* | *11.63* |
| | *(5.841)* | *(12.05)* | *(8.448)* | *(10.47)* | *(53.53)* |
| Capital Ratio | *12.97* | *62.27** | *-1.190* | *-2.304* | *-77.03* |
| | *(16.26)* | *(36.22)* | *(21.03)* | *(29.36)* | *(75.16)* |
| Δ Capital Requirements (sum t to t-3) | *-2.228*** | *-4.248*** | *-3.097*** | *-3.757*** | *-4.052* |
| | *(1.054)* | *(2.021)* | *(1.364)* | *(1.736)* | *(4.356)* |
| Constant | Yes | Yes | Yes | Yes | Yes |
| Time-Country Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Bank Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 9,693 | 4,873 | 4,820 | 2,736 | 2,084 |
| R-squared | 0.214 | 0.318 | 0.306 | 0.384 | 0.535 |
| Adj. R-squared | 0.0310 | 0.0618 | 0.00218 | -0.0220 | 0.0659 |
| Banks-quarters | 455 | 227 | 228 | 158 | 70 |

Table 7: The effect of parent location

Note: The table presents the estimated parameter values from fixed effects panel regressions. The dependent variable is the quarterly percentage change in cross-border bank lending adjusted for high qualty sovereign exposures. The data and variables are discussed in Section 3 and Appendix A. Standard errors are clustered at the bank-time level. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. The sample period is 2010Q1 to 2015Q3.

| | External Lending | External Intragroup Lending | | External Lending - Intragroup Lending | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| | All | Non-HQLA | HQLA | Non-HQLA | HQLA |
| ΔLiquidity Requirements (t-1) | *-0.693** | *0.551* | *-4.160*** | *-2.709*** | *1.136* |
| | *(0.401)* | *(3.748)* | *(1.602)* | *(0.859)* | *(1.299)* |
| Bank Size | *6.924** | *75.97*** | *0.876* | *-5.987* | *9.032* |
| | *(3.705)* | *(32.61)* | *(20.45)* | *(5.389)* | *(13.94)* |
| Commitment Share | *-11.45* | *-110.9* | *-21.75* | *-4.653* | *-25.99* |
| | *(11.15)* | *(124.7)* | *(19.92)* | *(43.36)* | *(21.86)* |
| Capital Ratio | *24.39* | *-312.2* | *3.366* | *-25.38* | *31.33* |
| | *(20.08)* | *(263.7)* | *(85.53)* | *(104.8)* | *(51.95)* |
| Δ Capital Requirements (sum t to t-3) | *-2.944*** | *9.597* | *-4.848** | *3.757* | *-0.958* |
| | *(1.278)* | *23.76* | *2.338* | *2.600* | *2.580* |
| Constant | Yes | Yes | Yes | Yes | Yes |
| Time Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Bank Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 437 | 44 | 100 | 65 | 135 |
| R-squared | 0.187 | 0.737 | 0.515 | 0.488 | 0.278 |
| Adj. R-squared | 0.0309 | 0.247 | 0.273 | 0.0636 | -0.0636 |
| Bank - quarters | 44 | 9 | 14 | 10 | 18 |

Table 8: The effect of intragroup lending

Note: The table presents the estimated parameter values from fixed effects panel regressions. The dependent variable is the quarterly percentage change in total cross-border lending (column 1), total intragroup lending (columns 2 and 3) and external lending minus intragroup lending (columns 4 and 5). The data and variables are discussed in Section 3 and Appendix A. Standard errors are clustered at the bank-time level. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. The sample period is 2010Q1 to 2015Q3.

| | Adjusted External Lending | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | All | All | Non-UK banks | UK banks |
| Δ Liquidity Requirements (t-1) | *-0.706*** | *-1.625**** | *-2.166**** | *-2.058** |
| | *(0.274)* | *(0.330)* | *(0.439)* | *(1.077)* |
| ΔLiquidity Requirements (t-1) * Deposit Share | | *0.0382**** | *0.0602*** | *0.0472*** |
| | | *(0.00976)* | *(0.0297)* | *(0.0221)* |
| Deposit Share | *0.184* | *0.195* | *0.121* | *0.396* |
| | *(0.121)* | *(0.120)* | *(0.223)* | *(0.251)* |
| Bank Size | *7.474*** | *8.042**** | *5.181* | *9.476* |
| | *(2.946)* | *(2.860)* | *(4.861)* | *(5.888)* |
| Commitment Share | *-0.609* | *-0.444* | *7.793* | *-11.23* |
| | *(5.892)* | *(5.805)* | *(8.561)* | *(12.41)* |
| Capital Ratio | *8.157* | *6.624* | *-7.557* | *67.69** |
| | *(16.38)* | *(16.14)* | *(22.30)* | *(36.30)* |
| Δ Capital Requirements (sum t to t-3) | *-2.277*** | *-2.648* | *-3.733**** | *-4.078*** |
| | *(1.043)* | *(1.015)* | *(1.368)* | *(1.990)* |
| Δ Liquidity Requirements (t-1) - total effect | | *-0.260* | *-1.180**** | *0.476* |
| | | *(0.262)* | *(0.364)* | *(0.399)* |
| Constant | Yes | Yes | Yes | Yes |
| Time-Country Fixed Effects | Yes | Yes | Yes | Yes |
| Bank Fixed Effects | Yes | Yes | Yes | Yes |
| Observations | 9,512 | 9,512 | 4,609 | 4,819 |
| R-squared | 0.215 | 0.216 | 0.312 | 0.324 |
| Adj. R-squared | 0.0312 | 0.0328 | -0.000790 | 0.0660 |
| Banks-quarters | 451 | 451 | 223 | 224 |

Table 9: The effect of deposit shares

Note: The table presents the estimated parameter values from fixed effects panel regressions. The dependent variable is the quarterly percentage change in total cross-border lending adjusted for high qualty sovereign exposures. The data and variables are discussed in Section 3 and Appendix A. Standard errors are clustered at the bank-time level. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. The sample period is 2010Q1 to 2015Q3.

| Variable | Definition | Source |
|---|---|---|
| Cross-border bank lending growth | Percent change (divided by 100) in cross-border lending to banks plus non-banks [CC15], only banks [CC15A] or only non-banks [CC15B]. | Bank of England CC forms. |
| Exposures to high quality sovereigns | Liquidity buffer qualifying securities by country from form FSA 50 [1A to 19A and 21A]. Two specifications were used. As a % of total assets refers to changes (in £) divided by total assets (in £) multiplied by 100. As a share of total exposures refers to difference (in £) divided by the sum of liquidity buffer qualifying securities to all countries excluding the UK multiplied by 100. | FSA 050 forms |
| ΔLiquidity Requirements | Changes in add-ons (in £) divided by total assets from previous period (in £), multiplied by 100 to express it as percent of total assets. | PRA, including forms FSA 047 /048 for total assets |
| ΔCapital Requirements | FSA/PRA-set minimum ratio for Pillar 1 plus Pillar 2 capital-to-risk weighted assets (RWA). [NHD500/NHD510 for BSD3 and 108A/(12.5* 70A) for FSA3. Multiplied by 100 to express it as percent of total assets. | Bank of England BSD3 form for data up to 2008 Q1. FSA3 form thereafter. |
| Commitment Share | Commitment ratio: Ratio of total commitments divided by total assets. [BT43/BT40] | Bank of England BT forms. |
| Bank size | Bank size: The log of a bank's total assets in levels (£1000s) [BT40], deflated by CPI inflation. | Bank of England BT forms. |
| Capital Ratio | Capital and other funds [BT19]/Total Assets [BT40] | Bank of England BT forms. |
| Deposit Share | Sight and time deposits of other UK residents [BT2H + BT3H]/ Total Liabilities - Capital and other funds [BT20-BT19] | Bank of England BT forms. |
| Excess liquidity | Liquidity Buffer (inc Pre-Positioned Collateral) - Liquid Asset Buffer Requirement at ILG / Total Assets | FSA 047/048 |

Table A.1: Variable Definitions and Sources